The Role of an Abstract Ontology in the Computational Interpretation of Creative Cross-modal Metaphor

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Abstract. Various approaches to computational metaphor interpretation are based on pre-existing similarities between source and target domains and/or are based on metaphors already observed to be prevalent in the language. This paper addresses *similarity-creating* cross-modal metaphoric expressions. The described approach depends on the *imposition* of abstract ontological components, which represent source concepts, onto target concepts. The challenge of such a system is to represent both denotative and connotative components which are extensible, together with a framework of all general domains between which such extensions can conceivably occur. An existing ontology of this kind is outlined. It is suggested that the use of such an ontology is well adapted to the interpretation of both conventional and unconventional metaphor that is similarity-creating.

1 Introduction

The last couple of decades have seen an increasing number of computational approaches to processing metaphor. By interdisciplinary consensus, this research has generally been implemented as processes that map an expression in a *source domain* (domain of the metaphorically used concept) to an interpretation in a topic- or *target domain* (domain of intended meaning). (Within-) physical-domain metaphor, as in the war horse *The ship plowed [through] the sea/waves*, has received attention early on [1]. Treatments that focus solely on physical-domain metaphor include those by Wilks [2] [3] and Fass and Wilks [4] and are discussed in [5]. Fass [6], while presenting an extensive treatment of metaphor in the context of literal, metonymic and anomalous expressions, also focuses mainly on physical-domain metaphor.

This paper argues for the role of an abstract ontology in the interpretation of *cross-modal* metaphor, with special attention to *similarity-creating* metaphor. Cross-modal metaphor extends across ”conceptual domains” (modes, levels), as in *The country leapt to prosperity*, which involves extension from a physical to a control (of wealth) domain, or as in *Encyclopedias are gold mines*, which involves extension from a control (of wealth) domain to a mental domain.

The discussion begins with an indication of what is meant by similarity-creating metaphor and how some of the major research on metaphor does not address it. Some notes on ontologies follow, as well as observations on abstraction, including mathematical abstraction and its potential contribution to an abstract natural-language ontology.

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A program that relies on an abstract ontology to address similarity-creating metaphor is then outlined, with an explanation of components of the ontology. This description is followed by brief illustrations of relevant aspects of interpretations of verbal and nominal metaphor. The paper concludes by noting that some other researchers have found it necessary to extend their metaphor processing systems with (at least implicit) abstract ontological components, suggesting the need for attention to an abstract ontology in a metaphor processing system, at least if the system is claimed to be explanatory.

2 Similarity-creating Metaphor

With respect to metaphor, the word ‘creative’ is often used interchangeably with the word ‘novel.’ By ‘novel metaphor,’ some researchers refer simply to metaphors that their systems–or perhaps even humans–have not previously encountered. Such metaphors may be based on representations that capture similarities existing prior to use of the metaphor. By contrast, Indurkhya [7] presents evidence of the significant role of similarity-*creating* metaphors in cognition.

As Indurkhya points out, in many metaphoric expressions where verbs are used unconventionally–some would say in a novel way, there is a pre-existing similarity. For example, in *The sky is crying*, there is an easily recognizable similarity between crying (tears falling) and one of the few things that fall from the sky (rain drops); the metaphor can be analyzed by *comparison*, though it also *suggests* sadness. Similarity-creating metaphor, on the other hand, is characterized as *change of representation*: ”In instantiating the source concept network in the target realm, parts of the realm are ‘grouped’ together and made to correspond to the concepts of the concept network. In this process, the target realm is given a new ontology, and its structure, as seen from the more abstract concept network layer, is changed” (p. 254).

Indurkhya acknowledges that the difference between suggestive similarity-based metaphor and similarity-creating metaphor may be a matter of degree, i.e., degree of participation of the target and source domains. That is, the closer the metaphor is to being similarity-creating, the more the source ontology is imposed and the less the pre-existing target ontology remains. In this paper it is assumed that cross-modal metaphor (which Indurkhya does not focus on) is in a sense always similarity-creating, because the real-world details of source and target will always differ. For example, in the metaphor, *Encyclopedias are gold mines*, there is little physical similarity between encyclopedias and gold mines, or between reading and mining.

3 Approaches to Metaphor

Through metaphor, different source concepts may be used to structure the target in different ways. Lakoff and Johnson [8] recognize both the ”conceptual metaphors” (or ”metaphor themes”) *LIFE IS A JOURNEY* and *LIFE IS A GAME*, and perhaps other ”life” metaphors. Thus similarity can be created by re-conceptualizations. A problem with Lakoff’s metaphors, however, is that they are categories, without specifications of which components of the source domain are extensible.

