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Toward a Semantic Notion of Space

Despite the claim of traditional functionalism, rarely is form entirely derivable from function. Both conscious and subconscious ideas about space play important roles in designers' conceptions of products, including their intended forms, functions, and meanings in the physical environment. Unable to directly penetrate this subconsciousness, we start with ordinary language — the language by which people describe what they are designing, buying, using, and discarding, as well as what sense such objects make in their lives. From there we proceed to a way of designing semantically intelligible products.

Although Alfred Sohn-Rethel was not concerned with either design or language, his distinction between physical and mental abstractions[1] is important. Both abstractions describe processes of conceptualization but have fundamentally different consequences. Physical (material or real) abstractions begin with observer-independent physical qualities and proceed to accounts of increasingly general commonalities, none of which refer to those who accomplish the abstracting. In contrast, mental abstractions begin with perceptions and proceed to increasingly deeper levels of understanding. We agree with Sohn-Rethel's distinction and, as applied to space, associate the physical with a geometric model and the mental with a semantic model, which we wish to develop. Evidence for both models is found in language.

1) Alfred Sohn-Rethel, *Geistige und Koërperliche Arbeit* (Frankfurt am Main: Suhrkamp Verlag, 1970).

Geometric space

The geometric model of space originated in ancient Egypt, where it was used to measure agricultural areas and assess taxes. Formalized in analytic geometry, the structure of the geometric model owes much to the principle of orthogonality, that is, the dimensions of a geometric space must be independent in the sense that moving along one dimension says nothing about moving along another. Geometric terms do not imply one particular point of view but several simultaneously — one for each orthogonal coordinate. These points of view are not located inside the space but infinitely distant from it. Thus, geometric models of space are comprehensible only from outside that space and therefore their

conception is observer- independent. This model is an example of the physical abstractions Sohn-Rethel talks about. Moreover, by projecting a spatial form onto three separate planes, for example, in the top, front, and side views of technical drawings, the abstract three- dimensionality of the geometric model provides no place for the representation of whole forms or gestalts. Each projection works independently and without reference to a particular observer. The singular whole entity or gestalt that humans might experience, as participants from their unique perspective, appears in the model as three independently quantifiable images. Designers are particularly aware of the difficulty of drawing complex forms in three projections, or conversely, of understanding such forms from drawings. One might even argue that the three eyes of geometry do not perceive space at all!

The geometric model of space has deep roots in European history. Although alternative concepts of space coexisted for centuries, geometric conceptions became prominent during the Renaissance and were closely linked to the development of mechanical technology and analytical science, whose physical abstractions required no reference to human perception. Both could and, indeed, were constructed outside human phenomenology. The geometric model of space not only supported the design of mechanisms, with its preference for linear or circular movements, geometrically ideal bodies (such as cylinders and rectangular shapes), and the mathematics that go with them, but the near global success of mechanistic technology also reified this model of space, spreading it worldwide. In view of the apparent complicity between geometry and technology, it is no accident that the term *three-dimensional* has almost displaced the word *spatial* in ordinary discourse.

The conceptual commitment to one model of space to the exclusion of others has profound implications for design. The three-dimensional geometric model in particular fails to account for specifically human perceptions and points of view. It ties designers to a technology devoid of human qualities and, above all, ignores processes of human communication that take place within, and that are often centered about, the spatial environment of everyday experience. Moreover, if geometry is crowned the apotheosis and governor of spatial synthesis, then those holistic and experiential qualities of space that are beyond the scope of a three-dimensional model are bound to escape attention as well.

In verbal accounts of how individuals relate to their own spatial environments, the recognition of an object's meaning is as important as its usability is in ergonomic terms, its mechanical functionality in engineering terms, or its utility in economic terms. Because it is simply incomprehensible that people would use something that escapes understanding, we can say that

meaning is indeed primary. Moreover, in the transition from mechanical to electronic technology — which has allowed products to become smaller in size and arbitrary in form and has rendered their increasingly intricate makeup more and more difficult to comprehend — the semantics of a product's form clearly become of mounting importance. For both reasons, semantics should take a prominent position in contemporary design considerations.

