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Aspectual Coercion and Logical Polysemy

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Abstract

Recent work in computational semantics and lexical semantics has made an interesting shift. Motivated by a concern for lexical organization and global coherence in the structure of the lexicon, some researchers have moved towards more expressive semantic descriptions, as well as more powerful methods of composition. There has been some concern expressed, however, as to the general applicability of type-changing operations such as coercion, as well as concerning the power of generative mechanisms operating in the lexicon and semantics. In this paper, we address these concerns directly, and show that, upon closer examination, these critiques are not substantiated by the linguistic data. Without a proper notion of constraints on coercion, however, there can indeed be overgeneration of interpretations in the semantics, and in fact the notion of conditions on coercion has always been integral to the basic spirit of generative lexicons. In particular, we examine the constraints on type coercion in complement constructions of aspectual predicates in English and French. What we discover is a natural explanation for the behavior of coercion that makes reference to different types of event selection while also addressing the polysemous nature of aspectual verbs.

1 POLYSEMY AND SEMANTIC EXPRESSIVENESS

Recently, work in computational semantics and lexical semantics has made an interesting shift. Motivated by a concern for lexical organization and global coherence in the structure of the language lexicon, some researchers have moved towards more expressive semantic descriptions, as well as more powerful methods of composition.[1] There has been some concern expressed, however, as to the general applicability of type-changing operations such as coercion, as well as concerning the power of generative mechanisms operating in the lexicon and semantics. In this paper, we address these concerns directly, and show that, upon closer examination, these critiques are not substantiated by the linguistic data. Without a proper notion of constraints on coercion, however, there can indeed be overgeneration of interpretations in the semantics, and in fact, the notion of conditions on coercion has always been integral to the basic spirit of generative lexicons. In particular, we examine the

constraints on type coercion in complement constructions of aspectual predicates in English and French. What we discover is a natural explanation for the behavior of coercion that makes reference to different types of event selection while also addressing the polysemous nature of aspectual verbs.

We will assume some general familiarity with the framework of a generative lexicon (GL), as outlined in Pustejovsky (1991a, 1993), and Copestake (1993). We feel it is important, however, to clarify the motivating principles and general methodology behind this work, since it is crucial to the analysis taken in this paper. The empirical study of the range and limits of type change and co-composition operations in natural language is an essential part of research in formal semantics. The advantages accompanying generative mechanisms and the characterization of languages as polymorphic in well-defined ways allow us to overcome the explanatory inadequacies inherent in traditional approaches to lexical design and semantic projection, what Pustejovsky & Boguraev (1993) call *word sense enumeration* approaches.

In order to help characterize the generative power of natural languages in terms of semantic expressiveness, it is natural to think in terms of semantic systems with increasing functional power. Furthermore, a natural way of capturing this might be in terms of the type system which the grammar refers to for its interpretation. There are reasons for describing semantic systems as falling on a hierarchy of increasing expressive power and it seems clear at this point that the current enumerative techniques for lexical description are too impoverished adequately to describe the richness of semantic data, much less to explain either how word senses relate to one another or the creative use of words in novel contexts.

A generative lexicon of the type we assume can be characterized as a system involving at least the following four levels of representations:

1. **Argument structure**: Specification of number and type of logical arguments.
2. **Event structure**: Definition of the event type of a lexical item or phrase. Sorts include STATE, PROCESS, and TRANSITION.
3. **Qualia structure**: Composed of FORMAL, CONSTITUTIVE, TELIC and AGENTIVE roles.[2]
4. **Lexical inheritance structure**: Identification of how a lexical structure is related to other structures in the type lattice.

A set of generative devices connects these four levels, providing for the compositional interpretation of words in context. The exact nature of these devices will determine the polymorphic expressiveness of the semantics in fairly definite ways. The best-studied illustration of this is the phenomenon of *type coercion*, but it is by no means the only one.

Copestake & Briscoe (1992) model the mechanisms of generative lexicon

theory as a type system for a lexical knowledge base. Pustejovsky & Boguraev (1993) extend this view into the compositional semantics by having the operations make direct reference to the types within the system. The qualia structure along with the other representational devices (event structure and argument structure) can be seen as providing the building blocks for possible object types. The typing information mentioned above comes together in the lexical representation for verbs as well.