The early approach of Carbonell [9] [10] is based on the stored conceptual metaphors of Lakoff and Johnson. However, systems that rely only on stored conceptual metaphors cannot interpret linguistic metaphors that do not fit any stored conceptual metaphor. Also, the metaphoric nature of the transferred properties themselves is not addressed. For example, the phrase ‘firmly supported,’ used in his example of the *MORE IS UP* conceptual metaphor, is simply applied to both source and target domains without semantic analysis.

Hobbs [11] addresses metaphor without recourse to stored metaphors, using inferences to express linguistic relationships. In his illustration he matches ‘send (a bill)’ in a Congress schema to ‘pitch (a ball)’ in a baseball schema, and proves the correspondences between roles in the two schemata. This metaphor is certainly novel, but Hobbs’s interpretation process is based on existing similarities between the source and target schemata.

Approaches of other researchers that show some potential to address similarity-creating metaphors are discussed at the end of this paper.

4 Ontologies

The term ”abstract ontology” might be seen as an oxymoron, and it is, if an ontology is that which purports to describe reality. Wilks [12], in dismissing the distinction between traditional/classical and modern/AI-type meanings of ”ontology” as unimportant for AI/NLP purposes, also rejects any claims that ”cleaning up” given ontologies will result in any notable advances in the field. This view (which I accept) is mentioned in order to emphasize that the focus in this paper is only on the role that abstracted components can play in a computational metaphor interpretation system with attention to presumed cognitive components, and on what *types* of components are needed and are peculiar to metaphor interpretation. While the ontology is explained below, the intent is not to justify the exact form the individual components take. It is important, however, that the ontology, being abstract, be relatively small and transparent, for purposes of evaluation and revision.

A cross-modal metaphor-relevant ontology is based not on any objective reality, but on a certain unconventional *view* of reality through language, which is itself conceptualized from reality. A perhaps noncontroversial observation of Quine [13] on the ontology of language would seem to apply to abstractions *from* language (i.e., to an abstract ontology) as well–namely, that differences between one person’s ontology and another may depend simply on how the ontologies are ”sliced” or how components are grouped; correspondences between ontologies will probably not be one-to-one (cf. also Whorf [14]. There is no claim in this paper, then, that the components of the abstract ontology are universal, uniquely ”correct,” or language-free; there is merely an appeal to a consensus of ”reasonableness” by speakers of the same language (and others that are related to some extent). Neither is there speculation on the source of the given ontology in developmental or evolutionary terms. Relying on any such ontology may raise the ”mentalism” criticism; however, as Quine says, ”I know no better.”

In cross-modal metaphor, any perceived or imposed similarity as mediated by the ontology is *abstract* (in the conventional use of that word); some considerations of abstraction follow.

5 Abstraction

In a sense, any representation, which is a mapping between reality and symbols, or between those symbols and higher-level symbols, is abstract. In the context of mathematics learning, Kaput [15] defines four interacting types of representation - 1) cognitive and perceptual, 2) explanatory representation involving models, 3) representation within mathematics and 4) external symbolic representation, such as a chip, which can be instantiated by many different objects and can thus be a *generalization* or *abstraction* for cookies, baseball cards, dollars, etc. In natural language, similarly, the concept underlying the word ‘object’ can be thought of as a generalization or abstraction for the mentioned items; it is plausible that the cognitive components which relate to mathematical abstraction are (or overlap with) those which structure linguistic metaphor. As it is being argued for an abstract ontology for metaphor, a consideration of relationships between mathematical and abstract linguistic components that might be included in such an ontology follow.

5.1 Mathematical Language

There are frequent references to the power of mathematics to account for many analogous situations through its abstract language. It is often difficult to characterize mathematical language and natural language independently in discourse, since mathematical *concepts* can be *embedded* in natural language, not only in mathematical word problems, but in our everyday language about situations. English can embed both explicitly numerical references, such as ‘ten’ and ‘a dozen,’ and expressions that are mathematically relevant but not necessarily so intended, such as ‘the rest of them,’ ‘a slice of pizza,’ ‘altogether,’ ‘join,’ ‘more than,’ etc. [16]. The meshing of these languages corresponds to Kaput’s interaction between cognitive/perceptual and mathematical representations and suggests common ontological components. For example, an interlingual ”PART” concept can be realized in both mathematical and nonmathematical language.

