Grammatical constructions, frame structure, and metonymy:
Their contributions to metaphor computation

Elise Stickles, Oana David, and Eve Sweetser
University of California, Berkeley

ABSTRACT. In conceptual metaphor theory, mappings between source and target frames entail relations between roles within those frames. However, the contributing functions of metonymic relations between frame roles and type constraints on those roles – e.g., whether the role is of type Entity or Process – must also be established. These metonymic links and type constraints enable metaphoric conceptualization, as does the particular frame structure of the metaphor's target and source domains. In this paper we use computational implementations of ontological structures developed in Embodied Construction Grammar and our own constructed metaphor repository to explore these relationships. We demonstrate that both role-to-role metonymic relations and type constraints on the roles are important in generating the correct metaphoric interpretation. In this way, the formal treatment of frame-internal and frame-to-frame mappings is brought to the fore in metaphor analysis.

Keywords: metaphor, metonymy, frame semantics, nominal compounds, embodied construction grammar, metaphor identification

1. INTRODUCTION. Consider two lexically and grammatically similar phrases: *pill-popping* and *pill-pushing*. Both involve a physical object ('pill') and a motor action upon it ('popping', 'pushing'). However, the first refers to a physical activity, and the second metaphorically describes the coercive behavior of a drug dealer. Yet, when *pill-popping* is itself embedded in a larger nominal compound – as in *pill-popping epidemic* – it metonymically evokes the larger notion of drug abuse, which is in turn a type of social problem and thus incurs the metaphoric reading SOCIAL PROBLEMS ARE DISEASES. The processes by which both humans and computers can recognize and disambiguate such metonymic and metaphoric language involve the complex interaction of frames, the semantics of elements within those frames, grammatical constructions, and the lexical constructions that respectively evoke and fill them. In the following paper, we illustrate a cognitive linguistic approach to metaphor analysis that emphasizes the critical role of analyzing the internal structure of frames and relationships between frame elements in tackling such complicated challenges as the highly productive English noun-noun compound.

A fundamental tenet of cognitive linguistics is that semantic frames, as defined in Frame Semantics, play a central role as basic units of linguistic analysis, defining and structuring core semantic concepts (Clausner & Croft 1999, Fillmore 1976, 1982). As such, frame structure not only reflects how we conceptualize and reason about the world, but contributes to language at both grammatical (e.g., Goldberg 1995, Östman & Fried 2005) and lexical (Fillmore 1982) levels. As a result, relations both within (metonymy) and between (e.g., metaphor) grammatically and lexically evoked frames play a central role in the way we

comprehend linguistic expression (Dancygier & Sweetser 2014). Contemporary approaches to Conceptual Metaphor Theory (Lakoff & Johnson 1980, 1999) recognize the central role of frame structure in metaphor analysis. However, the explicit contribution of internal frame structure and role relations to metaphor analysis remains an under-explored area of research. In this paper, we present a case study of a commonly-occurring and frequently metaphoric construction in English, the Noun1-Noun2 nominal compound, to illustrate the critical role that frame semantics plays in metaphor. This construction has been well-studied in cognitive linguistic frameworks, and is highly productive in both literal and figurative uses. Crucially, our analysis relies on formalisms developed in the MetaNet project (David et al. 2014, Dodge et al. 2014, 2015) and based on Embodied Construction Grammar (Dodge & Petruck 2014, Feldman et al. 2009).

MetaNet is a metaphor repository and identification system that is based on a union of Conceptual Metaphor Theory, Embodied Construction Grammar, and Frame Semantics. The union of these theoretical approaches and formalisms is justified as follows: conceptual metaphor (CM) is a language-independent cognitive phenomenon, yet it surfaces linguistically in linguistic metaphors (LMs), which are necessarily mediated via grammatical constructions. For example, the LM *depths of poverty* instantiates the CM, POVERTY IS A LOW LOCATION, which is a subcase of a more general metaphor NEGATIVELY EVALUATED STATES ARE LOW LOCATIONS. LMs bring their own constraints to the surfacing of the target and source domains of the metaphor, as is discussed in Sullivan (2007, 2013). For instance, in the above example, the metaphoric variant of the Noun1-of-Noun2 construction has Noun1 as the

source-domain-evoking word and Noun2 as the target-domain-evoking word. This generalization is true of this construction regardless of which lexical units it combines with. The source and target domains in turn constitute specific frames, which reside in intricate hierarchical relational networks, much in the way they have been implemented in FrameNet (Ruppenhofer et al. 2010). Because ECG already provides a good means to encode construction-to-frame relations and model constructional composition, it is a good candidate as a grammatical framework that can incorporate metaphor into grammar.

Part of the scope of MetaNet is the extension of a system as outlined above to a multilingual repository of a semantic network of frames and metaphors in order to support metaphor analysis that is reflective of the specific grammatical constraints typical of different languages (David et al. 2014, Dodge et al. 2014). So far, the system has been extended (with varying degrees of breadth and detail) to English, Spanish, Russian and Persian. While languages may show much grammatical variation, semantically all languages are hypothesized to converge on experientially-derived primary frames (called image schemas or cogs) and primary metaphors (Grady 1997), and diverge on more complex and culturally-specific ones (e.g., Kövecses 2005). Indeed, common image schemas found in all languages are those pertaining to motion, force-dynamics, causation, scalar structure, object manipulation and certain body and perception schemas, such as temperature and verticality (Clausner & Croft 1999, Croft 1993, Talmy 1983, 2003).

In an endeavor to leverage these conceptual primitives to uncover cross- and intra-linguistic commonalities and differences in metaphoric language, the MetaNet system

provides two main components: (1) an analyst-defined frame and metaphor repository, and (2) an automated metaphor extraction pipeline that scans over large corpora to identify and annotate possible linguistic and conceptual metaphors. The second component uses the first in the process of identifying whether a potential LM is metaphoric, and if so, what metaphors from those found in the repository are the most likely candidates as CMs.

