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Semantics: Meanings and Contexts of Artifacts

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SEMANTICS: MEANINGS AND CONTEXTS OF ARTIFACTS[1]

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1. PRELIMINARIES

English dictionaries trace the origin of the word, 'experience' to knowledge of or skill in making experiments. Its etymology suggests an important conceptual truth: experiences are not merely personal and subjective but crucially related to interacting with something of interest, an artifact, an activity, or a situation involving other people. What we will explore here must therefore overcome the objective/subjective Cartesian dichotomy and be concerned instead with how humans experience the world by acting on it and creating it.

The prefix 'ex-' also suggests that ex-periences require ex-ternalization, ex-pression, or ex-planations. We cannot know what others experience unless they let us know by whatever means are at their disposal. We cannot discuss or theorize experiences without using words. Thus, while the sharing of experiences is impossible, when we talk with each other of what we experience we do so con-sensually, that is, in reference to something jointly attended to – naturally including the discourse by which we coordinate our understanding and actions. It makes sense, therefore, to say that we shared a taxi ride or listened jointly to a concert, but not that we shared the experiences of these events. The latter may be different for each of us. Similarly, we can hear each other speaking, we may even talk about what we mean to say, but we cannot share meanings. Moreover, while

[1]This chapter reflects a long collaboration between Klaus Krippendorff, who wrote its text, and Reinhart Butter, who provided the photographic illustrations for this text.

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our experiences are not only shaped and conceptualized by the categories provided to us by our use of language, we cannot help but talking about them in the expectation of being understood, which implicates the interests of sympathetic listeners or the community in which talking of certain experiences is valued. Inasmuch as the use of language is essentially social, what we know of each other's experiences is, hence, fundamentally social as well, not entirely subjective. As Madison (1988, p. 165) suggests,

> Language is the way in which, as humans, we *experience* what we call reality… Expressed experience is experience that has settled down… Experience is not really meaningful until it has found a home in language, and without lived experiences to inhabit it, language is an empty, lifeless shell.

Our approach to design is human-centered, which contrasts with the technology-centered design of engineering and functionalism. Human-centeredness acknowledges the role of humans in actively constructing artifacts – conceptually, linguistically, and materially – being concerned with them, handling them, and putting them to work. It acknowledges the diversity of human conceptions that motivate how things are acquired, exchanged, rendered meaningful, and used. Consequently, when we talk of meanings, we must be clear about whose meanings we are talking of and allow for the possibility that we may see things differently. A technology-centered approach, by contrast, seeks objective, generalizable, and non-experiential accounts of things. It stresses technical functionality and efficiency.

We suggest four conceptual pillars that support our human-centered approach: *second-order understanding*, *meanings*, *networks of stakeholders*, and *interfaces*.

1.1. Second-order understanding

Technology-centered designers can work within a language that addresses their concerns without reference to the concerns of outsiders. Commitments to objectivity; belief in universalist theories of functionalism, economy, and aesthetics; the conviction that particular forms are responsible for particular uses, experiences, and feelings; and the privileging of one's own views over those of less qualified people, makes design relatively easy. It implicates an authority which assures that designs are used as intended, on the one hand, and creates the distinction between knowledgeable designers and merely responsive users in need of instruction and guidance, on the other hand.

In contrast, human-centered designers are committed to designing artifacts for use by others who may experience the same designs quite differently. It follows that human-centered designers cannot universalize their own conceptions of what they see and do. They have to understand how those that come in touch with their design understand it in the context of their own world. Understanding others' understanding requires listening to what they say they experience and acknowledging their understanding as legitimate, not inferior or mistaken, even when it deviates significantly from one's own. Understanding others' understanding is an understanding of understanding and this recursion is of a qualitatively different kind. We have called it second-order understanding and note that such an understanding is absent in technology-centered design. Machines do not understand, humans do, and the design of technology without user involvement can be accomplished by simple first-order understanding.

1.2. Meanings

It is a truism that we surround ourselves with objects that we are comfortable with and experience as meaningful. This is axiomatic for designers as well as for those who have a stake in their designs. To design artifacts for use by others is to design them to be or

to have the chance to become meaningful to these others – not merely in their designers' terms, but according to these others' own and often diverse conceptions. For these reasons, we prefer the term 'meaning' to 'experience' as it connects the design of artifacts – not to a psychological construct – but to how others see, feel, describe, and interact with in ways different to how we relate to them. We take semantics as the study of meanings in the broadest sense, not to be confused with how the word 'semantics' has been appropriated in the rigid structure of semiotics.

For the above reasons, in conceptualizing 'meaning,' we reject its ontologization, treating meaning as if it were an entity that could be attached to objects or contained in containers, for example, when saying:

X has the meaning Y, or
X contains the meaning Y,

both of which imply that meaning is the same for everyone. Saying:

We experience the meaning Y

moreover locates meaning outside the human species, as the cause of experience. The latter conception is also at home in Latour's (1996, 2005) actor-network-theory, which ascribes agency to artifacts, suggesting something like:

Meaning Y is inscribed in X and acts on their users.

We also want to avoid the representationalism of semiotic discourse, for example in such constructions as:

X represents Y,

or

X is a symbol of (or sign for) Y,

X having to be on a logical level other than *Y*. In design, semiotic conceptions encourage artifacts that signify something unrelated to its use, for example, products that look more valuable than they are or take an alien form, like a telephone in the shape of Mickey Mouse or a radio in the shape of an owl (Figure 14.1).

FIGURE 14.1

We find the cognitivist approach to meanings as internal representations of an external world equally troubling. This conception is rooted in the Cartesian dualism, violates the biology of cognition (Varela, Thompson and Rosch, 1991), and ignores the social contingencies of experiences mentioned above. On the other extreme, we also consider the phenomenological conception of meanings as 'inter-subjective' phenomena unfortunate. We affirm that many meanings arise in social interactions with or about artifacts, using the medium of language, but this does not suggest that meanings reside between people. Finally, although we created the term 'Product Semantics' (Krippendorff and Butter, 1984), we do not wish to restrict our concern to industrial products. Talking of products implicates the perspective of their producers or manufacturers, and this terminology ties design to the industrial era. In an information society, designers address many more and more exciting artifacts, mental, computational, organizational, and cultural. To design them in order to mean something in their users' world is the challenge.

Key to our conception of meaning is the recognition that humans create their own worlds and distinguish among their artifacts not in physical terms but according to what they mean to them, including how they enter the communications about them. Our concept of meaning involves a second-order understanding of how others come to understand and interact with our designs. Thus, for us, meanings cannot be separated from how people interact with the technologies that their culture creates and renders meaningful, with each other, and with how we – for example as designers or researchers – describe, conceptualize, and enact our conceptions of these meanings.

In *The semantic turn* (Krippendorff, 2006), we develop this approach to meaning more fully. Among others, we develop four theories of meaning for the design of artifacts, each culminating in particular design objectives and methods. These theories are not seen as alternatives but as concerning different aspects that human-centered designers cannot avoid.