5.2 Reification as a Basis for Spatial Structuring

In mathematical language, arithmetic equations represent structures with *numbers* as abstractions not only of sets of objects, but also of non-object concepts (as in ‘he fell *twice*’), and with *operators* that relate these sets; the abstraction to numbers establishes the basis for the equation. Similarly, in linguistic metaphoric extensions from the physical domain, nonphysical concepts may become abstract ”objects,” allowing verbal concepts to ”operate on” them. Reification (or ”nominalization”)–treating an action, relation or attribute as an ”abstract object” in the form of a noun–is thus a first step in the creation of this kind of metaphor. Expressed syntactically, reification is an instance of the ”abstract concept as object” metaphor [17], which has become integrated into (some) natural languages as dead metaphors, i.e., usually thought of as literal. Mathematical language and much of metaphoric language thus share spatial grounding, suggesting that not only physical-domain verbs/attributes, but also such concepts in nonphysical domains might be analytically based on simple spatial, i.e., existential and relational, structures.

To illustrate, the physical action underlying the verb construct ’chase out/away (e.g., mosquitoes)’ can be extended to apply to conceptually different types of objects. In ‘chase away an idea,’ the ‘idea,’ which is a reification in a mental domain, is ”taken away” from the thinkers of the idea; mathematically, to ‘chase away six mosquitoes,’ as in a word problem, may mean to subtract or ”take away” 6. In both cases, symbols are mapped from one domain to another through an abstraction representing ”leaving a state” (of thought or of the presence of the six mosquitoes). Reification, then, enables the natural-language extension similarly as quantification enables the mathematical extension.

Thus if we settle on a set of abstract components in terms of states of objects, existence and relations, and use them as the basis of abstract verb definitions in any domain, then these components can be considered to be extended in metaphor and to contribute to its interpretation (see Section 8).

6 An Ontology-based Metaphor Analysis Program

MAP, a computational metaphor paraphrase program [1] [5] [18], interprets an isolated simple-sentence metaphor in terms of a roughly equivalent paraphrase conventionally considered as ”literal.” The most critical aspect of the program resides in the (abstract) lexicon, where verbs and nominals are represented by components of an abstract ontology. For verb-based metaphor, components representing a verb which serves as a metaphoric *source* concept are interpreted in the *target* domain as indicated by the nominal concepts or ”objects” with which the verbal concept is used. Thus for ”She chased away the thought,” a mental domain is indicated by ”thought,” and the primitives underlying ”chased away” lead to a paraphrase including a phrase such as ”voluntarily stopped thinking about.” For nominal metaphor, the primitives underlying salient properties or predicates [5] of the source nominal are transferred to the target representation. Thus for *Political movements are glaciers*, extended predicates include components representing slow change.

MAP treats dead (frozen, assimilated) metaphors and novel metaphors (whether similarity-based or similarity-creating) in the same way, though of course dead metaphors and even some metaphors that are ”alive” but conventional could be defined directly in the lexicon for efficiency purposes. The focus of this discussion, however, is on MAP’s ability to interpret similarity-creating metaphors.

7 MAP’s Ontology

A recognition that natural language and mathematics share spatial structure, i.e., structure in terms of objects and relations, suggests that 1) a small number of abstract descriptors that overlap with those of mathematics in being spatially based reflect some intuitive consensus of speakers of the language with respect to the design of an ontology and 2) such spatially based structures provide a framework for additional, qualifying primitives, some of which can also be drawn from mathematics. The ontology described below consists of *extensible components* including spatial structures, which represent the potential similarities between source and target, and *domains*, which represent the differences.

7.1 Abstract Extensible Components

The task of determining a set of extensible components of verbal concepts entails considering which concepts speakers of a given language recognize in a literal meaning of a verb that allows them to understand a metaphoric use of that verb, even if they have never heard it before. If much of our language is spatially structured, we should be able to see (though not prove) some cognitive basis for components in the abstract domain of mathematics (arithmetic, calculus, logic) and its application in physics. The following structures and features either have a math-physical counterpart and/or have a broad linguistic consensus.

Structures. The basic structure assigned to all verbs is a STATE, the beginning or end of a STATE, or transition through a STATE, all of which correspond to boundary points in mathematical functions or to the space inbetween. The STATE itself may be either existential (OBJECT BE), existential with a (static or dynamic) attribute (OBJECT BE ¡attribute¿), or relational (OBJECT AT LOCATION). Any of these structures can be negated with the component NOT. In addition, any of the above structures can be caused, i.e., have an AGENT.[1] These abstract structures can be thought of as unary or binary abstract case structures,[2] either of which can be operated on by an AGENT.