2 LINGUISTIC EVIDENCE FOR COERCION

The phenomenon of multiple subcategorization has motivated much of the type changing literature. The approach taken in generative lexicon theory builds on the ideas developed by Partee & Rooth (1983) and Klein & Sag (1985), while attempting to derive the syntactic expression of a verb's complement from a deep semantic type assignment, together with syntactic constraints. For example, in the well-studied case of aspectual verb complementation in (1) and (2) below, the verbs *begin* and *commencer* carry a 'deep type' selecting for an event in complement position.

(1) a. John began to read the book. (VP[+INF])
    b. John began reading the book. (VP[+PRG])
    c. John began the book. (NP)
(2) a. Jean a commencé à lire le livre. (VP[+INF])
    b. Jean a commencé le livre. (NP)

This deep type is able to project to one of three possible surface forms in English, and two forms in French, depending on which coercion rule applies. There is, however, only one semantic type being selected for, and the clustering of the particular syntactic forms appearing as surface complement types in (1) and (2) are systematically projected by virtue of this semantic type. That is, a verb such as *begin* or *commencer*, selecting for an event, will paradigmatically allow for the expression of the grammatical forms shown above, assuming surface syntactic constraints are satisfied. For this reason, the structuring of this kind of linguistic knowledge, where this event type has syntactic expression as any one of the surface types in (1) or (2) is called a *lexical conceptual paradigm* (*lcp*) (cf. Pustejovsky & Anick, 1988).

In this view, the NPs, *the book* in (1c) and *le livre* in (2b), are coerced to the appropriate type required by its governing verb, in this case an event. What makes coercion possible in these cases is the availability of the selected type, given as part of the NP's *qualia structure*, indicating, for example, that the TELIC role for *book* is the event of reading, while the AGENTIVE role is an event of writing. The result of applying this coercion operator to an NP is effectively to

create an *extension* of the NP meaning, called a *metonymic reconstruction*. In the case of NP, *the book*, for example, the coercion operators provide two event interpretations, namely, *reading the book* and *writing the book*. This interpretation is produced by virtue of the type of the selected complement and the availability of such types in the qualia structure of the complement itself. It is important to point out that this is a semantic 'reconstruction' rather than a syntactic one.

3 PROBLEMS WITH UNCONSTRAINED COERCION

There are several phenomena discussed in the literature which would apparently suggest that type coercion is not a general interpretative strategy for compositional semantics. In this section, we review these apparent counter-examples and discuss each briefly to show why they are nonproblematic. We will concentrate, however, on the selectional properties of aspectual verbs such as *commencer* and *begin*, in order to show very clearly that sense enumerative approaches, such as that taken by Godard & Jayez (1993) are unable to capture linguistic and computational generalizations, with respect to how the lexicon contributes to the compositional semantics of natural language.

NP complement coercion. The first apparent counterexamples to the general application of type changing operations argue that *commencer* does not universally allow NP complements with a coerced interpretation (cf. Goddard & Jayez, 1993). For example, the NPs in (3) below do not appear to allow the analogous coerced readings that the sentences in (1) and (2) allow. Although the qualia for *highway* and *dictionary* presumably make reference to the events of driving and referencing, respectively, these interpretations are not available for the sentences in (3) and (4). Thus, the system would appear to overgenerate interpretations when no constraints on the application of type coercion operations are imposed.

(3) a. *Mary began the highway. (*driving on*)
    b. *John began the dictionary. (*referencing*)
(4) a. *Marie a commencé l'autoroute.
    b. *Jean a commencé la dictionnaire.

What these data show is that the acceptability of coercion with aspectual predicates such as *commencer* and *begin* is conditioned largely by the telicity of the event which is metonymically reconstructed in the complement position. Essentially, these verbs select for an event of the sort TRANSITION, ruling out the coerced complement interpretations of *drive on the highway* for (3b) and (4b), and *consult the dictionary* for (3c) and (4c), which are both PROCESS events.[3]

Observe that the sentences in (3) and (4) do have legitimate coerced readings with transitional 'create' interpretations, such as *building a highway* and *compiling a dictionary*. Constraints due to 'boundedness' of the predicate (sentences (5a) vs. (5b) and (6a) vs. (6b)) are also consistent with conditions on coercion. Observe that mass noun and bare plural NPs in complement position are not acceptable as possible coercions.

