Provotypes for Participatory Innovation

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ABSTRACT

Central to multi-stakeholder processes of participatory innovation is to generate knowledge about ‘users’ and to identify business opportunities accordingly. In these processes of collaborative analysis and synthesis, conflicting perceptions within and about a field of interest are likely to surface. Instead of the natural tendency to avoid these tensions, we demonstrate how tensions can be utilized by embodying them in provocative types (provotypes). Provotypes expose and embody tensions that surround a field of interest to support collaborative analysis and collaborative design explorations across stakeholders. In this paper we map how provotyping contributes to four related areas of contemporary Interaction Design practice. Through a case study that brings together stakeholders from the field of indoor climate, we provide characteristics of design provocations and design guidelines for provotypes for participatory innovation.

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Provotyping, User-centered design, Critical Design, Participatory Innovation.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design.

INTRODUCTION

Participatory innovation aims to generate knowledge about users “in a format that inspires company employees to reflect on product, producer role and company identity” [5], and to generate business opportunities in parallel. In this analytical and generative process, we see a bridging role for Interaction Design. Interaction Designers can support an organization in creating empathy for the field they serve by crafting ethnographic findings in such a way that they are more likely to be disseminated within the organization. Further, Interaction Designers can build on ethnographic insight to demonstrate how it can be used in the development of new products and services. Through both these roles Interaction Designers can contribute to internal user-focused organizational change [4, 20]. However, these objectives of supporting organizations in empathizing with the field and designing for the field are not straightforward.

A first concern is the uptake of ethnographic findings by organizations to empathize with a field of interest. Organizational stakeholders may find it time-consuming to read through detailed ethnographic reports and not inspiring enough to provoke rethinking of understandings. At the same time, there is a danger that attempting to summarize insights, for example as bullet points of key findings, might reinforce existing structured rationales of organizations [7, 27]. More actionable formats of ethnography that enable collaborative analysis across stakeholders are worth exploring, since they can engage a wider range of stakeholders in a shorter timeframe, create a common understanding of ethnographic findings and evoke a sense of ownership over a project [19].

Another concern is the nature of the relation between ethnographic practices and practices of designing, which is an ongoing source of debate in the HCI community. The debate concerns designers expecting that ethnography is about needs-finding and requirements gathering, which isolates research from design, limits the way that technology and practice can develop together, and so misses the full potential of the ethnographic practice for design [1, 8]. In recognizing these debates, a constructive way forward is for designers to draw on their skills as designers in engaging with ethnographic fieldwork.

In both these objectives, Interaction Designers are likely to encounter tensions across stakeholders or within the field that is studied: ethnographic findings can reveal issues that are at conflict with organizations’ inherent values or believes, which makes it harder to discuss these types of findings with organizations and more likely that they will reject them; and ethnographic findings can uncover topics that are internally contradicting, which calls for further exploration. As highlighted by activity theorists [11] and Scandinavian approaches to Participatory Design [16] we recognize that these conflicts can potentially be valuable – rather than destructive – in activities of empathizing with the field and designing for the field. In this paper, we revisit the concept of ‘provotypes’ [23], which provides an opening to utilize conflicts in processes of development. We begin by elaborating on relevant ideas behind
Provotyping, followed by four related areas within contemporary Interaction Design practice where provotyping can contribute to processes of participatory innovation. We then describe a case study into the use of provotypes to understand people’s experiences of indoor climate, which was carried out in collaboration with a number of participating families, five industry partners, and a fellow research organization. Based on our findings from this case study, we discuss characteristics of a design provocation and contribute a set of design guidelines for the design of provotypes for participatory innovation projects.

RELATED WORK
Provotyping was first proposed as part of a ‘cooperative analysis’ approach to systems design in the area of information systems in the early 1990s [23]. One impetus for the development of the provotyping approach was the observation that discussions with users about prototypes often revolve as much around issues within the current practice as they do around what might be desirable aspects of future practice. Provotypes sought to maximize this effect by deliberately developing provocative prototypes. From a theoretical perspective, the provotyping approach drew on Activity Theory, which conceives of activities as subject to internal and external contradictions [11]. These contradictions are seen as both driving and arising from dialectical processes of change that give rise to new forms of activity. Provotyping elaborates on contradictions that prompted the development of a particular practice, and exposes these in order to analyze the current practice and generate alternative ways to carry out the practice. Provotyping therefore fits between activities of investigation and the design of new possibilities and is regarded as a bridge between the two [23].

