Meaning-Text-Theory and Lexical Frames

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Abstract

We discuss the relationship between FrameNet and Meaning-Text Theory. We propose that the notion of frame can be used in MTT in order to give the conversive lexical function both a broader and a more precise definition. We include a discussion of some issues related to importing the FrameNet lexicon to MTT.

1 Introduction

This paper proposes an alternate (or additional) structure for the lexicon. This alternative is directly inspired by FrameNet and results from an effort to relate the FrameNet (Baker et al., 1998) lexicon to Meaning-Text Theory (Mel'čuk, 1988) conceptualizations. The result is fully compatible with the spirit of MTT, we believe, but captures the key intuitions of FrameNet. These intuitions allow for two enhancements to the MTT approach to the lexicon: first, it provides for a finer-grained notion of "conversive" which can make more subtle semantic distinctions; second, it allows for a generalized notion of conversive lexical function which captures are a wider range of phenomena.

Specifically, this paper has four goals:

- We would like to introduce the MTT community to a theoretical approach to the lexicon and a practical resource (an English lexicon) which is complementary to work in the MTT framework.
- We make specific proposals about generalizing the CONV lexical function in order to make it better defined and more usable.
- We make a specific proposal about how the notion of "frame" can be integrated into the MTT approach.
- We describe an attempt at automatically converting a lexical resource to the MTT framework. However, the goal of this paper is theoretical, and we mention this work only to show how our analysis can allow us to relate lexical resources.

We concentrate on verbs in this paper, tough FrameNet includes all parts of speech, and the extension of our discussion to nouns and adjectives would be interesting. This is left to future work.

There has been some previous work in relating FrameNet to MTT (Alonso Ramos et al., 2008). This work differs in that Alonso Ramos et al. (2008) concentrate on paradigmatic lexical functions, while we concentrate on syntagmatic lexical functions. Our work is thus complementary to theirs.

This paper is structured as follows. In Section 2, we summarize FrameNet. We then show how frames can be integrated with the MTT lexicon in Section 3.1, and propose our generalized conversive lexical function in Section 3.2. We then describe some practical issues related to extracting lexical functions from the FrameNet lexicon in Section 4.

2 FrameNet

FrameNet (Baker et al., 1998) is a digital lexical resource for English that groups related words together into semantic frames. FrameNet currently contains over 10,000 lexical units, where a lexical unit is defined as a pairing of a word (noun, verb, adjective) with a sense or meaning. In addition, there can sometimes be more than one lexical unit per word sense, based on different perspectives of that shared meaning. For example, the same sense of the verb SHOOT is represented by three separate lexical units corresponding to *shoot the target*, *shooting the gun*, and *shoot the bullet*. Each lexical unit is contained in one of nearly 800 hierarchically-related semantic frames, where each frame represents shared meaning between the lexical units in that frame. In addition, each lexical unit contains a set of annotated sentences which map the sentences' constituent parts to their frame-based roles. FrameNet, in total, contains over 135,000 annotated sentences across all lexical units. Not all lexical units have been annotated. For example, of the approximately 4,100 verb lexical units in FrameNet, only about 2,800 have annotated sentences.

A FrameNet frame consists of a set of frame-based roles, called *frame elements* (FEs). For example, the COMMERCE_SELL frame includes frame elements for SELLER, GOODS, and BUYER. These and other FEs represent the key roles that characterize the meaning of the lexical units in that frame. Frames can contain any number of individual lexical units. The COMMERCE_SELL frame, for example, has lexical units for the words RETAIL, SELL, VEND, etc.

The exact expression of FEs for a given annotated sentence constitutes what FrameNet refers to as a *valence pattern*. In this paper we represent valence patterns as lists of FE and grammatical function (GF) pairs. Grammatical functions are subject (*ext*), object (*obj*), second object (*Dep/NP*), and various other dependent phrases (*Dep/to*, *Dep/on*, *Dep/with*, etc.) which designate the particular prepositional phrase type. [1] So, for the verb GIVE, the sentence *John gave the book to Mary* has the valence pattern of: ((Donor Ext) (Theme Obj) (Recipient Dep/to)). And *John gave Mary the book* has the valence pattern of ((Donor Ext) (Recipient Obj) (Theme Dep/NP)). Every verb typically has many valence patterns, representing the various ways that verb can be used in sentences.

