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Reflections on Visualization in Cross-Cultural Design

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Introduction

It can be very difficult for designers of any visualization to recognize the assumptions embedded in their perspective when they, like me, grew-up and were educated in a society where visual representations are abundant and visual pedagogies have been refined and taught for many years, even prior to computing. I gained skills in technology, 3D modeling, composition and using semiotics, etc., in Denmark, a Western country with a rich history of visual arts, and, like other designers in similar situations, had few opportunities that provoked me to reflect on how my perspectives were situated in my own setting. Indeed, as I acquired specialist technical and design skills I was unaware that I would start on an ongoing journey in visual communication with people who have a very different history of visual expression and minimal exposure to digital technologies and design. In this article I reflect on some of the ways that evolving a visual platform for communication through dialogue and Participatory Design (PD) methods helped me recognize some of the assumptions embedded in my perspective. I describe examples that emerged when I introduced different visual prototypes to rural villages in Namibia. I aim to show how conversations around visualizations can increase a designer's sensitivity to others' perspectives, support mutual learning, and trigger the engagement and criticism that are vital for co-design.

Between the end of 2010 and 2013, I undertook eight research visits of 3 to 7 days to three different villages in rural Omaheke, Eastern Namibia, as part of a long-term collaboration on a research and development project. Most design activities took place in one village, Erindiroukambe (6 research visits), where relations were established via a local academic researcher whose family has a home there. Through participatory action research in Erindiroukambe, which developed since the end of 2008, we have engaged with a group of elders and run various design activities, which include amongst other activities four different digital prototypes, running on laptop and tablet computers. We have also evaluated the transferability of our co-design activities by applying some of the design outcomes and methods we used in Erindiroukambe in other villages in the region.

Addressing a Threat to Rural Indigenous Knowledge

Traditionally, people in rural communities in Namibia, in many cultural groups including the Herero, learnt their life skills through practical experience, oral information transfer,

and master-apprentice relations. Inter-personal interactions in the local social, physical, and spiritual context enabled acquiring, practicing, and disseminating livelihood-relevant knowledge and know-how for animal husbandry, treating illness with locally gathered and prepared herbs, etc. All aspects of this knowledge and know-how are crucial to the health and survival of people and life-stock in small communities that are often remote from grid electricity, modern services and products, such as vets, hospitals, and super-markets. Meanwhile, the knowledge system maintained social, spiritual, and ecological connections within the locale. For decades knowledgeable elders passed knowledge from generation to generation, and youth acquired a 'repertoire' (Wenger, 1999) of knowledge in a curriculum that is situated in the social, spiritual, and ecological connections of the local community of practice.

Various factors mean that youths of today miss out on their home community's cultural curriculum, and the consequential loss of knowledge may adversely impact on the social and physical ecosystem in which the Herero tribe have lived since they migrated and settled in Namibia in the 17th century (Wallace, 2011). The loss of knowledge may contribute to new problems regarding identity, self-awareness, and self-worth (Bidwell & Winschiers-Theophilus, 2012). However, the generation of custodians of local knowledge, village elders, diminishes. To participate in formal education children study in schools in cities and towns up to several hundred kilometers away from their home-steads in the rural villages where they remain for years, apart from visits home during holidays (Kapuire, Winschiers-Theophilus, Chivuno-Kurio, Bidwell, & Blake, 2010). Some youths return to their home villages to reassume active roles in community life after graduation but the majority does not return until after many years in the cities. Most Namibian youths are taught within school curricula that inherit from past European systems rather than the systems that sustained local livelihoods, values, and knowledge in the rural Namibia (Kapuire et al., 2010). Further, like in many Sub-Saharan countries, schooling in Namibia emphasizes topics that will contribute to the nation's social and economic development, prepare youths for a technologized and globalized world, and integrate them into a nation that is shaped by many different cultures, religions, and colonizing influences. Thus when they return (which the majority of Hereros do) to the rural areas they are formally educated yet unequipped with knowledge on interacting and living in the Namibian rural areas.

By designing with rural community members our goal is that the resulting system will act as a digital record of tangible and intangible heritage (see UNESCO, 2003). We believe that village elders, the knowledge custodians, must be able to use the system(s) fully in order to decide, share, evaluate, validate, curate, and disseminate their knowledge. Thus, the system needs to be accessible, usable, and available to elders who have limited digital literacy. Since most of the design team members are outsiders to the village and Herero culture, we acknowledge that we differ in epistemology.