1. A theory of meaning for artifacts in use accounts for how individual users come to understand their artifacts and interact with them in their own terms and for their own reasons. It follows Ludwig Wittgenstein's (1953) suggestion to locate the meaning of artifacts (for Wittgenstein: words) in their use, not as referring to extraneous things. It embraces James J. Gibson's (1979) ecological theory of perception but goes beyond it by focusing on human interfaces with artifacts, not only on what they essentially support. The theory provides numerous concepts – categories, visual metaphors, attractiveness, user conceptual models, constraints, affordances, metonyms, semantic layers, scenarios, and motivation. In *The semantic turn*, we develop ten kinds of clues, which we call 'informatives'. They are means to indicate how to proceed. This theory conceives of meanings as enabling individual users of artifacts to get involved, revealing what can be done with them and how, and ultimately rendering them reliable.

FIGURE 14.2

FIGURE 14.3

2. **A theory of meaning for artifacts in language** recognizes that artifacts also occur in conversations among people, not only in user interactions. For example, narratives establish the ownership of artifacts, cause the attribution of personalities – from being stubborn to (user) friendly – determine technical performance characteristics, and decide their fate, successes or failures. This theory is essentially interpersonal or social, and the concepts it embraces concern what comes to be shared within a community of language users – categorization; attributions, including aesthetics; individual, group, and institutional identities; using linguistic metaphors and narratives

3. **A theory of meaning in the genesis or life cycle of artifacts** recognizes that any artifact undergoes numerous transformations – from its conception to its retirement – and in that process, must enroll stakeholders to form networks through which it can travel with ease and direction. We will write about stakeholder networks in the next section, 1.3. Here, we merely state the obvious that for artifacts to survive the process of their genesis, each of its transformations must be meaningful to all those capable of bringing the process to fruition. Meanings are conceived of as enrolling a succession of stakeholders into a design project and informing them about the possibilities that a design affords them – again in their own terms. The theory addresses the critical sizes of the communities needed to support a technology, explains the condition for technologies to spread through a population, and offers whole life cycle accounts as a way to evaluate how a design succeeds. It is far more comprehensive than the two theories of meaning mentioned before

4. **A theory of meaning for ecologies of artifacts** is concerned with how whole species of artifacts interact with one another, affect their population sizes, compete or cooperate, and form technological complexes. Unlike in ecological theories of living organisms, artifacts are not agents, however, and an ecology of artifacts is fuelled by how populations of stakeholders experience and interpret artifacts relative to each other, particularly putting them to use selectively. The theory describes the ecological properties of the meanings that communities of stakeholders bring to populations of artifacts. For example, any one species of (necessarily identical) artifacts is stable if its members are reproduced at the rate of their retirement. Artifacts of different species with synonymous meanings (interfaces) compete for the same ecological niches, while artifacts that have complementary meanings can work together, cooperate, and may develop larger technological cooperatives. Ecological meanings, thus conceived, enable one to predict parasitism – when one species of artifacts thrives on the back of another – cooperative dependencies – when one species enhances another without being able to exist on its own, etc. For designers, the lesson of this theory is that for any species of artifacts to succeed on the long run, one needs to render them mutually supportive, cooperative with other species, and more efficient than competing artifacts. Ordinary users may not be aware of the ecological properties of their artifacts, which are brought about by inserting them in contexts of their choice, but to designers, these properties are of central importance for a design to have a chance of surviving in the context of other species of artifacts.

This chapter draws heavily on the first three theories above.

1.3. Networks of stakeholders

We also discourage talking about THE user. It is a deceptive myth. Users are not only diverse in their interests, knowledgeable about the artifacts in their use, experts in their lives, but they also rarely are the only ones that count. In reality, designers mostly deal with clients who represent a business or corporation, including all of its decision makers. There are financiers who are concerned for their investment in a design. There are engineers who will have to solve its technical problems. There are marketing researchers who

have a say in whether a design is sellable. There are merchants who must see some benefit in bringing a design to the market. There are governmental agencies that enact standards that protect citizens from being exploited. There are buyers who may be motivated quite differently than those who end up using an artifact or consume a product. There are critics who put a spin on a design that can influence how an artifact is perceived. There are repairpersons, recyclers, ecological activists, and many more who variously experience a design and collectively affect its fate. These groups of people are knowledgeable and capable of asserting their stakes in a design. They do not act in unison but form complex networks through which a design must proceed in order to be realized. We call this a stakeholder network.

By comparison, the concept of 'THE user,' commonly invoked by designers who assume the role of THE user's advocate, trivializes the network of stakeholders involved. THE user is nothing but a rhetorically convenient illusion that designers offer their clients in justifications of their design. This also includes references to so-called personas that designers conceptualize as endowed with particular social attributes. THE user as well as personas are designers' constructions. They conform to designers' expectations, have no voice of their own and cannot object or contribute to a design in unexpected ways.

Human-centered designers must acknowledge the critical role of stakeholders – supporters and opponents – welcome their active roles in bringing a design to fruition, and see themselves not as masterminding the process but as active participants in such networks as well.

1.4. Interfaces

We experience artifacts by interacting with them. Epistemologically, what artifacts essentially or materially are is not accessible to us. It is also of little interest to designers who, by designing for others, need to know what their designs mean to their stakeholders or the meanings that could emerge in use, language, genesis, or ecological interactions. Taking this premise seriously involves a radical shift from a concern for tangible artifacts, industrial products, for example, to a concern for how people interact with them, from what things objectively *are* to *processes* through which they are created and experienced, and from *ontology* to *ontogenesis*.

Computer interfaces are most familiar to us. As computer users, we have no clue of how the masses of zeros and ones change within a computer. If visualized, we would not be able to comprehend that process. Moreover, changes within a computer take place at speeds at which we cannot possibly read. Despite these basic facts, computer users can handle their computers quite well. They experience their computers by interacting with them in human terms, at human speeds, according to what they want a computer to do, which includes that the interface unfolds meaningfully. Computer architecture is one thing, meaningful interfaces are quite another.

We do not wish to limit the concept of an interface to computers. Handling a telephone is as much an interface as is driving a car or skiing downhill. To design artifacts for human use, one needs to go beyond their forms and decompose them into sequences of human actions and responses from the artifact, into sensory-motor coordinations that can be monitored, understood, and directed to desirable experiences. The form of artifacts is secondary to their temporally unfolding interfaces. To design artifacts as simple as eating utensils one needs to know how they support the cultural practices of their users. Eating with forks, knives, and spoons differs from eating with chopsticks and with one's hands, but they all can be conceived of as meaningful interfaces. Figures 14.4–14.9 show a range of interfaces.

FIGURE 14.4

FIGURE 14.5

FIGURE 14.6

FIGURE 14.7

FIGURE 14.8

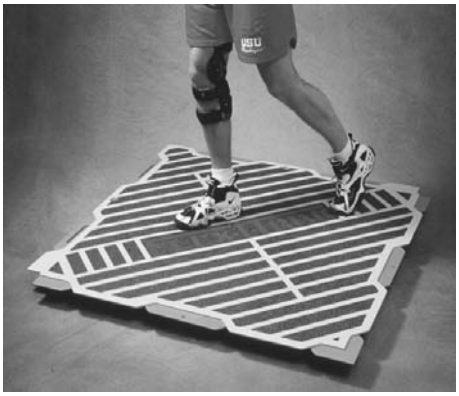

FIGURE 14.9

So conceived, interfaces require dual or interactive descriptions, in terms of the conceptions that humans can and do successively enact and monitor, and how artifacts in turn support or deny what they mean to their users. Our conception of an interface brings us close to the work of James J. Gibson.