(5) a. *John began the cheese (*eating*) / the book (*reading*).
    b. John began cheese (*eating*) / books (*reading*).
(6) a. Jean a commencé le fromage / le livre.
    b. *Jean a commencé du fromage / des livres.

In these sentences, the homomorphic relation between the NP type in (5b) and (5a) (mass vs. count) and the event type gives rise to process and transition interpretations of event structures, respectively (corresponding roughly to the amorphous and bounded readings within Krifka's 1992 analysis). That is, the mass NPs in (5a) and (6a) (*cheese*, *books*, *du fromage*, and *des livres*), when metonymically extended with their qualia, emerge as PROCESS or amorphous event types (i.e. 'eating cheese' and 'reading/writing books'). The count NPs in (5b) and (6b), on the other hand, emerge as TRANSITIONS or bounded events (i.e. 'eating the cheese' and 'reading/writing the book').

Finally, there would appear to be constraints on coercion which suggest that agentivity may play an important role in licensing the operation. For example, as pointed out by Godard & Jayez (1993), sentences such as (7) and (8) are ill formed:

(7) a. *The acid is beginning the marble. (*corroding*)
    b. *John is beginning the noise. (*being annoyed by*)
(8) a. *L'acide commence le marbre.
    b. *Jean commence le bruit.

In the discussion below, we show that the sentences in (7) and (8) are actually raising constructions rather than control structures, and that such constructions do not allow coercion at all.

Experiencer predicates. A second argument against coercion might appear to come from the selectional properties of experiencer predicates. Consider the sentences in (9) below.

(9) a. Books bore me.
    b. The movie frightened Mary.
    c. John's face scared me.
    d. Listening to Mary bores Alice.

While it seems straightforward to admit that verbs like *begin* select an activity of some sort in all their subcategorization forms, what common selectional

property would relate the different subject types in (9)? The answer is in fact very similar to that for verbs such as *begin*. We can view these sentences as involving a metonymic reconstruction of the subject to an event and, in particular, to an experiencing event between the surface object and the surface subject. That is, in (9), it is (*my reading*) *books* which bores me, (*Mary's watching*) *the movie* which frightened her, (*my seeing*) *John's face* which scared me, and (*Alice's*) *listening to Mary* which bores her.[4]

Thus, it seems that the linguistic evidence supports an underlying semantic type of an event as the subject, which would directly explain what the connection between the subject and object of the experiencing relation is. In Pustejovsky (1991b), it is suggested that the underlying semantics of psychological predicates such as *bore*, *anger*, and *frighten* is a causative structure where the surface subject is the logical object of an experiencing event. On this view, the lexical representation for the verb *anger* has something like the following form, where $Exp(x, y)$ is a sortally restricted relation of experiencing (e.g. hearing, seeing, watching, etc.), and $<$ is a strict partial order of temporal precedence.

(10) $\Box\forall x\forall y\forall e\,[anger(e, y, x)] \rightarrow \exists e_1\exists e_2\exists Exp\,[Exp(e_1, x, y) \wedge \neg angry(e_1, x) \wedge angry(e_2, x) \wedge \neg e_2 < e_1]$

This states that a verb such as *anger* involves someone directly experiencing something, and as a result becomes angry. What is interesting about examples such as (9a) and (9b) is that the semantics of the NP in surface subject position contributes information to the interpretation of what kind of experiencing event is involved. That is, the qualia structure projected by the NP *books* contributes to the particular manner in which I became bored in (9a), namely the NP's TELIC role of *reading*. Similarly, our knowledge of movies as something that we watch and experience in a particular manner is encoded in the TELIC role of *movie* in sentence (9b). The event projected from the noun *movie*, viz. *watch*, in turn satisfies the selectional requirements of the verb *anger* on its subject.