Provotyping and participatory innovation seem well suited, since core to both concepts is an analytical and generative character. Further, the provocative aspect of provotyping corresponds with the aim of participatory innovation to inspire reflection by stakeholders. However, bringing the provotypes approach into use by interaction designers in processes of participatory innovation does raise challenges for the approach that have not been explored in the earlier work in information systems design. Stakeholders in participatory innovation include not only the practitioner and the system designer/analyst, but also the wider design team, broader conceptions of the ‘user’, and stakeholders across a variety of organizations [5]. Additionally, whereas provotypes as developed in systems design took a focus on usability issues and the workplace, the objectives of contemporary Interaction Design have expanded to include aesthetics, values, sustainability, and experience [2], and application areas beyond work, such as the home [13].

We see provotypes as ‘types’ that embody tensions surrounding an area of interest, in order to support collaborative analysis of that area and to collaboratively explore design possibilities. In order to situate the provotyping approach with respect to current concerns in the field of Interaction Design, we describe it in relation to four areas of contemporary research where provotypes for participatory innovation can contribute: critical design; generative design research; collaborative ideation; and organizational change.

Critical Design
The notion of ‘Critical Design’, which emerged at the Design Interactions Department at the Royal College of Art, aims “to ask carefully crafted questions and ... stimulate discussion and debate amongst designers, industry, and the public” [9]. Critical Design is ‘critical’ in the sense that it takes a critical stance towards underlying assumptions and values within society and seeks to raise reflection on these through design. Though operating within a form-language of consumer products, the things produced by critical design are not intended as saleable goods. Instead, they are intended as ‘value fictions’, where a familiar form-language is used to express an unfamiliar set of values, thus provoking reflection on how values are currently and how they might be different. The Switch! project [22] experimented with critical design experiments to expose hidden norms as a basis for debate to rethink sustainability. In this project different possibilities were negotiated in a variety of competing values and conflicting issues, where the role of design was considered ‘problem finding’. Within HCI, the approaches value-sensitive design [12] and reflective design [26], share similar objectives to critical design of taking a critical stance to values embedded in products and interactions.

A difference in emphasis between the critical approaches above and provotypes for participatory innovation is that rather than taking a critical stance toward societal issues we seek to employ a critical stance within the design process in order to build understandings around issues of interest in the project and begin to articulate a design response to the field. In this sense, an approach that is closer to ours is Bowen’s Critical Artefact Methodology [3], which is an adaption of ideas from Critical Design to participatory design. A critical stance is maintained, but deployed for a more instrumental purpose within the design process in order to better understand the experiences of design process participants and open up the space of design possibilities.

Generative Design Research
There has been a widening of debate over the relations between analytic field work activity and synthetic designerly engagement in HCI. In line with the developing field of Design Anthropology which seeks to build relations between the disciplines of design and anthropology, several approaches and methods have been put forward within HCI that bring a designerly approach to engaging with and understanding the field, such as cultural probes [14] context mapping [28], and generative tools [24].
Of particular relevance for provotypes for participatory innovation is the idea of ‘technology probes’, which are working technical devices that are left with people in a context of use in order to study the way that technology may be appropriated into people’s everyday practices [17]. This method recognizes that new technologies cannot be fully understood until the technology is actually in use and that people’s use of new technologies is often unexpected. Technology probes and provotyping share the idea that working versions of technologies need to be deployed into the field. A difference in emphasis between the two is that technology probes are more focused on future technology potentials, whereas provotypes are seen as a ‘bridge’ between the worlds of design and use and between technology and human perceptions. An emerging related style of design research is the work of interpretive systems, where human machine interaction is seen as locally situated meaning making and the role of design as the provision of multilayered resources for this process [15].