The MetaNet approach to metaphor identification and analysis uses a series of constructional patterns that define argument structure relationships in which metaphoric expressions are likely to occur (Croft 1993, Sullivan 2013). For example, as a general property of the metaphoric Noun1(Target)-Noun2(Source) nominal compound construction, the target domain is realized in the first noun, which modifies the second noun where the source domain occurs, as in *drug pusher* or *pill-popping scourge* (note that the nominal slots may be occupied by NPs, not just bare nouns). By making use of these constructional constraints, the automatic metaphor identification system can filter corpora for those collocations likely to contain LMs, and can match the known Target-slots and known Source-slots to their respective candidate lexical units (LUs) in potential LMs.[1] Figure 1 illustrates a schematic metaphoric Noun1-Noun2 construction, and how the components of the construction map to the frame roles belonging to the frames that populate the source and target domains of a metaphor. The "meaning" and "evokes metaphor" fields would be filled with the meaning and metaphor instantiated in a particular construction exemplified by a particular construct, while the schematic representation remains unspecified. Under "meaning constraints", the meaning of the whole construction is the meaning of the target domain,

while the meanings of its constituent parts (NP1 and NP2) are associated with roles in different frames. These roles are evoked by the noun phrases themselves in the linguistic expression. This representation demonstrates how the MetaNet system uses ECG formalisms to match frame roles to constructional slots and to assign target- and source-domain status to the lexical components of the construction.
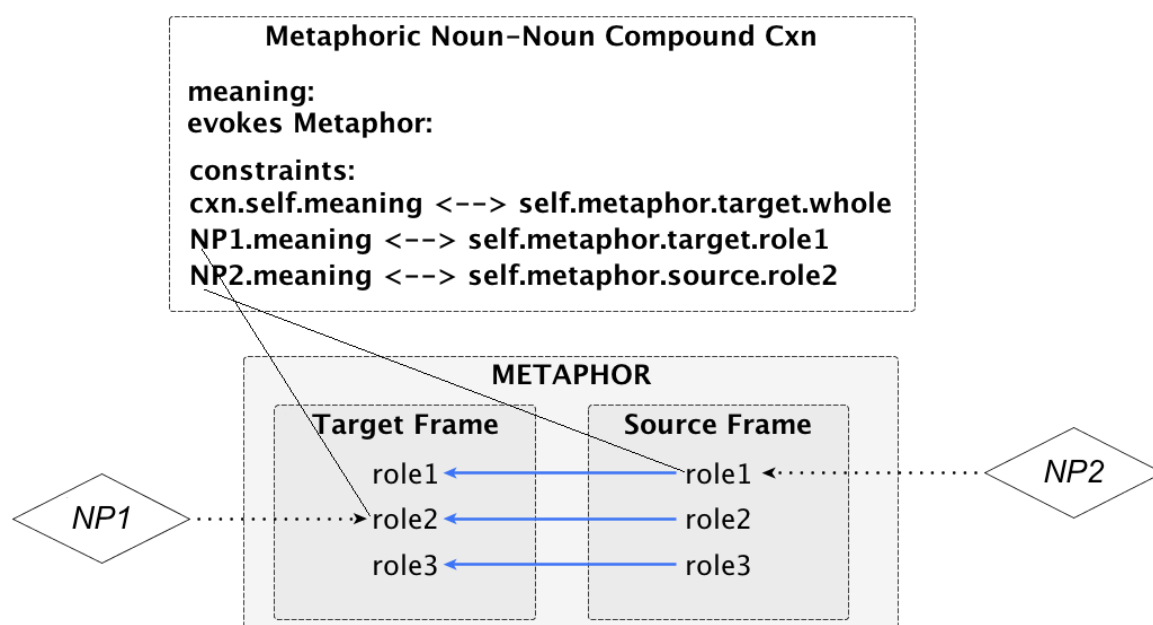

FIGURE 1. Metaphoric Noun1-Noun2 compound construction with bound frame roles evoked by lexical expressions.

We will also show that in addition to the relationship between lexical units and frames, metonymic relations within frames – in which one evoked frame role in turn activates the semantics of another role or of the whole frame – play a major function in metaphoric conceptualization. These metonymic relations commonly come into play when the same expression could have both metaphoric and non-metaphoric readings. For example, *drug*

pusher refers to a drug dealer who encourages a drug addict's addictive behaviors; in addition to literally providing them with drugs, they also metaphorically "push" the addict into drug abuse. Hence, in the metaphoric understanding of *drug pusher*, *drug* metonymically evokes the whole Drug Abuse frame, because it is the drug abuse that is being encouraged, and not the drug itself. Similarly, *pill-pushing* could either be understood as literal caused translational motion (such as pushing a pill across a table), or metaphoric caused translational motion, in which a drug dealer encourages the drug addiction itself; literal pills may or may not even be involved, depending on the drug of choice.[2] Whether a given expression receives a metaphoric or literal interpretation depends not only on context but on the interpretation of the relationship between the lexical items and the frames and roles *within* those frames that they evoke. The particular semantics of the evoked frame roles also contributes to interpretation of the phrase. In the case of literal *pill-pushing*, 'pill' is understood to be a physical object, and 'pushing' evokes a Caused Motion frame, in which an agentive causer acts upon a patientive affected entity (a physical object) and causes it to move. Hence, because 'pill' is a physical object, it aligns with the semantics of the Caused Motion affected role – also a physical object – and thus we can understand *pill-pushing* to refer to physically moving the pill. As we will demonstrate, computational metaphoric identification occurs when the semantics of the elements in the expression evoke frame elements that are incompatible and cannot be interpreted as filling slots in a non-metaphoric construction. In the case of such semantic mismatch, the expression can be understood as metaphoric. Just as

the computational model formalized in ECG strives to reflect human cognitive processes, so too MetaNet reflects a plausible representation of the mechanisms of conceptual metaphor.

In this work, we focus on two types of compounds. The first, such as *pill-popper*, are synthetic or verbal compounds (Lieber 1992, Terasova 2013), which are characterized by the first element being interpreted as the object of the action denoted by the second element; the latter is usually a deverbal noun with inflectional (e.g., *bicycle riding*) or derivational morphology (e.g., *music appreciation*) (Lieber 2010:128). As compounds with deverbal elements, expressions such as *pill-popper* or *drug-pushing* retain the verbal argument structure of verb phrases from which they are composed, but impose additional constructional meanings. The second, such as *drug epidemic*, are primary or root compounds, because the non-head (N1) does not function as an argument of the head.