Meaning and a semantic notion of space

Because the communicative aspects of form dominate ergonomic, technical, and economic concerns, an adequate understanding of these aspects requires a concept of space in which the semantic relationships between products and individual users can be mapped and more clearly conceptualized. In suggesting such a space, reduction of these semantic relationships to a one-dimensional entity, as might be suggested by the limiting ideas of "consuming," or "making use of" something, should be avoided. This notion of space is intended to encompass the whole complex of person- artifact relationships as viewed by the very individuals who participate in these relationships. Thus we are concerned not with physical but mental abstractions. In addition, we wish to enable designers to identify the qualities and meanings people attribute to the forms in such a space. We have elsewhere[2] called this space a *semantic space.*

2) Hans-Jürgen Lannoch, "How to Move from Geometric to Semantic Space," *Innovations* 3/2 (1984): 20-22.

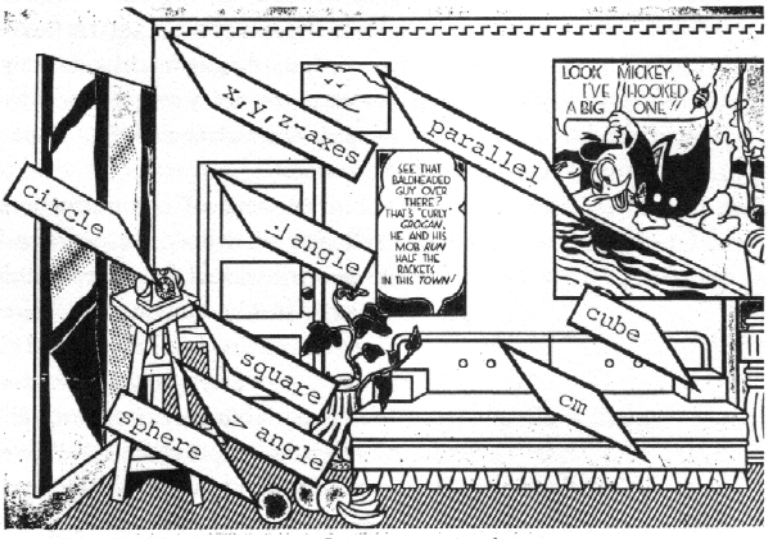


Fig. 1) three-dimensional geometric space

To compare geometric with semantic notions of space, consider the example of a table. In a three-dimensional geometric space, as depicted in figure 1, a table could be described as an object of a certain height, with a specific shape and size, as well as physical dimensions of its support system. Even if one were to adopt anthropometric concerns and measure its "leg room" in cubic

centimeters or inches, for example, such measurements would not reflect individual perception. One's personal relationship to the table simply escapes its geometry. By contrast, in a semantic space, a table is described as *high* or *low*, is said to have a *surface* and an *underneath*, and things can be placed either *on top* or *underneath* it. The tactile experience with this table may be *rough* or *smooth*, *hard* or *soft*, *warm* or *cold*. Some tables have a *front* and *back*, according to the role they play for users. An executive desk, for example, has a definite direction that helps define who the boss is and who must defer in his or her presence. A circular table, on the other hand, is directionless. Its "roundness" does not merely denote the geometry of a piece of furniture, but more important, a particular form of discussion, hence the term *round table*.

The above example makes two important points. First, interpersonal relationships act as constitutive components of semantic space whenever people project them onto or link them to the spatial properties of objects as perceived. Second, geometry is of little assistance in accounting for the way spatial characteristics make sense to people. In short, the geometric model of space represents objects without reference to observers and abstracts people out of their own spatial experiences; the semantic model of space makes the spatial manifestations of individual sense-making processes, including interpersonal relationships and human interactions with objects, which are its primary concerns.

