$^{A}13^{A}$

LEXICAL SEMANTICS

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1. Introduction

Many recent linguistic theories are based on the hypothesis that lexical properties may influence the syntactic and semantic understanding of language. These theories work by accessing sublexical information, specifically subevents within verb meanings. These can be deduced using various diagnostics, such as observing a word in particular constructions, or appealing to polysemy, or using various contradicting modifiers. Rappaport Hovav and Levin (1998) and Pustejovsky (1991) both forward representations that map the varying subevents for different types of verbs, in order to show how they relate to semantic arguments and other relevant parts of linguistic cognition. Rappaport Hovav and Levin front an articulated, linear structure which uses rules following the aspectual, Vendler-Dowty classification of verbs. They show the varying complexity of verbs by embedding subevents within subevents. Pustejovesky (1991), on the other hand, uses a tiered, minimalist theory to cover the same ground. This paper will outline the differences and similarities between their representations, before going on to present a proposed theory that seeks to deal with some of the issues not covered by the other representations.

2. Rappaport Hovav and Levin

2.1. **The Theory.** Rappaport Hovav and Levin distinguish two components of verb meaning: the 'constant' and the primitive predicate. The former is useful as an idiosyncratic element of meaning for distinguishing a verbs classification, whereas the latter is "the lexical property of a verb that is taken to determine it's syntactic behaviour...[so] a verb's meaning consists of an association of a constant with a particular lexical semantic template." (Rappaport Hovav and Levin 1998: 107) Lexical semantic templates, called event structure templates (ES) by Rappaport Hovav and Levin, are the rules presented in order to understand this meaning, and in particular the verb's allowable variation, and the constraints on said variation. The classification is based on the aspectual classification of verbs first laid out by Vendler (1967) and Dowty (1979) , which delegate a verb or a subevent into the template of a simple state,

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a simple action; a complex, inchoative/change-of-state achievement; or a complex, causative accomplishment. Rappaport Hovav and Levin posit the following ESs:

(1) a. Activity: [x ACT $_{<MANNER>}$]
b. State: [x <*STATE*>]
c. Achievement: [BECOME [x <*STATE*>]
d. Accomplishment: [[x ACT $_{<MANNER>}$] CAUSE [BECOME [y <*STATE*>]]]
e. Accomplishment: [x CAUSE [BECOME [y <*STATE*>]]]

As these are templates of verbal polysemy, not syntactic or categorical constructions, each verb aligns by default to one of these mappings, which is "determined by the nature of the concept it lexicalises." Rappaport Hovav and Levin spend a considerable amount of time mapping out the differences between 'result' (e.g. *break*) and 'manner' verbs (e.g. *run*) , a distinction not always clear cut (as with *climb*), resulting in most manner verbs prescribing to Activity, and result verbs to Achievement or Accomplishment templates. (Rappaport Hovav and Levin 1998: 104) However, they state that some verbs may be augmented to fill different templates: the result construction, for instance, allows an achievement verb to fit into the accomplishment template, as in (2): (Rappaport Hovav and Levin 1988: 103)

(2) a. Cinderella scrubbed her fingers to the bone.
b. *The clumsy child broke his knuckles to the bone.

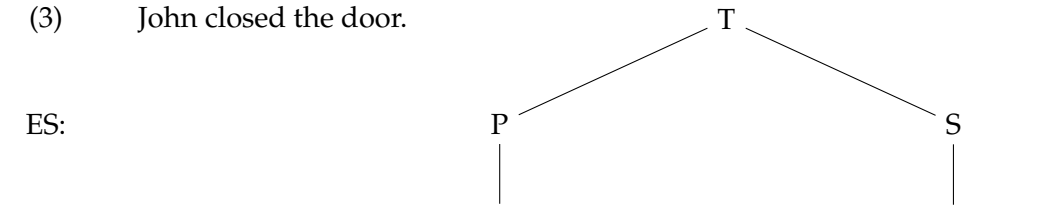
2.2. **Drawbacks.** This system has it's flaws. Rappaport Hovav and Levin submit the Subevent Identification Condition, which demands that "each subevent in the event structure must be identified by a lexical head." (Rappaport Hovav and Levin 1988: 112) They, correctly, do admit that a prototypical argument can be underspecified. (Rappaport Hovav and Levin 1988: 115) However, their model does not specify participants for each subevent, nor does it clearly state how the semantic arguments and events link to the syntax. As well, the $_{<MANNER>}$ and <*STATE*> predicates are not clearly defined: <*STATE*> is identified in different examples as WITH <*THING*>, <*PLACE*>, and <*DRY*>, without adequate expression of the argument slots or their ability to be modified; $_{<MANNER>}$ is used as a specifier of the 'constant' for instrumental, transitive verbs like $_{HAMMER}$, without mapping *hammer* onto an participant. This would be expected for *John hammers the nail*, where a hammer is underspecified syntactically

but understood semantically (that is, the verb constant is inconceivable without an expression of instrumentality). It is also not clear why there are two types of accomplishments: an example for an 'untypical' situation is not presented, even though "accomplishments are complex events composed of two subevents: the causing event - *typically an activity* - and the change of state it brings about." (Rappaport Hovav and Levin 1988: 104 (stress added))