Collaborative Ideation

In design oriented fields there is considerable agreement that physical objects can be used as shared representations of design ideas to bridge between communities [6]. Boundary objects are malleable enough to be adapted to specific needs and constraints that different groups may have, and at the same time are robust enough to retain an identity in different areas of use and different groups of people [29]. Boundary objects and provotypes for participatory innovation have in common that they should allow stakeholders to express themselves with and through them. Further, they both share that they should serve as a platform for collaborative ideation. In building on the critical approaches to design, we are interested on which ‘product level’ is reflected and ideated. For this, we refer to the Vision Based Model [21], which provides different levels that a product addresses, being the spiritual level (the intention, purpose, and philosophy behind a product), the contextual level (the specific setting and environment the product is intended for), the principal level (the product concept and the general form and function) and material level (the product’s detailed form and function). We will use these levels to indicate how and where the provotypes stimulate design explorations, distinguishing roughly between the abstract (spiritual and contextual) and concrete (principal and material) levels of a product. Because provotypes are positioned in the beginning of a design process, they aim to stimulate ideation on the more abstract product levels, where provotypes aim to stimulate reflection and ideation on the more concrete product levels.

Organizational Change

Ongoing engagements of organizations with ethnographic material can influence an organizational culture in becoming more human centered [20]. Organizational culture can be analyzed at different levels at which it manifests itself within an organization, ranging from concrete and tangible to abstract and intangible manifestations. Schein [25] shows three levels of organizational culture consisting of: artefacts (the visible organizational structures and processes); espoused beliefs and values (the strategies, goals and philosophies of the organization); and fundamental assumptions (the taken-for-granted beliefs, perceptions, thoughts and feelings). Relating to these levels, Junginger [20] proposes a so called outside-in approach to organizational change, where ongoing human-centered product development invites organizations to see the world differently and so instigates organizational change. One of the roles of an artefact here is to trigger a discussion that encourages fundamental assumptions to surface. A critical note is made that if organizations want to take advantage of these tools, they must allow new product explorations, and need to think of product development as an inquiry into the organization.

Provotyping partly replies to this concern in its naming and function. The naming itself might support the organization in thinking of provotypes as opportunities for inquiry and reflection. A provocative type raises different expectations than proto-type, which is regarded as a first version of a type. By taking a critical stance and deliberately grounding provotypes in the tensions between an organization and a field of interest, provotypes potentially catalyze the process of the organization in becoming more user-centered by challenging organizations’ perceptions.

THE INDOOR CLIMATE PROJECT

The ‘Indoor Climate and Quality of Life’ project brought together stakeholders from five indoor climate related companies in the building industry, a multi-disciplinary team of university researchers, and five participating families. The aim of the project was to generate new knowledge about people’s experience and understanding of indoor climate ‘comfort’ in homes, offices, and institutions in order to open up new development directions for the building industry. The project was founded on field studies [18] performed at the five families across a range of contexts (Figure 1.1). Findings from these field studies were analyzed and cross-compared through a number of workshops with the project partners (Figure 1.2). These workshops enabled us to identify not only tensions within the field, but also tensions between perceptions from the field and the perceptions of the participating organizations. This process of analysis and cross-comparison led to the development of six ‘comfort themes’ that identify relations between prominent aspects of indoor climate and people’s experience of comfort. They are: comfort is bringing feeling, observing, and understanding in tune; comfort is
about being healthy; comfort is what people make; comfort is about social relations; comfort is a political construct; and comfort is connected to the outdoors.

Within the context of the project, we developed provotypes to support the shift from analysis to synthesis by: deepening initial understandings on these themes; calling forth what the involved families and industrial partners valued in indoor climate systems; and using these understandings as points of departure in exploring design directions (Figure 1.3, 1.4). The two provotypes that we present here are named the Twist-Vase and the Render-Lamp, building respectively on the themes being healthy and bringing feeling, observing, and understanding in tune.

This raises questions around whether providing information about indoor climate health is actually useful or simply provokes anxiety in people, and exposes tensions around indoor climate systems, which often remove direct control over the indoor climate from inhabitants even as they function to maintain a ‘healthy’ indoor climate. Exposing contradictions on these topics could be achieved by monitoring health related issues that are invisible – provoking sense-making, but simultaneously opening up for multiple interpretations – provoking issues of control. One salient health related indoor climate variable is air quality, as stated in rather technical European norms [10]. The twist-vase was designed as a dynamically transforming object which responded to air quality levels as a way to help families develop sensibilities related to air quality and to raise issues surrounding interpretation and control.