Gibson (1979) made the profound suggestion that we perceive not things but what they afford us to do. In Gibson's human-centered ecology of perception, it would be a categorical mistake to describe the physicality of things separate from how we perceive and act on them. He suggests that we cannot perceive what something IS, but what we can do with it or how it can affect us. Considering artifacts as bundles of affordances means describing them – not in terms of kilograms, but in terms of whether they are easy for us to lift or move; not in terms of heights, but in terms of whether they are reachable for us; not in terms of quantitative measurements, say, of the diameter of handles, but in terms of their 'gripability;' not in terms of efficiency (measured in gain over effort), but in terms of whether they aid our sense of success; not in terms of whether something IS beautiful, but in terms of the fascination and excitement they trigger in us; not in terms of user-friendliness as an objective property, but in terms of how comfortable we are in handling them without fear of failures. The suffix '-able' always refers to what actors can do, not to physical properties.

Gibson was a psychologist with little interest in cross-cultural comparisons, and he studied enduring kinds of sensory motor coordinations, like walking on flat surfaces, handling small tools, including landing airplanes. This led him to characterize affordances as what we perceive unfailingly and direct. We must note that the sensory-motor coordinations he studied have very long histories of humans adapting their interactions to the relatively stable nature of our terrestrial environment. When we deal with technology, affordances cannot be presumed given and perceiving them is learned.

Following Heidegger's notions (Dreyfus, 1992; Dourish, 2001), in *The Semantic Turn* (Krippendorff, 2006, p. 89 ff.) we differentiate three qualities of experiences with artifacts. Since they are typically experienced sequentially, we describe them here as stages. Acco rdingly, human interfaces with technology always are in one of three stages:

1. Recognition, more accurately, re-cognition or cognizing something again, refers the stage in which we categorize artifacts according to what they could afford us to do or prevent us from experiencing. Recognizing what something is leads us to approaching, ignoring, or avoiding it. Without a clue to how an artifact could help or harm us, it is not likely to come into use. At the recognition stage, there is little feedback. Mistaken identities may surface only after our expectations fail. Figure 14.10 shows an artifact that may not be too obviously recognizable as a personal security device.

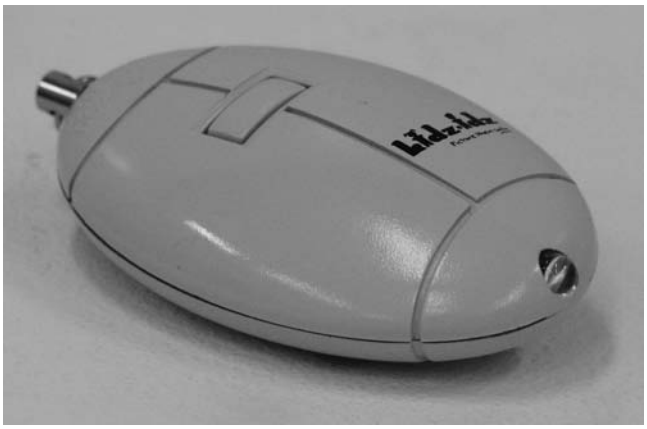

FIGURE 14.10

2. Exploration follows recognition and the experience of failures. It describes the stage during which we search for ways to handle an artifact. Whereas recognition presupposes familiar forms, exploration involves expectations about the sequence of interactions that can bring about desirable contexts or results. Figure 14.11 shows the handling of the above mentioned security device. In the context of a hand, the device makes more sense. Recognition and exploration are two stages that we want to be transitional, not to be stuck in, in order to come to what really matters.

FIGURE 14.11

3. Reliance is the stage in which we have mastered the interface with an artifact and proceed naturally, seamlessly, and flawlessly. At this stage, an artifact recedes into the background of the interface, is taken-for-granted, and no longer noticed. Instead of attending to how it is handled, we focus on what we wish to accomplish with it. Alternative but less differentiated concepts of reliance are user-friendliness, usability, the naturalness of interfaces, and Gibson's notion of directness.

These three stages define a dynamic that usually starts with *recognition*, identifying an artifact of interest by its category. Once it is identified as such, one needs to position it in relation to one's body, in order to engage in *exploration*s of how to handle it and monitor the consequences of one's actions. The aim of exploration is to reach reliance where one's interface with the artifact flows without uncertainties and doubts. Reliance can be disrupted, however, which brings one back to the need for explorations of alternative ways. For example, once the correlation between the moving and clicking of a computer mouse and the pointing, selecting, grabbing, and dragging of icons on the screen is mastered, that mouse can be relied upon but is then no longer seen. When something interferes with that correlation, for example, when the mouse has reached the edge of the mouse pad, and the interface is disrupted, then one is thrown back from reliance to exploration – until the disruption disappears. Undoubtedly, what a computer mouse affords its user to do is learned. Its affordances may well be experienced directly – in Gibson's sense – but only after having achieved reliance.

One could say that the aim of all human-centered design is reliance, the stage where technology disappears from our attention, where we do not need to reflect on what something means to us, and where we can address what actually matters to us. Reliance is also the condition needed for intrinsic motivation to arise (Krippendorff, 2004b), a motivation

to engage interfaces for their own sake, skiing, for example, playing music, or loosing oneself in a game. However, a viable design needs to succeed through all three stages, easily and with a minimum of disruptions. What these stages have in common is their guidance by the meanings that we bring to a design and are willing to enact.

2. ARTIFACTS AND THEIR VARIOUS CONTEXTS

With these preliminaries, which are described more fully elsewhere (Krippendorff, 2006), we can now address the often-ignored but for designers central relationship between artifacts and their various contexts of use.

The word 'context,' is of Latin origin and refers to the weaving together of words, their connections, and coherencies. Today, the use of the word 'context' is no longer limited to text. It denotes the surrounding conditions of something that shed light on its meaning. Regarding texts, most words are ambiguous by themselves – note how many meanings a dictionary typically lists for a single word. In the context of a larger discourse, however, word meanings are usually singular and clear. Similarly, by themselves, artifacts may not mean much unless they are placed in a particular environment in which they play recognizable roles.

It is important to note that relations generally, and the relations between artifacts and the contexts in which they may or do occur in particular, do not exist in nature. Artifacts are made, not found, and the distinction between them and their contexts is an intentional act, and so are considerations of how they are related. Attributing meaning to artifacts is a way of rendering the relationships between artifacts and their contexts sensible and coherent. While the natural sciences have no place for contexts, understandably, there are good reasons why the stakeholders in a technology, including of course the designers, must perceive its relations to its context of use differently. However, all ways to enter them into considerations of meanings are motivated by the apparent need to create individually satisfactory and socially acceptable explanations.

We capture the forgoing with the help of Figure 14.12, which the following text will then elaborate.