As stated, the notion of semantic space is intrinsically tied to the ordinary use of language. Individual spatial experiences are expressed in words. These experiences are communicated to others, and the semantic notions of a spatial environment are collectively constructed in language as well. The example of the table, for instance, literally uses the way people talk about tables, relate to tables, account for their experiences with tables, describe what they consider appropriate social behavior in the presence of particular tables, and so forth. Jean Piaget's observation that all human cognitive operations are manifest in the use of ordinary language, whether in its syntax or semantics,[3] supports our effort of taking language use as an indication for the mental abstractions that users make.

3) Jean Piaget, *Probleme der Entwicklungspsychologie* (Frankfurt am Main: Syndikat Verlag, 1976).

Language organizes much of our experiences, both the concrete and abstract encounters with the physical world and our responses to them. Language enables us to conceptualize, think, and communicate about these experiences detached from the presence of time and sensation. Moreover, and this is the primary concern, language enables us to manipulate, invent, realize, and cooperate in the creation of new experiences by design.

Semantic dimensions

In ordinary discourse concerning space, there are six interrelated types of linguistic expressions of meaning, which are evidence for

six semantic dimensions. However, unlike the geometric model, these dimensions are not considered independent or orthogonal. The choice of the term *dimension* should be regarded as a mere metaphor from geometry and not allowed to detract from the complexities to be captured with this concept. These semantic dimensions coordinate with more than human perceptions of space, human decisions and actions within that space, and creative alterations of space through design. Semantic dimensions also direct attention to cultural interpretations. The six semantic dimensions are as follows:

- The dimension of *experiential qualities* includes references to qualities that are attributed to spatial forms based on an individual's immediate sensory experiences (without comparisons to other qualities, real or imagined). Figure 2 exemplifies some terms used to describe space according to such primary experiences.

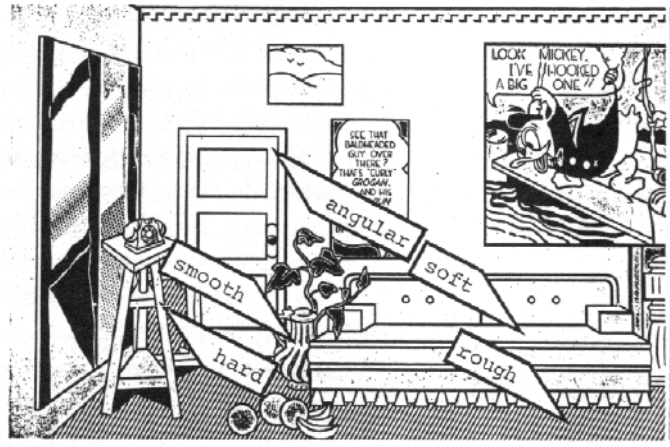


Fig. 2)

- The dimension of *orientation* contains directional assertions indicating the location or position of something relative to a typical user or observer. Orientations characterize a spatial form from a particular point of view and thus require reference to the human body. Being *in front* or *behind*, *left* or *right*, *inside* or *outside* implies such references. Figure 3 exemplifies others.

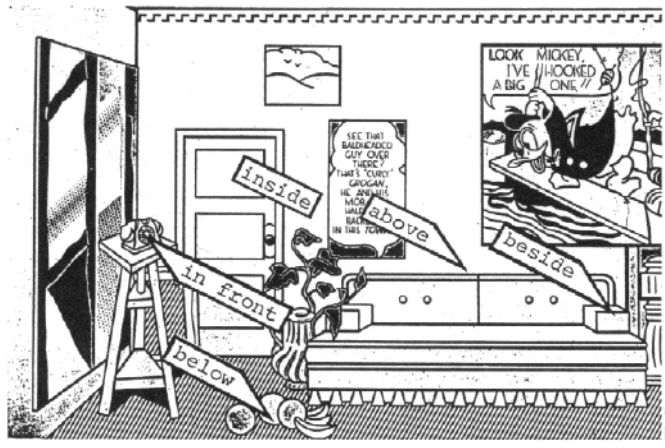


Fig. 3)

■ The *state* dimension encompasses accounts of alternative ways of being, the different positions or states that something may occupy, one at a time, or the range of conditions under which something can operate without breakdown or change of its identity. Figure 4 gives some examples.