Both types of compounds are classified as endocentric compounds, because N2 acts as the grammatical head as well as the semantic referent of the whole compound. These endocentric compounds have more constrained semantics than do exocentric nominal compounds, also called 'creative compounds' (Benczes 2006), such as *jailbird* and *muffin top*, because they are constrained by the argument structure and frames evoked by the verbs involved. Exocentric and endocentric compounds interact with metaphor in different ways, and the current analysis focuses on the metaphoric construction specifications of the latter.

Compounds have received attention in cognitive linguistics literature most notably in conceptual integration analyses following the approach of Fauconnier and Turner (1995, 1996, 1998), such as Coulson (2001) and Sweetser (1999), and in Cognitive Grammar

approaches in Langacker (1987, 1990, 1991) and Ryder (1994). Following these traditions,

and the insights into compound semantics gleaned from Construction Grammar analyses of

compounds (Bundgaard et al. 2006, Onysko 2010, Terasova 2013), the ECG approach taken

here assumes that the construction possesses a schematic meaning shared by all specific

instances of the construction. Namely, due to their deverbal nature based on transitive verbs,

the constructional meaning of the *pill-popper* NN type is grounded in affectedness, as

detailed in the discussion of the Caused Motion schema above, whereby N1 is understood as

affected by the action in N2. On the other hand, the semantics of the *drug epidemic* NN type

is similar to that of domain adjectives, such as *economic collapse*, as discussed in Sullivan

(2013). That is, N1 sets up a domain onto which the semantics of N2's frame maps; here, the

term *drug* tells us that *epidemic* should be interpreted in the domain of drug use (see also

Sweetser 1999 for a comparable discussion of domain profiling and elaboration in adjective-

noun compounds). These will be further elaborated upon in the case studies presented below.

These constructional meanings would be specified in the meaning slot of the construction in

Figure 1.

In section 3, we demonstrate how computational implementations of the ontological

structures developed in ECG and the MetaNet repository instantiate frame relationships in

metaphoric contexts. ECG is a good framework for this type of formalization because roles

are systematically defined within frames, and frames are related to each other in the

computational grammar. Further, role-to-role bindings are inherent in the system, and

constructional slot matching to source- and target-domain frame roles is possible with the

architecture already in place in ECG. This type of system captures some important components of metaphor cognition – metonymy, role type constraints, and constructional mediation of metaphoric meaning – that any adequate study of metaphor (whether a computational implementation or analysis by a researcher) should account for.

2. FORMALIZATION. In MetaNet, metaphors and frames are organized into a complex lattice-like ontological network. Frames are formally defined according to their frame roles, their relations to other frames, and the lexical units that evoke them. In addition, they are specified for internal inferential structure, such that, for instance, in the Caused Motion frame, we not only know there is a motion causer, a moved entity, and a path of motion, but we also know inferences about their interaction (e.g., once caused to move, the moved entity is no longer in stasis, and will soon reach a goal). Frames are further organized into macro-frame families according to semantically coherent broader domains. Figure 2 shows a frame network for a group of frames in the family of Social Problems. Crucially, this is a partial representation of the frame network; it highlights a small, semantically-related conceptual neighborhood within the broader network. Furthermore, semantic relations between frames are defined in the network as well, although they are not illustrated here.
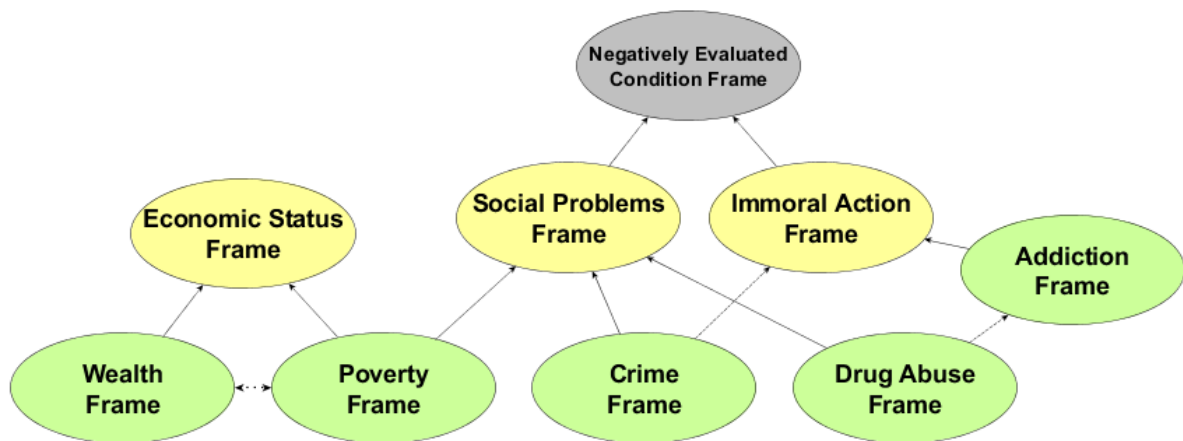
FIGURE 2. Example of a frame-to-frame relation network for Social Problems.

In addition to instantiating the network of frame-frame relations, MetaNet provides detailed representations of frames as well, as driven by their roles in metaphor analysis. Figure 3 is an example of the representation of the structure of two individual frames in the system; a frame is internally-defined with its roles, relations to other frames, assignment to one or more families, and has several inferences defined. Frames contain entity/participant frame elements and process frame elements, which, once a frame is evoked via an LM, are bound appropriately to constructional slots.
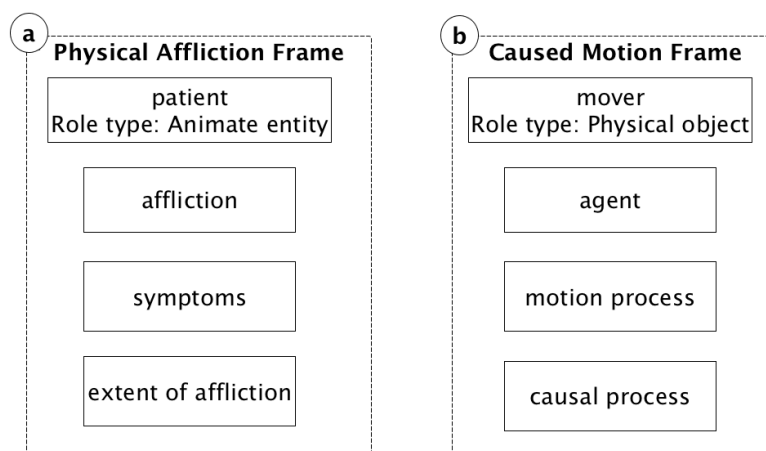

