Culture as Mediator for what is *Ready-to-hand*: A Phenomenological Exploration of Semantic Networks

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ABSTRACT

Upon what philosophical foundation are semantic network graphs based? Does this foundation allow for the legitimization of other semantic networks and ontological diversity? How can we design our computational and informational systems to accommodate this ontological diversity and the variety of semantic networks? Are semantic networks segmentations of larger semantic landscapes? This paper explores semantic networks from a Heideggerian existentialist and phenomenological perspective. The analysis presented uses cultural schema theory to bridge the syntactic and lexical elements to the semantic and conceptual dimensions of semantic network graphs and offers reasons why the viability of such graphs as they are currently constructed are insufficient for creating semantic interoperability for our information technologies. Reconceptualizing semantic networks as cultural landscapes offers us insight as to where our understanding of semantic networks falters and what we might do to improve them.

INTRODUCTION

Semantic network representations have been described in a variety of ways: as a method of encoding a hierarchy of knowledge (Collins & Quillian, 1969), as a directed graph structure of nodes and edges (Konstable, 2007), as representations of concept and concept relationships (Collins & Loftus, 1975), as visual representations of properties, attributes and predicates, etc. Sowa (1992) identifies six types of semantic networks based on their intended purpose: definitional, assertional, implicational, executable, learning, and hybrid. Sowa claims "what is common to all semantic networks is a declarative graphic representation that can be used either to represent knowledge or to support automated systems for reasoning about knowledge."

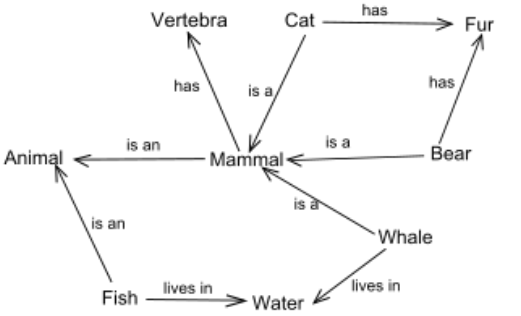

Figure 1. Example of Semantic Network Graph with Mammal as the central node (Konstable, 2007).

Looking at the directed graph in Figure 1 we see several elements. There are lexical units (words) that form the nodes of the graph, and there are edges that have labels describing the relationships between the lexical nodes. The edge labels are mereological (*is a, is part of, is a kind of*), which is similar in construct to formal ontologies, albeit more simplified. Semantic network graphs might be described as naïve or folk ontologies. Both semantic network graphs and formal ontologies attempt to impose a structure or structural relationships upon a lexicon, usually for a particular domain. The lexical elements of a semantic network refer to entities or phenomena in the world in a semiotic type of relationship described by Pierce (Peirce, 1998). There is an entity in the world that has an associated referent that derives from and is a lexical expression of our conceptualization of that entity or phenomenon. A representational entity such as a semantic network graph focuses our cognition upon a particular facet or element of the entity or phenomenon in the world. However, "[T]here are also many aspects of semantic structure not captured in our simplified semantic network models: the context sensitivity of meanings, the existence of different kinds of semantic relations, or the precise nature of the relations between word meanings and concepts" (Steyvers & Tenenbaum, 2005).

It is important to recognize that semantic network graphs *exclude* some of the conceptual connections that may exist as part of our complex conceptualizations of the entity. We may see this as obvious, as all models exclude something whether by convenience or design, but when we model semantic networks, do

we make a fundamental mistake of excluding what makes the lexical and syntactic representations actually semantic? In this paper, we want to focus of the issue of exclusion with respect to semantic networks.

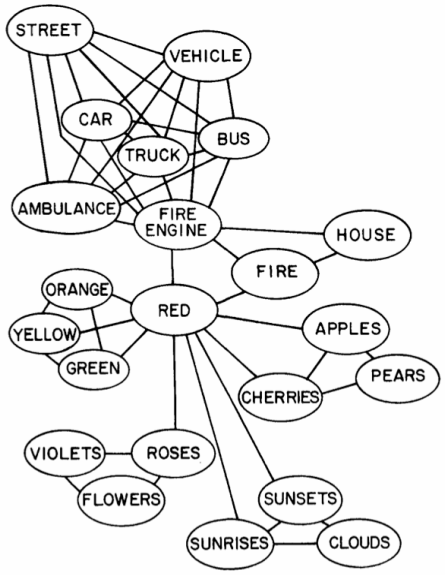

Figure 2. A schematic representation of concept relatedness in a stereotypical fragment of human memory (where a shorter line represents greater relatedness) (Collins & Loftus, 1975)