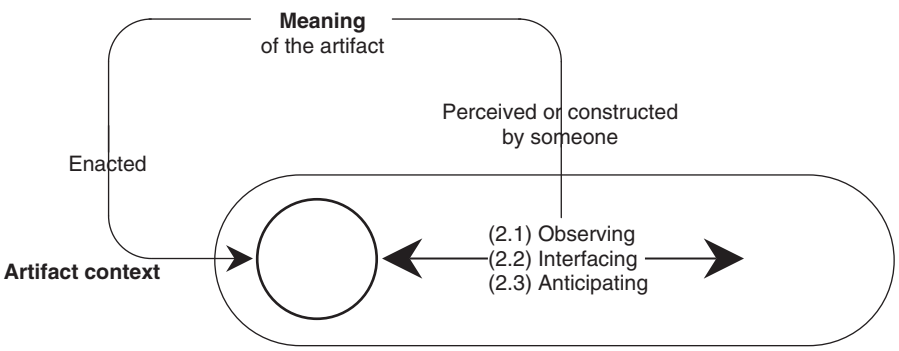

FIGURE 14.12 An artifact in its context of use.

When inquiring into meanings, we claim that there are fundamental methodological differences between merely (2.1) observing and describing how others, users or stakeholders, put their artifacts to various uses; (2.2) interfacing with them according to the

meanings we bring into these interfaces and thus participating in their contexts; and (2.3) anticipating contexts of use from the narratives in which artifacts make sense to us. These distinctions chime with those developed by Pool and Folgers (1988), who, concerned with validating social interaction data, have distinguished between three modes of researcher involvement. When observing, researchers are limited to describing their own observations of what others experience. Such researchers are then concerned with the *experienced*. When participating in a social process, researchers can be concerned with *experiencing* interactions with and in the presence of others. And when receiving verbal accounts of what particular individuals experience in such situations, researchers are informed about individual *experiences*. The distinction between the three kinds of data – about the experienced, the experiencing, and the experiences – loosely correlates with our distinction between *observing* the meaningfulness of artifacts, *interfacing* with artifacts based on their meanings, and anticipating contexts of use from narratives we accept about particular artifacts. These three ways of inquiring into meanings are shown in Figure 14.12 as accounting for the relationship between artifacts and their contexts and will be addressed in the following three sections.

2.1. Observing the meaningfulness of artifacts in contexts of their use by others

A conceptual prerequisite for speaking of meanings is that artifacts must be able to occur in more than one context, particularly in contexts other than the one presently at hand. Experientially, meanings require that something could be used otherwise, are variously interpretable, and different for different people, of different cultures, in different situations, or at different times. Without variability in the contexts of artifacts, meanings could not explain anything. The other extreme of the continuum in which meanings make sense is due to the requirement that the variability of contexts in which artifacts can occur must exhibit some constraints. If artifacts could occur everywhere, at any time, and for everyone alike, there would be nothing remarkable about the artifact–context relationship. Meaningfulness presupposes choices.

In the position of an observer, for example, as a detached scientific observer, bystander, spectator, or tourist in an unfamiliar culture, one is of course quite free to interpret what one sees, free to create any meaning one pleases. This is because the meanings with which observed others approach their artifacts are inherently inaccessible. This is the unfortunate situation in which designers find themselves whose research consists of observing how existing artifacts are used, or watching videos of where their design will have to function – without the ability to ask questions of those involved. While the meanings that guide observed others' interfaces are then not knowable, this does not prevent designers from studying the manifestations of observed others' meanings, meaningfulness. We define:

> The meanings of an artifact are manifest in the set of contexts into which a community of its stakeholders places them – deliberately, i.e. to a degree better than chance.

It reaffirms the foregoing, namely, for artifacts to have meanings to somebody, they must be able to function in different contexts, and these contexts must be manifestly non-arbitrary. As suggested above, without evidence that choices have been made regarding appropriate contexts in which an artifact is allowed to occur, the concept of meaning would be meaningless.

This definition also refers to a community of users – stakeholders of all kinds, including designers. People may have different reasons for using an artifact in a particular context and different interpretations for what it does there. However, if an artifact is observed to have been placed in a limited number of contexts, it is reasonable to assume

that these are the contexts in which that artifact makes sense to their stakeholders, that the observed artifact–context relationships are manifestly meaningful to them. In other words, without the ability to inquire into the reasons for the choice of contexts, all that designers can observe is how meanings manifests themselves, which is the set of contexts in which an artifact is presumed meaningful.

FIGURE 14.13

FIGURE 14.14

FIGURE 14.15

FIGURE 14.16

Often it is possible and desirable to differentiate among communities according to the set of contexts in which a particular artifact makes sense to them. We already mentioned the network of rather different stakeholders through which the various incarnations of an artifact needs to pass on its way to retirement. We know of cultural differences among users that result in different sets of acceptable contexts for an artifact. One may also acknowledge unequal competencies, interests, and willingness to acquire new meanings.

In the absence of verbal communication, but also if one has reasons to distrust what people say about their uses, human-centered designers need to know the set of contexts in which existing artifacts occur. However, inasmuch as a design differs from what already exists, designers may have to extend this list and decide in which contexts their design should work and where it should not. For example, there are contexts in which artifacts could harm their users and safety measures become important, preventing hands to get into gears. There are contexts in which one community should have privileged access while another community should not, medications in hospitals. And there are contexts that artifacts transform into other contexts, impacts on the environment. For a design to have the potential of being or becoming meaningful to their stakeholders calls on designers to study the set of contexts in which similar artifacts occurred.

The fact that the experiences and meanings of others are observationally inaccessible has not prevented designers from interpreting the manifestations of others' meanings in their own terms. They may justify this practice by claiming that they share the same cultural heritage with the user of their design and believe they can speak for that fictional user. While this claim may succeed with similar minded clients, our overwhelming experience is that designers are different from those who have a stake in their design. When sending them in the field, they often return surprised if not shocked in disbelief that potential users experience their design in ways far from expected. Our experiences can serve as a warning against unwarranted projections of observers' meanings to the meanings held by the observed. This is why the above definition refers to *manifestations* of meanings, not the meanings themselves, and encourages a concern for the contexts in which a design needs to make sense.

For example, we can observe a knife on a dining room table, in a kitchen, and in the hand of someone arguing with someone else. These observations, however, merely suggest that it means something to those involved in these contexts. Whether the context in which the knife turns up in someone's hand is a robbery, a negotiation of its sales price, a theatrical performance, or a criminal trial in a court of law makes all the difference. To come to know what something means to others, much needs to be known about the stakeholders involved, the culture in which that something is contextualized, the rules governing its context of use, and, most importantly, what the people who are part of that context tell each other about what its use means to them.