Design Vision

I built upon an initial idea that sought to use the significance of places in rural Herero knowledge systems as a principle to assist storing and retrieving scenario-based information. The idea proposed to represent places in visualization and tie videos, audio, and other media of rural Herero knowledge practices, recorded by elders and/or researchers,

to spatial points in a virtual landscape (Rodil, Eskildsen. & Rehm, 2011). Contextualizing media, such as video, in an interactive navigable 3D graphical world aimed to provide an information structure to upload, index, organize, search, and browse for content that is both accessible to users without print and computer literacies and compatible with aspects of local ontology because elders' discussions of their knowledge often referenced or was indexed to places (see: Bidwell, Winschiers-Theophilus, Kapuire, & Rehm, 2011; Bidwell, Winschiers-Theophilus, Koch-Kapuire, & Chivuno-Kuria, 2011). We intend that Herero elders, with limited IT and print literacy, use such a visualization to create virtual contexts themselves in which to embed their own media, for instance, to represent the place where events and/or activities occurred or where a story was told. Finally, we hoped that visually representing living and non-living objects, negotiated with local people, can express information that is important to their cultural heritage but that video cannot record or record in sufficient detail. For instance, by exporting drawings of objects, drawn by local people during our participatory design activities or by modelling in 3D scenarios that local people described but were unable to record in real-time, we speculated that the representation might become a scaffold for various systems to facilitate learning indigenous knowledge by ex-situ youths. For instance, we might create small games based on local practices where youths could, say, go hunting, in ways similar to games based on Aboriginal practices in north Australia (e.g., Standley, Bidwell, George, Steffensen, & Gothe, 2009), or create a novel storytelling place for ex-situ youths to virtually meet, such as the inspiring design by Heyes (2011) involving Inuit elders in creating a visual representation of cultural heritage to enable de-situated youths in virtual reality to partake in storytelling.

Technology Appropriation across Contexts

Enabling holders of indigenous knowledge to develop IT for themselves, as called for by many authors (e.g., Hughes & Dallwitz, 2007), certainly removes a need for elders to adapt to foreign designers' literacies in design. However, it cannot address the issue that digital devices and media tools are already embedded with functional and representational constraints that were molded and programmed in by the culture currently dominating technology development.

PD is historically centered in Scandinavian socio-technical developments for workplaces and within trade unions in the 1970s and 1980s to democratically adjust the power balance between workers and management (Kensing & Blomberg, 1998). Hypothetically one could state that if Western designers need participatory methods to align IT development with local Western practice, then that will also be the case for IT students in Namibia, since they are de-situated from the communities thus ipso facto already using the dominant technology and absorbed into a "Western perspective" through "Westernized" schooling. This project includes a number of local students and, besides obvious linguistic advantages, they are often just as lost as when my Danish students try to understand what Danish elders think of IT prototypes.

Neither one of these significant issues implies discarding visual communication or intercultural co-design altogether. Indeed, there are many examples where holders of indigenous knowledge have worked with designers to invent novel representations of heritage. An example of this is the use of virtual reality for repatriation of architectural as well as

traditional knowledge in order to disseminate it to young Inuit (Dawson, Levy, & Lyons, 2011). It is an example where visualization functions as a bridge between worldviews, which is pertinent to our aim of using the representation to communicate with youths. Increasingly, Namibian youth interact with digital technologies and representations while away from villages in watching TV or playing digital games. Increased sensitivity is invested in making the terms and forms of a digital representation as flexible as possible, enabling the elders to appropriate it effectively. With the realization of technologies already permeating Namibian cultural life, we have to make a choice of being observers of a change or to actively appropriate technology design to and with the people involved, and, as a persisting thread throughout the appropriation of technology design, to infuse local values into the design – not only limited to the content as being of 'cultural' material, but as an example by designing interfaces according to local viewpoints.

Visualization as a Method of Communication

We have framed our research and design activities within PD due to the explicit differences between researchers and local participants. From a socio-political perspective it is desirable to create a tool empowering elders to utilize it avoiding a top-down and alien agenda on how to frame and represent their knowledge – as previously experienced with colonization and Western hegemony. Müller (2003) describes the world of the HCI professional and the world of the end-user as each having their own set of defined boundaries, knowledges, and practices – thus moving from one to the other is not of a trivial nature. The cultural boundaries of epistemological nature, the use of technology (in its broadest meaning) in our daily practices makes just some of the differences obvious. Our understanding is full of blindness about the Hereros' perspectives. Bødker, Ehn, Knudsen, Kyng, and Madsen (1988) describe this situation as, "The normal resolution or understanding includes the blindness created by the tradition they come from. The design process is characterized by a breakdown of this understanding, by which a situation of irresolution is created." Similarly are the Herero elders unfamiliar with digital technology, not only on the operational level, but on how technology puts an emphasis on certain things –leaving other things out. For instance how video recordings only record what the cameraman chooses (and what he is allowed to record) or that privileging text excludes other forms of expression.

An approach to recover from this breakdown is the process of mutual learning, explained by Dearden and Rizvi (2008) as:

> "… where technology designers learn about the setting where technology is to be used, and users continuously learn about technology design and designers."

Learning is vital for designers to reduce spots of blindness through explicit help by participants. According to Mutema (2003) the evaluation of the knowledge gained should be a participatory process. Mutema explains, "Understanding is made possible through dialogue, conversation and communication between the researcher and the actors." This allows the interpretations to be checked and reinterpreted.

Equally, learning is vital for local participants to evaluate and criticize the previously unknown nature of IT, enabling them to co-design a knowledge system on their terms.

Familiarization with IT is not for local participants to gain digital literacy, but to avoid a digital curation shaping the curated without the ability for the elders to evaluate it.