Adjectival selection. A third argument against coercive operations involves examples such as *a long novel* and *a bright bulb*. If adjectives such as *long* in this case are analyzed as event predicates, as suggested in Pustejovsky & Anick (1988), where *long* modifies the activity of reading a novel, then there would appear to be a problem with selection in sentences such as (9), where the verb *acheter (buy)* selects for an individual while *long* selects for an event. The question is, how can the head of the NP possibly denote both an event and an individual, since such sentences are perfectly natural?

(11) Jean a acheté un long roman.
'John bought a long novel.'

What these adjectives demonstrate is not a violation or puzzle for coercion and selection; rather, they serve to illustrate the selectional properties of different classes of adjectives, as modifying different facets or qualia of the head. Modification by an adjective such as *long*, *rapide (fast)*, or *brillant (bright)*, can be seen as event predication, submodifying the appropriate quale of the head.[5] The adjectives in these cases modify a distinguished event predicate (i.e. the TELIC quale) associated with the head, *read* for *book*, and *illuminate* for *bulb*. Thus, *a long book* is interpreted as one taking a long time to read, while *a bright bulb* is a bulb which shines brightly when illuminated. These adjectives, on the other hand, should be contrasted with modifiers such as *expensive* in *an expensive book* and *opaque* in *an opaque bulb*, both of which refer to the physical object rather than an activity or state associated with the object. These adjectives can be seen as modifying the FORMAL role of the qualia for these nouns. Given this discussion, it should not be surprising that an entire NP can appear in an environment typed for an individual (e.g. as the object of *buy*), while its head is modified by an event predicate within the NP (e.g. as modified by *long*). Assume that the lexical semantics for the noun *novel* is that given in (10) below:

(12) a. $\lambda x[novel(x) \wedge \text{CONST} = narrative'(x) \wedge$
$\text{FORM} = book'(x) \wedge$
$\text{TELIC} = \lambda y, e^T[read'(x)(y)(e^T)] \wedge$
$\text{AGENTIVE} = \lambda y, e^T[write'[x](y)(e^T)]]$

The analysis of adjectives such as *long* and *bright* does not change or shift the overall type of the NP, as illustrated in (11) below:

(12) b. $\lambda x[novel(x) \ldots \wedge$
$[Telic = \lambda w, e^T[read(x)(w)(e^T) \wedge long(e^T)]] \ldots]$

The reading in (11) specifies that the event of reading is modified by the event predicate *long*. The resulting compositional structure is still the type of the whole NP, and has no effect whatsoever on selection by an outside governor such as *acheter (buy)* as in (11). That is, verbal selection and event modification are operating within different predicative domains. While the matrix verb *acheter* selects for an individual such as a physical object, within the NP, an event predicate such as *long* can submodify the TELIC event associated with the object (namely, reading) while not affecting the overall type of the NP.

In what follows, we demonstrate how the apparent violations of the coercive behavior of aspectual predicates actually reveal a much deeper semantic distinction between two logically related senses of the verb in all the complement forms they select, and not just NP complement cases, which can be applied *mutatis mutandis* to *commencer*. We will show that this distinction is due to the event structure of the complements selected by the aspectual

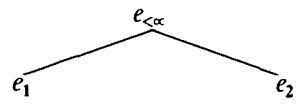
predicates. We also demonstrate why *commencer* and *finir (finish)* allow coercion while *cesser (cease)* and *arrêter (stop)* do not.

4 THE RELEVANCE OF EVENT STRUCTURE

In order to understand better the behavior of aspectual coercion, we review our assumptions regarding the structure of events as encoded by lexical items. We begin with the uncontroversial assumption that events can be subclassified into at least three sorts: *processes*, *states*, and *transitions*. Furthermore, we assume, following Pustejovsky (1991b), a *subeventual* structure to these event sorts as well. This has the advantage of allowing principles of predicate-argument binding to refer to subevents in the semantic representation, a move which has significant theoretical consequences (cf. Moens & Steedman 1988; Grimshaw 1990; Pustejovsky 1991b; and Moens 1987). Evidence from unaccusativity, aspectual predicates, and the varied nature of causative constructions show, however, that even this notion of event structure does not fully explain the underlying behavior of semantic projection to argument positions in the syntax. We will adopt an event structure analysis employing the notion of *headedness* in order to account for the richer range of syntactic behavior.