A good example is presented to us in the first 12 minutes of the 1984 movie titled *The Gods Must Be Crazy*. We see a small airplane crossing the Kalahari Desert. Bushmen live there and we are told they consider airplanes as evidence of gods in the sky. Its pilot finishes a Coke and throws the empty bottle out of the window. The bottle lands near a bushman named Xi, who, having never seen a glass bottle before, first carefully probes it with a primitive tool and then, having convinced himself of no apparent danger, takes it home to his tribe. There we see the bottle being collectively examined with curiosity if not awe. Although the camera cannot show what the bushmen think, we are told that they consider it a gift from the gods. The Bushmen turn out to be ingenious in finding all kinds of uses for it. In a place without rocks, the hardness of the bottle encourages its use as what we would call a pestle for smashing roots. Its smoothness is seen to aid the flattening and stretching of snake skins. Its opening finds its use as a stamp for decorating a garment with circles. It turns out to make sounds when blowing over its opening as well as when it turns, tied horizontally at the end of an untwisting rope. No one discovers its use as a container, perhaps because water is scarce in the desert. But because there is only one of its kind and popular for its many uses, the bottle also encourages competition, creates hostility, and starts to hurt somebody in ways, we are told, these Bushmen had not known before. The commentator explains that the gift from the gods becomes

an evil thing, which Xi, the leader of the tribe, then tries to get rid of, encountering all kinds of misadventures.

Without sound, we have no trouble observing the many contexts in which what we call a coke bottle seems to make sense to the Bushmen, but not what it means to them, hence the need of a commentator who claims to speak for the tribe. Whether the commentator's interpretations are fair is something we cannot judge without asking the Bushmen themselves. The point of the story is that we may observe the many contexts in which an artifact is used. Assuming their use to be deliberate, we can conclude that they must be meaningful to those involved. As observers, we can create our own interpretations. However, understanding the meanings that others bring to a situation requires communicating with them, not more extensive observations.

2.2. Interfacing with artifacts according to what they mean, thus being part of their contexts

Observing artifacts in use by others takes place from a position outside their artifact–context relationship. When actually interfacing with artifacts, experiences arise from inside that relationship and unfold in time. The difference between observing and being in such a relationship accounts for the difference between the ability to describe what it is that others experience, the *experienced* – of course only in observers' terms – and *experiencing* one's involvement in an interface first hand. When observing artifacts in use, one can at best speculate about their possible meanings. When interfacing with them, the set of possible meanings are reduced to those actually understood and also afforded, and when sharing these experiences with us, to those that can be articulated. For those actively involved:

> The meanings of an artifact are the recognizable actions and articulations it affords a community of its stakeholders.

The example from *The Gods Must Be Crazy* already demonstrated the limitations of observation. While the movie showed much talk among the Bushmen, it had to rely on a commentator to speak for them and bring their experiencing closer to us.

An example closer to experiences in many U.S. cities, is the illegitimate use of milk crates. Manufacturers ship milk to retail stores in crates containing smaller individually sold milk containers. These crates are made of sturdy plastic and of a size that people can handle. Despite printed warnings that literally criminalize misuse – unintended from their manufacturers' perspective – people invent numerous and widely popular applications for them. In the context of a home, they can become laundry baskets. Workers use them as stackable containers for small tools and supplies. Bicyclists tie them to the front of their handlebars to carry small personal items around. Upside down and stacked, they substitute for stepladders or, turned sidewise, they serve as open shelves for books. With their bottom cut out and mounted to a pole, they enable city kids to practice basketball on sidewalks and in backyards, etc. In these contexts, they are entirely different things and people are quite proud of 'their creations' and willing to explain them. When one is aware of their origin, it makes sense to say that these milk crates have acquired very many meanings to city folks. If a design is to enter these contexts, designers need to know the meanings with which it might be approached. Incidentally, to limit unintended uses, their producers enlarged the holes of these crates so that the milk cartons do not fall through but smaller objects could no longer be carried in them.

Just as different contexts can make the same artifact into different kinds, as in the above examples, so can the same context make different contexts into the same kind. This is the flipside of the artifact–context relationship that meanings do inform.

One experiment, easily reproduced with variations, is to take one familiar context, for example the drawer of a cabinet, and vary what it contextualizes, what it features on its front. We know that drawers need to be pulled open and pushed shut. Given that context, it is amazing to see the diversity of objects that, attached to its front, acquire the meaning of a means to open it. Knobs, handles, and keys are conventional examples, often produced for this purpose. But, a hole, a string, a ring, a tie, a nail, a push button, a dice, a nut and bolt, a Coke bottle, even the head of Barbie doll, all acquire nearly the same meaning. Affixing a numerical keyboard to its front adds the suggestion of privileged use. Using a heavy handle suggests the need to apply considerable force. Mounting small objects on the draw – a spoon, a wristband, a pen – may suggest what one finds inside the drawer. Even when painting a red circular surface on the front of a drawer, and nothing else, users are likely to think that they had to push there to open the drawer. A familiar context, like the drawer, can be quite determinative of the meanings of what they contextualize (see Figures 14.17–14.19).

FIGURE 14.17

FIGURE 14.18

FIGURE 14.19

Evidently, intended functions are secondary if not irrelevant to the meanings that artifacts acquire. Intentions describe what someone hopes to accomplish, functions, the role that an artifact is to play in a context. Neither is observable. Neither may be shared among the stakeholders of a design. Surely, Coke bottles are produced intentionally. In *The Gods Must Be Crazy*, the airplane pilot knew that he was throwing an empty Coke bottle overboard. For the Bushmen, however, what fell from the sky was something altogether different and it acquired all kinds of – for us unanticipated – meanings as they assimilated the 'thing' into their cultural practices. It would violate the idea of second-order understanding if one insisted that it was a Coke bottle that fell from the sky into the Bushmen's world. It was a gift from the spirits living in the sky. The same is true for the milk crates in the city. Their manufacturers' effort to control their use by threatening criminal actions against 'misuses' is quite meaningless when few if anyone cares. When it is tied to a pole on the street, it no longer is a milk crate but a net for the basketball. The original meanings of the objects that could be mounted on the front of a drawer were erased by the context of the drawer. In a market driven information society, where a diversity of stakeholders of a design assert their interests and create their own meanings of what is available to them, one can no longer presume compliance with designers' intentions. The enforcement of intended meanings requires coercive institutions, for example, the police regarding the use of traffic signs, or the military regarding the use of weapon systems.

Eliciting peoples' stories that parallel their interfacing with artifacts is a common way to gain access to how users are experiencing the process of their engagement. Such narratives chain kinesthetic senses of actions with perceptions of their consequences weave into them the emotions and motivations that go along with them. Protocol analysis, pioneered

by Newell and Simon (1972; Ericsson and Simon, 1993), concerns problem solving in interfaces. Interviews, focus groups, even surveys can elicit other kinds of meanings. Even experiments with how subjects interface with given artifacts are framed by verbal instructions about what the experimenter wants the subjects to do. What is observed here is informed by the use of language and cannot be separated from the subjects' ability to understand and enact the instructions given to them. The experiment with drawers as the single contexts for a variety of attached objects exemplifies this challenge. The point is that the process of experiencing interfaces with artifacts is not only influenced by the use of language, it also needs to be articulated in order for human-centered designers to take such meanings (other than their own) into account. We need to state what should be obvious from the above, that meanings escape measurements, say, of user-friendliness or efficiency in technical, objective, i.e. non-human terms. Meanings are always tied to the use of language.

