Transfer Scenarios: Grounding Innovation with Marginal Practices

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ABSTRACT
Transfer scenarios is a method developed to support the design of innovative interactive technology. Such a method should help the designer to come up with inventive ideas, and at the same time provide grounding in real human needs. In transfer scenarios, we use *marginal practices* to encourage a changed mindset throughout the design process. A marginal practice consists of individuals who share an activity that they find meaningful. We regard these individuals not as end-users, but as valuable input in the design process. We applied this method when designing novel applications for autonomous embodied agents, e.g. robots. Owners of unusual pets, such as snakes and spiders, were interviewed - not with the intention to design robot pets, but to determine underlying needs and interests of their practice. The results were then used to design a set of applications for more general users, including a dynamic living-room wall and a set of communicating hobby robots.

Author Keywords
Transfer scenarios, grounded innovation, design methods, marginal practice

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H.5.2 [User Interfaces]: Prototyping, Theory & methods, User-centered design

INTRODUCTION
Technical progress is a great source of innovation – but too often technology is developed with little regards to its ultimate use. If a new technology should make a real difference in peoples' lives, it has to be coupled with a holistic view of technology use. For instance, the modern desktop computer arose out of a combination of new technical opportunities such as bitmapped graphics, the laser printer, the Ethernet, the mouse, etc., not to mention steady advances in digital storage capacity and processor speed. But it was not until they were coupled with the vision of personal computer use as developed at Xerox PARC in the 1970's that these and other technical advances gelled into a useful tool that would have a profound impact on how people live and work.

There are many design techniques used in specific points in the design process to generate *inventions* –such as an interaction mode, a new functionality, a specific device, etc. But for a new idea to become an *innovation,* it is not enough to be inventive – it must contribute to a transformation in a community, i.e. become widely adopted by users [4]. Many design techniques do not involve any inquiry into the needs of potential users, and if inventions created by such techniques do result in innovations, this is because they have been taken further and incorporated in existing social contexts. Conversely, relying solely on studies of potential users can help to produce results that solve specific problems for specific user groups, but it may also mean that many inventive ideas fall by the wayside. Ideally, any method aimed at producing innovations should therefore support *both* idea generation and studies.

This paper introduces *transfer scenarios*, a method for developing novel interactive technology. It takes as its starting point a novel technology that has an untapped potential for new applications. The method involves different steps where the designers can use their own preferred techniques to affect to design outcome. It aims to change the designer's mindset regarding the chosen technology, while simultaneously grounding it in existing human interests and needs. In the process we draw on a *marginal practice,* i.e. individuals who share a specific activity that they find meaningful. Participants in such a practice have interests or needs that are particular, but their underlying motivations could be applicable also for a more general group of people. Thus, its practitioners are not regarded as end users, but are involved to provide underlying human interests and qualities of interaction, relevant for the design outcome. With this approach we aim to drastically alter the view of what a technology is and can be used for, to stimulate new application ideas and interaction possibilities.

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SUPPORTING INNOVATION

Denning [4] makes a useful distinction between *innovation* on one hand, and *invention* on the other. "Invention", he writes, "means simply the creation of something new – an idea, an artifact, a procedure". There is no guarantee that even the most clever of inventions will ever become innovations. Innovation, he continues "requires attention to other people, what they value and will adopt". For the purpose of this paper, we choose to call the act of giving attention to other people – through studies, interviews, focus groups, and so on – *inquiry*.

We schematically sketch the two axes of inquiry and invention in **Figure 1**. This is not intended as an exhaustive taxonomy or framework for all methods, but it can be useful to map out the innovation space and identify the aims of various methods and techniques. In this schema, we can roughly place different approaches, including isolated design techniques, complete design methods, as well as specific projects. The X axis describes the degree of *inquiry* – how much effort is spent to provide grounding by studying and understanding users. For instance, a method or project that requires a deep ethnographic study that takes place over many years will appear much farther to the right than a daylong observation. The Y axis describes the degree of *invention* – how much attention is aimed at coming up with novel ideas. For instance, a project that aims to come up with a completely new device requires very high invention, while one that incrementally improves an existing device would appear much lower in the chart.

In the diagram, we can identify several interesting areas. To the left along the Y axis, we have methods and techniques that support invention with none or little attention to real-world user needs. We can call this space *idea generation*. On the bottom across the X axis, we have methods and techniques that purely aim to provide understanding of a certain user group or setting, without any claims to provide design input. We can call this area *studies*. In the middle, we find the most common category – those that mix invention and inquiry to support the design of new systems. We can call this space *user-oriented design*. Finally, in the top right corner we have an "ideal", the – perhaps unattainable – methods that combine the best of both worlds and provide a high level of both invention and inquiry. We have decided to call this "sweet-spot" in the innovation space *grounded innovation*.