FIGURE 3. Roles within Physical Affliction (a) and Caused Motion (b) frames.[3]

Importantly, in ECG frame roles are assigned semantic *types*. These types are themselves hierarchically-structured frames, such as Entities, as shown in Figure 4.
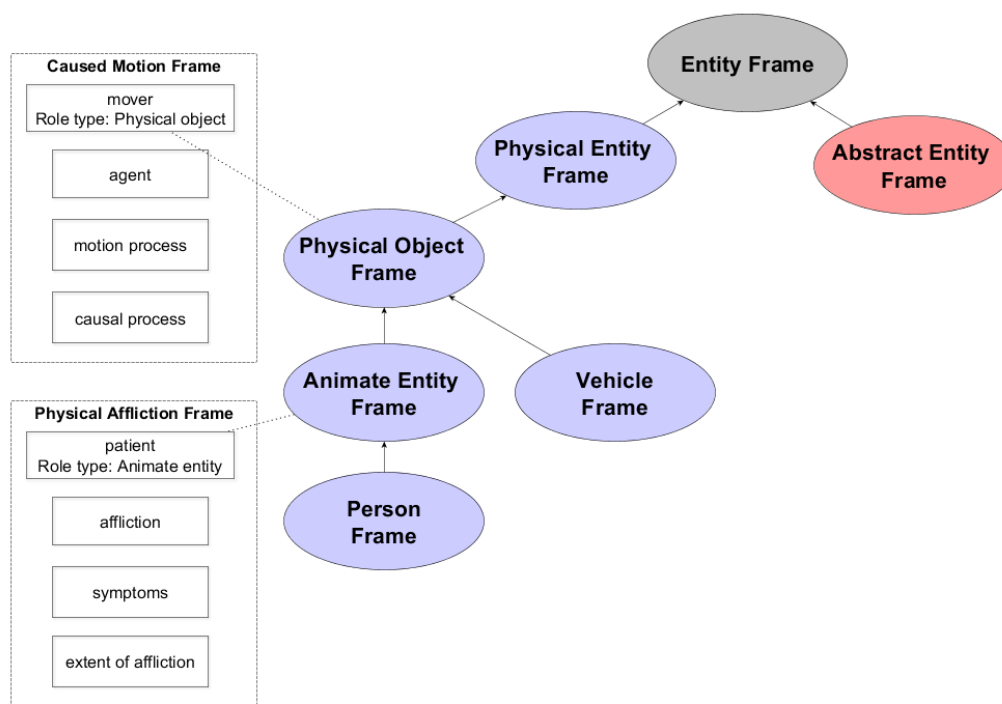

FIGURE 4. Partial illustration of hierarchical relationship between Entity frames; some intermediate frames are not shown.

Depending on the specificity of a frame, an entity role may be type-constrained to, for example, Animate Entity, such as in the Physical Affliction frame as illustrated above in Figure 3a, which requires that the patient role experiencing the physical affliction must be a living thing. Hence, a Vehicle, which does not evoke the semantics of an Animate Entity, cannot fill the patient role of Physical Affliction. We term this semantic violation a *role type mismatch*, in which the semantic type of a potential role-filler is in conflict with the semantic type constraints of the role. In contrast, the Caused Motion frame (Figure 3b) only requires

that the entity undergoing motion (the mover) must be some kind of physical object, and hence that role's type only constrains it to be a Physical Object of some kind. Because Animate Entity inherits from Physical Object, this means that Animate Entities, as well as any other frames inheriting from Physical Object such as Vehicles, may successfully fill the entity role in Caused Motion. These type constraints are in part defined in the grammatical construction: for example, in the ECG analysis of the Caused Motion Construction, the affected entity role, which experiences movement, is constrained to be of type Mover, which must be a physical entity that can undergo motion (Dodge & Petruck 2014). Just as frames are organized into hierarchical conceptual networks, metaphors are also organized as illustrated in Figure 5, with the relationships between metaphors determined by the relationships between their constituent frames.
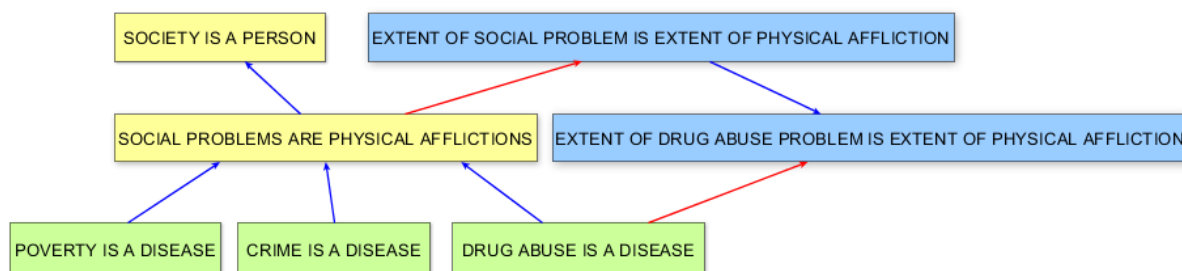
FIGURE 5. Example of a metaphor relation network. [4]

Metaphors are represented as mappings between two frames, which comprise its source and target domains. For example, the metaphor SOCIAL PROBLEMS ARE PHYSICAL AFFLICTIONS relies on the conceptualization of society as a person and therefore could be susceptible to experiencing harm due to an ailment. Inferential structure of the Physical Affliction frame –

such as the understanding that it applies to an animate living entity, causes harm to that entity, and can be potentially alleviated and cured to reduce or eliminate the effects of that harm – is then transferred via the frame-to-frame mapping to the target domain of Social Problems. Furthermore, the individual roles of the frames map onto each other as well, such that society is understood as the entity experiencing harm and the social problem is the physical ailment causing harm.