Form and Functioning of the Twist-Vase
The appearance of the twist vase (Figure 2a) is inspired by a vase. The vase is made up from 18 layers between the base and a top. The rotation of the lowest layer can be controlled, which pulls the layers above to gradually move in response. This changes the appearance of the vase from in-line to ‘disharmonious’. The vase twists slowly, in response to the measured air quality level (measured through CO2 concentrations). Whenever the measurement exceeds a ‘critical’ level the vase quickly twists from one outer position to the other. The vase repeats this with intervals until the air quality is below the boundary value.

Tensions around Bringing Feeling, Observing, and Understanding in Tune
The theme bringing feeling, observation and understanding in tune addresses how people’s perceptions of indoor climate are shaped through their experiences with it. It is about experimenting with indoor climate systems, observing relations between actions and reactions, and learning how to create a comfortable atmosphere. In this
process, ‘experts’ (whether persons or systems) are usually trusted to ground perceptions. We encountered patterns in the studies where the perceived temperature was creating discomfort, but where the authority in control of the indoor environment argued – based on temperature measurements – that there was no need to make changes. The degrees Celsius determined if it was comfortable, and not people’s perception of temperature. Similarly, in prior activities of collaborative sense-making with the project partners, the idea of defining ‘comfort levels’ by measurable parameters also surfaced. This apparent conflict between project ‘expert’ perceptions and perceptions from the field was a point of departure for the Render-Lamp prototype.

Form and Functioning of the Render-Lamp
The Render-lamp (Figure 2b) measures the most dominant indoor climate parameters: temperature, humidity, sound, light, and CO2, and tries to holistically reflect this in the light the lamp shines. The lamp consists of a main lamp and 5 boxes that each measure a separate parameter and wirelessly transmit this measurement to the lamp. These parameters are mapped to the appearance of the lamp as follows: temperature is coupled to the color of the light; CO2 is coupled to the height of the light; light intensity in the room is coupled to the intensity of the light; sound is coupled to the amount of lights that are shining along the height of the light; and humidity is coupled to the angle in which the light shines. The Render-Lamp aims to capture two conflicts within indoor climate perceptions. Firstly, the dominant idea to break up the indoor climate into individual parameters, versus the holistic experience of indoor climate. Secondly, the idea of relating to indoor climate through abstract light (putting emphasis on individual perceptions), versus relating to indoor climate through concrete measurements (putting emphasis on inscribed meaning).

FAMILY ENGAGEMENTS
The provotypes were given to two families who were involved in the earlier ethnographic studies. The Twist-Vase was deployed for ten days at the home of a Danish family, H and A, aged in their thirties with three young children. H was a teacher at a high school and A was employed as a caseworker at the municipality. The Render-Lamp was deployed for ten days at a second Danish family, F and T (also in their thirties) with four young children. Their home was a single-story house in a new neighborhood in a small village. The husband, F worked as a manager in a local company, which produced mechatronic equipment. At the time of the study, the family was part of a regional energy saving program. Both deployments took place at the end of the summer.

At the end of the deployment periods we conducted semi-structured interviews in the homes of the families. The interview about the vase was conducted with both the husband and the wife of the house (H and A), whereas the interview about the lamp was conducted with the husband of the house alone (F). The aims of the interviews were threefold: to reflect on the provotypes themselves; to reflect on living with the provotypes; and to reflect on the indoor climate as experienced through the provotypes.

Results from the Twist-Vase

Provocation in first encounters
The vase was delivered to A, to whom we briefly explained that the vase responded to air quality. We purposely did not reveal technical details, since we felt that some mystery surrounding the provotype could trigger the family’s curiosity and we wanted to allow the family to form their own hypotheses about how the vase worked. Our brief explanations stirred some confusion, because A seemed to be expecting that the vase would have a more explicit functional purpose:

A: What do I have to do with it? … Do I have to open the windows or door when it rotates?