SEMANTIC INTEROPERABILITY

When we impose a structure upon our lexicon to create a semantic network graph, we are also *excluding* many of the other conceptual connections that may exist as part of our contextualized, experiential conceptualizations of the entity or phenomenon. We select particular elements for representation, and through doing so crystallize a segment of our semantic landscape as a semantic network. While our representations of semantic networks are limited and bounded, our semantic landscape is vast and continually changing and adapting as part of our lived experience. If the purpose of identifying a semantic network is to achieve semantic interoperability for our information systems, issues of inclusion and exclusion with respect to the semantic landscapes becomes important as part of the hermeneutic process of meaning-making and understanding.

If we examine our interpersonal discourse, we realize that conveying meaning doesn't require our discursive lexicon to be overly structured. Moreover, the more experiences we share, the less necessary it is to be extraordinarily detailed in our communications in order for us to understand one another. In our close personal relationships, for example, we easily make meaning of another's body language and voice tone—no syntax or lexicon necessary. Syntax is no doubt helpful to meaning-making, as in English when we transpose the verb and object to signify a question: "Is this ball blue?" But syntax and lexicon are insufficient in the creation of meaning. Context and situational awareness are necessary to appropriate semantic interpretation and understanding.

However, we tend to reify the network graph as representative of things in the world (See Figure 2). This satisfies our realist tendencies and assumptions, and our scientific epistemologies, which are reinforced by intersubjective agreement.[1] This intersubjective agreement, however, is a hermeneutic cultural phenomenon. It is based on our shared cultural schemas and assumptions about the world in which we are immersed. Ironically, we recognize that our understanding, our sense making of entities and phenomena in the world, adapts and changes throughout our lives and throughout history. Semantic technologists came to realize that sense making was a more complex hermeneutic phenomenon than they originally thought:

> *". . . we found that we as representatives for different semantic technologies were talking different languages. We were explaining our technologies with different terms to mean the same thing and the same term to mean different things, and our models for addressing the issue of semantic interoperability were so different it was hard to get our message across to people who already identified deeply with their own way of thinking. We were supposed to be experts on semantic technologies, but we experienced a complete breakdown of semantic interoperability among ourselves*." (Aassve et al., 2007)

Is the solution, as they believe, more structure, more standardization, more explicit rules, more syntactic structure? By imposing more structure and adding greater degrees of specificity, are we heading directly

[1] Here, "intersubjective agreement" signifies not only the social agreement as to what we become committed to ontologically but also the epistemological means by which we achieve it, i.e., the "valid" ways of measuring and assessing the entities and phenomena we experience.

into another type of Zeno's paradox by adding finer and finer gradations and distinctions to bridge the distance to our semantic goal? Are we confusing syntax for semantics, structure for meaning, language for thought, the lexical for the ontological?

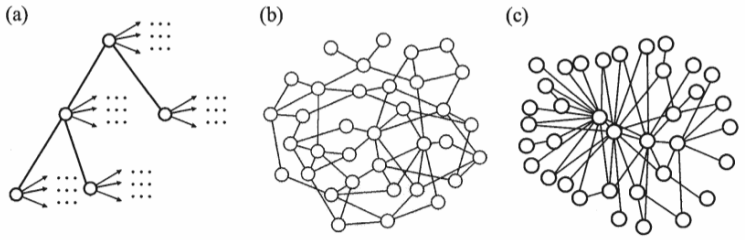

Figure 3. Proposed large-scale structures for semantic networks: (a), a tree-structured hierarchy; (b), an arbitrary, unstructured graph; (c), a scale-free, small-world graph (Steyvers & Tenenbaum, 2005).

We recognize that semantic networks are typically domain-specific. We assume that there is at least general agreement within a domain with respect to their semantic networks. If we were to portray a semantic network graph to persons from a particular domain, we expect that they would be able to readily match the representation to their shared conceptualization (e.g., with a representation such as in Figure 3a). Persons from other domains likely wouldn't produce the same semantic network graph. For example, we would expect a semantic graph composed around the concept of "rate" would differ, probably significantly, when composed by financial analysts as opposed to physicists.