3. PUSTEJOVSKY

3.1. **The Theory.** Pustejovsky (1991) also works with an aspectual system, but he approaches it using a tiered system organised through formal logic. He factors out the event structure (ES) from two lexical conceptual structures (LCS), one an annotaion on the event structure, which essentially maps out the specifications of the arguments (LCS'), and the other with lexicalisation of the participants (LCS). His system has transitions, processes, and states. A transition is a complex event which has an initial process and a resultant state, equivalent to Rappaport Hovav and Levin's "BECOME". A process maps the basic relationships between events and states. The purpose of the tiered nature of the system is to stop erroneous conflation of meaning, and to present a logic-based but psychologically real system. An example of his accomplishment structure is given in (3): (Pustejovsky 1991: 60)

(3) John closed the door.



LCS: cause([act(j, the-door)], become([closed(the-door)]))

3.2. **Drawbacks.** The main flaw in this system is that factoring out the relations between events into a separate tier fundamentally would change the way that the event is conceptualised, as well as changing the participant's relations to events. As well, the temporal relationships between subevents is completely underspecified: Pustejovsky states that the difference between an accomplishment and an achievement is specified in the LCS' (Pustejovsky 1991: 59), such that an accomplishment has [act(x, y)], as in (3), but this disregards the temporal differences, which would most clearly lie in the event structure. This can be seen clearly in *John*

closed the door slowly, where the [act(j, the-door)] must have a different temporal aspect from the transition from [¬closed(the-door)] to [closed(the-door)].

4. Differences and Similarities

4.1. **Linearity and Temporal Relations.** The dichotomy of approaches towards sublexical complexity and representation is shown in the definition of complexity, the mapping of temporal relations, and the layout of the representations. The approach to complex events influences the make-up of the temporal relations and LCSs. "Event complexity has been defined in two ways; either in terms of the result state definition of telicity or in terms of the temporal relations which hold between subevents. " (Rappaport Hovav and Levin 1998: 114) Pustejovsky takes the first view. Because of this, his accomplishments and achievements, present in the ES, are equally complex, as opposed to Rappaport Hovav and Levin's model, which stipulates that an accomplishment is more complex. The trade-off is that Pustejovsky's system imitates conceptual structures more (in the clear representation of the event transitions), and he makes explicit the temporal relations of achievements, albeit in the ES, where the temporal notion is bounded, as that ontological level represents events and states together. Rappaport Hovav and Levin, on the other hand, don't take into account the syntactic linearisation that Pusteyovsky's LCS does, but instead organises subevents by temporal ordering, from left to right, such that there is implicit ordering. None of the events is specified for time out of context of other subevents, however. (Pustejovsky does have a similar ordering, but that is coincidental, brought about by similarities in syntactic and not temporal ordering.) Rappaport Hovav and Levin take the second view of event complexity, as they argue that "this type of event complexity does not matter for argument realisation in the way that the type of event complexity defined by the second approach does."(Rappaport Hovav and Levin 1998: 114)

4.2. **Arguments.** However, the realisation of arguments for subevents is a complex issue in itself. In Predicate logic, predicates are events and states, arguments are their participants. The word argument is ambigous: sometimes this refers to syntactic arguments (as the subject or object), sometimes semantic arguments (henceforth the ER and EE). These are fundamentally different, as semantic representations must work with passive and middle constructions (as well as ergative languages), although they often necessarily coincide.

There is no way to map semantic arguments without a verbal constant, which must specify both the number of participants (Rappaport Hovav and Levin 1998: 108), as well as the qualia,

or semantic features, necessary for those participants (such that in [die(x)], x must be something that has the quality of 'not dead'). Both Pustejovsky and Rappaport Hovav and Levin are guilty of not considering that events which are arguments of other events must themselves have semantic participants: i.e. 'BECOME,' in [x CAUSE [BECOME [y <*STATE*>]]], must have an ER of y. Rappaport Hovav and Levin argue that each subevent must be lexicalised in an argument on the verb (Rappaport Hovav and Levin 1998: pg 113), whereas Pustejovsky makes no such claims, and in his transition structures there are participants that are just actions.