With regard to the form of the vase, A indicated that the actual shape and appearance of the vase didn’t fit the family’s taste, and that the dimensions of the vase were perceived to be too large for an indoor climate system. This shaped the vase into a ‘visitor’, which challenged domestication.

A: It doesn’t really fit in our furniture style. It’s too large… It looks quite modern. It is perfect in a modern Danish home, but it should be more discrete in our home.

Provocation in use
During the deployment of the vase, the family related activities in the house to the way the vase moved. These actions were air-quality related such as the opening of a window, the number of people in the room, and noise levels. However, this didn’t lead to an explanation for the behavior of the vase that was satisfactory for H and A.

H: You think it changes when you open the window.
A: Yes, or when we are more people in the room. Or when the children were shouting at the thing. Then it moved. …Strangely, the upper ring hardly moves. Is there a reason for that? I thought it was to reach the ideal indoor climate, but then we never reached it.

H: Your guess is that it is more harmonical in the shape when the air is better. We don’t know.
Further, the mechanism to make the vase rotate caused a noticeable sound when nothing was going on in the room. This unplanned side effect challenged acceptance borders, but showed to be beneficial for the vase to not disappear in the background of the environment.

**H:** I paid most attention to it (the vase) when I was sitting in the sofa watching TV, or reading a book, and then it turned wrrvvmm. And I didn’t know why. …It (the sound) is not disturbing, not that you can’t sleep, that’s not the case. But I wouldn’t like such a thing in the bedroom.

**A:** I think the noises are rather disturbing. It would be nicer to lower the noise, and just looking at the shape of the thing.

**Provocation upon reflection**
Explaining the technical workings of the vase provoked additional questions, mostly related to the consequences for personal well-being. Moreover, it showed H’s and A’s desire to be able to understand that what is monitored – to be in control and to take appropriate actions:

**H:** The sounds are there always. So what is the consequence? Our air is always bad?

**Exploring the new through the Twist-Vase**
Revealing the workings of the twist vase transferred the discussion into the exploration alternatives for monitoring indoor climate. H builds on his difficulties in making sense of the vase, and proposes an alternative, evoking A’s response about desirability of H’s alternative:

**H:** But actually wouldn’t it be easier with a scale or a number?
   *A digital scale? Where you read, it is 0.5 % or anything?*
**A:** But it’s not so nice to have such a display in your living room.

**H:** It could be a small one.
**A:** If it has to be a display, then it should be a display with more functions.

Further explorations gradually shifted the dialogue towards the role of ‘intelligent’ systems in the living environment, bringing in issues of imposition and control.

**H:** I think it is a good idea if there is something to tell you that the air is not as good as it could be. But I am free to ignore it. I wouldn’t become angry at the machine. I can open the window maybe later when I come back… I mean, we have lots of these signal, also the dishwasher, if you have to add salt, you can choose whether you want it now or later. We are used to that there are machines that tell us what we should do.

**A:** It is nice to be told that it is good or bad.

In the explorations we recognized a gradual move from a concrete principal level (the digital scale proposal), towards more abstract levels regarding the product expression (“nice to look at”) and eventually the product intention (“it is nice to be told that it is good or bad”).

**Results from the Render-Lamp**

**Provocation in first encounters**
The lamp was happily received at its introduction, shown by F’s eagerness to unpack the lamp from its bubble foil, and excitingly replacing the former living room lamp with the new lamp.

**F:** It looks better than the old lamp!

F was told that the 5 boxes in the lamp each measured one indoor climate parameter, without further explanation. What the boxes measured and how they related to the light in the lamp would be revealed in the interview at the end of the trial – to stimulate engagement during the period of deployment. F appeared to be quite committed and explorative, since he started right away with making a plan where to place the boxes and how to find out their working.

**Provocation in use**
F’s engagement with the challenge was shown by the numbers that he placed on the boxes to carefully keep track of where he placed them. F changed the location of three boxes in the middle of the week, considering the more drastically changing indoor climates, as the bathroom and kitchen. In contrast to the vase, the lamp was accepted and appreciated in the living room. It’s ‘behavior’ remained quite stable, since the temperature didn’t change much throughout the week.