Persons from different cultures, with different languages and experiences of their environment, will almost certainly have different conceptualizations of the same entities or phenomena in a particular environment. For example, what meaning does an academically trained GIS practitioner and an aboriginal Australian of the Krantji clan make of the geographic entity known as *Krantjirinja*? The geographer sees a rock formation composed of slate, which can be mapped to a Cartesian grid, located atop a natural spring that serves as the source of the areas hydrological cycles. The member of the Krantji clan sees *Krantjirinja*, his Kangaroo Ancestor, who has existed since the *Dreamtime* and continues to exist and exert his influence today, who must be given deference as a revered ancestor, and whose power protects the red kangaroos that graze in the surrounding landscape. The semantic network graphs drawn by the geographer and the Krantji clan member would differ significantly (Kane, 1998; Saab, 2003). In fact, there may be no overlap at all in terms of the lexical units and relationships between these two graphs of the exact same geographic entity they "see." What outcomes might we expect as part of the automated reasoning support given by these different graphs? How would a machine know which one to employ as part of its reasoning process at any given time or in any given context?

Meaning requires a contextualized perspective. We need to understand both the context *and* what elements of it our discourse partner finds salient. We need a shared understanding of the context and its salient elements in order to communicate meaningfully. The semantic technologists quoted above discovered that while they had similar vocabularies, the salient contextual elements related to their lexicon were imprecisely aligned. Each was using a slightly different ontology related to their lexical expressions. They assumed that since they were all semantic technologists that they shared a common understanding of the salient elements, entities and phenomena related to semantic technologies. However, through their extended discourse, they discovered that they derived different meaning from the same lexical units and that their different ontological conceptualizations made progress towards their collective goal slower than originally expected.

We recognize that different domains (i.e., cultures) can have different perspectives about a particular extrapersonal structure, and we are willing to accommodate such diversity generally. We simply prefer to think of our own cultural schemas as realist, privileged above others because of the assumed superiority of our epistemological methods. Whatever justification we use for establishing that privilege does not negate the fact that we are one culture among many, nor that each culture has its own ways of legitimizing meaning and handling the semantics of their discourse. Recognizing that there exist different ontologies and different epistemologies among different cultures is not an anti-realist position; rather it is a transcendence of the realist/anti-realist dichotomy. It is relativist to the extent that legitimizes the existence of diverse cultural perspectives but it is not a chaotic relativism. The cultural schemas we develop and employ have a stabilizing influence upon members of a culture and enable them to co-create shared understanding of the world.

CULTURAL LANDSCAPES

Semantic networks are not the representations found on a directed graph. Nor are they syntactic patterns of lexical elements. Semantic networks are partial representations of our conceptual networks that comprise larger cultural landscapes, i.e., our ontologies—our understanding of what exists and what is real. Semantic networks form the bridges, not simply between our lexicon and what we recognize as existing outside of our body-mind, but more importantly between our complex network of ontological conceptualizations and our culturally-shared contextualized experiences of the world and the structures that we recognize as embedded in it. Semantic networks allow us entry into a more vast cultural landscape.

Why reconceptualize semantic networks as entry points to cultural landscapes? The simple answer is that by trying to formalize meaning through the computation of lexical units and how they are structured in relation to one another, we exclude the essential element of a contextualized perspective—the very thing that allows us to create meaning of our experience in the world. Woven together, our semantic networks comprise larger semantic landscapes (i.e., ontologies), and because they require a contextualized perspective to be understood by the agents involved in the discourse, they can also be described as *cultural landscapes*. At this point we need to clarify what we mean by culture.

Culture is an emergent phenomenon that arises through the interplay of intrapersonal schemas and extrapersonal structures. Schemas are strongly connected networks of cognitive elements, having a bias in activation through repeated exposure to the same or similar stimulus, but they are not rigid and inflexible.[2] D'Andrade (1995) explains in more detail that schemas are "flexible configurations, mirroring the regularities of experience, providing automatic completion of missing components, automatically generalizing from the past, but also continually in modification, continually adapting to reflect the current state of affairs." Describing them as 'flexible, mirrored configurations' implies that schemas are structural entities within cognition that are comprised of several elements. Schemas are not the individual elements rather strongly connected clusters of elements of experience within cognition, i.e., *networks*.