Crucially, these mappings occur between roles of compatible, but different, semantic types. Entities map onto entities, and processes map onto processes. However, the mapped types differ as to their specifics: for example, in the above metaphor, the society role of the Social Problems frame is an Abstract Entity, whereas the patient role of the Physical Affliction frame is an Animate Entity. Metaphoric interpretation of a linguistic expression occurs when lexical items co-occurring in a grammatical construction evoke semantic types which are incompatible with the role types specified by the construction. Thus, *role type mismatch* enables the metaphoric mapping between the source and target domain roles within the metaphor. In the next section, we provide a case study illustrating the architecture of the frame and metaphor networks, focusing on LMs from the domain of drug use and specifically targeting nominal compound constructions.

3. CASE STUDY. One commonly recurring metaphoric construction in our database is the Noun1(Target)-Noun2(Source) construction, in which the second noun, which specifies for a source domain lexical item, and the first noun specifies for a target domain item. By

constraining a search to lexical units (which may be multi-word NPs) evoking the Drug and Disease Spread frames co-occurring in this constructional pattern, we find such attested instances as *pill-popping epidemic*[5], *pain pill epidemic*[6], *drug abuse plague*[7], and *drug addiction scourge*[8]. In all of these instances, drug abuse is conceptualized as a widespread disease infecting society. While the target domain lexical items directly refer to drug abuse itself, in these contexts they are frequently metonymic for the greater effects of drug abuse as it affects society at large, rather than just the negative effects of drug abuse on the individual addict. The predominant metonymy found is frame metonymy (Dancygier & Sweetser 2014), often in the form of ROOT CAUSE FOR RESULTING EFFECT. Thus, both metonymic and metaphoric processes play a role in the interpretation of these linguistic expressions.

The lexical items related to drug abuse (*pill-popping*, *pain pill*, *drug abuse*, *drug addiction)* evoke the Drug Abuse frame. For example, *pill-popping* evokes the drug taking process, which metonymically activates the whole frame. In these contexts, this use of the Drug Abuse frame not only evokes the notion of Drug Abuse itself, but also its larger effects on society; hence, there is a metonymic instantiation of the Drug Abuse frame, a special case of the more general Social Problems frame; the specific frame only additionally specifies that the particular social issue is Drug Abuse.

Given this metonymic relation, the metaphoric interpretation of a phrase such as *drug abuse epidemic* can be analyzed. In such examples, the social effects of drug abuse are metaphorically understood as a disease infecting society, via the general metaphor SOCIAL PROBLEMS ARE DISEASES. In particular, the source domain lexical units *epidemic, scourge,*

and *plague* profile particular aspects of the Disease scenario frame: namely, the broad extent of the disease, and the fact that it spreads across populations rather than being isolated to individuals. Hence, these lexical items instantiate an entailment of the general metaphor: EXTENT OF SOCIAL PROBLEM IS EXTENT OF DISEASE. Given that the target domain lexical items specify the type of social problem (i.e., 'drug abuse'), this can be refined to EXTENT OF DRUG ABUSE PROBLEM IS EXTENT OF DISEASE.[9]

To see how we can understand drug abuse as an epidemic, we must now consider how the specific internal structure of the linguistically-evoked frames and the constructions in which they occur contribute to metaphoric interpretation. If a Disease-frame-evoking linguistic element fills the second slot in the Noun1-Noun2 (N1-N2) construction, the *literal* N1-N2 construction specifies that the first slot must be occupied by a noun which evokes a frame compatible with the structure of the Disease frame. However, if the discourse context is not Disease-related, when such a compound occurs with a Disease-evoked N2, then it is possible it is rather a realization of the *metaphoric* N1-N2 construction. As such, the N1 will evoke a different, non-Disease frame. In such a case, the semantics of the frame role evoked by the N1 will clash with the semantics of the frame role evoked by the N2. In particular, this clash is reflected in the semantics of the frame roles as determined by their *role type*, as specific varieties of Entity or Process.

We can illustrate this interplay of construction, frame, and metaphor using the example LM *pill-popping epidemic*. Looking first at the source domain of Disease as evoked by *epidemic*, we see that the frame role of the diseased entity has the semantic role type