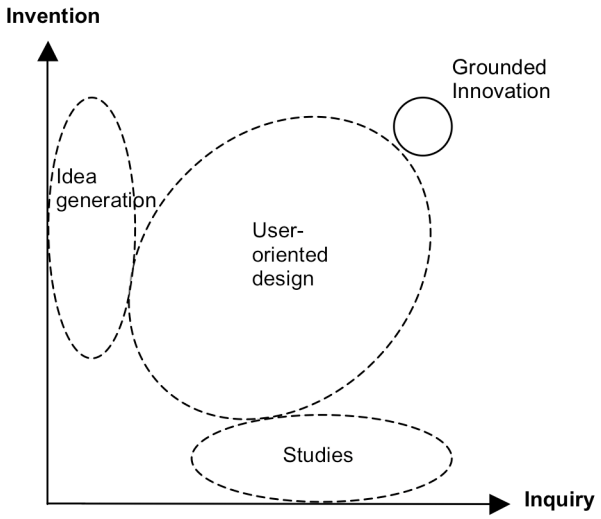

Figure 1. A schematic diagram of the innovation space

Idea generation: invention without inquiry?

Creating new conditions for design is important from a design theory perspective. Löwgren and Stolterman [21, p. 8] describe design theory as "knowledge that can liberate the designer from preconceived notions and conceptions of how the design process can and should be performed". In a design process where everything is possible and nothing is given, creativity has no friction and nothing to build on [21]. Therefore, constraints can cultivate creativity rather than limit it. However, when aiming for inventive ideas, the provided constraints need to force the designer thinking creatively rather than stay inside the box.

Brainstorming techniques, such as body storming [2], extreme characters and interaction relabelling [5], etc. provide constraints that force thinking in specific directions, which can trigger novel ideas. However, if a brainstorm is held to generate ideas around rich ethnographic data, it may be difficult to rise above the data and generate novel ideas. On the other hand, if a brainstorm is held without data, this may result in design that is not grounded in any real human interests or needs.

In reality, such techniques are usually applied within the context of a specific project or problem. Therefore, pure idea generation with no grounding whatsoever in human needs is rare. However, many schooled designers work with an approach closer to artists than researchers, in that they take inspiration from a multitude of different sources and often base their work on their own interests and experiences rather than on an inquiry in external users. A similar approach has been suggested when designing interactive systems, in the form of *autobiographical design* [29] where the researcher designs a system directly based on his or her own experiences. This approach should not be interpreted as indicating that grounding is unnecessary when designing new systems; just that it may be used in different ways, and that the sources for grounding may differ from those in traditional user studies.

Studies: Inquiry without invention?

Studies without any intention for design are rare in HCI, as the field is rooted not only in areas like social and cognitive science, but also in engineering and design. That said, there is a tension between the act of purely studying a user group or setting, and actually using this material to design new systems. Ethnographic methods, such as interviewing and observing users are well-established methods that can help designers to understand users needs and interests. But even if ethnography can provide solid ground for technological

systems it does not necessarily lead to innovative design outcomes [28].

In fact, Dourish [6] claims that ethnometodology has never been intended to support design, but its purpose is to "understand" a setting. He argues that there is a current discrepancy between what is expected from ethnography and what is a potential role for design. Thus, methods that merely focus on understanding users, such as ethnography and interviews, do not in themselves provide tools for inventions that can lead to innovations. Macdonald [24] argued that even if the concept of user driven design is widely accepted and many businesses use focus groups and ethnographic research, these methods are currently not used in a way that supports inventive ideas. He stresses that designers and design team need to learn *how* to use qualitative methods such as ethnography to not only analyze but also to generate design.

Stuck in the middle?: User-oriented design

In reality, most methods that are commonly used in research and product development today are situated in the middle ground, drawing on both invention and inquiry. With more or less success they attempt to combine both idea generation and user studies to produce novel and/or useful systems and products. But different methods and techniques emphasize invention and inquiry to different degrees. Some are firmly rooted in the data gathered from users and strive to design systems that address very specific problems; others take this information as just one of many inputs to the design process.