Schemas are the cognitive elements in the "structural coupling" of our experience described by Winograd and Flores (1987). Schemas are cognitive entities that help us process information. Elements of experience are clustered in cognition, in our neural networks, because they are clustered in our lived experiences. Clustering cognitive elements makes them more efficient by reducing the cognitive load associated with processing experience. Schemas are powerful processors of experience, help with pattern completion, and promote cognitive efficiency. They serve to both inform and constrain our understanding of experience. Because of their functionality in pattern completion, schemas function, in some sense, as flexible filters of experience, enabling us to attend to its salient features while filtering out the non-salient. People recall schematically embedded information more quickly and more accurately (DiMaggio, 1997). In fact, schemas hold such sway in our cognition that people may falsely recall schematically embedded events that did not occur. They are more likely to recognize information embedded in existing schemas because of repeated activation of the patterned cognitive elements.

What is meaningful is culturally based. People from different cultures can look at the same extrapersonal structure and derive completely different meanings from it. Our high-contrast example above concerning *Krantjirinja* illustrates this point simply and effectively. In this sense, semantic networks also reflect the veracity of our characterization of semantic landscapes as cultural landscapes. Being cultural, they must therefore include both the intrapersonal schemas as well as the extrapersonal structures of the world. It is the interplay of the intrapersonal and extrapersonal that provides the contextual frame for proper interpretation of semantics. We engage in such interplay effortlessly in human-to-human interactions, as all experience is culturally contextualized—we are always situated within a context, and our cultural schemas shape our understanding of it. When we decontextualize the semantic network by representing it as lexical units and mereological relationships within a directed graph, we transform the intrapersonal schema into an extrapersonal structure. Our representations metaphorically crystallize it, making it rigid and inflexible. Representation externalizes the schema and thereby eliminates its dynamic and emergent nature. Extracting a small part of the larger cultural landscape to represent as a network graph excludes the

[2] They have also been referred to variously in the literature as frames, scenes, scenarios, scripts, models, and theories (D'Andrade, 1995).

essential intrapersonal cultural elements that allow for the emergence of meaning. If we want to achieve semantic interoperability among our informational and computational systems, our analysis suggests that we can't exclude the cultural schemas that are essential to the emergence of meaning and provide for us the complex connections to what Heidegger refers to as the *ready-to-hand*.

WHAT IS *READY-TO-HAND*

Reconceptualizing semantic networks as segments of cultural landscapes is better explained using a Heideggerian ontological perspective rather than an Aristotelian one. For Heidegger (1927), the basic state of *Dasein*—man's being—is understanding, making sense, making meaning of the world in which he is embedded. Immersion in the world is an inescapable fact of human existence. The world and the meaning we make of the world are inextricably linked through our experience within the world. Our experience of the world is also always cultural—what we recognize as salient is dependent upon the conceptual *fore-structures* (i.e., intrapersonal schemas) we employ in making sense of our contextualized experience (i.e., the extrapersonal structures we encounter).

Another inescapable fact of our existence is temporality. We are always *falling* into the next moment with an accompanying directionality of our conceptual *fore-structures*. In other words, we have expectations as we move temporally through the world. The expectations generated by our *fore-structures* have a duality about them. They are able to accommodate the holism of our experience to some degree by what Heidegger describes as *ready-to-hand*, as well as the more narrow focus of our attention and the entities and phenomena that become *present-at-hand*. Our *fore-structures* shape our *falling* such that the world we experience can be described as a cultural landscape. Our cultural landscapes have coherence because they have structure that derives from our cultural schemas, which encompass what is *ready-to-hand* and what is *present-at-hand*.

We have already described semantic networks as segments of larger semantic landscapes and argued that the latter are actually cultural landscapes. From a Heideggerian perspective, we can also describe semantic networks as what becomes *present-at-hand* within the wider landscape of the *ready-to-hand*. What is *present-at-hand* is the extrapersonal structure that is momentarily salient and becomes the focus of our attention. That momentary focus constrains our experience in terms of its directionality because we are attending to the salient elements of the entity or phenomenon we experience. It limits the possibilities of what is *ready-to-hand*. But we continue *falling*, and we attend to what is *ready-to-hand*, and transform those elements into salient focus, making them *present-to-hand*. In other words, each constraining focus opens up a limited set of possibilities, which in turn constrains then opens another set of possibilities in an unending process of emergent experience—a hermeneutic circle.