FrameNet makes a distinction between "core" FEs (those that are unique or characteristic to the meaning of the frame) and "peripheral" frame elements (which do not uniquely characterize a frame). For example, TIME, LOCATION, and MANNER are typically peripheral FEs since they can be instantiated in any appropriate frame. In contrast, in the COMMERCE_BUY frame (which includes the verbs BUY and PURCHASE), the FEs for BUYER and GOODS are core since they are central and conceptually necessary to the meaning of that frame.

FrameNet frames are related to each other by a fixed set of frame relations. These allow us to find semantically related verbs across frames. In addition, since frames can give arbitrary names to their frame elements, frame relations are used to define the mapping between corresponding frame elements in the related frames. Some relevant frame relations are:

INHERITANCE: This relation represents an is-a relation between two frames. An example is the ESCAPING frame which inherits from the DEPARTING frame.

PERSPECTIVE_ON: This relation links perspectivized frames which represent two different points-of-view of some other neutral frame. For example the frames for verbs BUY and SELL are related as perspectives on the COMMERCIAL_TRANSACTION frame. Similarly, there are three frames for SHOOT corresponding to *shoot the target*, *shooting the gun*, and *shoot the bullet*. These three frames are related via the PERSPECTIVE_ON relation.

REFRAMING_MAPPING: It's not uncommon for lexical units to be moved into new frames. This frame relation remaps the names of FEs from one frame to another when frame boundaries have changed

[1] Note that the FrameNet syntactic annotation always calls the first NP following the verb the object, even in the double-object construction (*John gave Mary a book*), where the standard analysis would call the second NP the object and the first NP the indirect object. We follow the FrameNet annotation, despite the fact that the standard analysis is more appealing, because we need to work with the given annotation.

(Petruck et al., 2004). For example the FORGING frame (containing verbs such as FALSIFY, FAKE, and COUNTERFEIT) is related via the **REFRAMING_MAPPING** frame relation to the FEIGNING frame (which contains separate lexical units for some of the same verbs plus others for verbs such as AFFECT and PRETEND).

INCHOATIVE_OF and CAUSATIVE_OF: The relationship between stative frames and corresponding inchoative and causative frames is encoded with the **CAUSATIVE_OF** and **INCHOATIVE_OF** frame relations. For example, the verb COOL is represented by separate lexical units in the frames for CAUSE_TEMPERATURE_CHANGE (as in *John cooled the apple*) and INCHOATIVE_CHANGE_OF_TEMPERATURE (as in *The apple cooled quickly*). The frame CAUSE_TEMPERATURE_CHANGE is related by **CAUSATIVE_OF** to INCHOATIVE_CHANGE_OF_TEMPERATURE which in turn is related with **INCHOATIVE_OF** to the stative frame TEMPERATURE.

SUBFRAME: Some frames refer to sequences of other frames. These subframes are related to the parent frame via the SUBFRAME relation. For example, the frame CAUSE_IMPACT contains the lexical unit SLAM (as in *john slammed the car door*). This frame has a subframe IMPACT which contains a separate lexical unit for SLAM (as in *the door slammed shut*).

USING: The **USING** frame relation is used in cases in which a part of the child's meaning refers to the parent frame. For example, the COMMUNICATION_NOISE frame is used by verbs where communication takes place via a sound (e.g. the verb CLUCK in *"Sorry, Jimmy," the teacher clucks sympathetically at one unfortunate.*. To represent this dependency, it is related to the MAKE_NOISE frame via the **USING** frame relation.

SEE_ALSO: This frame relation is primarily intended for human users of FrameNet. But it sometimes encodes a direct relation between frames that would otherwise be only indirectly related. For example, the PERCEPTION_EXPERIENCE frame (e.g., verbs like SEE) and the PERCEPTION_ACTIVE frame (e.g. verbs like WATCH which imply a volitional act) are related indirectly via the **INHERITANCE** frame relation to their common parent frame PERCEPTION. They are also directly related by the **SEE_ALSO** frame relation.

Note that verbs in the same frame and related frames can vary significantly in meaning. For example, the SELF_MOTION frame contains a large number of verbs related only by the fact that the SELF_MOVER moves under its own power in a directed fashion without a vehicle. As a result, this frame contains strongly related verbs such as WALK and STROLL but also verbs with very different manner of motion such as SWIM and SWING.