In this sense the term 'visualization' associates with several inter-connected ambitions: firstly, that visualization is a methodological approach for us to gain insights about how interfaces and representations can be accessible to and available for appropriation by elders; secondly, that visualization functions as a medium for researchers and community members to engage in dialogue about Herero culture and together explore relationships between technology design and knowledge.

Reflecting on Assumptions

By translating aspects of Herero knowledge into objects and relations that researchers and designers can identify and recognize, visualizations are communication media that helped me recognize some of the assumptions embedded in using representations that are often unnoticeable. 'Digital natives' like me grow up in technology-rich environments and our habitual interactions with technologies mean we embody meanings that are not usually obvious to us. The terms 'visualization' and 'representation' are used interchangeably throughout but I refer mainly to 2D/3D digital graphics on digital devices.

Visualization does not represent an objective and universal reality

In late 2010 we introduced the first visualization on a laptop computer during a 5-day visit to Erindiroukambe (Rodil, Eskildsen, & Rehm, 2011). The visualization was my response to a challenge to generate a design idea that could be used to preserve cultural knowledge for indigenous groups in Namibia (Winschiers-Theophilus, Bidwell, Kapuire, & Chivuno-Kuria, 2010). The design idea was influenced by another project I was involved in with Aalborg Zoo, which aimed to disseminate information about 'African animal migration' to Danish pupils in an interactive curriculum (Rodil, Eskildsen, & Rehm, 2012). The pupils could explore and learn from a large virtual world that depicted the Serengeti and conveyed information from the zoo partners. The design idea was also influenced by the life-style and beautiful red garments of Maasai warriors and my life-long fascination with rock paintings and their artistic and communicational value. In fact, in 2010 before I even knew about Hereros in Namibia, I created in a game engine a 3D scene of three Maasai warriors sitting around a fire. With the click of a mouse on the 3 men or the fire a 2D plane would appear between them showing a video recording of Maasai dance rituals (Figure 1).

When I developed the first prototype I did not consider that much of my inspiration was not local to the intended users in the small rural community in Namibia. I did not realize that the Maasai people inhabit Kenya and Tanzania, that rock paintings are credited to the San and other tribal groups, and that digital graphics are rare in rural Herero communities, whose own history of visual expression is not extensively graphical (see: Bidwell, Winschiers-Theophilus, Kapuire, & Chivuno-Kuria, 2011). I was also unaware of many other endeavors in using 3D visualization for communicating indigenous knowledge; for instance, seven years earlier the Digital Song lines project began to use a 3D game engine as a storytelling vehicle for urban and rural Aboriginal groups in Aus-

tralia (see Gard & Bucolo, 2005; Truna, 2006; Wyeld et al., 2007). Digital Songlines aimed to respond to the importance of walking 'country' to Aboriginal knowledge systems by representing physical features graphically as virtual context for audio recordings of oral stories.

Figure 1 - 3D visualization of Maasai warriors.

While visualizations may not be rural Herero's existing means to communicate knowledge, they are certainly not new to humankind, so I was not surprised that elders in the village engaged enthusiastically in dialogue about what they saw on the laptop's screen during the first visit to the village. Visual communication has a long history throughout the world; for instance, rock paintings exist on all inhabited continents. In Spain the El Castillo cave paintings are considered to be more than 40.800 years old (Than, 2012) and in Namibia the Apollo 11 cave paintings date between 26.300 and 28.400 years old (Bradshaw foundation, n.d.). Along the southern Cape coast tools for making paint in Blombos Cave are dated to be between 77.000 and 100.000 years old (Bradshaw foundation, n.d.). While rock paintings provide a legacy of the people creating them, it becomes difficult to validate what contemporary spectators decode from them. This form of communication is limited by the paint strokes and the rock surface medium and, thus, presents us only with illusive fragments of knowledge about the people encoding it.

The elders responded positively to my visualization and indicated that features, such as the gestures of animated people, were compatible with meaning-making in their communities. I admit that my lack of surprise that the elders could relate objects from their

village to the visualization was because, at that time, I assumed that humans share a perceptual reality of tangible things and 3D graphical visualization represent this reality objectively, even if some of the meanings we associate with visual qualities, such as color, are culturally-dependent.

My assumptions that there is a universal perceptual reality and that 3D graphical visualizations can somehow represent this reality objectively were unsettled because, as well as comment positively, the elders also critiqued details of the visualization. I had carefully matched the textures of the terrain and objects in the visualization to photos and video; but some features of virtual animals and plants did not align with the elders' experience of the world. For instance, they said that the size of tails, the color of cows, and the details of trees in the visualization were unlike their experience in the world. In fact the elders did not readily recognize the 3D recreated part of the village as being the same spot where they were viewing it. The elders' feedback prompted me to reflect more deeply on how visualization is "*an act or process of interpreting in visual terms or of putting into visible form*" ("Visualization," n.d.) and the selectivity this involves.