Inquiries into meanings in the context of ongoing interfaces have to acknowledge two constraints. First, they cannot elicit the meanings of interfaces in their most desirable stage, reliance, when users have mastered their interfaces to the point at which the participating artifact has retreated into the background of what users wish to accomplish with them. It is well known that when one asks experienced knitters, for example, to explain in detail how they knit, they can no longer do it with the regularity and speed at which they are comfortable. Piano players, bicyclist, typists, and experienced artisans do far better without articulating the meanings they expertly enact. This points to a fundamental paradox. While reliance is or should be the aim of human-centered design, information about experiencing reliable involvement is nearly unobtainable. What subjects can articulate and designers can learn from concerns the stage of interfacing that precedes the goal of human-centered design: exploration.

Second, such inquiries are limited to studying practices that already exist, or can be simulated by using models or prototypes experimentally. Articulations of meanings require attention to what is experienced, monitored, and acted upon. During such inquiries, subjects typically face relatively stable affordances, which exclude situations in which meanings are not tested, affordances are anticipated but without a history of successes, and contexts are novel or emerge unexpectedly. This situation is addressed in the following section.

2.3. Anticipating contexts of use from narratives involving particular artifacts

Recall that Gibson theorized 'direct perception' of affordances. Directness is experienced in states of reliance, when enacting unproblematically afforded meanings, treading familiar grounds, and interfacing with artifacts without experiencing disruptions. In much of our artificial world, these certainties are continuously challenged by the design of new interfaces, new artifacts that may build upon familiar ones but work in new contexts and require new kinds of practices. Under these circumstances, affordances cannot be considered natural and fixed.

Adoption of new technologies tends to start with information about the possibilities they offer (Rogers, 2003), often in the form of narratives, whether from neighbors, television, or the technical literature. Narratives shape meanings before they are enacted. They prepare people to act and serve as hypotheses that have the potential of being enacted. Given suitable motivations and opportunities, narrative meanings may create new contexts of use, not merely derive from them – as addressed in the previous section, 2.2.

The Gods Must Be Crazy presents us with a story, a sequence of images, narrated by a commentator. In it, we are told and have no reason to disbelieve, that the Bushmen had never seen what we call a Coke bottle and that their elder, Xi, was therefore carefully

experimenting with it before feeling confident it could be touched and taken. The movie shows us also how the community appropriated it into their culture. The process started with relating it to their bodies – learning very basic affordances – for example, putting a finger into its opening, trying out different way of handling it, including swinging it like a hammer, and utilizing its unusual properties. Importantly, these explorations were public. They took place with much talk among handlers and bystanders during which, we can only imagine, scenarios were suggested, uses were hypothesized, meanings negotiated, and settled, only some of which were actually enacted, tested for whether they would be afforded. Narratives guided the use of 'the thing' away from bodily affordances, outward to becoming a tool for all kinds of purposes. The process of appropriating the thing in the Bushmen culture proceeded from narrating conceivable uses to more abstract characterizations. For example, in use, there also emerged unexpected and unfortunate experiences, that, we are told had no place in the Bushmen culture. Therefore, 'the gift from the Gods' became an 'evil thing,' part of a narrative that determined the direction of the remainder of the movie: how to give it back to the Gods or getting rid of it.

Narratives are told to be understood, their contents are inherently imaginable, and the meanings of the artifacts occurring in them are necessarily conceivable – regardless or whether they turn out to be afforded in practice.

Consideration of meanings in the absence of experiences but in the expectation of being afforded is also of central importance to professional designers. By definition, designers propose something new that would not come about naturally. Their proposals need to narrate desirable futures into being – artifacts, contexts of use, and practices – and such narratives must fuel the imagination of stakeholders who could realize a design. Whether designers weave sketches, drawings, models, prototypes, and experimental evidence into their arguments, effective proposals suggest meanings that must be conceivable and compelling. This leads to our third way to inquire into the meanings of artifacts:

> The meanings of an artifact are the narratives in which that artifact can occur, conceivable and realistic to a community of stakeholders.

Taking this definition seriously opens another line of inquiry. It would suggest asking people to tell us all the stories they know of the artifact in question or can imagine, provided they are considered realistic, not fiction. One should note that we mostly learn about new artifacts through narratives, can organize our knowledge of artifacts in narratives, and interfaces often follow scripts first conceptualized as narrative. Scenarios, a sequence of possible situations that a user can navigate conforms to a narrative structure. Narratives told to novices may render complex interfaces manageable. One can extract a list of the conceivable contexts of an artifact from available narratives, extensive interviews, and focus group data by content analysis (Krippendorff, 2004a). Naturally, such lists can become extensive, depending on the creativity of those asked, but also on the interpretive flexibility of a technology (Pinch and Bijker, 1987) that prevails in a community. As almost anything can be rearticulated and obtain new meanings, such lists may not be finite. Yet, human-centered designers need to understand the diversity of meanings that their design can suggest and to whom, and which ones could be learned, under which circumstances, and which narratives can and need to be told and to whom.

Designers also have to decide which meanings should be afforded by their design and which are to be discouraged. As a rule, designers have two ways to accomplish the latter: The semantic way, using forms unlikely to encourage undesirable uses, for example camouflaging ways for non-professionals to open an appliance; and a physical way, introducing mechanical constraints on what the artifact can do (forcing functions, according to Donald Norman, 1988), which makes undesirable contexts impossible.

Designers are not the only ones concerned with narrative meanings. Although ordinary people are not expected to have a second-order understanding, or to consider large numbers of contexts, as designers need to do, meanings that are narrated and create future contexts of use occupy much of everyday life. For example, people easily envision and can be observed to argue with their partner how the furniture they see in a department store might look in their living room, what it means to wear a particular outfit to a social occasion, or what one might experience when flying a hang glider for the first time.

When the enactment of meanings is afforded, when the interfaces they guide are not disrupted, we may easily come to the mistaken conclusion that the reality we are facing is known to us. That meanings, even when afforded, do not represent what an artifact actually is or does is easily exemplified by the everyday use of computers. Obviously, the near incomprehensibility of how computers work internally does not prevent people from narrating how to use their computer, using metaphors, for example, from the familiar paper world, to conceptualize what goes on inside it. Dragging the icon of an unwanted file to an icon in the form of a wastepaper basket initiates much computational work, which we can hardly imagine. In addition, most options that contemporary computers do provide are never explored by any one user. Thus, successfully and reliably enacted narratives hardly bring us closer to reality, only closer to what we wish to do.

Nor does the experience of failure, disruption, or breakdown in one's interfaces provide us clues as to why they happen. Speaking metaphorically, one might say that material reality is not a helpful communicator. It cannot possibly know the narratives that prove not to be afforded. Artifacts can object to how they are treated, but they cannot reveal the reason of their objection. When facing a disruption, users need to modify or replace the unworking narrative by a more viable one, but the latter can be hold on to only until another disruption occurs. Karl Popper's insight that empirical tests can disprove a theory but never prove its enduring correctness applies to enacted narratives as well.