By way of an example, we show how various frames related to the commercial transaction meaning are related in Figure 1.

3 Frames in MTT

In this section, we address the question how the notion of "frame" can be incorporated into MTT. In particular, we are interested in exploiting the relations between frames, and the extended notion of conversive that these relations allow.

3.1 Relating SemRs

In FrameNet, the core meaning of "frame" is provided by "semantic overlap". For atomic frames, the criteria for "semantic overlap" are very strict: two verbs can only be in the same atomic frame if they have the same number of actants, the same aspectual behavior, the same presuppositions, and if their (obligatory and non-obligatory) actants are interpreted in the same manner with respect to the underlying semantics. This latter point can be illustrated by purpose (or reason) clauses; this example is adapted from (Ruppenhofer et al., 2006) (the sign '#' denotes semantic infelicity):

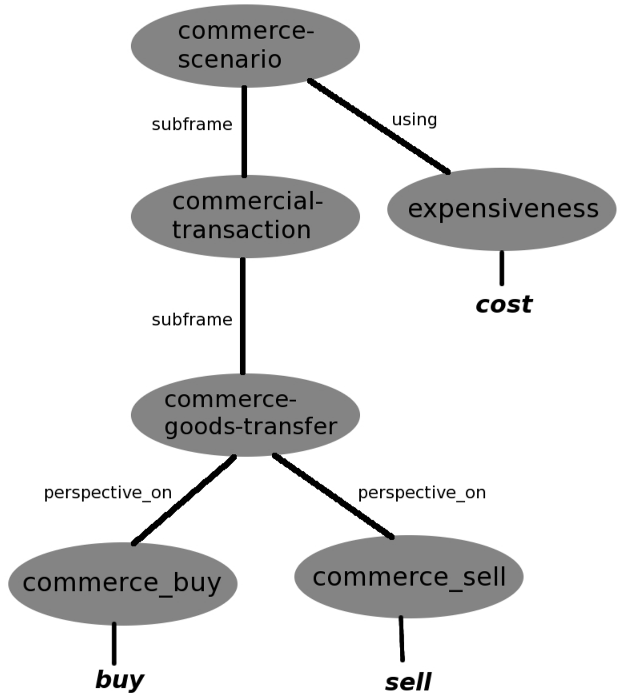

Figure 1: Relation between frames relating to commercial transactions

(1) a. Mary sold Peter an apartment because she wanted to make him happy/#he wanted to make her happy

b. Peter bought an apartment from Mary because he wanted to make her happy/#she wanted to make him happy

c. An apartment was sold to Peter by Mary/Peter was sold an apartment by Mary because she wanted to make him happy/#he wanted to make her happy

In (1a), the *because* clause can only refer to Mary's motivations,[2] and in (1b), the *because* clause can only refer to Peter's. As a result, as discussed by (Ruppenhofer et al., 2006), these two sentences are not paraphrases of one another.[3] Since BUY and SELL are conversives in MTT, this means that FrameNet atomic frames are more restrictive than MTT's notion of conversive in terms of semantic requirements. It also means that conversive do not always license paraphrases in MTT. We leave aside the issue of why the motivation clauses choose the (underlying) subjects, how MTT represents this, and why this fact is not relevant to the MTT definition of the basic conversive.

We define the atomic **lexical frame** to be the SemR L of a given lexeme, and we associate with it extensionally all lexemes that have exactly the same SemR L. We then relate lexical frames to each other using the following asymmetric specialization relations on semantic representations (SemRs), which we define in

[2]The variant marked with '#' are pathologically acceptable if contextually one may infer that Mary wanted to fulfill Peter's desire by letting him make her happy. However, it is still an explanation of Mary's action, not of Peter's,even though this commercial transaction involves actions by both Mary and Peter. Similar comments apply to the other sentences.

[3]1c) shows that this is not an effect of the *because* clause being oriented towards the surface subject – (1c) has the same interpretation as (1a), not as (1b).