Approaches that try to involve users more creatively in the process, and thus might include a higher level of invention, can be found in the area of *participatory design* [12, 26]. A high level of user involvement has produced innovative results in areas ranging from home electronics to wastewater treatment [3]. Various techniques can be used to improve collaboration between designers and users; for instance, video artifacts can be used to create a creative dialogue between designers and users, and help formulate inventive ideas that are rooted in the users' own experience [22].

Several methods and techniques put more emphasis on invention, while still using inquiry as an integrated part of the process. For instance, *cultural probes* is a technique for data collection which is commonly used in interaction design [10]. By giving users packages with informal exercises, the designers hope to provoke inspirational responses to inspire design. Other methods are closer to technical invention. *Technology probes* takes advantage of the users to guide the design [16]. These probes are technical devices with one single main function, preferably open-ended, that log the users' activities. This method can be effective in analyzing the users interest and their possible creative use of the introduced technology.

The ideal: Grounded Innovation?

The best way of producing innovations would seem to be to combine technical and conceptual novelty with a thorough grounding in user needs and interests. From the above it seems an "ideal" method would provide the highest degree of both inquiry and invention, to heighten the chance of producing successful innovations. Such a method is not likely to exist, not least because no method can guarantee perfect results – the outcome of any design process is to a large extent determined by the skills and diligence of the designers involved. That said, we think it is useful to identify this as a sort of "sweet-spot" to strive for. The intention with the term *grounded innovation* is to highlight our belief that successful design projects will include a high level of grounding (provided by various methods of inquiry) while at the same time producing results that are highly innovative (provided by methods that stimulate invention).

INNOVATION BASED ON MARGINAL PRACTICES

Spinosa et al [30] claim that *marginal practices* have been sources of history-making and innovation in society. Shared styles of practices make people cope with things in similar ways, have similar concerns and see similar possibilities. When a practice is dominating it becomes invisible for the people involved and they will include others in that style, losing sensitivity to marginal ways of doing things. A marginal practice is often overlooked, as an out of the ordinary approach or viewpoint. As an example, the early feministic initiative was first a marginal practice, which then spread and led to important changes in society. Throughout history, a variety of marginal practices such as citizen actions have contributed to fundamental changes, affecting the heart of perception of society and contributing to innovation [30]. Thus, the power of marginal practices lie in that they can affect or even become a central practice. In the same vein as marginal practices, *lead users* are a minor group of advanced users whose unusual creativity with a product has been successfully used to inform future design of interactive products [31]. The creative practice that the lead users demonstrate is marginal, rather than representing the average user. However, their original and inventive use of a product, can point towards business opportunities for a future general market.

We are interested in using marginal practices as a way to encourage a new mindset in a design process. In particular, we try to find practices that can be matched with, and provide inspiration for the design of technology. We define a marginal practice as *individuals sharing a specific activity that they consider meaningful.* The marginal practice should consist of people that do not reflect the majority of end-users and may even be a group of people that are unlikely to be end-users of our proposed systems. The point is that such a practice can provide a new perspective on the use of the technology, raising design ideas that are based on alternative viewpoints and ways of doing things. A practice that is considered meaningful for a minor group, can still involve underlying needs that a more general group can

benefit from. This can provide a new and grounded design outcome of interactive technology, which we will exemplify below.

Previous experience with marginal practices

We have previously worked with specific individuals to develop novel user experiences based on new technical possibilities [13]. In one such project we developed a new kind of digital camera. This application intended to explore new practices for digital camera technologies, different from analogue, and change pre-conceptions of what a camera can achieve. Our technical starting point was to use sensors, such as a thermometer, an accelerometer, a microphone, etc. to change the appearance of a digital picture in the moment it is taken [14].

Early in the design process we took inspiration from *Lomography*, which clearly stands out from more conventional amateur and professional practices of taking pictures. It is an amateur practice, making use of old Russian analogue cameras with optical defects. The lomographers ignore traditional "rules" of photography, for example by "shooting from the hip", i.e. avoid looking through the viewfinder when taking a picture. They are known to bring their camera everywhere, to always be ready to take spontaneous pictures. Their attitudes towards taking pictures, sense of aesthetics and enjoyment gave us important insights into what we consider a marginal, yet interesting practice to inform the design of a new camera.