The elders' response to the first prototype illustrates the vital importance of conversation between designers and the knowledge-holders who are the intended user(s) of the system. When a designer produces an artifact based solely on his/her perception and without listening to others' ways of saying or observing others' ways of doing and interacting, the artifact can represent only the designer's worldview and construction of reality. Without conversation around the designed artifacts the system manifests what Bennett (1986) calls "*the ultimate ethno-centrism, where one's own world view is unchallenged as central to reality*". The elders' critique of my visualizations challenged aspects of my reality perception. Indeed, I started to follow changes in opinions about visualizations that happened over the past 300 years in Anglo-European discourse on visualization and objectivity. From the 18th Century botanists and anatomists "tried to bring out the fundamental uniformity of nature concealed beneath its apparent diversity" (Golinski, 2008). They represented through a principle of Truth-to-Nature an idealized version of their subject of study (Daston & Galison, 2010). This was, according to Daston and Galison (2010), followed by an era of Mechanical Objectivity focusing on representing nature's imperfections and positioning the researcher as a mechanical non-interpreting element to overcome subjectivity. "In the 20th century, it came to be accepted that personal traits will always influence scientific observation but that they can nonetheless be cultivated to yield reliable knowledge" (Golinski, 2008).

Over the course of my research I realized it is impossible for a designer to represent another's world-view in its own form on its own terms and the best a designer can achieve, using visualization, is an "*integration of difference into one's world view*" (Bennett, 1986). Thus a collaboratively produced visualization will be in hybrid form incomplete with each subjective perspective involved. I will now suggest this expression of difference can prompt us to check our own perspectives.

Visualization does not offer a neutral context in which to articulate differences

The visualization is the material that orients conversations between the elders and me and to which we reference our respective perspectives and in which we articulate differences. The visual terms and visible forms that the visualization makes available results from my own habits of interacting in the Western world and my use of digital tools that inherit from the knowledge system of that world. The visualization, thus, reflects the culture of its production and frames the elders' perspectives in that culture; it is, as Turner and Bidwell (2007) write, "*a reality space, a context in and of itself – it is both a window and a mirror or a reflection of the cultural context of its construction.*"

The framework for the visualization includes two core elements: a map-like representation of 3D space and a set of 3D graphical objects representing visually observable, tangible real-world objects. These two core elements each incorporate various concepts that are deeply embedded in Western knowledge systems.

> "The map is obviously less than the territory it represents. This abstraction is advantageous because it focuses on what may be important for our purposes, with all the unnecessary detail left out. It is structured and organized in a way which may be helpful and relevant. Therefore, a representation is not just a concept – it's really a number of concepts together." (Bohm, 2007)

My conversations with the elders about local knowledge systems evolved in relation to these elements. That is, our discussions about local knowledge are framed by an onto-epistemology that prioritizes the abstract concept 'space' (see Dourish, 2006) and tangible objects and other 'things' in this space (see Green, 2012).

The visualization prototypes I have created so far represent tangible objects with certain qualities and properties, such as different animal types each depicted at a certain life-stage and with a certain range of orientations and movements. We negotiated the objects to be represented with rural elders using participatory methods we evolved over time (Winschiers-Theophilus, Chivuno-Kuria, Kapuire, Bidwell, & Blake 2010). In response to conversations with elders, around the prototypes, I extended the range of objects and adapted qualities and properties of some of them. When the elders expressed that an object should differ from my original representation I changed its appearance and properties, and if they said that another type of object should be included I modeled it based on what they showed me – and evaluated these on following field trips. However, the objects and their properties represented, in response to elders' comments, unavoidably represent meanings they articulated by referring to the terms and forms of the visualization and, thus, are indexed to the concepts and other relations embedded in the 3D map-like representation and ontology about tangible objects in this space. Through our conversations and interactions with the visualization, the elders have embraced the visual language of the representation and use it to make aspects of their knowledge legible to me. Thus, the visualization is a critical agent in the dialogue and shapes the way all participants learn and adapt.

In studying indigenous knowledge systems, Mutema (2003) calls for a fusion of horizons in researcher's and indigenous perspectives. Fusion means to blend thoroughly, for in-

stance by melting or melding together, and what can be fused depends on the fusing agent such as pressure, adhesive, or heat. The mediating agent for fusing– in our case spoken conversation around visualizations - constrains what can be fused. The mediating agent is further trapped behind a linguistic barrier requiring translation. The visualization is somewhat alike an ethnographic account and, as explained by Gegeo & Watson-Gegeo (2001):

> "When outside researchers, including anthropologists, write ethnographic accounts of other people's knowledge(s), or construct theories of other people's cultures, they certainly constitute an epistemological community. But it is not the epistemological community that created the knowledge they are re-theorizing."

The ambition is to show, based on experiences in the Herero communities, that visualization offers more than just being an evaluation of 3D objects, but when the visuals become center for the discourse much can be learned from the conversations by the outsiders about being Herero. It is a limiting factor that the topic sets the agenda, thus when Herero elders adapt, comment, and emphasize features in the visualizations, other modalities are less prioritized.