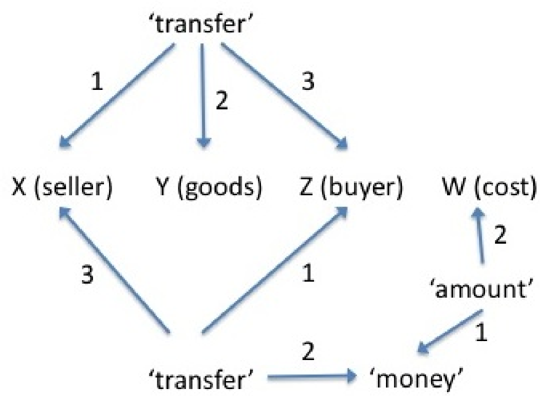

Figure 2: SemR for the COMMERCIAL_TRANSACTION frame

analogy to the frame relations of FrameNet (see Section 2). All these relations have in common that they relate a more specific SemR to a less specific SemR which contains less information (i.e., fewer nodes). They differ in what kinds of meanings are added, and thus in how the SemRs are related semantically. We define the extension of a less specific SemR to be the set of all lexemes associated with the frames it specializes. Note that we may encounter SemRs which themselves do not correspond to verbs, though usually the noun (or adjective-noun collocation) which is the name of a lexical frame is also a nominal lexeme with that meaning. (Recall, however, that we do not consider nouns in this paper.)

- **PERSPECTIVE_ON**: this relation links two SemRs which differ only in the fact that one records perspective, i.e. (typically), it attributes agentivity, while the other (less specialized) does not. It remains to be seen how this is expressed in MTT, this is not the topic of our paper. For example the frames for verbs BUY and SELL are both related as perspectives on the COMMERCIAL_TRANSACTION frame. The SemR of this frame is shown in Figure 2.

- **CAUSATIVE_OF**: this relation adds a causer to a SemR. For example, the verb COOL is contained in both CAUSE_TEMPERATURE_CHANGE (as in *John cooled the apple*) and INCHOATIVE_CHANGE_OF_TEMPERATURE (as in *The apple cooled quickly*). The frame CAUSE_TEMPERATURE_CHANGE is related by **CAUSATIVE_OF** to INCHOATIVE_CHANGE_OF_TEMPERATURE. Determining whether an actant is a causer is not always straightforward, see (Iordanskaja and Mel'čuk, 2002) for a discussion.

- **USING**: The **USING** frame relation is used when a SemR specializes another SemR by adding a completely new purpose or function. For example, the COMMUNICATION_NOISE frame is used by verbs where communication takes place via a sound, and it is related to the MAKE_NOISE frame via the **USING** frame relation.

- **SUBFRAME**: Some SemRs describe sequences of events, one of which is is described by another SemR. These subframes are related to the parent frame via the SUBFRAME relation. For example, the frame CAUSE_IMPACT contains the lexical unit SLAM (as in *John slammed the car door*). This frame is a subframe of IMPACT which contains a separate lexical unit for SLAM (as in *the door slammed shut*).

- **INHERITANCE**: This relation represents a generic is-a relation between two SemRs and is used when one of the more specific ones does not apply. An example is the SemR for ESCAPING which inherits from the SemR for DEPARTING, adding the meaning that the departure required circumventing barriers aimed at preventing it.

3.2 Extending the CONV Lexical Function

The conversive lexical function preserves meaning but changes the syntactic realization of arguments. Given our fine-grained typology of relations between SemRs sketched above, we can be more precise about what sort of semantic relation exists between two lexemes related by a conversive lexical function. Recall that we have defined a lexical frame as a SemR and the set of verbs whose SemRs are related to this SemR in one of the specializations or generalizations listed in Section 3.1. Now, as the SemRs of two verbs start to differ more and more, the conversive becomes less and less meaning-preserving. We propose to indicate this by including, as a superscript on the CONV function name, the list of specializations that the SemRs undergo in order to become the SemR of the same frame.

Consider the classic pair of BUY andSELL. As can be seen from Figure 1, these two verbs are not in the same atomic frame, but they are both in the COMMERCE_GOODS_TRANSFER frame. Their atomic frames are both related to their shared frame through the **PERSPECTIVE_ON** relation. We thus get:

X buys Y from Z for W (=cost)
Z sells Y to X for W
$\text{CONV}^{\text{persp}}_{3214}$(BUY) = SELL

The first actant of BUY corresponds to the third actant of SELL, and the third actant of BUY corresponds to the first actant of SELL. The second and fourth actants correspond to the second and fourth actants, respectively. The superscript "persp" tells us that the two lexemes are identical in meaning, subject to the specified argument permutation, except for the agentive perspective, and can be substituted in paraphrases except when this agentivity comes into play (say, in the presence of purpose clauses).