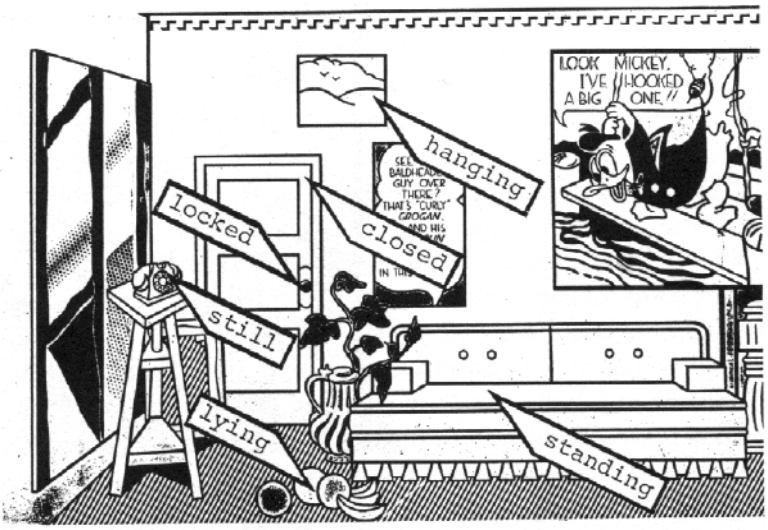


Fig. 4)

■ The dimension of *comparative judgment* entails expressions of a form's deviation of some aspect from the ideal or referent,[4] real or imagined. Figure 5 offers some examples, all of which invoke some kind of standard reference point for comparison. (In psychology, experiential qualities are sometimes called absolute judgments, whereas the comparative qualities are, of course, said to be relative.)

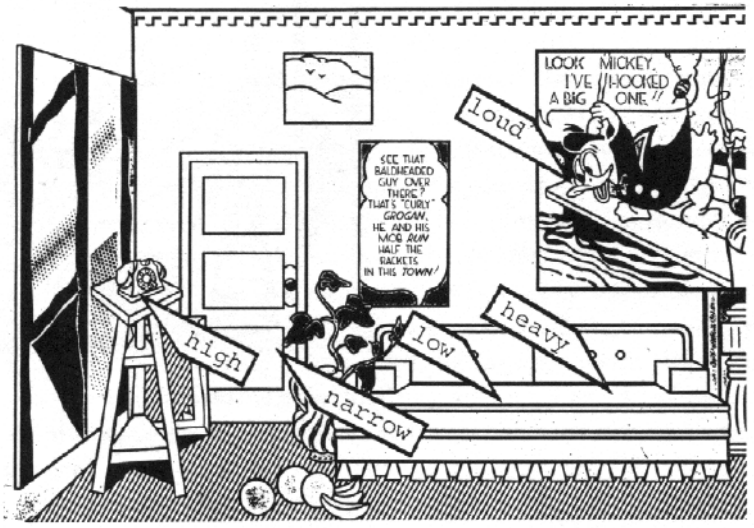


Fig. 5)

4) This deviation from an ideal type, also called "typicality," is discussed in Uday A. Athavankar's contribution to this issue entitled "Categorization — Natural Language and Design."

■ The *affordance* dimension is composed of accounts of how something can be used, what it does for someone, or what it is capable of performing in interaction with users. Figure 6 illustrates such words.