Throughout the design process a group of lomographers generously shared their interests, and provided us with important considerations as they reflected on our concept. We also tested an early prototype with both amateur photographers and lomographers [19]. The lomographers were never intended as end users, but rather to provide us with insights of their view on picture taking and enjoyable moments in their practice. The concept has now been developed further and implemented on a camera phone. In a user study, the results indicated that participants used the camera with new goals of taking pictures, expectations of the results, views of aesthetics and picture-taking approach [15]. This implies that we succeeded in breaking from preconceptions originating from the limitations of analogue cameras and enabled new ways of taking creative pictures with digital cameras.

From this case we developed experience to make use of a marginal practice in design, here to explore new practices around the picture taking moment in digital photography. If the goal of the design had been different, for example to design a digital picture album with a specific technology, we would have chosen another marginal practice. Collectors of stamps or toys might have been more suitable then, to emphasize specific human interests and needs with collections –matching the intended design outcome. When working with the lomographers, we did not focus on how to describe the process so other designers could take advantage of marginal practices. We are now more systematically investigating *how* to transfer a marginal practice into design.

TRANSFER SCENARIOS

Transfer scenarios is both a technology-driven and user-oriented method developed to raise the level of invention in a design process, without losing the grounding that is essential for innovation. It is not an ideal design method for every situation, but useful to encourage a new mindset of an existing technology, or to explore interesting application and interaction possibilities for not yet mature technology.

This method could be used with almost any interactive technology with the potential to give rise to new innovative and useful applications. The idea is to ground the design in a group of people, which are not necessarily end users, but which share a relevant marginal practice. Such a practice, meaningful for a minor group, could potentially contribute with specific qualities for a design intended for a more general user group. It needs to be carefully chosen to match the intended design outcome, and is used to understand higher-level motivations and human interests, carried out in an alternative approach. This is then transferred to a design in a different context (involving the technology in mind), to achieve a result which is both grounded in human needs, and takes advantage of the specific properties of a technology.

Below we introduce steps that we have developed to explain how transfer scenarios can work, when using the technology as a starting point. This involves how to learn about the technology and match it with a marginal practice, how to investigate and analyze the practice, and then how to transfer the findings into actual design. In the section after this, we complement the steps by showing how the method was used in a real design process.

1. Learn about the technology

This step involves *exploring and learning about the general properties of the technology.* An overall understanding of the properties and potential of the technology is needed to perform the next step, where this knowledge will be used to find a matching marginal practice. The goal is to get an overview of the possibilities and limitations of the technology, rather than to get a deep technical knowledge. With a broad understanding of the technology, it will be easier be to find a related marginal practice. This step should involve sorting out not only the existing technical properties, but also to find possibilities that combinations with other technology could give. If the technology is novel, how do other technologies with similar properties work? Has some technical possibility or functionality been overlooked? What are the current applications? What are the future trends? For some projects, the properties of the intended technology may already be well known, and thus reduce the work in this step.

Learning about the technology could involve activities such as investigating existing applications through academic

papers, company websites, blogs, reading technical magazines and hands-on workshops.

2. Match the technology with a marginal practice

Another important step is to *investigate potential marginal practices and decide for one*. First, it is necessary to assemble information on a set of marginal practices that could be an interesting match with the technology being developed. The practice does not have to involve future users of the technology, but should be chosen to match its properties and the intended design. Members of the practice should engage in activities that are meaningful for them, preferable different from the general style or the potential users' current perspective of doing things. Their specific practice should illustrate underlying human motivations and interests, which are carried out in an alternative way, but still can inform a meaningful design.

This step is very important for the outcome and therefore the choice of marginal practice should be considered carefully. The intended design outcome, in consideration with the most interesting properties of the technology, should determine which practice to use. For instance, when investigating a technology with possible tangible interaction possibilities, it could be useful to look into a marginal practice that involves tangible use of for example paper notes. A camera technology could be matched with people having a very unusual approach to picture taking, a robot-technology could be matched with a marginal practice of interacting with living creatures, and so on. The aim is not to improve or design artifacts that support the practice, but to learn about and make use of its underlying motivations. The matching depends on what technical properties are interesting for the intended design outcome. A possible match of a marginal practice could also be to involve people who share an interest in using a related, but older technology. Such a practice may involve old technical properties that are creatively made enjoyable or useful in the practice, but have been lost in its modern counterpart. Another consideration is the constraints concerning the design outcome. For example, if this should involve everyday use, it is likely that it is a better match with a practice involving activities on a daily basis, to learn about motivations for upholding such a daily interest.

Exploring marginal practices can involve looking into practices and communities through websites, blogs or even contacting people sharing specific interests. Brainstorming techniques can also be useful to come up with ideas about a possible marginal practice that could be matched with the technology.