We now must address a technical limitation of the conversive lexical function. In its presentation to date, it relates only verbs which have the same number of actants: the subscript indicates the permutation of the actants, using standard mathematical notation for permutations. (A permutation is a total bijective function from a set onto itself.) For example, BUY and SELL both have four syntactic actants; but COST has at most three actants (*the goods cost the buyer the price*). Thus, their actants cannot be related by a permutation, and the verbs cannot be related by a CONV lexical function. This seems an artificially imposed restriction: the two verbs share some common meaning in their SemRs. Note that for COST, the missing actant is in fact implied: there can be no cost situation without a seller. It is just not realizable syntactically using COST as the main verb. We therefore propose a second extension to the CONV lexical function notation, which allows for any mapping between the set of actants. We introduce the following, very explicit notation:

$\text{CONV}^{\text{persp,subframe,using}}_{1\rightarrow\emptyset,2\rightarrow 1,3\rightarrow 3,4\rightarrow 2}$ (SELL) = COST

The subscript tells us exactly and explicitly how each actant of SELL is mapped to an actant of COST; actants which COST does not realize are given null targets. Here, the superscripts tell us that the meaning has changed in several respects: there has been a change in agentivity (in fact, COST has no agentive actant); there has been an elimination of several parts of the meaning which correspond to substeps (the transfer of the bought goods is not part of the meaning of COST); and a core meaning is used for a different purpose.

It is clear that, with our new generalized conversive, we can easily express the standard permutation-based conversives as well:

$\text{CONV}^{\text{persp}}_{1\rightarrow 3,2\rightarrow 2,3\rightarrow 1,4\rightarrow 4}$ (SELL) = BUY

However, in addition, our new extended conversive lexical function notation handles several cases which the permutation-based one does not(we omit the superscripts as they are not relevant to this discussion).

1. Many verbs have optional arguments: for example, for BUY, arguments 3 and 4 are each individually optional. In the MTT dictionary, this is indicated in the valency pattern which relates the deep-syntactic representation to the surface-syntactic representation. While this is perfectly good from a theoretical perspective, it may be useful to consolidate the knowledge about possible argument realizations in a single part of the lexicon: if our extended conversive can relate BUY to COST (which has fewer actants), it may also be expedient to relate BUY with four actants to BUY with two or three actants. Of course, this is still the same lexeme, it is just a new technical means of indicating that an actant is optional. (The "inher" superscript tells us that some meaning is removed.)

   $\text{CONV}^{\text{inher}}_{1\to1,2\to2,3\to\emptyset,4\to4}$ (BUY) = BUY
   $\text{CONV}^{\text{inher}}_{1\to1,2\to2,3\to3,4\to\emptyset}$ (BUY) = BUY

2. Diathesis alternations of the type studied by Levin (1993) are a complex issue representationally. In these cases, semantic arguments can appear in different deep-syntactic argument positions. For example, in English we have *John loaded the truck with hay* as well as *John loaded hay into the truck*.[4] One approach is to have one lexeme but two valency patterns. The relationship between these two valency patterns can be expressed with an extended conversive, if we consider there to be underlyingly four actant positions such that the second actant is not mapped to any semantic argument, only the first, third, and fourth.

   $\text{CONV}^{\text{atomic}}_{1\to1,2\to3,3\to\emptyset,4\to2}$ (LOAD) = LOAD
   $\text{CONV}^{\text{atomic}}_{1\to1,2\to4,3\to2,4\to\emptyset}$ (LOAD) = LOAD

   As in the case of optional arguments, the knowledge about which semantic arguments can be expressed how is concentrated in one place, namely in the extended conversives. The "atomic" superscript tells us that the SemRs are identical.

Thus, in summary, we have proposed an extended notation for lexical functions, which is based on the notion of lexical frame, and which is both more flexible as to the realization of arguments,and more precise as to the nature of the meaning shared by the two related lexemes.