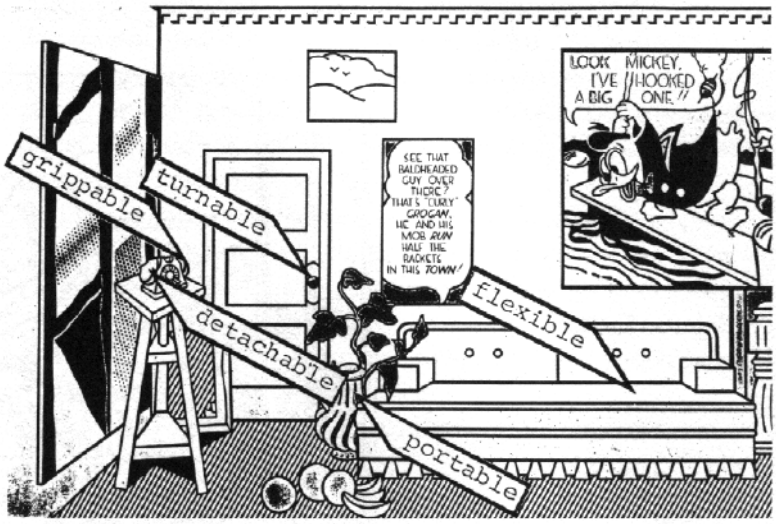


Fig. 6)

■ The dimension of *values and conventions* refers to statements that are derived from the assumption of socially shared and conventional standards, relative to which something is evaluated or appraised. It entails comparative judgments that are applied not to spatial qualities but to desires, stereotypical ideals, or evaluative conventions. Figure 7 depicts some examples.

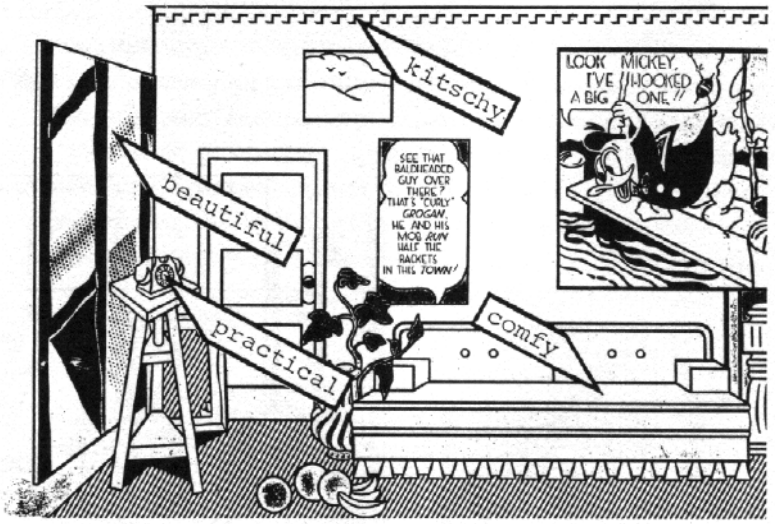


Fig. 7)

Semantic transfer

The six kinds of linguistic expressions are believed to be concerned about aspects of meaning that go beyond their function in speech. They provide clues about the largely nonlinguistic and often subconscious phenomena of human cognition. These extra-

linguistic meanings need to be analyzed to construct semantic spaces in which design can take place. The realization of semantically meaningful products can then occur. The method of going from a semantic analysis of linguistic expressions within a particular product domain to the realization of individually meaningful spatial forms is called *semantic transfer*: *semantic* because the concern here is with the meanings of speech, interpersonally constructed whether in conjunction with particular forms or anticipated in the absence of concrete experience, and communicated to the perceiver as analyst; *transfer* because the method proceeds from one medium to another, that is, from the medium of language to the medium of space. In this process, the dimensionality of meanings is carried along.

Semantic transfer begins with an examination of words that play a role in discourse about space — the semantic spatiality of objects, including the interaction between people and their environment. These expressions, sometimes only simple words, may not have obvious spatial connotations to begin with but, upon closer scrutiny, can find a position within the six semantic dimensions. The words *hard* and *soft* are such examples.