Realizing that elders might interpret features differently and consider some qualities of visualizations more or less important than I did in conveying information in their knowledge system, led me to consider whether these differences were due to perceptual and cognitive processes. Until the end of the 20th Century a universalist approach to visual communication was influential and underpinned conclusions in cultural comparisons using scientific methods. Proponents of a global view regard cognition and perception to have universal characteristics and attribute differences in people's cognitive and perceptual functions to inherited traits and factors in the environment in which people develop (Kostelnick, 1995). This position frames Hudson's (1960) famous study that described how members of Bantu groups, a collective label for up to 600 ethnic groups in Africa, had difficulties in perceiving depth-cues in perspective line-drawing on paper. Criticism of Hudson's (1960) study demonstrates the problem with a universalist approach to exploring visual communication and assuming that cognition and perception can be investigated, assessed, and analyzed empirically in culturally-neutral objective ways. One critique of Hudson's study referred to the 'possible lack of detail' in the drawings used in tests (Deregowski, 1989), that is, the differences Hudson found result from characteristics of the methods and artifacts used in the scientific inquiry rather than characteristics of Bantu perception. This type of critique can appeal to a graphic designer who experiences highly detailed visualizations as more 'real', for instance, feeling immersed in a big-budget 3D movie screened in high-definition but not in a 2-colour sketch drawing. However, I learnt that my careful attention to some details in the visualization, such as buildings, did not seem to make those objects appear more real or more relevant to Herero elders.

As I was guided through the literature, I learnt that deducing universals between cultures encounters difficult challenges because culture, perception, and cognition are inseparable. Culture shapes perception and cognition, and perception and cognition shape culture. This mutually affecting process includes shaping the recognition and reasoning we

apply when we differentiate between cultures and identify and evaluate differences. For instance, the scientific method that distinguishes and interprets differences between cultural groups is embedded with a set of cognitive and perceptual literacies that are shaped by those very methods. That is, the structure and methods, be they scientific, technological, or phenomenological, that we use to articulate differences between cultures is part of our culture. As Taylor (2011) explains, referring to the analysis by Verran, Christie, Anbins-King, Van Weeren, & Yunupingu (2007) of everyday logics in Africa, the only way to tell the difference between two knowledge systems is to translate one knowledge system into the terms of the other. That is, the only way that I can determine that the elders interpret features differently is through the features that I recognize.

Visualizations provide a certainty to always uncertain translations

Since visualization is not objective, due to its origin, dialogue and the elders' comments on the designs are the guiding principle for my research. However, **t**ranslating aspects of the elders' knowledge system into the terms and forms of the knowledge system embedded in the visualization is not only a matter of the elders indexing their knowledge to the visual literacies and visual language I used to represent the world. Our activities usually involve linguistic translation between Otjiherero and English, and sometimes between Afrikaans and English. My home language is Danish and I also speak English, however the elders' home language is Otjiherero and few speak English, although most also know some Afrikaans and other African languages. The Herero academic researcher with a home in Erindiroukambe, who often translates on site, speaks Otjiherero, Afrikaans, and English, and we also rely on post-situ translation of recorded material by other translators. The multiple verbal languages involved in our project introduce the problem of translating not only between individual experiences of a representation but doing so between languages. "The sensations of another", as Poincaré suggests, "will be to us a world eternally closed. [Whether] the sensation that I call red is the same as that which my neighbor calls red, we have no way of verifying" (Daston & Galison, 2010, p. 275); moreover, establishing certainty about what exactly another person is referring to using the label "red" introduces a further problem,

Quine's (1960) classic analysis of the "*Gavagai problem*" illustrates the difficulties of establishing a common ground and shared understanding of contexts when speakers do not share a language. To apply Quine's claims to our design context, imagine walking with a Herero elder who suddenly points at a rabbit and says "Gavagai". Translating "Gavagai" involves accounting for several conflicting representations based on what all participants observe in the world; for instance, simplistically, Gavagai could mean rabbit, or dinner, or the shrub under which the rabbit is sitting. It could also indicate the scenario as a whole, that the meaning is constructed with all elements present. Quine argues that the situation is indeterminable because there is no way to know which interpretation is correct. The English-speaking listener cannot claim to fully understand the Otjiherero utterance by translating 'Gavagai' through his/her own experience of the world (Raatikainen, 2005; Rodil, Løvborg Jensen, Rehm, & Winschiers-Theophilus, 2013).

The issue about uncertain meaning in translating linguistically is critical given that dialogue is fundamental for our mutual learning; however, it is somewhat reduced by constraining the terms and forms of the dialogue to Western visual language. The descrip-

tions and responses elders, and the Otjiherero academic researcher translating, make are situated in interactions with and conversations framed by our research objective and the various prototypes we have introduced. From the beginning of our work prototypes have always had many visual elements and thus not only make the Western visual language visible to participants but show that it is a form that we, external researchers, understand. Participants have sometimes used various visualizations in explaining concepts to us. For instance, in 2011 I walked in the bush with Alex, one of the elders, and asked, through our translator, about concepts of time. Alex spoke and gestured to explain that he just looks at the sun and the shadow to tell the time and when I asked him if he could say what time it was, he replied that it was close to 10AM – my watch showed 09:50AM. Thus, Alex had indexed his method of understanding time to an abstraction and representation of time that is familiar to me. When I asked Alex to explain the difference between the seasons, and how he differentiated between summer and winter; he drew a curved line with smaller circles at each end in the sand to depict the two different paths the sun takes, in summer and winter, over the village, which he drew as a larger circle (see Figure 2). Thus Alex used drawing to show me how the differentiation between seasons and the way this affected the movement of the sun over the village. These kinds of enhanced conversations were also used by the other villagers at formal and informal encounters at any visit.