4 Converting the FrameNet Lexicon to MTT Relations

To generate paraphrase transformations for a given verb we first determine its FrameNet frame and then find related frames using the following frame relations: Null (i.e. look at other verbs within the same frame); **PERSPECTIVE_ON**; **USING**; **REFRAMING_MAPPING**; **INCHOATIVE_OF**; **CAUSATIVE_OF**; **INHERITANCE**; **SUBFRAME**; and **SEE_ALSO**. We then collect a list of potential target verbs in those related frames. Note that the target verb can be the same as the source verb. This allows us produce paraphrases involving diathesis alternations and argument ommission.

In selecting potential verbs we rely upon WordNet to test for different types of synonymy. WordNet (Fellbaum, 1997) is a lexical database for the English language. It groups nouns, verbs, and adjectives into sets of synonyms called synsets and arranges those synsets into a hypernym/hyponym hierarchy. So, for example, the synonyms SHOPKEEPER and STOREKEEPER are in the same synset. They are hyponyms of MERCHANT and hypernyms of FLORIST and TOBACCONIST. Note that WordNet synsets and FrameNet lexical units for a given lexeme don't usually correspond exactly. For example, WordNet has a single synset for the verb CLANG, while FrameNet has four lexical units representing separate frames for CAUSE_TO_MAKE_NOISE, CAUSE_IMPACT, IMPACT, MAKE_NOISE, and MOTION_NOISE.

In order to ensure that verb pairs are extended conversives, target verbs must satisfy one of the following conditions:

[4] We leave aside issues of restrictions on argument realizations in different patterns, for example on pronouns.

- The source and target verbs are in the same WordNet synset and hence treated as synonymous. This allows verbs such as HALT and STOP to be paired.

- The source and target verbs are respectively WordNet hyponyms or hypernyms of each other. So, for example, GO is a hypernym of WALK. Thus, sentences like *John walked to the store* and *John went to the store* could be used to describe the same event.

- The source and target verbs are related via the **PERSPECTIVE_ON** frame relation. This covers the case where the two verbs have different surface meaning but denote the same underlying event from different points of view. For other frame relations we require one of the synonym, hypernym, or hyponym relations as described above.

Note that in this strategy, we will miss some valid paraphrase pairs because of the granularity of meaning in WordNet. For example, in WordNet, BATHE and WASH are not synonyms, hypernyms, or hyponyms of each other. Instead they are both children of CLEANSE which also has unrelated children such FLOSS. As a result we would require some other technique or resource to identify close siblings such as BATHE and WASH in order to include them in our paraphrase pairs.

After collecting the possible target verbs, we then identify all valence patterns for the given source verb. These represent the possible left-hand sides of the transformations. Then, for each of these left-hand side patterns, we collect the right-hand sides from target verb list which have compatible valence patterns. Since we are primarily concerned with paraphrase, the right-hand side valence patterns must only reference FEs that are explicitly expressed in the given left-hand side.

Constructing the valence pattern from the annotation is straightforward, as both the grammatical function and the FE are marked, except for one very important aspect: grammatical voice. The active/passive alternation can be seen as an entirely productive verb alternation in English, and it would make no sense to suggest that every valence pattern for every verb has two additional variants (the passive, and the passive with *by*-agent). Instead, we want to normalize for voice, i.e., we want to always represent the valence pattern for active voice. This is non-trivial, because the syntactic annotation of FrameNet does not include a feature for voice, and the provided grammatical function annotation is for the surface grammatical function. We have implemented a series of heuristics that exploits the part-of-speech and grammatical function annotations, as well as the annotation for missing arguments in passives without *by* agents. However, some cases are impossible to disambiguate for a variety of reasons, including a fair number of examples in which the main verb form is not disambiguated between past tense and past participle and there is no auxiliary (reduced passive relative clause or conjunctions). Thus, grammatical voice is the major source of errors for us in determining the valence pattern.