By extensive semantic analysis, the meanings of words are then examined, particularly for the clues they offer not only about the structure of individual sensory experience but to their sociocultural implication as well. For example, the word *hard* does not only denote a mere material property. There are hard jobs, hard men, hard women, hard decisions, hard hats, hard sell, hard-hearted people, and so forth. Even so, the context in which this word is used delineates its meaning and such meanings surely enter conceptions leading to the description of something as hard. In exploring such meanings we might even ask whether "hard" has something to do with the idea of "on top" or "underneath." The analysis of *narrow* and *wide* in figure 8 exemplifies this exploratory step.

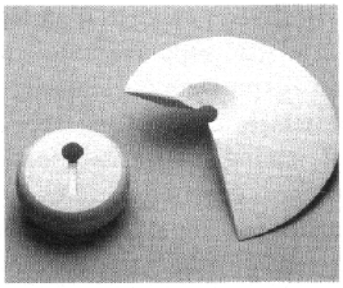
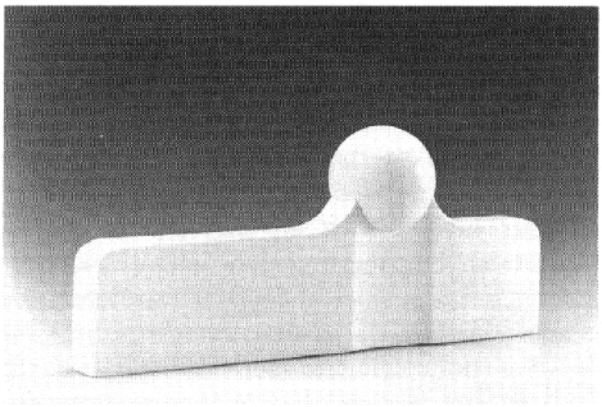


Fig. 8)

After exploration of relevant meanings, the actual transfer occurs. A complex web of verbal imagery is translated into spatial forms by the creation of concrete manifestations or objects that express word meanings, without alluding to the functional aspects of a desired product. It is a process of form-finding that is initially informed not by teleological preconceptions, but by linguistic accounts that have spatial implications. It forges verbal meanings, sensory experiences with the physical environment, and conventional notions of space into meaningful manifestations that then can be evaluated for semantic clarity. Figures 9 and 10 illustrate the results of exercises originating from the words *removable* and *outside*.



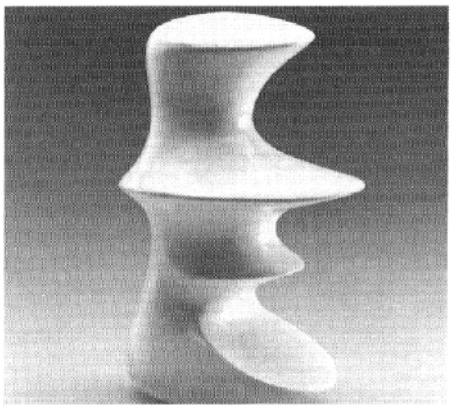


Fig. 9)
Fig. 10)

Conclusion

We emphasize that this approach to semantic transfer is not intended to support a semantic iconography, which would articulate a limited repertoire of symbols, thus stifling the way people interact with their designed environment. It is also not intended to be a systematic design method that would impose a grammar of form akin to a style, equally retarding human interaction with objects. Rather, semantic transfer draws on the richness of spoken language, responds to the natural drifts of meaning, and gradually evolves from the wealth of connotative meanings and ambiguous references to corresponding spatial manifestations.

The geometric model of space has driven processes of design toward a universal form of language that supports industrial production at the expense of individual expression and indigenous cultural meaning. In contrast, the semantic model of space is expected to nurture tendencies of joining human and spatial characteristics in a novel synthesis that focuses on meaning and understanding, as opposed to disembodied technology. Moreover, because of the social origin of language on which the semantic model is constructed, semantic transfer is not independent of culture, as is the geometric model that is now clearly associated with Western technology and science. The reliance on language embeds product semantics inside specific cultures and is thus capable of preserving, or, at least, responding to cultural identities, promoting locally meaningful product varieties, and protecting users from the semantic overload of alien symbolism.