**F:** It’s actually 22 or 23 degrees all the time. The last four days the colours have been more or less like this.
   …In general it was very relaxed and calming. …An indoor climate lamp, I think it is a good idea to let a lamp tell you what the climate is during the day and over a period of time. I would be interested in buying something like that. …It would actually be nice to have it a little longer.

**Provocation upon reflection**
In revealing which sensor box measured what, and how that related to the light, F didn’t consider sound to be one of the measurements, which caused some frustration:

**F:** Sound has not been an option for me I guess. (hitting his forehead with his hand). Sound is also a major factor. I didn’t relate it to the indoor climate. …It explains the afternoon, about now, in Denmark, we call it the hour of the wolves. The kids are hungry, they want to see television, they are going outside. ….About four to six in the afternoon
it (the light) was really intense (many lights were shining), and I guess it has something to do with the sound issue.

Surprisingly for us, F measured how many Watts the lamp actually consumed. This shows his engagement with the energy saving program, and his concerns when it comes to new alike systems in the domestic environment.

F: And I can tell you that it uses 13 Watts, as an average all the time, so that’s actually not too bad. That’s 119 kroner for a year.

Exploring the new through the Render-Lamp
Clarifying the functioning and corresponding appearance of the lamp, led the discussion into design explorations of alternative indoor climate systems. The explorations focused merely on additions or adaptations of the lamp as it was deployed, for example additional indoor climate measurements that the lamp could integrate, or complementing the lamp with concrete information.

F: I actually thought about a measurement of wind (to add), because there is a lot of wind up here. …Somehow we could put in the energy factor. Everybody is talking about saving energy to protect our environment.
…You could also make some small versions of it, on the wall. It’s more or less science fiction, but a small monitor in every room, next to the contact of the light or something, and some sensors around.

F seemed to embrace the philosophical idea behind the provotype, which explains why the explorations mainly appeared on the principal product level (e.g. rough functionality), with short deviations to the contextual level (e.g. expanding the idea to each room in the house).

PROJECT PARTNER ENGAGEMENTS
The provotypes were presented and demonstrated to the project partners who operated in the following fields: natural ventilation (J), mechanical ventilation (L), windows (K), insulation (S), and indoor climate consultancy and quality assurance (O). The university partners come from a technical university (R and P) and from our own university department (B). We now elaborate on the dialogue that was evoked when the provotypes were presented to the project partners for the first time right after their deployment.

Challenging perceptions and exploring design directions with the Render-Lamp
When the lamp was introduced to the project partners, conflicting perceptions of indoor climate quickly surfaced. This concerned the individual holistically experienced indoor climate on the one hand versus the constructed indoor climate by its individually measured variables on the other. This conflict was initiated by university partner P:

P: What if they have too many… That they have to grasp too much information on this lamp. My problem with the lamp is that I would have too much information, that I would be confused whether it is CO2 or temperature.

Figure 5: Project partner engagement with the provotypes

B: Maybe that is only because we are engineers and think into parameters, in order to be able to grasp it (indoor climate) in the first place. If people experience indoor climate as a holistic thing, then maybe they can just relate their experience to whatever the lamp does.

O: When the lamp looks like that, I’m comfortable. But maybe there, she looks at the lamp, the same lamp, and feels discomfort… That’s why I think this gives so much meaning; it’s not God itself that speaks, this is good and this is bad. This is how you read it, and your sense it is good or bad.

The project team agreed that the abstract way of presenting indoor climate supports the shaping of an understanding of individual comfort. This transferred the discussion into the exploration of applications for representing the indoor climate in an abstract manner, such as awareness systems and educative tools, and possibilities to complement the abstract with concrete information.

P: I feel the lamp is a wonderful media of visualizing something that is invisible for us, but if we want to affect people, probably we should be much more… suggesting.

K: Having the provotype (the lamp) is the abstract language, but it could also on the backside of the lamp have a figure and a recommendation. That you have both in the lamp or device. …The abstract one is the one who is making the flag to you. It is very important to get the attention.

R: I think it would be good idea to recommend them to open a window, but it is your decision. They just have to know that when you don’t open the window you might get mould in the corners. …You could say, OK, now it is -50 outside, if you want to have 28 degrees in your living room, fine, just, you know, it is going to be expensive. Those things could be good to display to people. So they know the consequences of their actions.