We need to emphasize that narratives, meanings, perceptions, and affordances, are never guaranteed. Something may turn out not to be what it appears to be, whether by misreading or deception, pretentious semiotization, for example. Artifacts can break down when least expected. With an unintended click on an icon, computer users may find themselves in an unwanted world. Ignorance of the cultural context of a design may get people into trouble. For example, in the U.S. flipping an electrical switch upwards turns the equipment on. In Britain, flipping it upwards turns it off. Smiling in Japan has different meanings than smiling in Europe. Confusing the colorful medication of their parents with candy can get children into serious difficulties. Incidences like these are what human-centered designers need to address.

It is all too easy but typical and convenient for people to blame their artifacts for failing them, for example, telling stories about faults in material, artisanship, production, or design. However, an epistemologically more appropriate strategy would be to search for the causes of mishaps in one's own conceptions, replacing inadequately attributed meanings by those that prevent future disruptions. This recommendation applies to designers as well. Designers often blame the stakeholders of their designs for misunderstanding their ideas, failing to use their design as intended, ignoring written instructions, misinterpreting crucial clues, pressing the wrong button, or being careless and ignorant. We are suggesting that human-centered designers can no longer play the authority on how their design is to function but need to face the multiplicity of narratives that the stakeholders in their design could bring to the scene or are willing to learn and enact.

There is one kind of narrative that designers need to address; these are narratives that can keep users trapped in untested conceptions. Such narratives underlie the phenomenon of technophobia or the fear of using certain technologies. The emotion of fear

is based on narratives of the possibility of being harmed so terribly that one does not dare to go near that possibility. It is considered rational by those who share that fear and irrational by those who do not. The pathology consists of being unable to escape from that conception by not risking to verifying it. Technophobia typically emerges by generalizing the experience of failures in interfaces with a particular technology. Even in a less drastic form, the unwillingness of trying new things for fear that the comfort of traditional practices may be lost is a major bottleneck for the design of new artifacts. One of the more challenging aims of designers is to encourage narratives that reduce technophobia. Eliminating disruptions of an interface may not be possible entirely, but preventing human errors from having serious consequences and allowing them to be reversed without punishments are options that designers may consider. The ability to undo an action, going back to a computer screen that preceded the realization that a wrong path was taken, did much to overcome the resistance to adopting PCs. Other complex artifacts, which are the target of technophobia, are genetically engineered food, nano-technology, the health system, the ecology, and government, which are treated with suspicion and reluctance to get involved. The latter still await redesign in human terms, including narratives that are not entrapping.

3. THREE CONCLUDING OBSERVATIONS

3.1. Meaninglessness

One may be asking whether there are contexts that cannot provide meanings to artifacts. Although we humans can hardly escape making sense of our world, making up stories even if and especially when there seems to be no ground, in making meaningful connections between things and their surroundings, there are occasions where we:

- Cannot or do not care to distinguish between something and its surroundings and have no reason to explain the difference, for example, when one faces a seamless continuum, when the two are causally determined – not the result of human actions – or simply of no interest.
- Presume total arbitrariness of the relation between something and its surroundings, as when we cannot imagine any intentionality, even a mythical one, for example, when something is dropped accidentally, regretfully lost, or found where it does not belong.
- Have no history of making sense of it, such as an inexplicable happening.

Such incidences are rare and their validity may be questioned. However, once we draw a distinction, we imply that the results of the distinction are different, which is the condition for meaning to arise. Taking the context of an artifact as 'accidental' or 'without a history of making sense,' is in fact a narrative with a minimal explanation. Inasmuch as humans live in narratives, with or without a physical basis, meanings are nearly inevitable, but they differ in their usefulness and ability to act on them.

Backgrounds are always implicated in constructing meanings. They may not be meaningless but merely not noticed – except in comparisons. Within any one culture, how artifacts relate to a culture's grand narratives is typically backgrounded, unnoticed from within. In India, for example, it makes sense to relate artifacts to her national identity, including Hindu mythology. Mahatma Gandhi's use of the spinning wheel, wearing of non-regionally marked linen clothes, and promoting a simple village life provided the mythological context of India's unity in her struggle for independence (Balaram, 1989). In the

industrial West, technological progress, efficiency and accuracy, and the democracy of the market place provides the taken-for-granted context that yields meanings that are difficult to analyze from within. Even deliberate attempts to invent national identities, for example, Scandinavian design or Japanese design; if successful, they may become so pervasive that they are no longer distinguishable from within. However, looking from one community or culture to another sheds light on one's own grand narratives. It would be a mistake, however, to conclude that what has meanings to us has the same or any meanings for others.

3.2. The size of a context

One may also want to ask how large a context has to be for an artifact to acquire the needed meanings. This question is more difficult to answer. Natural scientists would argue that the notion of context defies formalization, as it has no boundary. It can be literally limitless in size. For a particular person, however this rarely is a problem. The size and features of a context consulted for an artifact to make sense depends on the depth of meaning with which one would be satisfied. To use our drawer example, one user may be content with focusing on the drawer that needs to be opened. A designer may look at how the manner of opening drawers relates to the cabinet as a whole – functionally, economically, and aesthetically. The writer of an article that discusses the cabinet may relate it to its contemporaries, to other works by its cabinetmaker, to the cultural period in which it was made or used – and so the context expands. However, for any one effort to suggest desired meanings there is a subjectively clear limit below which one has the feeling of insufficiency and above which one may be bothered by redundancy.

Questions concerning the appropriate size of a context have a corollary: How resistant is an artifact to the imposition of meaning from its context? The answer to this question depends on the amount of detail it exhibits. A circle painted on the drawer's surface does not provide much detail and is relatively ambiguous as such. In this context, it might simply suggest: 'push here and the drawer will open.' Geometrically simple shapes inform very little by themselves and are usually ready to assume various meanings in different contexts. A complex artifact is more resistant to the imposition of meanings from its surroundings. A bicycle, for example, is a bicycle regardless of whether it is displayed on the box it was delivered, someone rides it on the street, a tarp covers it for protection from the elements, or finds itself piled up in a junk yard together with other recyclables. In these diverse contexts, a bicycle is sure to acquire different attributes – new, fancy, lightweight, protected, or broken, but its bicycleness is rarely modified by these contexts. The archetype of a bicycle is only minimally affected by where it occurs (see Figures 14.20–14.22).

FIGURE 14.20

FIGURE 14.21

FIGURE 14.22

As a rule, the difference in details exhibited by either side of the asymmetrical artifact–context relationship informs the meanings of the less complex side. If the artifact has a simple structure relative to that of its context, its meaning is likely to be determined by that context. As the artifact exhibits more details about its identity, it becomes increasingly resistant to contextual determinations. Designers need to balance the amount of details or information provided depending on what the stakeholders of a design are familiar with and expect.