In Pustejovsky & Busa (1994), the event constructions first introduced in Kamp (1980) and van Benthem (1983) are extended to a model called an 'extended event structure' in order to represent the relation between an event and its proper subevents. An extended event structure is a tuple, $<E, \leq, <, \circ, \sqsubseteq, *>$, where E is the set of events, $\leq$ is a partial order of *part-of*, $<$ is a strict partial order, $\circ$ is overlap, $\sqsubseteq$ is inclusion, and $*$ designates the 'head' of an event, to be defined below. This model provides a formal interpretation for the event representations with structured subevents such as those in Pustejovsky (1991b), shown in (13) below.[6]

(13)



An *event tree structure* can be defined in terms of (at least) one of three relations: (1) that of 'exhaustive ordered part of', $<_\alpha$, if there is strict precedence on the ordering of the events involved (such as the verb *break*, for example); (2) that of 'exhaustive overlap part of', $\circ_\alpha$, where the lexical item encodes an event containing two completely simultaneous subevents; and (3) that of 'exhaustive ordered overlap', $<_{\circ\alpha}$, where an event contains two basically simultaneous subevents, e_1 and e_2, where e_1 starts before e_2. We shall see that because of this partial ordered relation, a type of causative relation exists beween the subevents,

and it is just such a relation that is involved with aspectual predicates such as *begin* and *commencer*, as we shall argue below.

The other notion which is critical to understanding the selectional properties of aspectul predicates is that of *event headedness*. Event headedness, first introduced in Pustejovsky (1988), provides a way of augmenting the event structure with some way of indicating a type of foregrounding and backgrounding of the subevents. We can view an event structure as providing a configuration where events are not only ordered by temporal precedence, but also by relative prominence. One notion of prominence for an event we will entertain is that of a *head*, *. The conventional role of *head* in a syntactic representation is to indicate prominence and distinction. Rules of agreement, government, etc. militate in favor of marking structures in terms of heads of phrases. Within the interpretative domain of events when viewed in a structural or configurational manner, the possibility of referring to heads also becomes available. Informally, the head can be defined as the most prominent subevent in the event structure of a predicate, which contributes to the 'focus' of the interpretation. We can view * as a relation between events, $*(e_i, e_j)$, where $e_i \leq e_j$:

$$*(e_i, e_j) =_{def} [e_j, \ldots e_i^* \ldots]$$

Headedness is a property of all event sorts, but acts to distinguish the set of transitions, specifying what part of the matrix event is being focused by the lexical item in question. Given that transitions have a binary event structure, there are four possible head configurations, where we mark the head with an asterisk:

(14) a. *build*: ε^{*T}
b. *arrive*: ε^{T*}
c. *give*: ε^{*T*}
d. *break*: ε^{T}

Intuitively, structure (14a) represents accomplishment verbs, where the focus is on the action bringing something about; (14b) represents achievement verbs, for which the persistence of the final state is the focus of interpretation; (14c) illustrates events involving relational statements on each subevent; and (14d) is the representation which is crucial to the analysis of verbs as logically polysemous.[7] In terms of event structure, polysemy occurs where the expression is lexically unspecified with respect to headedness, i.e. headless. A headless event is an underspecified representation which admits of two possible interpretations. More generally, a predicate should be as many ways ambiguous as there are potential heads in the associated event structure. Support for this view comes from data on unaccusatives and causatives in Italian and other languages. Unaccusatives such as the verb *arrive* are specified as lexically right-headed

events and have no lexical causative counterpart. Verbs such as *sink* and *break*, however, appear in both unaccusative and causative constructions, due to the headless nature of the underlying event structure associated with the verbal semantics.

5 COERCION WITH ASPECTUAL VERBS

In this section, we examine in more detail the behavior of the three French and English aspectual verbs *commencer (begin)*, *finir (finish)*, and *arrêter (stop)* with respect to complement selection and coercion. In particular, we observe that *commencer* and *finir* and *begin* and *finish* permit NP coercion while *arrêter* and *stop* do not. We see that both *commencer* and *begin* and *arrêter* and *stop* are polysemous between both raising and control senses, and we show why this polysemy exists.[8] Interestingly, however, while the English verb *finish* exhibits only a control reading, we observe that the French verb *finir* appears to be polysemous between control and raising senses, but in fact is strictly a control verb.