3. Investigate needs and interactions

The third step involves *investigating the human activities in the chosen marginal practice*. The reasons for matching the practice with the technology play an important role here. For example, if physical interaction is important in the design outcome, some questions should involve why the interaction is carried out way it is in the current practice. In the previously described case of working with Lomographers we asked about their style of "shooting from the hip" (instead of looking through the viewfinder) to understand their motivations for this kind of interaction. However, it is also important to get a general overview of the people in the practice. For example, why do they consider their practice meaningful? What do they do, how and why? Why do they prefer doing this instead of using a more conventional approach? How did they get interested in this practice? The questions should relate to the intended design, and can thus be different depending on the goal with the design.

To investigate general needs and interest in the practice a suitable inquiry technique, such as interviews or observation is needed. Several techniques can also be combined. With the Lomographers we combined interviews with a workshop, where they could show and talk about their pictures [14]. Overall, this step should provide answers to what the marginal practice is about, how do they do things and why, to inspire design in the next step.

4. Analyze and Transfer Data to Initial Design

This step is about *analyzing data, such as transcribed interviews or videos, to transfer the findings into design*. This involves determining which properties in the practice that are the most interesting for the intended design. Further, this step involves selecting and organizing specific data as a basis for design. The data should be used as design input during idea generation, for which a variety of design techniques could be used. The chosen design technique is intended to help combining the data and the emerging ideas into a coherent whole.

One technique that can be used in this stage is Personas [27]. This involves creating fictive, but realistic user profiles based on the data. First, this technique should be done without giving any regard to the look and feel of the technology. Not until the personas reflect some interests and meaningful activities that are possible to be shared with end-users, the design of technology starts. This approach helps to make the human interests and motivations more vivid, before going into technical limitations and possibilities. This also prevents technical considerations to take over the discussions too early.

5. Detailed Design and Technology development

In the final step of transfer scenarios, interactions and meaningful activities found in the marginal practice have already been transferred into the proposed design. This step continues with the actual design of the technology, involving intended users. Even if the marginal practice is the underlying motivation for the overall design, further development and detailed design has to face real users, which can provide a more detailed feedback of realistic use situations. In this step, it is also likely that the view of possible users have shifted. New perspectives are likely to have emerged compared to the beginning of the process, as a result of new insights arising from the marginal practice.

If the previous steps have involved a specific technique such as personas, this step can involve working in more detail with the design technique to meet technical limitations. This may for example involve rewriting and taking the personas further, while finding a balance between the technical development, the persona and from testing the design with real users.

CASE STUDY: AUTONOMOUS EMBODIED AGENTS

In the European project *Embodied Communicating Agents,* ECAgents [7], we are exploring applications for autonomous embodied agents, e.g. robots, which can evolve their own behavior by communicating with each other as well as with human users. The field of Human Robot Interaction, has traditionally focused on developing social robots with human-like behavior and appearance, or other forms of high level social communication [9]. Here we wanted to investigate alternative types of meaningful and interesting robotic products for everyday environments, and used transfer scenarios in the design process.

Learning about the technology

As a starting point for this case, we looked into which core features that agent and robot technology may involve. This involved reading research articles, websites about communication between embodied agents (such as [7]), blogs about various robot projects, emerging behavior and robotic products for everyday environments (e.g. [11]), different types of robots and agents etc. Descriptions such as Maes [23] definition of an agent as "a system that tries to fulfil a set of goals in a complex, dynamic environment" were discussed in relation to descriptions of communicating embodied agents as being able to interact directly with the physical world and "to communicate between them and with other agents (including humans)" [7]. We considered that one of the most prominent properties of embodied agent technology was to be able to act autonomously and to take advantage of the physical world. We also discussed the history of robots in everyday environments, how to avoid the anthropomorphic view and high-level communicating robots, to open up for enjoyable relations to agents that involve much less complex communication. Future possibilities, and current challenges in human robot interaction were also discussed. Overall we got a broad understanding as well as some starting points for which agent properties that would be interesting to investigate.

Matching the technology with a marginal practice

We were interested in a marginal practice that could provide insight into possible roles for robots or other autonomous artifacts in everyday environments. To find this we brainstormed about human interests that already involve or could involve entities or systems involving some form of autonomous and emergence related behavior. The brainstorms touched upon a variety of practices that involved some form of agency-like interaction, such as pilots in automated airplanes, people growing plants, and people owning pets. When discussing further we found it suitable to understand what makes some people uphold a continuous interest for very limited interaction, something we saw as a possibility to create interesting robot applications with less complex interaction and communication possibilities.