Figure 2 - Alex draws in the sand to explain how the sun moves over the village.

Alex's use of the visualizations to index information to a framework I can understand indicates how representations can provide a sense of certainty in tackling the uncertainty of translation. Many translations occur when Herero elders communicate about their knowledge situated in the scenario of interacting with technologies, my questions, and the academic researcher translating between us. Some translations occur because of language. Other translations occur because technology can only record and represent some aspects of a context; for instance, video recordings can only visually depict some of the gestures of a narrator holding a camera (Bidwell, Winschiers-Theophilus, Kapuire, & Rehm, 2011) and audio recordings cannot visually depict any gestures. Because technol-

ogies cannot record all aspects of communication, translations occur through re-contextualizing information that is recorded, or, as Grudin (2001, p. 3) explains, *"The context that is captured is removed from its context, namely the context that is not captured."* Thus even when elders record and interact within their own video, their descriptions about knowledge differs from when they describe their knowledge without video (Bidwell, Winschiers-Theophilus, Kapuire, & Rehm, 2011). All representations present a context that differs to the phenomenon represented. The translations that occur do not inevitably undermine the Herero knowledge system; in fact these types of translations are essential if youth living away from the village are to acquire their elders' knowledge. However, some of the information that each translation removes or affects understanding and the nature of representation tends to render a certainty than can hide the uncertainty of translation.

Metaphors are not translatable across contexts

My confidence in gaining insights into the rural Herero world is in part a testament to participants' willingness to express themselves in the Western terms of the visualization. In 2011, we introduced the HomeSteadCreator (HSC), a new prototype that aimed to enable elders to arrange virtual objects in their own 3D visualization using touch interactions. I developed the HSC to explore ways that village elders can actively create their own representation, using visual tools, and gain insight into what information might be missing since elders did not always recognize the environment represented in the visualization. I coded the app using the Unity3D development kit to run on a Motorola Xoom tablet. The initial interface presents an 'empty' 3D terrain and options for the user to select a camera point-of-view (POV). Without requiring any textual literacy users can represent their own homestead in 3D by selecting one or many objects of various types, such as cows, fences, trees, and people. The elders select an object which is instantiated on the terrain, and then they can manipulate that object to a position in the terrain (Rodil, Winschiers-Theophilus, Jensen, & Rehm, 2012).

The HSC provided tangible terms that participants used to explain tangible and intangible concepts to me. For instance, in 2012 we visited a town close to the Botswanan border where outside the local food shop a local man, Vatjarike, began explaining Herero custom while creating a virtual homestead using the HSC. I was already aware that a visitor to a homestead never passes between the homestead and the holy fire in the yard, as doing so is disrespectful, but I did not know the details of the practice. Vatjarike confidently moved the 3D objects around on the touch screen to show where a car should park if visiting a homestead, where the holy fire would be located in relation to the sun, the cattle kraal, and the entrance of the main house (See Figure 3). Vatjarike continued for almost an hour to explain how positions are important for the Hereros and object positions in relation to each other. Thus, the HSC provided visual detail that would be difficult for anyone not familiar with the details of customary layouts to understand from verbal conversation alone.
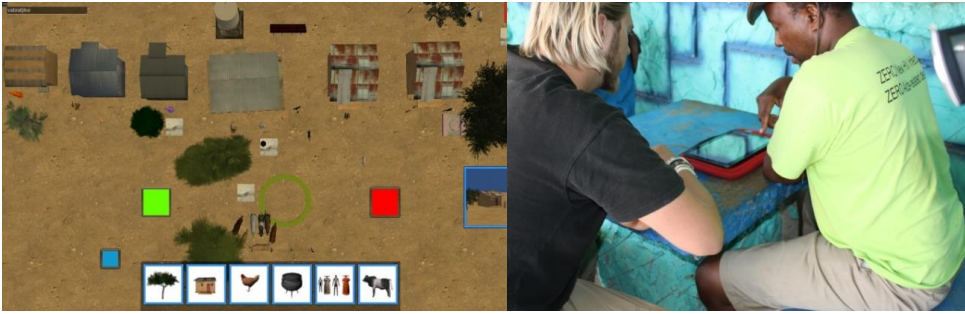
**Figure 3. Left: The homestead Vatiratjike created in the HSC.
Right: Vatjarike explains Herero traditions while placing objects in the HSC.**

Local interactions with HSC made visible aspects of Herero world that would have been otherwise invisible to me and suggested ways these aspects contribute to meanings local people make about objects' spatial relations. For instance, I learnt about tensions between local practices and some of the standard metaphors used in computer interface design. The first prototype HSC allowed users to delete virtual objects, for instance if they decided that an object they had selected was inappropriate. To represent the functionality I modified an established metaphor for deleting virtual objects (Rodil, Winschiers-Theophilus, Løvborg Jensen, & Rehm, 2012). The 'trashcan' and 'recycling bin' icons have become well known to Mac and Window users, since they were conceived in the 1970's, however, I had not seen their physical analogy in the villages. Thus, I adapted the way the academic researcher whose family has a home a local researcher's disposed of waste by creating a virtual garbage hole. The elders' expressed understanding of the metaphor 'to throw away' but also expressed concern that they hardly ever throw away objects that they can reuse and 'deleting' a virtual cow, person, or whole house that they had added to the visualization was unfitting. The elders store currently unused things for later use and, thus, not throwing away is knowledge that elders consider important.