We saw in Section 3 how *commencer* and *begin* allow both VP and NP complements, the latter which we analyzed as resulting from type coercion (cf. (1) and (2) repeated below):

(1) a. John began to read the book. (VP[+INF])
    b. John began reading the book. (VP[+PRG])
    c. John began the book. (NP)
(2) a. Jean a commencé à lire le livre. (VP[+INF])
    b. Jean a commencé le livre. (NP)

The aspectual verbs *finir* and *finish* also allow multiple complements types, patterning in a similar fashion (cf. (15) and (16)):

(15) a. He has finished reading the book. (VP[+PRG])
     b. He has finished the book. (NP)
(16) a. Il a fini de lire son livre. (VP[+INF])
     b. Il a fini le livre. (NP)

Like *commencer* and *begin*, they also permit certain bounded NPs as complements but disallow coercion with the same class of NPs prohibited by *commencer* and *begin*, as illustrated in (17) and (18) below.

(17) a. *I finished the symphony. (*listening*)
     b. I finished the chocolate. (*eating*)
     c. *I finished chocolate. (*eating*)

(18) a. *J'ai fini la symphonie.
b. J'ai fini le chocolat.
c. *J'ai fini du chocolat.

Now consider the verbs *arrêter* and *stop*, which do not allow this type of coercion at all (cf. the ungrammaticality of (19b) and (20b)).

(19) a. Madame a arrêté de verser le thé.
Madame stopped steeping the tea.
b. *Madame a arrêté le thé.
*Madame stopped the tea.
(20) a. Jean a arrêté de lire le livre.
Jean stopped reading the book.
b. *Jean a arrêté le livre.
*Jean stopped the book.

Upon examination of the above data, the immediate question that comes to mind is this: why does coercion, if it indeed applies in these contexts, seem so idiosyncratic in its application with the verbs *commencer*, *begin*, *finir*, and *finish*, and why does it not apply at all with the verbs *arrêter* and *stop*? In order to answer this question, we will tease apart the syntactic contexts in which coercion is applying by differentiating two senses of aspectual predicates. We will see that this distinction plays an important role in determining whether a predicate licenses coercion or not.

We will argue that there are two different but logically related types of aspectual verbs, *control* and *raising* verbs, and that only the former allows coercion. The idea of analyzing aspectual verbs as essentially ambiguous is not new, but was already proposed by Perlmutter (1970) for English and Lamiroy (1987) for French. The traditional method for distinguishing between control and raising verbs involves a battery of diagnostics testing for selection, agentivity, and controllability (cf. Dowty 1979 and Zaenen 1993). Perhaps the best indicator of a raising predicate is that it imposes no selectional restrictions on its subject, as illustrated with the verb *seem* in (21).

(21) a. The lake seems to have frozen.
b. A riot seems to have happened yesterday.
c. This fact seems to have escaped Mary's attention.

The subject in each sentence in (21) is restricted by the embedded predicate in the VP selected for by the verb *seem*. A control predicate, on the other hand, imposes clear and obvious restrictions on the subject NP (cf. (22)):

(22) a. Mary tried to leave the party.
b. *A riot tried to happen yesterday.

There are also syntactic constraints imposed by control predicates that are absent in raising constructions:[9]

(23) a. There seems to be a riot going on now.
b. *There attempted to be a riot.

Perlmutter (1970) mentions *force*-complement constructions as another clear indication of a control verb. Compare the sentences in (24a) to that in (24b).

(24) a. Mary forced John to begin writing his thesis.
b. *Mary forced it to begin raining yesterday.

The sentence in (24a) illustrates that the matrix object stands in a control relation to the embedded VP. Observe, however, that the ungrammatical sentence in (24b) illustrates that a 'raised' NP cannot satisfy the selectional constraints imposed by *force*. The same facts hold with the verb *obliger (force)* in French, as well, where (25a) shows a legitimate control relation with the embedded *commencer*-predicate, while the raising construction in (25b) results in an ungrammatical structure.