Animate Entity. This is an Entity frame, which inherits from the Physical Object frame (Figure 4). In contrast, *pill-popping* evokes the Drug Abuse frame via the frame element of the drug-taking process: the process is metonymic for the frame as a whole via part-whole metonymy. In turn, the perspective of Drug Abuse as a Social Problem is metonymically evoked via the relationship between the Drug Abuse frame and the drug abuse problem role within the Drug Abuse as a Social Problem frame. 'Pill-popping' is associated with the mechanistic aspect of taking medicine, and therefore focuses on a scene whereby an individual takes steps to alleviate an ailment. It is therefore perspectivized as a highly individualistic behavior. Nevertheless, the metaphor, evoked via *epidemic*, frames this as a social problem. As Figure 6 shows, the society role in this target domain frame is of semantic role type Abstract Entity. Whereas both Abstract Entity and Animate Entity are Entities, there are specific semantic conflicts between the two. Abstract Entities do not have physical form, and therefore cannot be alive. Thus, this role type mismatch between the diseased entity (Animate Entity) role in Disease and the society (Abstract Entity) role in Drug Abuse as a Social Problem (as metonymically evoked by *pill-popping*) leads to the metaphoric understanding of SOCIETY IS A PERSON. Given that society is construed as a person, it can then be understood as a person experiencing a physical affliction. A social problem that has widespread effects throughout society is understood as a widespread affliction, such as an epidemic or plague that infects a wide area via the entailment EXTENT OF SOCIAL PROBLEM IS EXTENT OF DISEASE, or more specifically EXTENT OF DRUG ABUSE PROBLEM IS EXTENT OF DISEASE. The full analysis is illustrated in Figure 6.
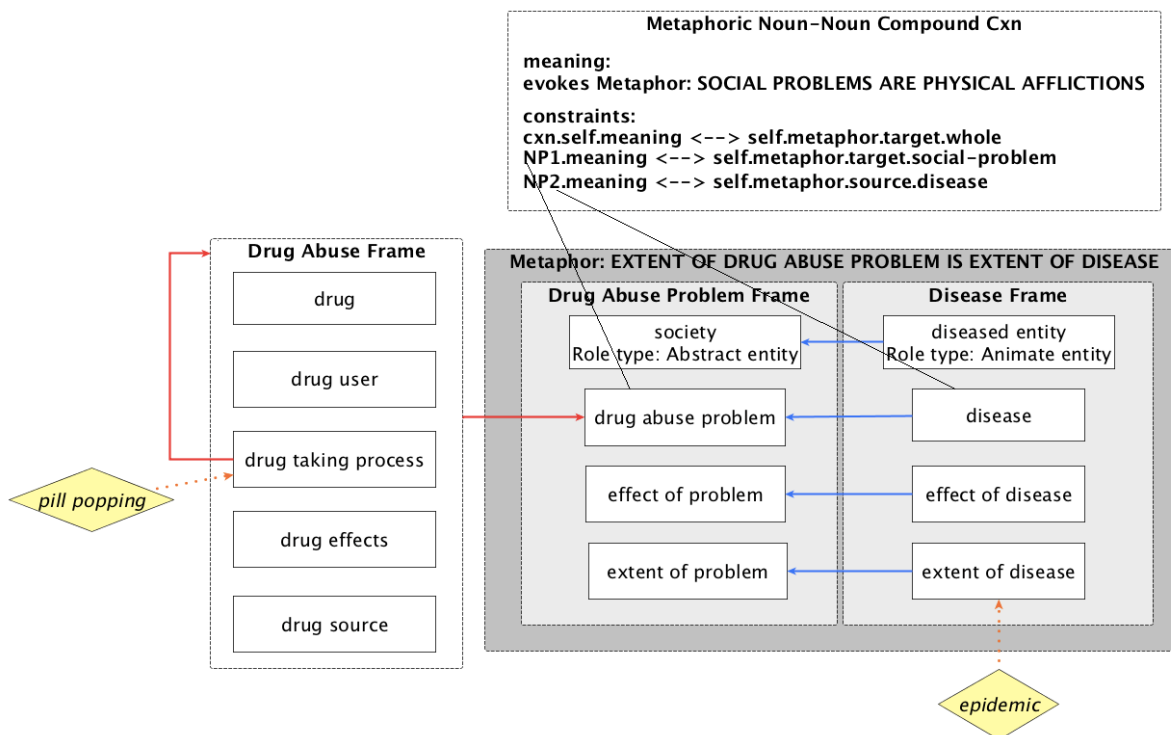
FIGURE 6. Analysis of *pill-popping epidemic*.

Additionally, by contrasting expressions such as *pill-popping epidemic* and *pill-pushing*, we

can show how the Drug Abuse frame can also highlight the drug dealer's actions, which in

turn has a different set of metaphors. In the target domain, drug consumption/use/abuse on

the one hand, and drug dealing/selling on the other, constitute different parts of the social

problem, and hence different metaphors are evoked depending on which of those aspects of

the target domain is highlighted. Drug use and abuse are problems for the drug-taker or

society as a whole, while expressions such as *drug-pusher* lexicalize aspects of the Drug

Abuse frame from the supply side. Unlike *pill-popping*, which is strictly metonymic, and only

becomes metaphoric when part of a larger N1-N2 compound like *pill-popping epidemic*, *pill-*

pushing is generally metaphoric, evoking the COERCION IS FORCED MOTION metaphor. Figure

7 shows the integration of this metaphor with the same N1-N2 metaphoric construction.
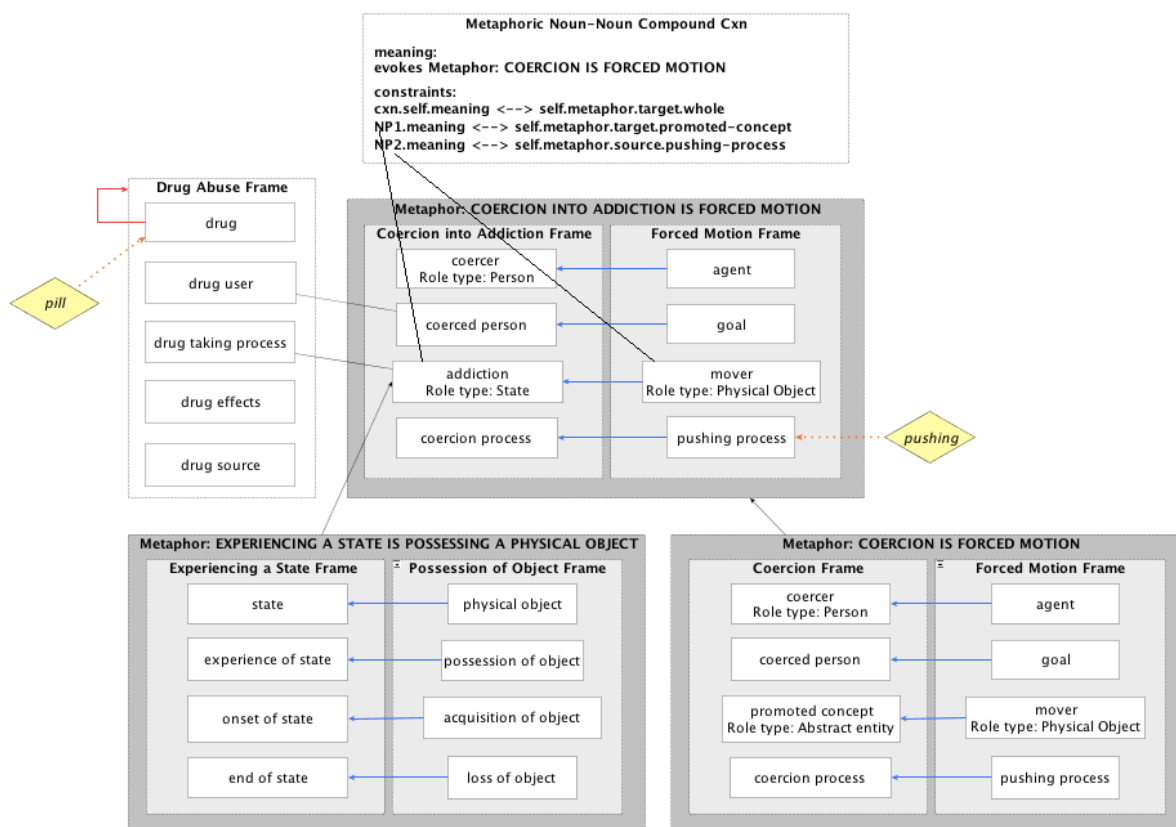

FIGURE 7. Analysis of *pill-pushing*.