Although the concept of a semantic space has been developed from our experiences as industrial designers, the concept does not seem limited to one particular application. Any area of design in which human and spatial characteristics come together needs a spatial conception that takes both into account. Fashion design and ballet, for example, which have always taken place in predominantly semantic domains, could develop new ideas by consciously working in semantic dimensions. Semantic models of

space would also enable architects to design human spaces that are more than a combination of floor plan and facade.

There are several design movements that have also turned against functionalism, against its inhuman, mechanistic approach and its inability to respond to cultural changes in the way individuals interact with their environment. The term *postmodern* may describe these as a group. In architecture, for example, postmodernism has introduced an eclecticism that relies on iconographic forms from history as metaphors for new buildings intent upon visualizing their meaning. In contrast, rather than using historically established metaphors, our approach calls for participation in the process of metaphor creation. Our belief is that semantic transfer can establish contemporary metaphors, borrowing neither from historical precedents nor from unrelated semantic domains, and can apply directly to human interaction with artifacts.

From a larger perspective, postmodernism can be associated with the structuralist concept of *posthistoricism*. In his *Studies in Anthropology and Sociology*, Arnold Gehlen uses this concept to characterize an historical condition in which "the basic stock of culturally available possibilities are fully developed." This condition would leave those living in it the task of merely tinkering with familiar elements and recombining them over and over again.[5]

5) Arnold Gehlen, *Studien zur Anthropologie und Soziologie* (Berlin: Luchterhand, Verlag 1963).

Interestingly, Claude Levi-Strauss contrasts tinkering with engineering (here equated with design). According to Levi-Strauss, engineers, when "faced with the constraints inherent in the contemporary state of civilization, always seek to break out of their confinements and set themselves about them, whereas tinkerers voluntarily or by necessity work within them."[6] By semantic transfer we hope to lead designers to a breakthrough that takes the all-embracing natural language as a point of departure for the creation of meaningful products.

6) Claude Levi-Strauss, *Das Wilde Denken* (Frankfurt am Main: Suhrkamp Verlag 1968).

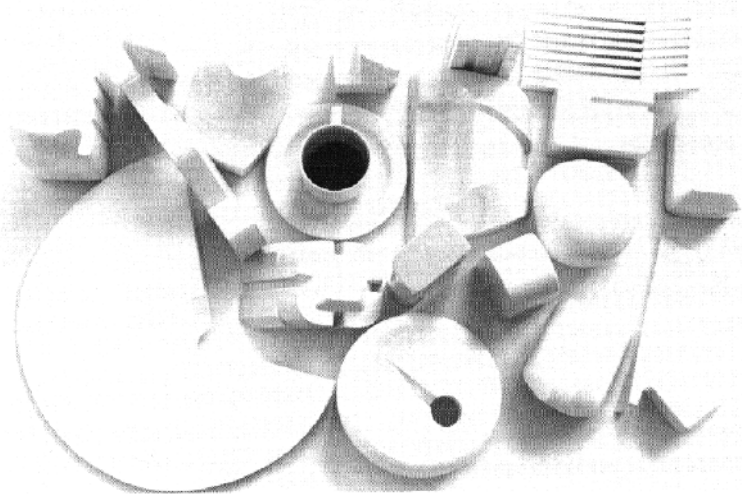


Fig. 11)

In conclusion, we wish to emphasize that semantic models of space are not conceived as rigid systems. They vary from culture to culture. They differ across semantic domains and, above all, they evolve in close contact with the distinctions continuously drawn in human communication about artifacts and during user interactions with artifacts. This proposed approach to product semantics may thus enrich the development of new individually meaningful cultural identities.

Fig. 12) Semantic Water Drop Faucet