Implementing functionality to throw away objects undermined meanings important to elders and did not align with the way the elders relate the visualization to their practices. I had represented a set of concepts that are deeply embedded in computers and by associating the concept "to throw away" with the garbage hole and things to put into the hole, I made aspects of the metaphor available to the elders. However, my focus on one element of a concept, 'deleting from the visualization' meant it did not, as Lakoff and Johnson (1980) explain "*see other elements of the concept that are inconsistent with that metaphor*". Thus, the metaphor to dispose of objects revealed tensions in visual semiotics in the language of interfaces which might "*force a user to leave his or her surrounding culture behind while interacting with the newly implemented technology*"(Merritt & Bardzell, 2011).

Basic functionality about putting a virtual object into a virtual world is not necessarily inappropriate, provided it does not disrupt representing the importance of saving objects or introduce other meanings. For instance, restoring objects, such as retrieving deleted files from a recycle bin or a virtual cow from a garbage hole, may itself associate with meanings, for instance a degrading act of scavenging (Shen, Woolley, & Prior, 2006). Thus, I am currently exploring ways to respond to elders' comments about saving things that can be used later. In the newest version, the user can pick-up an object from

an area where it 'traditionally' belongs and move it to a new area, but if s/he decides not to use it after all s/he can move it back to the area where it came from. Locating sites in the visualization for objects to belong involves relating the visualization to the real world and knowledge about where things 'traditionally' belong according to Herero custom (Rodil, Winschiers-Theophilus, Jensen, & Rehm, 2012), and thus means the HSC offers a platform for translating knowledge about relationships between things and between things and places in the real world according into the terms of the visualization space.

Since the characteristics of visual communication are only fully accessible within their contexts of origin; our conversation shows how important it is for knowledge holders to scrutinize a visualization to decide if what it actually communicates differs from what it should. Thus it is also vital that it is reflected in the design method, ensuring that evaluation/usability not only focuses on one-way communication but also the underlying meaning from which any metaphor is constructed.

Dialogue around my design faux pas showed that the metaphor could not account for the meanings that emerged in the interaction because it did not evolve in the local context. The visualization, together with its associated action of 'deleting', triggered conversations that were deeper than merely evaluating a metaphor and illustrate how visualization can function in eliciting critique. The HSC also functioned to trigger conversations. For instance, my conversations with Vatjarike triggered further conversation on intangible heritage and the factors.

Visual representation and oral storytelling are *irreconcilable*

Hereros primarily express knowledge and know-how through undertaking activities and by talking, but we sought to digitalize stories and transport them. After the first technical evaluation of HSC was over (Rodil, Winschiers-Theophilus, Jensen, & Rehm, 2012) we saw an elder was sitting with a youth talking and moving objects around on the screen. Despite errors in the prototype, the visualization served as a mediator for two generations sitting together talking; thus, a year later (late 2012) we explored if the elders could use the HSC for storytelling purposes. We observed the four elders sharing their stories by placing objects and narrating; however, the HSC does not force a uniform approach to storytelling. Sometimes elders spoke and placed objects while they told stories, another time an elder first created an environment and features using the HSC and then spoke, and on another occasion an elder asked a young man to 'illustrate' using the HSC as he told the story. The visualization provided different affordances for storytelling, some people preferred to use it in one part of storytelling and some another. Figure 4 shows Vehiha telling a story to the young boy and young man sitting next to him. Vehiha both created the scene and told the story as he proceeded for almost 50 minutes. While it is much encouraging to see the HSC being used without almost any previous experience with it, the actual use also reminds us that people tell stories differently.

**Figure 4 - Vehiha telling a story to the young boy and
young man sitting next to him**

Thus there is also within this form of telling a story through visual means, oral narrative, and touch interaction a potential risk of leaving out material that does not find its place into or through the visualization – and into a system for de-situated assimilation. It is obviously not simple to represent the whole storytelling setting digitally and in ways that can be experienced with the same shared experience. The togetherness of the storytelling is not recordable in a 1-to-1 mapping, but the objective is not to recreate a storytelling session through digital form, but to translate as much content as possible from the storytelling into digital form.

Constructs of space are not culturally neutral

Much literature has been dedicated to the fact that Hereros attribute values to place and link historical events to geography. Kavari & Bleckmann (2009) discuss how Herero praise verses (Omitandu) bind "collective memory" to places and embed this memory in the landscape. "Omitandu connect people that were born, stayed, or were buried in place and cattle, resources, and events with the place in a highly descriptive manner which "paints the character of the place and at the same time spatializes its memorable features". The role of place in rural Herero communities had been explored in relationship to technology in formative research by Bidwell and Winschiers-Theophilus et al. (2012) and my own experiences in the village.