(25) a. Je t'oblige à commencer à lire le livre de Proust.
I am forcing you to begin reading the book by Proust.
b. *Je l'oblige à commencer à pleuvoir.
*I am forcing it to begin to rain.

The well-formedness of object complement coercion with aspectual predicates such as *commencer* is conditioned by the event sort of the qualia associated with the NP itself. Thus, only NPs having associated transition events will allow coercion and control. This is not to say, however, that *begin* selects only for transition events. There are, of course, perfectly grammatical examples of process or state complements, as shown in (26) and (27) below:

(26) a. L'acide commence à corroder le marbre.
The acid is beginning to corrode the marble.
b. Il commence à pleuvoir.
It is beginning to rain.
c. La neige a commencé à tomber à minuit.
The snow began to fall at midnight.
d. La guerre commence à atteindre la Bosnie.
The war is beginning to reach into Bosnia.
e. Jean commence à perdre du sang.
John is beginning to bleed.
f. Jean commence à être ennuyé par le bruit.
John is beginning to be annoyed by the noise.

g. Jean commence à être malade.
John is beginning to be ill.

The above examples illustrate the use of *begin* as a raising verb. The two senses of the verb *begin* conform to the distinction that Perlmutter originally made, namely, as either a *raising* or a *control* verb.[10] As a raising verb, the event sort specified as the complement to *commencer* and *begin* may be any sort. As a control verb, it appears that the complement must be a TRANSITION.

There do appear to be some counterexamples to this basic distinction. Sentences such as (27a) and (27b) appear to have a control component to their interpretation, even though the complement event-type in each case is atelic.

(27) a. Jean commence à chercher du travail.
John is beginning to look for a job.
b. James a commencé à travailler à Brandeis en 1986.
James began to work at Brandeis in 1986.

Notice, however, that although verbs such as *look for* in (27) and *work on* in (28) are indeed atelic,

(28) a. Mary is working on a book.
b. Mary is beginning to work on a book.

their semantics incorporates an obvious 'telicity' in the qualia sense. That is, the intensional context involves mention of the goal state, or TELIC role of the activity. For example, the relation *look-for(x, y)* modally incorporates the relation *have(x, y)*; similarly, in (28), *work-on(x, y)* modally incorporates the goal state of *exist(y)*. Hence, in some sense, the aspectual classification of these predicates as simple processes does not reflect this goal-oriented property. In order to explain the behavior of these verbs with respect to controllability in the sentences in (27a) and (28a), we refer to this class of predicates as *intensionally telic*, and suggest that this is why control readings are acceptable.[11] That is, it is due to this implicit goal state that these verbs pass the tests for controllability.

Let us turn finally to sentences such as (27b). Is this a true counterexample to the claim that control with *begin* involves a transition event-type? We argue that it is not, and that this is actually an example of raising with a potentially agentive subject. For notice that raising does not preclude all agentive force on the predicate. Even canonical cases of raising, such as (29a) below, can be construed as involving a certain amount of potential agency on the part of the subject. Yet, we still would not want to claim that they are control contexts, as (29b) makes clear.

(29) a. John began to feel ill from eating too much food.
b. *Mary forced John to begin to feel ill from eating too much food.

Interestingly, (30a) also has only a marginal *force*-complement construction compared to the same construction with *start*:

(30) a. ?Mary forced James to begin working at Brandeis.
b. Mary forced James to start working at Brandeis.

What this suggests is that, given sufficiently strong reasons for accepting the analysis of control *begin* as selecting for transitions only, then such cases as (27b) can be legitimately classified as raising cases, as argued above.

Finally, as pointed out in Jacobson (1990), VP-ellipsis can be used as a diagnostic for determining whether a complement is part of a raising or control construction in English; namely, only control complements enter into the construction. Notice that in (31), the only fully grammatical sentence involves an overt control interpretation of *begin*, (31b).

(31) a. *John began to bleed and Mary began, too.
b. John began to read the book, and Mary began, too.