Ultimately, we chose to focus on the marginal practice of people owning unusual pets, such as reptiles and spiders. This practice was likely to provide us with knowledge the underlying reasons for showing continuous interest in such pets, even though it is often not possible to interact much with them, e.g. play or teach them tricks, as opposed to more conventional pets such as dogs. Rather than aiming for the anthropomorphic tradition of designing robots as pets, we hoped that this practice could provide insights in alternative agent behaviors for everyday environments. We were not aiming to use our insights into the practice to design robots that look and behave like reptiles, or zoomorphic embodiments of the technology (e.g. [25]). Instead we wanted to see beyond the actual artifacts involved, and find underlying motivations for this kind of interest, reaching beyond limitations in interaction and communication. Thus, our interest concerned things like engagement, enjoyment, identity, and social networks that the practice entailed for them – to transfer these qualities into the design of interactive technology.

Investigating general needs and interactions

We held interviews with 10 pet owners, six men and four women, who owned pets like snakes, lizards and spiders. Three of them were found through friends, one through the local Herpetological Association, and six through a reptile owners' website. Their age was between 17 and 55 years old (mean 25.6 years, median 22.5). Due to time and logistic restrictions, three interviews were made face-to-face, and seven by phone.

The questions we asked to the pet owners aimed to answer for example:

- What they consider important qualities owners find in their pet (for example that it is easy to care for)
- Why they are interested in having this kind of pet
- What they do with their pet
- What the pets do
- How they see if a pet is sick or in different moods
- Social interaction with other pet owners

Each interview was recorded and then transcribed.

Analyzing and Transferring Data to Initial Design

Analyzing the data involved looking into why the pet owners consider their practice meaningful. We focused on understanding their key activities, motivations and interests. We also tried to understand differences in how the pet owners reflected on their relation to their pets. However, we did not look into for instance how a snake owner's interest was different from a spider owner. Rather, we were interested in finding out variations of relations, interests, interaction and enjoyment for this kind of practice.

Figure 2. a.) Selected data was taken out as notes from the transcribed data. b.) The notes where sorted in clusters, each being a starting-point for one persona. c.) Affinity diagrams were used to sort out the different interests of each persona.

Sample findings

In the transcribed data, we looked for underlying motivations for people for being involved with reptiles. For example, we found how some people considered their terrarium almost as an interior design object. One participant was asked where he kept his terrarium and answered: *"Well, I have had it (...) in the living room, and then... well it's like a little extra furniture piece with a jungle theme."* Another person described the following as important qualities of a pet: *"Well, it should be… be like a furniture preferably, nice to look at and at the same time easy to care for"*. This person was asked why he wanted a pet in the first place and replied: *"That's a hard question, why do we want to have flowers in the windows?"* And then he continued: *"But it is fun to have, it is nice with a living thing."* He did regret that his pet (a spider) was not more lively, as sometimes it could decide to not move at all for a week. Another person expressed similar reasons to have snakes: *"Eh, the company and to have something living around you, I feel this is good for the soul (...) you feel good from it."*

Simply watching the animals and creating their environments was a major motivation for someone to keep this kind of pets. *"Well, I don't know really, partly it is fun to build these environments, and partly it is that I can spend hours to just sit and look at them when I have fed them or something like this."*

We noted some differences the relation to the pet. On a question if any of the animals where more special than others one person replied: *"Eh… here is a leopard gecko, it is partially sighted, so I have fed it with tweezers since it was small, and now it is a bit over a year, so it is pretty special to me."* Someone expressed that she regretted not being able to pet her lizards: *"Yes, [I miss] that you can't hold them and pet them, you can't do that with a lizard because they can get dust mites, and die."* Another one expressed that he did not consider that his snakes lacked any properties as pets: *"Well, no, I mean the snakes are constructed in a specific way and if you get them you have to accept that they aren't any cozy pets or alike, you have to have them as your interest."* This person expressed his interest as a hobby, and his reason for enjoying it as: *"Yes, well, it's mostly that it is exciting and a challenge to develop certain colors and things like that."*

Using Personas as a Design Tool

To transfer our findings about people's relation with reptiles into the design of personal embodied agents, we used personas as design tool. We selected data that illustrated qualities that the pet owners enjoyed and other specific interests and experiences on Post-it notes (see Fig. 2a). By replacing the word pet (in excerpts where one or several pets were represented) with the word *agent* or *agents* on each note, we forced ourselves to facilitate the transfer from the data's content of interacting with reptiles, to the outcome of this design process.