When I first imagined locating stories in an African village at the places where those stories were told, I did not consider that spatial and temporal abstractions, such as Cartesian space or clock-time, represent stories and experiences selectively. I aimed to honor the importance of place by characterizing its appearance and ensuring that elders could link this characterization to their memory of events, resources, people, and cattle. However, using the abstraction 'space' in which to represent place in the visualization intrinsically shapes the story that can be told and there is a risk that interacting with the repre-

sentation consciously or unconsciously forces elders to tell stories in ways that suit the abstraction and, in doing so, emphasize aspects differently. While we have explored the possibility of GPS tagging real objects (Jensen, Theophilus, & Rodil, 2012) in the world to import into the 3D visualization we have also realized that such prescriptive modeling hinders the Herero elders in their own creative re-construction of their very own perceived world. As Dourish (2006) expresses, "*Space is the opportunity, place is the (understood) reality*". Thus Bidwell, Radoll, and Turner (2007) discuss, in the context of mapping Aboriginal knowledge in Australia, that an abstraction of space from place and representation of geography is laden with culturally-specific values, politics, and power relations. While HSC enables users to create their own virtual place, it represents the world above the ground and between the sky according to a geographical 3D space which uses a set of linear co-ordinates that map to another set of linear co-ordinates that frame the world. Allow me to return to the proof of concept of the HSC as being a theatrical performance where the storyteller positions and moves objects in a virtual space where relativity is allowed. Opposed to this is an absolute representation of objects in space where, for instance, external researchers map locations of objects in the village by GPS and thus construct and select a perceived set of relations between objects. One major limitation exists in the metric tagging when compared to a space with places and that is a convenient focus on making a snapshot at a certain period in time. Picking out a structure of objects in constant motion and attributing that particular structure a valorization seen with museum objects disconnected from what meaning they had. By no means is the living village a set of static objects with static relationships. However, interactive storytelling sessions with the HSC suggest that the visualization does afford appropriations of space, time, and movement. For instance, one elder explicitly moved a virtual character, which he said represented himself walking between places, in the terrain to emphasize spatio-temporal sequence in a story. Thus, again, while the visualization represents the world as a 3D space, elders are able to express themselves using these terms.

Conclusion

Using 3D graphical visualization as a communication medium to convey knowledge that is embodied in a heritage and life-style that significantly differs from that in which digital technology evolved is not merely about creating an artifact that represents *our* experience of a foreign culture. Within a dialogue centered on a visualization assumptions embedded in the ways we abstract from, represent, and communicate about our experience surface and can be deconstructed. When designers from highly technologized worlds visit the world that Herero elders experience every day in Erindiroukambe they bring with them assumptions that are often quite invisible to them. Manifesting these assumptions in digitally visualizing another world to explore with that world's inhabitants can offer a valuable exercise to designers in recognizing their assumptions besides uncovering essentials in representations. It is only within the actual design interpretations and technology interactions that representations can be negotiated rather than relying on third party accounts or on one's own biased analysis. As Suchman explains:

> "…it is precisely the fact that our vision of the world is a vision from somewhere – that it is inextricably based in an embodied, and therefore partial, perspective – which makes us personally responsible for it."(Suchman, 2002)

I do not believe that visualization offers a neutral context in which to express, display, or interact with indigenous knowledge or determine the ways knowledge holders perceive and interpret their world. It provides an abstraction that in some instances are already abstractions constructed from another perspective; it is, as Hacking (1983) explains, a way to "cut up the world into objects" in a particular way in order to represent it. For instance the 3D space in the HSC is emphasizing certain spatial features over others. Visualization does not provide the full spectrum of Herero ontology, but the framing through the various visualization approaches introduce aspects of it in creating dialogue and critique about it valuable for mutual learning. This also means that other aspects of Herero ontology move into the background throughout the discourse.

I began my journey/narration with two anchor points: *Visualization as a matter of a methodological exploration to facilitate participation* and *an approach to find a form of the digitalized knowledge management system.* During the course of my involvement in the project I have seen various elements of 'visualization' being the trigger for participation. From nuanced critique of 3D models, to hourly long interactions with a tablet and the HSC. Approaches to understanding the local viewpoints, such as applying a card method for investigating ontological relations between objects (Rodil, Rehm, & Winschiers-Theophilus, 2013), drawings in the sand, and community drawing sessions (explained in Winschiers-Goagoses, Winschiers-Theophilus, Rodil, Kapuire, & Jensen, 2012), are all within a participatory framework: participation meant in the sense of critical dialogue, trust, mutual learning, and interest in constructing something together. I strongly believe that the visualization approaches in general create thoughts and reflections necessary for reflecting our perceived understanding which, in turn, is cardinal for designing together.

Since the introduction of various visually centered prototypes, it has been an objective to explore the final form of a knowledge management system. Knowledge sharing has already occurred with children, albeit within the village, it has a digital form and traces of the Herero knowledge have been externalized. Although my primary focus has been on the representation of cultural practices through visualization, it was never meant to be an exclusive visual digitalization, but rather a context for further representations. As with the rock paintings, visualizations present only a fragment of what it might mean to be a Herero but also provide an entry point for dialogue, thus we continue to explore both that and other forms for dissemination to the youths.

Acknowledgement

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