The lamp eventually provoked the industrial partners to reflect on quite fundamental questions concerning stakes and objectives for the project.

S: It is also a question, what do we want as a company? As a company you want people to do something that make them buy your product.

P: To buy S’s insulation they need to have a certain argument, like I need to do this, in order to be within my comfort. This is probably what we had in mind for this project.
The estranging Twist-Vase

Compared to the lamp, the vase stirred fewer responses from the company partners. In its form, function, and interaction the partners seemed to find the vase estranging. The industrial partners noticed the difference in enthusiasm of the involved families, which instigated discussion on how to make people buy indoor climate related products:

R: If this going to be product that people should buy, how do we motivate them to buy it, to get into the homes and do their job at it?

Further, the vase made the partners revisit the idea that a rather abstract way of presenting indoor climate could be complemented with concrete information. Interestingly the vase prototype needed quite some interventions from our -the developers - side to explain they are stepping stones towards a design space. The vase provoked the project team to ask themselves quite fundamental questions in which design direction to proceed.

R: It is of course the question of what the thing does. But that brings us back to the purpose of the thing. Is it to raise awareness, or is it to tell people what to do? Or suggest people what to do?

DISCUSSION

We began this paper by outlining concerns for Interaction Design of supporting organizations in empathizing with the field they serve and designing for that field. Figure 6 presents a mapping of the four potential areas for contribution of a provotyping approach that were discussed based on how these relate to processes of participatory innovation. The mapping is organized first by who is the target group for the provocation (organizations or users) and second by the underlying objective of the intervention (whether to provoke and analyze, or explore and design). Through this mapping, we can conceptualize related areas of research as providing overlapping fields of interest within which a provotyping approach can be positioned. We will now discuss characteristics of design provocations based on our findings before outlining guidelines for the design of provotypes for participatory innovation.

Characteristics of Design Provocations

From the case studies we have learned that design provocations embody and reify tensions, require facilitation, and come at different moments.

Design provocations embody and reify tensions

With regard to provotypes as a platform for collaborative analysis, we have to illustrate the value of tensions in driving dialectical processes of change. The vase addressed a tension within the field, by calling forth health related issues of control and sense-making. The resulting provocation was strong with the participating family (e.g. the frustration of H and A of not knowing what the vase did and what it meant for the air quality in the living room), where the project partners were merely estranged from the vase and weren’t provoked to reflect on issues of control and sense-making. On the other hand, the lamp addressed a tension between perceptions from the field and perceptions from the project partners – the tension between an individually experienced indoor climate and an indoor climate that is fragmented into measurable variables. The provocation of the lamp appeared strong in the dialogue with the project partners (e.g. P: "my problem with the lamp is that I would have too much information" followed by B: “maybe that is only because we are engineers and think into parameters”), where the participating family seemed to bring us back to the purpose of the thing. Is it to raise awareness, or is it to tell people what to do? Or suggest people what to do?

Design provocations require facilitation

Next to carefully choosing and embodying a tension that surrounds a field of interest, we see a role for the interaction designer to tune provotypes by embodying particularly those tensions that correspond to an area of research or project interest. Further, we acknowledge that it takes time to develop a working prototype. Therefore, the tension embodied in a provotype needs to be carefully considered by the interaction designer or project facilitators. In our studies we have attempted to develop provotypes related to each comfort theme, as a way to explore at least one tension from within the findings.

Figure 6: Contributions of provotyping to participatory innovation
understanding of the different stakes and values at play within a participatory innovation project. These understandings enable the interaction designer to align generative activities with the previous provoked beliefs. Further, facilitation of provotype engagements is a way to actively engage with a field of interest.