For example, the verb GIVE has the following left-hand side patterns (each pattern consisting of FE and GF pairs):

Left-hand side pattern	Example sentence
((Donor Subj) (Recipient Obj) (Theme Dep/NP))	*John gave Mary the book*
((Donor Subj) (Theme Obj) (Recipient Dep/to))	*John gave the book to Mary*
((Donor Subj) (Theme Dep/of) (Recipient Dep/to))	*John gave of his time to people like Mary*
((Donor Subj) (Recipient Dep(to)))	*John gave to the church*

Verbs in related frames have the following valence patterns. As a result, the possible right-hand side patterns will be drawn from the following list:

Possible right-hand side patterns	
((Donor Subj) (Theme Obj) (Recipient Dep/to))	((Donor Subj) (Theme Obj))
((Donor Subj) (Recipient Obj) (Theme Dep/NP))	((theme Subj))
((theme Subj) (Recipient Dep/to))	((Donor Subj) (Recipient Obj) (Theme Dep/to))
((Donor Subj) (Theme Obj) (Recipient Dep/on))	((Donor Subj) (Recipient Obj))
((Donor Subj) (Recipient Obj) (Theme Dep/with))	((Donor Subj) (Theme Obj) (Recipient Dep/for))
((Donor Subj) (Theme Obj) (Recipient Obj))	((Donor Subj) (Theme Obj) (Recipient Dep/Poss))
((Donor Subj) (Recipient Dep/to))	((Donor Subj) (Theme Dep/of) (Recipient Dep/to))
((Recipient Subj) (Theme Obj))	((Donor Subj) (Recipient Obj) (Theme Dep/VPto))
((Donor Subj) (Theme Obj) (Recipient Dep/upon))	((Donor Subj) (Recipient Obj) (Theme Dep/the))

For each possible valence pattern on the left-hand side we collect all valence patterns for the right-hand side that contain only FEs present in the given left-hand side valence pattern. For each of these target valence patterns we list all corresponding verbs (including their lexical unit ID and their frame) along with a matching annotated sentence. In presenting these examples of extended conversives we use the actual annotated sentences associated with the given lexical units in the FrameNet corpus. So while the overall pairs of sentences don't have the same meaning, they contain verbs with shared meanings, and all examples are naturally ocurring. For example, here's a single output entry for the verb GIVE:

FROM	
Pattern::	((Donor Subj) (Recipient Obj) (Theme Dep/NP))
Verb:	[LU-4344 "give.v" Giving]
Example:	*Katy and Jamie got ready very quickly and Mum* **gave** *each of them two wee spoons.*
TO	
Pattern:	((Donor Subj) (Theme Obj) (Recipient Dep/to))
Verb:	[LU-4344 "give.v" Giving]
Example:	*They wrapped it up and* **gave** *it to her , and it did have a head like a baby.*
Verb:	[LU-5344 "donate.v" Giving]
Example:	*Ralph and Philip are looking for local sponsors to* **donate** *money to their twin charities.*

In constructing these valence patterns we only consider core FEs since these will be characteristic of the verbs in question. Also, in collecting the valence patterns in the mappings from one frame to another, the FE names will often be different. For example, the COMMERCE_SELL frame (used by the verb SELL) has a FE called SELLER, but in the Expensiveness frame (used by the verb COST as in *the book costs 10 dollars*) this identical role is called PAYER. FrameNet's frame relations specify how these different FE names get mapped into each other. We use this information to automatically normalize the names to the namespace of the parent frame. It is the normalized FE names that are output in the paraphrase transformation patterns.

By relaxing the constraint that right-hand side valence patterns can only reference FEs explicitly expressed on the left-hand side, we get alternations such as the following:

FROM	
Pattern	((Agent Subj) (Projectile Obj) (Firearm Dep(from)))
Verb	[LU-5314 ”shoot.v” Shoot_projectiles]
Example	*You can use it to* **shoot** *heavy balls of metal from large guns.*
TO	
Pattern	((Agent Subj) (Firearm Obj))
Verb	[LU-5315 ”shoot.v” Use_firearm]
Example	*Alex Household must have said it just before he* **shot** *the gun;*

5 Conclusion and Future Work

This paper has discussed the relation between FrameNet and MTT, specifically the organization of the lexicon proposed by the two theories. We have suggested that FrameNet;s hierarchical notion of meaning and its fine-grained inventory of relations between meanings can be expressed in MTT as well, leading to an extended notion of the conversive lexical function which is both more inclusive and more precise. Future work will require a more detailed elaboration of the SemRs of FrameNet frames; in this manner, MTT will contribute a clearer (and computationally interesting) definition of lexical meaning for FrameNet.

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