Features. It is qualifiers and connotations that are often the reason for a metaphor. These are represented as abstract, conceptual features (more flexible than explicit categories), with polarity or magnitude specifications as appropriate. As qualifiers of actions, features for action verbs correlate with function-relevant mathematical descriptors: CONTINUITY, REPETITION (frequency) and SPEED (rate). Verbs with quantitative attributes (‘grow’), may have MAGNITUDE and GREATER/LESS-than. VOLITION is a feature describing an actor. Responses of an experiencer of the metaphor have EVALUATION values and FORCE magnitude. EVALUATION and FORCE correspond to Osgood’s [21] ”evaluative” and ”potency” factors–two of the three nonstructural factors (the other being ”activity,” refined in the action features above) he empirically determined to be extended in metaphoric usage (see also Aarts and Calbert [22]. Various emotions are also incorporated. Emotional states are not abstract in themselves; however, they *are* abstracted rather than literal; the fear experienced when one’s hope is torpedoed is probably not the same as that when one’s boat is literally torpedoed.

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[1] In the case of an agentive verb, it is the ”effect” or ”result” of the action that is considered of primary salience and receives the domain specification. Verbs involving other higher-level primitives, such as PURPOSE, are formalizable in the ontology but have not yet been included in MAP’s lexicon.

[2] Abstract case structures are simpler than traditional case structures, as Fillmore’s [19] dative and locative cases or Schank’s [20] ”conceptual” cases are combined in (abstract) LOCATION.

7.2 Conceptual Domains

Conceptual domains are orthogonal to the extensible portion of the ontology. For cross-modal metaphor, the domains are only those general, Aristotelian-like domains which, along with the PHYSICAL (animate and inanimate), are thought of as human faculties: MENTAL, with subdomains of intellect, attitude and volition; SENSORY, with sense-specific subdomains linking PHYSICAL and MENTAL; and CONTROL, with subdomains intrinsic (e.g., ‘talent’) and extrinsic (e.g., ‘wealth,’ ‘rights’). This taxonomy within the ontology is obviously breadth- rather than depth-oriented. Every verb in the lexicon is assigned the conceptual domain in which it is thought to be literal. The model allows a concept in any conceptual domain to be a source, though the source is more often PHYSICAL. It is the difference between the conceptual domains of a verb and its object or subject that triggers cross-modal metaphor recognition.[3]

The ontology of MAP is thus based on a small, organized set of primitives. The delineation of (a small set of) extensible and nonextensible components in a transparent framework allows the management of the ontology and the representation of verbal concepts in terms of that ontology to be feasible. Also, by defining open-set words through the abstract components, we can observe directly to what extent a metaphoric use of that word is adequately interpreted (how well it conforms to human understanding), and we can note which components, when imposed on the target domain, positively or negatively affect the interpretation of similarity-creating metaphors.

8 Interpretation

8.1 Constraints

MAP does not *compare* a source representation with a target; it is not similarity-based. Rather, the abstract source representation is *imposed*, i.e., directly projected onto the target. However, source representations cannot be imposed arbitrarily. There are some constraints on interpretations to assure (as far as possible) that the expression makes sense metaphorically, i.e., is not ”anomalous,” indicating a probable mis-parse. For example, when a transitive verb is used metaphorically with an object nominal in a different conceptual domain, there are still some abstract constraints that the object must satisfy. These constraints are realized in MAP as conceptual (abstract) features of nominals. For cross-modal metaphor interpretation, these features are fewer than literal semantic features of nominals, since many details of the nominal concept drop out of the picture. For example, PART (of), CONTAINED (in) and FIXED (to) features that might apply to literal language merge, because the specific topographical features of literal objects are not significantly distinguished for abstract concepts. This feature set and its application are discussed in detail in [18]. Current (binary-valued) features are: SHAPE (vs. amorphous, mass), 1-DIMENSIONAL (linear-like), FIXED/PART/CONTAINED (subordinate), COMPLEX (vs. elementary), FLUID, ANIMATE (dynamic).

[3] That the meaning of a novel metaphor depends on its literal meaning does not necessarily imply that literal meanings are accessed *before* metaphoric ones by humans.