**Design provocations come at different moments**
We identified three moments where the provotypes provoked: provocations in first encounters, provocations in use, and provocations upon reflection. With provocation in first encounters we refer to the provocations in the presentation of provotypes with complementary textual and verbal comments. This can be compared to the ‘provocation’ that conceptual critical work instigates, as for example gallery work and the work presented in the Critical Artefact Methodology [3]. With provocation in use we refer to provocations of the provotype during the time of deployment. It includes the provotypes’ interventions that allow the development of insights, and the unexpected side-effects and use of the provotype. This relates to technology probes [17] and the Placebo project [9], where working versions of technology are deployed in family homes. Provocation upon reflection refers to revealing properties of a provotype after deployment and use. This allows interaction designers to capture the moment where previous experiences are mapped to the actual form and function of provotypes, and so inspiring explorations of new possibilities. Provotypes enable generative design processes in each of these three moments of provocation. The strength of provotypes lies in covering all three moments, similar to the locally situated meaning making of interpretive systems [15]. This can benefit both family engagements and project partners’ engagements. In our current research we are exploring the deployment of provotypes at organizations, in order to support dissemination of ethnographic findings and organizational change.

**Guidelines for Provotypes**
In addition to characteristics of design provocations, we present the following three design guidelines for provotypes in a participatory design setting. We take along that design provocations come with different moments, and we expect the number of guidelines to grow.

**Balance between inconspicuousness and intrusion**
When we consider provotypes as ongoing stimuli to provoke reflection on abstract issues of concern, they are not in the foreground of participants’ attention all the time, but move in and out of attention over time. The lamp was aesthetically embraced and acting in the background (e.g. F: “in general it was very relaxed and calming”), where the vase estranged and was more intrusive (e.g. A: “I think the noises are rather disturbing”). The undesired side-effect of the sound turned out to be beneficial in noticing and reflecting on the vase and its relation to indoor air quality. We feel that the lamp could have been more intrusive to increase provocative encounters in use. Provotypes should be intrusive and estrange to challenge perceptions and stimulate ongoing reflection, but should also be inconspicuous and embraced in order to be domesticated and not be rejected. When provotypes are primarily encountered once, the conceptual ideas behind provotypes should balance estrangement and embracement. The vase estranged and tempered the discussion within the project team. However, the vase did provoke quite fundamental reflection on project aim and project direction (e.g. R: “that brings us back to the purpose”). The lamp initially stirred a dialogue about conflicting perceptions, but eventually enabled the project team to identify a design space. Certain qualities of provotypes should be embraced and recognized to be stepping stones in the exploration of the design space, however, these qualities shouldn’t be completely embraced so that other opportunities for development are overlooked.

**Maintain some mystery, but explain eventually**
In the family engagements, we sensed that obscuring the technical workings and appearance was beneficial for the engagement with the provotype. With the lamp, the technical measurement of each box and its relation to the light was obscured. Likewise, the relation of the vase to indoor air quality was intentionally kept a little mysterious. This allowed different interpretations (e.g. H to A: ‘Your guess is...’) and stimulated reflection on the provotypes’ actual workings and their relation to the phenomena they addressed. At a closing interview however, there is also a value in clearly exposing and explaining functionality, thus opening up for people to explore alternative options based on their prior experiences. In primarily first encounters, the technical workings and functionality should clearly be exposed. This helps avoid discussion becoming merely concerned with concrete product levels or actual workings. The rationale behind the provotype and the concept in itself should stir dialogue amongst project team members on the abstract product levels.

**Provide handles for exploration**
Providing handles to explore the workings of the provotype stimulates ongoing engagements in learning about its relation to the phenomena it addresses (e.g. F who spatially explored the domestic environment). This increases the likelihood of having provocative encounters with and through the provotype, especially in relation to a challenging or mysterious functionality or appearance. In this respect, there is an important role for Interaction Design in designing these handles for exploration. Provotypes should support people to follow their curiosity about a provotype (or the phenomena it addresses) through their engagement with it.

**CONCLUSION**
The provotyping approach exemplifies an attitude toward field studies as opportunities for designerly engagement with the tensions at play within a participatory innovation project. In this paper we have shown how by embodying
tensions that surround a field of interest, provotypes can serve as platforms for collaborative analysis and exploration of a design space. We have situated the approach with respect to current areas of concern in Interaction Design and shown how interaction designers have an important role to play in designing effective provotypes. In order to support others in applying the approach, we have described characteristics of design provocations and outlined guidelines for their design. Approaching field studies as opportunities for designerly engagement allows for different kinds of knowledge about the field and involved stakes, and helps bridge between understandings of the field, design, and organizations.

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