The type constraint on roles with this metaphor occurs at the level of the mapping of a state

(in this case, addiction) onto a physical object (the entity being pushed), via the metaphor

STATES ARE OBJECTS and the entailment that EXPERIENCING A STATE IS POSSESSING AN OBJECT.

The fact that there is a type mismatch at this level results in the expression *pill-pushing* or

drug-pushing being inherently metaphoric. The contrast between *pill-popping* in Figure 6 and

pill-pushing in Figure 7 – the first metonymic and literal, and the second metonymic and

metaphoric – shows that the system cannot generalize as to the metaphoricity of the expression solely on the basis of the same surface constructional pattern (here N1-N2); rather, it is the role type mismatch in the role-to-role mapping, in combination with N1 metonymy (*drug* or *pill* for the Drug Abuse frame) that indicates whether this will be a literal or metaphoric expression.

4. CONCLUSIONS. By focusing on one small set of frames and metaphors involved in understanding expressions such as *drug abuse epidemic*, *drug pusher*, *pill-popping*, and *pill-pushing*, we have seen how systematized role-to-role metaphoric relations, constructional slot matching to the source and target frames, and metonymic links within the frames help yield the correct interpretations for such expressions. The analysis we provide using an ECG framework is compatible with a conceptual integration approach and shows how meaning compositionality, whether literal or metaphoric, occurs via the binding across frame and constructional spaces. To this we add that both role-to-role metonymic relations and type constraints on the roles are important in generating the correct metaphoric interpretation. A computational system that makes explicit the frame-to-frame and metaphor-to-metaphor relations (by implementing a hierarchical ontology of frames, metaphors, and their relations), can be useful in combination with a construction-matching mechanism in identifying more general metaphors for a particular linguistic metaphor string. Metonymy is crucial to such a system because metaphors can underlie essentially concrete expressions, such as *pill-popping*, whose metaphoricity is only evident when encountered in a metaphoric construction, such as

in *pill-popping epidemic*; the metonymic link between *pill-popping* and the Drug Abuse

frame reveals the underlying metaphor. In this process, the linking of metaphoric source and

target frames to constructional slots is necessary. Constructions are layered, such that

metaphoric target domains in the smaller constituent components affect the metaphoric

reading in the larger construction.

REFERENCES

BENCZES, RÉKA. 2006. Creative compounding in English: The semantics of metaphorical and metonymical noun-noun combinations. Amsterdam: John Benjamins Publishing.

BUNDGAARD, PEER F., SVEND ØSTERGAARD, AND FREDERIK STJERNFELT. 2006. Waterproof fire stations? Conceptual schemata and cognitive operations involved in compound constructions. Semiotica 161.363-393.

CLAUSNER, TIMOTHY. C. AND WILLIAM CROFT. 1999. Domains and image schemas. Cognitive Linguistics 10.1-31.

COULSON, SEANA. 2001. Semantic leaps: Frame-shifting and conceptual blending in meaning construction. Cambridge, UK: Cambridge University Press.

CROFT, WILLIAM. 1993. The role of domains in the interpretation of metaphors and metonymies. Cognitive Linguistics 4.335-370.

DANCYGIER, BARBARA AND EVE SWEETSER. 2014. Figurative language. Cambridge, UK: Cambridge University Press.

DAVID, OANA, ELLEN DODGE, JISUP HONG, ELISE STICKLES, and EVE SWEETSER. 2014. Building the MetaNet metaphor repository: The natural symbiosis of metaphor analysis and construction grammar. Paper presented at the 8th International Conference on Construction Grammar, Osnabrück, Germany.

DODGE, ELLEN K., JISUP HONG, AND ELISE STICKLES. 2015. MetaNet: Deep semantic automatic metaphor analysis. Proceedings of the Third Workshop on Metaphor in NLP at the Conference of the North American Chapter of the Association for

Computational Linguistics – Human Language Technologies (NAACL HLT 2015).
To appear.

DODGE, ELLEN K. AND MIRIAM R. L. PETRUCK. 2014. Representing caused motion in
Embodied Construction Grammar. Proceedings of the 2014 ACL Workshop on
Semantic Parsing 39-44.

DODGE, ELLEN, OANA DAVID, ELISE STICKLES, AND EVE SWEETSER. 2014. Constructions and
metaphor: Integrating MetaNet and Embodied Construction Grammar. Paper
presented at the 8th International Conference on Construction Grammar, Osnabrück,
Germany.

FELDMAN, JEROME. A., ELLEN K. DODGE, AND JOHN BRYANT. 2009. A neural theory of
language and embodied construction grammar. The Oxford handbook of linguistic
analysis, ed. by Heiko Narrog and Bernd Heine, 111-138. Oxford: Oxford University
Press.

FAUCONNIER, GILLES AND MARK TURNER. 1995. Conceptual integration and formal
expression. Metaphor and Symbol 10.183-204.

FAUCONNIER, GILLES AND MARK TURNER. 1996. Blending as a central process of grammar.
Conceptual structure, discourse, and language, ed. by Adele Goldberg, 113-130.
Stanford, CA: CSLI.

FAUCONNIER, GILLES AND MARK TURNER. 1998. Principles of conceptual integration.
Discourse and cognition: Bridging the gap, ed. by Jean-Pierre Koenig, 269-283.
Stanford, CA: CSLI.

FILLMORE, CHARLES. J. 1976. Frame semantics and the nature of language. Origins and evolution of language and speech, ed. by Stevan R. Harnad; Horst D. Steklis; and Jane Lancaster, 20-32. Annals of the NY Academy of Sciences, Vol. 280.

FILLMORE, CHARLES. J. 1982. Frame semantics. Linguistics in the morning calm, ed. by The Linguistic Society of Korea, 111-137. Seoul: Hanshin Publishing Co.

GOLDBERG, ADELE E. 1995. *Constructions: A construction grammar approach to argument structure*. Chicago: University of Chicago Press.

GRADY, JOSEPH E. 1997. Foundations of meaning: Primary metaphors and primary scenes. Berkeley, CA: University of California, Berkeley dissertation.