The selected notes were sorted into four groups, where each group was discussed as the starting point for one persona, illustrating specific interests and behavior (see **Figure 2b**). On the basis of the resulting clusters, four personas with different interests and personalities were created and named: Nadim, Magda, Christopher and Anne. At one point in the process we also placed the notes into affinity diagrams of each persona, where related interests or features were grouped together (see **Figure 2c**). At this point we focused mainly on the persona's life, interests and activities, rather than the form and the behavior of the agents.

To explore different properties of the agents we brainstormed further about interests and interaction with the agents, and how this was different or similar from the other personas. This was complemented with brainstorming about possible appearances and behaviors of the agents. Throughout the process we also explored moving specific notes from one persona to another, to take new viewpoints and to avoid creating too much of a "stereotype" persona.

Personas

Below we give an overview of each persona and how they relate to their agents. These are not the complete personas; a detailed description can be found in [20].

Anne:

- Anne feels it is good for the soul to have something alive around her, creating a nice atmosphere in the room

- She has no need for being in contact with other people who own similar agents
- She likes her agents because they are easy to care for and that they are almost like a piece of furniture
- Anne enjoys watching the agents slowly take form and likes to be part in affecting this
- The agents do not recognize her, and in fact she likes this better than if they would

Christopher:

- The agent is around if he feels lonely and inspires him to get out and be active
- His agent works like a pedometer, and appears emotionally affected by Christopher's activity as well as other similar agents
- Christopher finds it fascinating to get to know his agent and find out what it likes
- He likes to get in contact with other like-minded people, and talk about the unique properties of their agents

Magda:

- Magda's agent extends her own identity. It is worn like a broche on her clothes every day, attracting attention from others
- Magda likes the idea of being a little different. She wants to be the expert when it comes to how to treat her agent
- She finds it thrilling that her agent is unpredictable and can cause minor electrical shocks to someone that is not used to handle it
- Her agent reacts on proximity to other agents and other devices with network capabilities

Nadim:

- Nadim does not pet his agents, nor is he interested in different personalities of the agents
- He is interested in evolving patterns and wants to learn about the agents' visual behaviors and how to affect them
- He enjoys watching the patterns slowly evolve, and has lots of patience to get it the way he wants

Detailed Design and Technology Development

After the initial design, we have continued the work with personas, and started to build working prototypes. Currently we are working on the design concepts that are represented in the personas Anne and Nadim. We are now combining the technical development with the development of personas, adapting to technical challenges while retaining the important human considerations from each persona. The prototypes will soon be tested by intended users and then developed further. Below we describe the results of each design, and give a brief example of its intended use and the state of the prototype development.

Anne´s dynamic living room wall

Figure 3. A photo from a camera phone creates a flower on the wall.

While most people change their wallpaper every other year or so, Anne cares for her dynamical wall almost every day. She takes pictures when browsing in trend magazines, or during a stroll in the city, to use for her wall. For each picture that Anne sends to the wall, a flower with specific properties and behavior is created. If Anne adds several pictures, there will be several flowers affecting each other's behavior on the wall. Anne does not have full control over her dynamic visualization, but cares for it on a more or less daily basis by adding new pictures, with different colors or motives. Some days she is less active and only watches the patterns slowly take shape.

In the prototype, a camera phone with a Bluetooth connection is used to take and send pictures to the system. For each picture, a unique flower (agent) with a specific behavior and appearance is created. The flower visually grows based on the pictorial input and its relationship to other flowers. The prototype is projected on a wall from a PC, and we use an ultra-sonic positioning system to allow the user decide the position of each flower. The system will be evaluated with potential users, for instance people with an interest in interior design.

Nadim's dynamic hobby pieces

Nadim has his robots as a hobby, rather than as pets. He is especially interested in robots that have visual patterns that evolve over time. Nadim explores different ways to affect the visual outcome, and to do this he experiments with different lights, sounds and motions for his robots. He also brings his robots to friends that have the same kind, so that

Figure 4. Small mobile robots communicate and evolve visual patterns for users to enjoy by actively contributing to.

the robots can affect each other's patterns at different points in time. Nadim does not care if the robots evolve different personalities, nor is he interested in petting them. He simply wants to develop interesting evolving patterns, an interest he shares with his closest friends.