8.2 Paraphrase

If there happens to be a verb in the target domain that has an abstract representation in common with the source (at least the structure), then that verb can be included in the paraphrase.[4] For the example *news torpedo his hope*[5] that verb might be 'disappoint,' which has the same structure as the verb 'torpedo,' i.e., AGENT cause LEAVE-STATE (OBJECT BE), where the OBJECT is in the MENTAL-ATTITUDE domain. In an "undoing" of reification, the reified abstract OBJECT 'hope' from the input is mapped to the *verbal* 'hope' as part of the paraphrase. If any (or all) components are "left over" from the source representation, they are lexicalized directly; here, this would be FORCE: HIGH, SPEED: HIGH. Lexicalization gives:

STRUCTURE: news cause he stop hope

CHARACTER of the ACTION: intensely, suddenly

If no target word with a similar abstract structure is found, all the abstract components are lexicalized, together with an indication of the target domain. Abstraction necessarily entails a loss of information, and the paraphrases produced often seem inadequate in being too general, though "literal" and not wrong. However, it was deemed important to start with a broad, non-*ad hoc* framework, rather than to attend to target-domain detail.

The characterization of nominals for nominal metaphor interpretation is much more open than for verbs, since objects can mean many things to many people. As the meaning of even one sense of a nominal is less constrained than that of a verb, which has inherent structure, there are more possibilities for similarity-creating metaphors. For nominal metaphor, MAP transfers putative salient properties of source nominals [23] [5], represented in terms of the described ontological components, to the target. One of the most prominent properties of a nominal that enters into metaphoric interpretation is its function (cf. Gibson's "affordances" [24] or typical action.

As nominal metaphor typically involves extension of verbal or attributive components, a brief indication of nominal metaphor interpretation will serve to illustrate further representational aspects of verbal metaphor as well. For the example *Encyclopedias are gold mines*: The FUNCTION of '(gold) mine' (one takes gold out of it) has the resultant STATE structure ('*' is a reference to the user of the concept having the function)

(ENTER-STATE) (AT (OBJ: +PHYSICAL/gold LOC: *)),

which is in the CONTROL-EXTRINSIC (of +PHYSICAL) domain. A connotation is that the OBJECT is very valuable (EVALUATION: HIGH). The abstract structure *and* the EVALUATION are transferred to the FUNCTION predicate of 'encyclopedia,' (one reads it), which has the resultant STATE structure

(ENTER-STATE) (AT (OBJ: +MENTAL-INTELL LOC: *))

in the MENTAL-INTELLECTUAL domain. The paraphrase is 'One read encyclopedia has result one has knowledge which-has high value.'

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[4] Such verbs in English often have Latin or Greek etymology, that itself metaphorically imposes physically derived components on otherwise inexpressible concepts. Syntax itself also reflects this semantic structuring; direct objects can be non-PHYSICAL, i.e., not "really" objects, showing an analogy between PHYSICAL and non-PHYSICAL usages.

[5] Irrelevant grammar-related elements are ignored in input and output examples.

This example is of only average richness, but the added connotation of high value, along with the lack of pre-existing literal similarity, makes it similarity-creating. A metaphor that is perhaps more clearly similarity-creating is the PHYSICAL-domain metaphor *Dumps are gold mines*. Here the entire FUNCTION structure of 'dump' (to put things *into* it rather than literally *or* metaphorically take them out) is overridden; the interpretation is that something of extreme value can be found in dumps. Of note is that in both cases the property of "high value," along with other factors such as connotations, are culturally based and constitute the kind of information that Indurkhya [7] claims must be represented in meanings of objects if similarity-creating metaphors are to be interpreted computationally. Nominal metaphor interpretations are considered to be only *likely*, not definitive. However, metaphors that have more obscure interpretations usually require further elaboration, requiring multi-sentence analysis.

This approach appears to correspond with Indurkhya's view of similarity-creating metaphor; the source ontology is imposed onto as opposed to compared with the target domain. Moreover, cultural and experiential factors–the imagined experience which Indurkhya claims as missing from computational treatments of metaphor– are represented symbolically as imposed concepts.

9 Comparative Evaluation

While most computational approaches to metaphor do not address similarity-creating metaphors, as they are not based on a semantic analysis that allows ontological components to shape the target domain, the following research has some aspects corresponding to aspects of MAP.

Martin's [25] system is similar to Carbonell's earlier work (see Section 3), with a much more comprehensive implementation. However, he has extended his system through a recognition of the conceptual relationship between states and their beginnings and endings. These correspond to MAP's basic abstract structural components.