4.3. **Specification.** Rappaport Hovav and Levin also wrongly argue that "the basic idea behind the canonical realisation rules is that the minimal elements of meaning encoded in the constants must be given syntactic expression." (Rappaport Hovav and Levin 1998: 109)This error is exhibited in *John drove home* and *John hammered the board*, where the semantic participants of a *car* (or other locomotive vehicle) and *hammer* are present in the mind, but not in the syntactic expression of the semantic representation. These participants are evoked from the idiosyncratic predicate of the verb, and are underspecified syntactically but not unspecified. The difference is apparent when considering Rappaport Hovav and Levin's definition of result verbs: "There are two types of result verbs: one type lexicalises a resulting state and the other a resulting location. A verb of change of state, such as *break, dry,* or *widen*, as the name implies, lexicalises a particular achieved state, and the verb denotes the bringing about of this state. But though the verb itself denotes the brining about of this state, it leaves the nature of the causing activity involved unspecified." (Rappaport Hovav and Levin 1988: 101-2) Verbs of exchange, such as *send* and *give*, provide other good diagnostics of semantic unspecification and underspecification. In (4), *Mary* can be underspecified, as it is understood semantically but not lexically realised. In (5), *Gary*, the direct object the same as *Mary*, is specified semantically and syntactically, and must be realised in the lexicon.

(4) John sent [*Mary*] the package.

(5) *John gave [*Gary*] the money.

The situation of argument realisation is made more complex by the fact that the verb is not always the predicate, as it's aspectual class is sensitive to other grammatical elements. An example is *I'm not going to drink a beer tonight*, which is a bounded event, versus *I am going to drink beer*, which is unbounded. Drinking, and other verbs, can therefore be underspecified for boundedness, and must refer to the semantic of the sentence, not necessarily the syntax, for

specification.

4.4. **Feature Blending.** Pustejovsky's accomplishments are noted as transitioning from [¬closed(the-door)] to [closed(the-door)]. This is due to an inability (or unwillingness) to specify the lexical features that are shared from a predicate to it's subject. "No existing framework, in my view, proves a *method for the decomposition of all lexical categories*." (Pustejovsky 1991: 53) In order to bypass this, the subject is posited first as the negation of the predicate, such that the transition involves merely a mapping of what the predicate is, and does not involve a definition of those features. Rappaport Hovav and Levin, on the other hand, use 'BECOME', which doesn't clearly specify the features, either, and fails to distinguish between a spreading of relevant feature values with an assimilation of all features. The scope of feature spreading or predicate negation will not enter the purview of this paper, due to space constrictions, but it is clear that further work on this subject is necessary.

5. Theoretical Explanation

If it follows that a good theory is one that explains all of the data, then a mix of Pusteyovsky and Rappaport Hovav and Levin could perhaps offer more than either alone. Pusteyovsky fined tuned his minimalism, but neglected some of the finer details, particularly involving temporal elements and participants. Rappaport Hovav and Levin, on the other hand, failed to suitably provide a general theory, instead splitting up the data into more LCSs than were strictly necessary: a good example of this is the two accomplishment rules, even though for x to influence 'CAUSE' it would have to perform [x ACT $_{<MANNER>}$] in any event (as the nature of 'CAUSE' is underspecified in their system). A proposed theory, then, would need to present suitable processes for the realisation of subevents, as well as a system of mapping each subevent onto it's particular participants, and finally an output that can link it suitably to the syntax - such a system is suggested below.

This system has four functions, each representing a different Vendler-Dowty classification. There are four tiers, but it does not factor out event structure as Pustejovsky does. The first tier specifies the input, which is only of importance in an Accomplishment, when there is a third variable. (Ditransitives are not considered in this system, due to space constrictions). The second tier is the function by which the verb's primitive predicate is called, and the 'constant' features (identified with $_c$) are altered or spread to the participants. This roughly equates to the ES tier in Pustejovsky, and to the implied ESs in Rappaport Hovav and Levin's linear system.

The third tier is the mapping of participants for each event or state: each classification is taken to have embedded within it the lower classification. The linear, embedded nature present in Rappaport Hovav and Levin and Pustejovsky is employed here, as well. The fourth tier is the output, which specifies what arguments can be recalled semantically or syntactically. This is most important for Achievements, where the subject's pre-functional state cannot be recalled, thus performing the function of 'BECOME' or Pustejovsky's transition. This does not entail cognitive memory, which can clearly recall, say, *John*, after the sentence *John died* is processed: what it entails is semantic mapping, such that *John* in *John died* has undergone a change of state. This change is represented by the pre-functional mapping of x as x_1, and the post-functional mapping as x_2.