KÖVECSES, ZOLTÁN. 2005. Metaphor in culture: Universality and variation. Cambridge University Press.

LANGACKER, RONALD W. 1987. Foundations of cognitive grammar 1: Theoretical prerequisites. Stanford CA: Stanford University Press.

LANGACKER, RONALD W. 1990. Foundations of cognitive grammar 2: Descriptive application. Stanford CA: Stanford University Press.

LANGACKER, RONALD W. 1991. Concept, image, and symbol: The cognitive basis of grammar. Berlin: Mouton de Gruyter.

LAKOFF, GEORGE AND MARK JOHNSON. 1980. Metaphors we live by. Chicago: University of Chicago Press.

LAKOFF, GEORGE AND MARK JOHNSON. 1999. Philosophy in the flesh: The embodied mind and its challenge to western thought. New York: Basic Books.

LIEBER, ROCHELLE. 1992. Deconstructing morphology: Word formation in syntactic theory. Chicago: University of Chicago Press.

LIEBER, ROCHELLE. 2010. On the lexical semantics of compounds: Non-affixal (de)verbal compounds. Cross-disciplinary issues in compounding, ed. by Sergio Scalise and Irene Vogel, 127-144. Amsterdam; Philadelphia: Benjamins.

ONYSKO, ALEXANDER. 2010. Casting the conceptual spotlight: Hybrid compounding in German as an example of headframe internal specifier selection. Cognitive perspectives on word formation, ed. by Alexander Onysko and Sascha Michel, 243-300. Berlin: Walter DeGruyter.

ÖSTMAN, JAN-OLA and FRIED, MIRJAM. (Eds.). 2005. Construction grammars: Cognitive grounding and theoretical extensions (Vol. 3). Amsterdam: John Benjamins Publishing.

RUPPENHOFER, JOSEF, MICHAEL ELLSWORTH, MIRIAM R. L. PETRUCK, CHRISTOPHER R. JOHNSON, AND JAN SCHEFFCZYK. 2010. FrameNet II: Extended theory and practice. Berkeley, California: International Computer Science Institute.

RYDER, MARY ELLEN. 1994. Ordered chaos: The interpretation of English noun-noun compounds. Berkeley/Los Angeles, CA: University of California Press.

SULLIVAN, KAREN S. 2007. Grammar in metaphor: A construction grammar account of metaphoric language. Berkeley, CA: University of California Berkeley dissertation.

SULLIVAN, KAREN S. 2013. Frames and constructions in metaphoric language. Amsterdam/Philadelphia: John Benjamins Publishing.

SWEETSER, EVE. 1999. Compositionality and blending: Semantic composition in a cognitively realistic framework. Cognitive linguistics: foundations, scope, and methodology, ed. by Theo Janssen and Gisela Redeker, 129-162. Berlin/New York: Mouton de Gruyter.

TALMY, LEONARD. 1983. How language structures space. Spatial orientation: Theory, research, and application, ed. by Herbert L. Pick Jr. and Linda P. Acredolo, 225-282. New York: Plenum Press.

TALMY, LEONARD. 2003. Toward a cognitive semantics, Vols 1 & 2. Cambridge, MA: MIT press.

TERASOVA, ELIZAVETA. 2013. Some new insights into the semantics of English N+N compounds. Wellington, NZ: Victoria University of Wellington dissertation.

[1] However, this process by nature can only identify constructs in which both the S and T of the metaphor are realized lexically, and is blind to such metaphoric expressions as *modern women have **hit a glass ceiling*** or *he's **moving up the ladder***.

[2] Note that the noun-noun compounds *pill-pushing* or *pill-pusher* are never used to refer to the act of physically pushing a pill in our corpora; although the pattern could perhaps be used in a creative manner, such as calling a pharmaceutical machine that counts pills a "pill-pusher", its usage is clearly canonically metaphoric. Its constructional entrenchment as a metaphoric expression is typical of metaphoric constructions with metonymic roots in physical scenes, an entrenchment pattern not exclusive to noun-noun constructions. This enforces the idea that the construction plays a major role in contributing to the role type mismatch in the mapping.

[3] Note some elements of frame structure (lexical units, relations to other frames, inferences, and additional roles) are not represented here.

[4] General metaphors are in yellow, specific metaphors are in green, and entailments are in blue. Blue arrows indicate subcase relations and red arrows indicate entailment relations.

[5] *So, is there a solution to the latest housewives pill-popping epidemic that's sweeping our suburbs?* http://www.newjerseynewsroom.com/healthquest/housewives-are-desperatepill-popping-epidemic-sweeping-the-suburbs

[6] *Who is responsible for the pain pill epidemic?*

http://www.newyorker.com/business/currency/who-is-responsible-for-the-pain-pill-epidemic

---

[7] *Any prescription for the drug abuse "plague," they say, counts on the political will of all of the countries involved.* http://www.csmonitor.com/1987/0617/oconf.html

[8] *Touted by Hythiam as the first effective treatment for methamphetamine and cocaine addiction, it quickly won converts among some drug treatment specialists who reported "phenomenal" results from its use and from investors who know how profitable it would be to have a magic bullet for the drug addiction scourge.*

http://www.nbcnews.com/id/22315918/ns/health-addictions/t/setbacks-plague-drug-addiction-remedy/#.VWe2A2RViko

[9] Note that the framing of Drug Use as a Social Problem is only possible by virtue of the metaphor evoked by the source item *epidemic* – i.e., it's apparent that it is a social problem and not an individual problem due to the spreading nature and population-wide scope of a disease epidemic. In a sense, issue framing and constructional mediation of metaphor are mutually-dependent, and one does not come before nor occur independently of the other. If framed as a problem of individual moral failing rather than a social problem, *epidemic* would be highly unlikely to co-occur; instead, we may encounter other metaphors in other constructions, such as *drug addicts are infecting our city*. This would take the perspective that individuals with poor morals are the root of the drug abuse problem, in which case it is the individuals themselves who are the infection while society is the infected entity. Such a perspective would perhaps lead to measures like putting up walls and other physical barriers or not extending public transit to well-to-do neighborhoods, in order that the "undesirables"

cannot physically access and therefore "infect" the nicer – and by implication morally

superior – areas.