3.3. Metaphors revisited

Simplified, a metaphor is seeing one thing in terms of another. Although this statement does not tell the whole story, it stresses changes in perception (seeing) as the defining consequence of metaphors. For example, the metaphorical statement 'The village is covered with a blanket of snow' invariably conjures images of coziness, warmth, and friendly village folks despite the wintry cold and without literally saying so. How does this come about so reliably? The study of linguistic metaphors has recently progressed beyond the mere identification of this rhetorical trope. Following Lakoff and Johnson's (1980) seminal work, we identify four necessary features of linguistic metaphors:

1. Metaphors operate between two conceptual domains, a target domain of something presently attended to, here, a snowed-in village, and a typically more common source domain, here, the human use of blankets to cover themselves.
2. The vocabularies used in either domains enables one to construct a superficial structural correspondence between them, here, 'being covered'.
3. This albeit tenuous correspondence serves as the bridge for entailments from the source domain to enter and inform the perception of the target domain, here, the warmth and comfort provided by being covered with a blanket.
4. The entailments of a metaphor organize their users' target domain, here, one perceives a friendly place where one can feel comfortable and warm, and be with well intended people – unambiguously but without using such words literally.

In powerful linguistic metaphors, the vocabulary imported from a source domain continues to grow in the target domain, taking it over, so to speak. Consider the familiar 'war on drugs' metaphor. Its target domain, the 'drug scene,' is far from clear by itself, but 'war' certainly is. War entails urgency, to which a government must respond by allocating extraordinary resources to win it. War also entails enemies that users of this metaphor promptly construct. War is not merely talked about, it must also be fought and won. In the U.S., the war on drugs is a mission of several Federal agencies, etc. The use of this metaphor reconstructs the use of drugs in terms originally reserved for war. While non-linguistic or visual metaphors may not proceed quite as straight forwardly, they too alter the perceptions and subsequent actions by those who recognize them.

In the domain of artifacts, we contend that the shift of our attention to their contexts opens a new understanding of non-linguistic metaphors.

Before detailing how non-linguistic metaphors work, we should warn against vulgarizing the concept. A telephone in the shape of a Mickey Mouse, or a radio with an MP3 player in the form of a car, as in Figure 14.23, currently sold by Sharper Image, do not qualify as metaphors as their appearances have nothing to do with their use and may even impede it. Similarly, a truck in the shape of a huge hotdog may well serve to advertise a hotdog manufacturer, but sausages do not teach anything about driving a truck, much less about advertising. These are examples of what we have called 'pretentious semiotizations' (Krippendorff, 1988, 2006), 'pretentious' because such products pretend

to be something other than what they are, and 'semiotization' because their forms rely on a representational theory of meaning – defining meaning as what a sign (in the case of an artifact, an icon) represents (Mickey Mouse, a car, or a hotdog). These examples are neither ironical, as their appearance and use fail to produce tension between ignorance and understanding, required by irony, nor paradoxical, as neither denies the other. They are simply pretentious of something else. Now consider two examples of non-linguistic metaphors.

FIGURE 14.23

Just as with linguistic metaphors, non-linguistic metaphors bridge two empirical domains. The source domains of most metaphors are more familiar than their target domains, which are often difficult to understand. For example, the metaphors by which computers are being understood by their users is the world of paper handling, creating documents, reading them, organizing them into files, and moving them individually, in file folders, or packages of file folders. As already mentioned, what computers actually do, for example, when users think they open a file or discard it is something altogether different. Trashcans are familiar to us from a context in which household trash is collected and removed. In the metaphorical paper world of a computer screen, dragging the icon of a document, which iconically resembles a document in everyday live, to the icon of a trashcan, which iconically resembles familiar trashcans, suggests disposing that document. The computer, however, merely changes the index of the information thought to be contained in this file. This iconicity enables *experiences from the context of the source of a non-linguistic metaphor to inform the perception of what can be done in the context of its target*. Without such entailments, without the ability to draw on experiences in an absent but familiar context, pictorial resemblances mean little if anything. What distinguishes metaphors from analogies, metonymies, ironies, and iconic representations is their capacity of making practices from the context of familiar but absent source domains available in a less familiar but present target domain.

One example may suffice. In the early 1970s, high volume paper copiers had become complex machines, almost printing plants. Not only did they become increasingly difficult to handle, frequent breakdowns required costly repairs by experts and caused disruptions and delays in office work. Xerox designers reconceptualized the machine in terms familiar to the office workers who used them. The overall shape of the new copier resembled a raised table on which office workers are accustomed to sort their paper work, now while standing. Its horizontal plane was interrupted by an indentation, resembling a familiar paper tray in which office workers tend to keep piles of documents, face up to work from, here, to be copied. The copies exited at the other end, suggesting that the paper flowed

through the machine in one direction, moreover making it difficult to insert documents where copies were to exit. The front of the machine featured drawers, just like in familiar chests. In the context of copying, it was natural to keep blank paper (of different sizes) in theses drawers. Similarities or structural correspondences between features of the new copier and of artifacts that users know from a familiar context served as the conduit of experiences and expectations from familiar contexts to the context in which the new copier was to work.

The Xerox designers also introduced what we call semantic layers. While copying documents, office workers operate in one layer of coherent metaphors. When something goes wrong, they can open a door and find themselves in another layer, a world with well-marked paper flows and colored handles to undo paper jams. This second layer shields the user from the complexities of a third semantic layer, which is accessible only by trained repair personnel.

Today, the metaphors employed in the Xerox copier have become so standard that their origin is nearly forgotten. This is the fate of most metaphorical meanings. Their novelty wears out over time and their meanings end up being indistinguishable from literal ones.

Thus, metaphors are not entities that could be photographed or recorded. They organize perceptions and render understandable situations that users have difficulties with comprehending. They are rooted in what poets have always known and human-centered designers may utilize as well. Whereas linguistic metaphors transfer meanings by adopting vocabularies from a source domain in a target domain, visual metaphors transfer meanings from the context of a source domain to a target domain, including the artifact's context of use.

Our elaboration of how meanings connect to the contexts in which artifacts are used brings non-linguistic, particularly visual metaphors into a clearer focus. Whereas the entailments of linguistic metaphors reorganize present perceptions, the entailments of non-linguistic metaphors restructure the present contexts of artifacts. The Xerox copier was designed to metaphorically invoke common office experiences – without having to understand how the copier actually works, without fear of being caught in its mechanisms, and without requiring expensive repair services for undoing minor paper jams. Without the use of metaphors in the human interfaces with computers, computer use would have been confined to a few specialists.

4. CONCLUSION

In the foregoing and with reference to Figure 14.12, we have demonstrated how the meanings of artifacts derive from and subsequently direct stakeholders' conceptions and interactively transform an artifact's contextualizations. It is not enough to merely talk about their meanings – agree or disagree on what they are, usually at the expense of the diversity of contexts that support them – meanings are best seen as guiding human actions. In human interfaces with artifacts, these meanings are enacted, tested for their affordances, and modified to fit what one wants to accomplish. Metaphors alter an artifact's context as well, but perhaps more thoroughly, more effectively, and perhaps least noticed.

Finding practices to rely on or ways to create the conditions for desirable interfaces with artifacts to emerge is important to human-centered designers. Knowing how such practices are transferred from familiar to new artifacts enables designers to intervene successfully into how their designs may be used. Linguistically, 'success' comes from 'succeeding.' In this sense, a design succeeds by traveling through an always-emerging

network of its stakeholders – directed by the meanings that its stakeholders attribute to it and that designers may wish to track and utilize.

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