The relationship between wave and particle in quantum physics might provide us with some analogical insight. Let us think of our cultural landscape as a wave, as a phenomenon that can only be grasped as temporal and in continual flux. When we try to focus upon the wave, it collapses into a particle. The quanta exhibit the qualities of both waves and particles. Our cultural landscapes are similar. They exist within a continually emerging experience, as if they were a pattern of waves. The segmentation of a cultural landscape into a semantic network graph is similar to a series of particles that results from the focus of our attention and the limited possibilities of what is *ready-to-hand*. Every interaction we have with the wave alters it, just like every contextualized experience we have alters our intrapersonal schemas. The difficulty we have is that our semantic network graphs are lexically expressed—a syntactically sequenced series of particles. If we want to achieve semantic interoperability among our computational and informational systems, we must devise ways of including the waves of the cultural landscape—what is *ready-to-hand*.

CONCLUSION

Can semantic network graphs facilitate semantic interoperability among our machine information systems? Our analysis suggests that they can't, at least as currently contrived, because semantic network graphs are not semantic, per se, but rather extrapersonal structures of lexical units syntactically (and/or spatially) arranged. While providing some structure that facilitates the sharing of meaning we engage in as *Dasein*, such graphs are insufficient because they exclude too much of the vast cultural landscapes of our experience. More specifically, they exclude cultural schemas that are essential for meaning making and that would provide the connections to the larger conceptual landscapes.

In this paper, I have argued that we must embed within our machines the ability to negotiate meaning through hermeneutic discourse based on the creation and incorporation of cultural schemas—to adapt their "intrapersonal" schemas to those of others, both human and machine. Our machines' semantic networks and cultural landscapes would not need to be perfectly aligned, as they are now with respect to formal ontologies, but having "intrapersonal" schemas that are flexible and adaptable would facilitate the formation of shared cultural schemas and conceptualizations through hermeneutic discourse. Embedding this capability within our machines become more critical as the diversity of devices, forms of information, and cross-national and intercultural communications increase. We have an increasing number of cultural landscapes that are becoming part of the global discourse through blogs, tagging, social networks, wiki spaces, mashups and more. We must look to handling their emergence through a hermeneutic process rather than try to impose a privileged and particular set of cultural schemas that just happen to align with our own.

REFERENCES

Aassve, Ø., Berre, A.-J., Danenbarger, S., Garshol, L. M., Klûwer, J. W., Valen-Sendstad, M., et al. (2007). The SIM Report, A Comparative Study of Semantic Technologies. Retrieved June 5, 2008, from http://web3.custompublish.com/getfile.php/589755.177.stbawqcpsv/SIM2007-101.pdf?return=www.norstella.no

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological Review, 82*(6), 407-428.

Collins, A. M., & Quillian, M. R. (1969). Retrieval time from semantic memory. *Journal of Verbal Learning and Verbal Behavior, 8*(2), 240-248.

D'Andrade, R. (1995). *The Development of Cognitive Anthropology*. Cambridge: Cambridge University Press.

DiMaggio, P. (1997). Culture and cognition. *Annual Review of Sociology, 23*, 263-288.

Heidegger, M. (1927). *Being and Time* (J. Macquarrie & E. Robinson, Trans. J. Macquarrie, E. Robinson, 1962 trans. ed.). New York: Harper and Row.

Kane, S. (1998). *Wisdom of the Mythtellers*. Peterborough, Ontario: Broadview Press.

Konstable. (2007). Semantic_Net.svg: Wikipedia.

Peirce, C. S. (1998). *The Essential Peirce, Selected Philosophical Writings* (Vol. 2, 1893-1913). Bloomington and Indianapolis, IN: Indiana University Press.

Saab, D. J. (2003). *Conceptualizing Space: Mapping Schemas as Meaningful Representations*. Unpublished Master's Thesis, Lesley University, Cambridge, MA, http://www.djsaab.info/thesis/djsaab_thesis.pdf.

Sowa, J. F. (1992). Semantic Networks. *Encyclopedia of Artificial Intelligence* Revised Second Edition. Retrieved February 1, 2009, from http://www.jfsowa.com/pubs/semnet.htm

Steyvers, M., & Tenenbaum, J. B. (2005). The Large-Scale Structure of Semantic Networks: Statistical Analyses and a Model of Semantic Growth. *Cognitive Science: A Multidisciplinary Journal, 29*(1), 41-78.

Winograd, T., & Flores, F. (1987). *Understanding Computers and Cognition: A New Foundation for Design*. Boston: Addison-Wesley.