The robots we are developing are based on the E-puck platform [8]. We have extended the basic hardware platform with LED screens that can display dynamic and colorful patterns. We are investigating how visual patterns can be created and evolve, and how they can be communicated between robots. We aim to continue the design with possible users, for example people that enjoy computer games, to evaluate this concept.

DISCUSSION

Transfer scenarios is a technology-driven design method, where human motivations and interests are transferred from a marginal practice into design requirements for interactive technology. The intention is to *ground* technology with the help of existing human needs, and at the same time *elevate* empirical data to support inventive design (c.f. **Figure 5**). While we cannot claim that transfer scenarios will lead to the "ideal" of grounded innovation, it does represent a conscious effort to get nearer to that goal. The fact that the studied practice is different from the intended users, is challenging, while at the same time being the reason why it is possible to get new ideas that are both based on the technical properties and a human practice. In a way, transfer scenarios is a way to *defamiliarize* a viewpoint of a technology. It changes our mindset to see the design from a new perspective, matching the technology with a practice instead of the other way around. In ethnography, defamiliarization is a tool used for critical reflection of the familiar, thus providing a new perspective, for example of the use of an artifact or a social situation [1]. In a similar way, our method aims to provide a fresh perspective of possible needs or interests and interaction that a specific technology could support.

Lincoln and Cuba [18] coined the term *transferability* as the possibility to take findings from naturalistic inquiry conducted in one setting, to understand another specific setting. Transfer scenarios also investigates a possible match between settings, but has the intention of matching fundamentally different ones. Both approaches require that the involved contexts are understood enough to determine if a match between them is possible. This is prominent not only when matching a technology with a marginal practice, but also when the data has been collected and is transferred into the design. For this step it is important to have a feeling for *which* underlying needs that potentially could meet needs or interests among the intended users, which thus is yet another context to consider. This kind of matching is not trivial, demanding not only good imagination and design experience, but also faith in the resulting design.

Transfer scenarios should not only involve marginal practices, and involving potential users is crucial when doing detailed design. Getting input from different users at different points in the design process is already an accepted approach in HCI [17]. Further, the design technique Personas makes use of data to give life to a "typical user" and to make this character credible, rather than to represent an existing user [17]. This is also how the technique is used when applied in transfer scenarios.

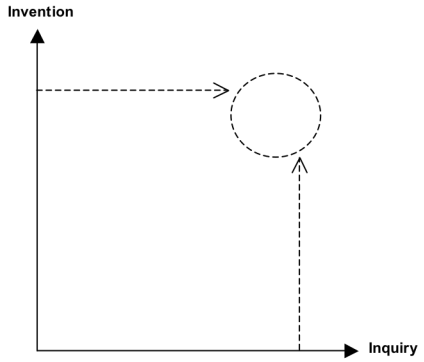

Figure 5. Transfer scenarios attempt to ground inventive ideas with empirical data.

Finally, methods and techniques are only vehicles for developing the designer's abilities, and can never be better than the capability of the people involved [21]. Thus, the choice of using transfer scenarios in the design process has to be made in consideration to the situation at hand.

CONCLUSION AND FUTURE WORK

Transfer scenarios is a method that provides designers with a way to take advantage of both inquiry and innovation, to increase the possibility of a successful innovation. It takes advantage of the perspective provided by marginal practices to help the designer think outside the boundaries of technology. Similar kinds of design constraint are used in many idea generation techniques; the difference here is that this method supports a changes mindset through the entire design process, not just for a short brainstorm. With the design case of autonomous embodied agents we have showed that it is possible to sustain the changed mindset throughout the design process, and to produce novel design.

Transfer scenarios is not useful for every design problem; its current steps have been specifically designed to create innovations based on technological pre-requisites. However, we believe it could be modified to include other types of pre-conditions, using for example a certain location or activity as a starting point. For instance, when designing for urban commuting one might look into other ways of moving about, such as the Aboriginal Walkabout, which are journeys on foot that take place as much in the spiritual world as in the real. Such activities can generate new ways of seeing a familiar setting and increase the potential for innovation.

Our next step in this work is to involve external designers to try out the method, preferably for a variety of design cases and technologies. By doing this we hope to gain

further insight into how the method may affect different design processes. We will also continue to develop and evaluate the design cases described in this paper. We will then use user-oriented techniques, such as placing the prototypes in the homes of users in a similar manner to technical probes, inviting focus groups for workshops to try out the technology, evaluate specific aspects of the interaction, etc. These results will then be fed back into new prototype designs which might – eventually, if we are lucky – turn into true innovations.

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