In this system "the accomplishment representation is the most complex representation." (Rappaport Hovav and Levin 1998: 105) This is most likely due to processing limits, as generally more than two embedded clauses are too complex to parse (evident in the failure to process *John, who the cat, who the dog that the mouse scared didn't like hated ran away*). The justification for the fourth-degree depth in Accomplishments is that 'State(x, y)' can be stored as a variable, as *the bottle being broken* does not have to be syntactically analysed for the parsing of *john broke the bottle*. Finally, it should be noted that in each function tier, a temporal relation is specified as a time index. These (as well as an uncertain (due to space constrictions) amount of features in the predicate) can be modified by adverbials, prepositional phrases, and certain constructions. The resultive construction, for instance, would specify telicity by demanding an extra event for +bounded in the achievement phase, thus positing 'manner' verb in the accomplishment template.

6. THE LCS

Unfortunately,due to space constraints, it was not possible to give more than one example for each classification, and so the constructions are not here properly diagnosed.

A state is the function of $X = x_c + y_c$, where x is the subject and y is the predicate, and $_c$ is the 'constant' qualia of each. The definition or the subject is changed by the function, and that change is the spreading of features from y.

State	
input:	x_1, y
function:	(x_c + y_c)
mapping:	is(x_1, y_c)
output:	x_2

State: *John is yellow*	
input:	John$_1$, +yellow
function:	(John$_c$ + yellow$_c$)
mapping:	is(John$_2$, yellow$_c$)
output:	John$_2$ (who is yellow)

Note that the copula in a state does not need to be specified syntactically.

Event	
input:	x_1, y
function:	(x_1 + y_c), (y_c: time +unspecified)
mapping:	y(State(x_1, y_c))
output:	x_1, x_2, y, y_c

Event: *John danced.*	
input:	John$_1$, Dance
function:	(John$_1$ + dancing$_c$), (dancing$_c$: time +unspecified)
mapping:	Dance(is(John$_1$, dancer$_c$))
output:	John (non-dancer)$_1$, John (dancer)$_2$, Dance, dancing$_c$

'dancing$_c$' is included in the output, as it can be syntactically called as a gerund. An event specifies the manne of existence for a state, with it's own mapped arguments.

Achievement	
input:	x_1, y
function:	Event(State(x_1, y_c)) - x_1, (Event$_c$: time +bounded)
mapping:	y(Event(State(x_1, y_c)))
output:	x_2, y, y_c

Achievement: *John died*	
input:	John$_1$, Die
function:	Event(State(John$_1$, dying$_c$)) - John$_1$, (Event$_c$: time+bounded)
mapping:	die(Event(State(John$_1$, dying$_c$)))
output:	John$_2$(dead), Die, dying$_c$

An achievement verb entails a specification of temporality, with an inability to semantically recall the previous argument as an argument.

Accomplishment	
input:	x_1, y, z
function:	z, Achievement(Event(State(x_1, y_c))), (Achievement$_c$: time +unspecified)
mapping:	y(z, Achievement(Event(State(x_1, y_c)))
output:	z, y, y_c, x_2

Accomplishment: *John broke the bottle*	
input:	John, Break, Bottle$_1$
function:	John, Achievement(Event(State(bottle$_1$, breaking$_c$))) (Achievement$_c$: time +unspecified)
mapping:	Break(John, Achievement(Event(state(bottle$_1$, breaking$_c$)))
output:	John, Break, break$_c$, bottle(broken)

7. SUMMARY

Pustejovsky's and Rappaport Hovav and Levin's theories come from different standpoints. Pustejovsky acknowledges the four main terms of aspectual classifications, and then seeks the most minimal theory to encapsulate them in general. Rappaport Hovav and Levin seek to provide templates the cover all possible sublexical polysemic constructions, and so have sacrificed generality for detail. In doing so, they put more meaning into the lexical: their verbs are split into 'manner' and 'result' groups, the first of which Pustejovsky equates merely to a simple process. He puts meaning somewhere else from event complexity - but his representations are necessarily linear, as there is no ordering. The claim of event ordering is in the event structuring of the representation, whereas in Rappaport Hovav and Levin the event ordering is actually in the template.

The theory presented in this paper seeks to bridge the divide between these two theories by clearly mapping out arguments, by specifying the manner of feature spreading, by indexing temporal quality for each event, and by attempting to link up the semantic arguments with syntactic input. It is hoped that the algorthmic application of such a model illuminates the need for further work and clarification of the present representations of lexical complexity structures.

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