Carbonell and Minton [26] specify their method for metaphor interpretation in terms of transfer of portions of a graph consisting of concepts (nodes) linked by relations. Thus for *X is a puppet of Y*, the node CONTROL between the object 'puppet' and the actor 'puppeteer' is transferred to the node between X and Y. This process and type of representation is similar to that of MAP. However, a comprehensive representation system does not appear to exist, and they do not incorporate affective or cultural components.

The idea underlying the representations of the system of Suwa and Motoda [27] is perhaps the most similar to that of MAP. Their ontology itself does not explicitly distinguish domains as in MAP and thus is not as transparent as MAP's, but they do use a finite, relatively small ontology consisting of what they call abstract primitives. These are only in the form of verb *structures*, through which they *match* source and target verbs–a method which apparently succeeds in an interpretation only if such a match exists. Experiential factors are not incorporated. Their system therefore does not address similarity-creating metaphor as it stands; however, they discuss the addition of "new" components to the target and could in theory achieve this, given their abstract ontology.

In the recent work of Barnden et al. [28] [29] and Agerri et. al. [30], it is acknowledged that many metaphoric usages are not adequately covered by Lakoff's conceptual metaphors. They present "view-neutral mapping adjuncts" (VNMAs), which 'transfer those aspects that are not part of any specific metaphorical view' or conceptual metaphor [30]. VNMAs appear to correlate with the structural metaphoric extensions of MAP, and are applied as "default rules."

The metaphor theory and attendant hypotheses underlying the system of Narayanan [31] also have significant similarities with the described system (though his model differs in his neural-like implementation). As aspects of his theory in part applies to Barnden et al.'s and Agerri et al.'s work as well, it will be discussed in somewhat greater detail. Narayanan's treatment of nominals, verbs and adverbs in verbal metaphor in terms of invariant components corresponds with that of MAP in at least two ways. First, the prevalence of spatio-temporal structures as extensible to other domains is incorporated. (Narayanan proceeds further to establish correspondences between motion verbs expressing such structures and possibilities as part of a sequence of actions and inferences leading to a goal in a target domain.) Second, from looking at databases, Narayanan has concluded the invariance of certain "parameters" which correspond to MAP's adverbial features expressing evaluation, agent attitude/intent and other (nongrammatical) aspects. His determination can be viewed as corroborating support for the inclusion of such features.

The fine granularity of Narayanan's representation of his two target domains, e.g., economic policy and politics is appealing, though limited in breadth. While Narayanan works out specific mappings to his target domains, MAP deals *generally* with metaphoric extension between domains in a proposed domain ontology. MAP thus reveals how a source domain, which may sometimes *not* be the spatial/physical domain (and may even be an "abstract" domain, such as the economic domain), can structure *any* domain.

Another difference concerns the way in which source concepts are projected metaphorically onto the target. In Narayanan's system, entities and actions are projected directly through pre-established "conceptual metaphors" in the sense of Lakoff, such as *MOVERS ARE ACTORS* or *OBSTACLES ARE DIFFICULTIES*, which must be stored. From the point of view of language understanding, MAP shows how a metaphoric usage might be understood in terms of perceived or imposed similarities represented by semantic components of literally understood lexical items, whether the metaphor is conventional or creative, and whether stored or not. Apart from these explanatory differences, Narayanan's system for projecting verbal concepts has similarities *in concept* to MAP, with more detailed paraphrases for the two domains he treats. The differences perhaps reflect the differing intended tasks–narratives within a specific topic domain/discipline in the case of Narayanan's system, and spontaneous references to metaphor in open discourse in the case of MAP.

10 Conclusions

Some metaphor programs other than MAP produce more detailed interpretations as a result of being similarity-based or being restricted to certain domains. MAP on the other hand was designed for scope rather than detail, without regard to any specific examples or domains, and its focus on extensible components based on the semantics of the metaphorically used concept enables it to at least minimally "understand" similarity-creating metaphors. The described ontology accounts for both similarities (through extensible components) and differences (between conceptual domains) underlying cross-modal metaphor. Extensible components include not only structures but also connotations and stereotypic experience, imposition of which is offered as an example of what Indurkhya calls a re-structuring by projection of the source concept network onto the target realm. It would seem that the computational interpretation of similarity-creating metaphors with cognitive relevance requires either an abstract ontology of the type presented or some implicit incorporation of its elements into the method.

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