What this discussion illustrates is that there are indeed two constructions at play here—control and raising—which are teased apart by certain diagnostics, namely VP-ellipsis and the *force*-complement construction.

In order to understand the significance of this distinction more clearly, let us review some of our theoretical assumptions. We assume a system of types similar to Montague's intensional type system, augmented with event types with sortal specifications. While the type ⟨e, t⟩ is conventionally interpreted as an unsaturated proposition (i.e. a *propositional function*), for purposes of this discussion, we will treat the sentences below as denoting events of some sort, ε^a; unsaturated events will be analyzed in an analogous fashion as *eventual functions*, ⟨e, ε^a⟩.[12] We will argue that the following typing assignments characterize the distinction between these two senses:[13]

(32) a. *begin* as a Control verb: ⟨⟨e, ε^T⟩, ⟨e, ε^T⟩⟩
b. *begin* as a Raising verb: ⟨ε^a, ε^T⟩

The type in (32a) specifies that the verb selects for an unsaturated event of sort TRANSITION in object position, and an individual in subject position. The resulting type is an event of sort TRANSITION. The type in (32b), on the other hand, specifies that the verb selects for a saturated event.

Something more needs to be said, however, to explain the sentences in (33). Only left-headed TRANSITIONS, which make reference to a predicate opposition and the activity of an individual bringing about this change seem possible with the control sense of these verbs. Notice that right-headed TRANSITIONS are only possible with the raising interpretation and not the control reading, and preferably if they shift to PROCESS readings:

(33) a. ??Je commence à arriver.
?I am beginning to arrive.
b. Les invités commencent à arriver.
The guests are beginning to arrive.
c. *Je commence à trouver la clé de la maison.
*I am begining to find the house key.
d. Je commence à trouver des poux sur mon chien.
I am beginning to find fleas on my dog.

This shift is possible with *degree-achievements* (cf. Dowty 1979) or in the presence of a plural indefinite or mass noun in the subject or the object (cf. Krifka 1992; Moens 1987; Pustejovsky 1991). These seem much worse in French than in English as raising constructions, but the significant observation is that the control reading is impossible with these verbs. These data would suggest that the control sense of *begin* selects for a complement that is a left-headed TRANSITION, ε^{*T}, while the raising sense selects for a complement of any event sort.

It is natural at this point to ask why aspectual verbs such as *commencer* and *begin* have both these two senses, and whether it is an accidental lexical ambiguity or a logical polysemy. We argue that these two senses are not arbitrary types but are logically related to one another in the same way that the different senses of unaccusative/causative verbs, such as *break* and *sink* are related. In Pustejovsky & Busa (1994) it is shown that verbs such as *break* and the Italian *affondare (sink)* are logically polysemous in predictable ways, and do not need to be assigned multiple lexical entries. For example, verbs exhibiting the causative/unaccusative alternation (cf. Levin 1993) are analyzed as cases of logical polysemy. That is, both intransitive and transitive forms of verbs such as *break* are taken as underlyingly causative. The statement in (34) captures the underlying semantics of causation involved in those predicates that enter into the causative/inchoative paradigm:[14]

(34) *Default Causative Paradigm (DCP)*:

$$\forall R, P, x, y[[R(e_1, x, y) \wedge \neg P(e_1, y) \wedge P(e_2, y) \wedge \neg e_2 <e_1] > cause(e_1, e_2)]$$

We take this to be one paradigm for the semantics of causal relations as encoded in lexical items. In a lexical entry embodying this conceptual paradigm, all the arguments as well as the subevent types of each relation in the DCP will be coherently bound in the qualia to the AGENTIVE role, which denotes the cause, or to the FORMAL, which denotes the effect:[15]

(35) $\lambda y \lambda x \lambda e_1 \lambda e_2 \exists P \exists R [\alpha$: FORMAL $= [P(e_2, y)] \wedge$ AGENTIVE $= [R(e_1, x, y)]]$

This says that a predicate α is a relation between two subevents and two individuals such that some relation exists between x and y in the 'bringing

about' (the AGENTIVE role) of the resulting state of y (the FORMAL role), where this state, $P(e_2, y)$ did not hold before.[16] This representation is underspecified, however, in that there is no event head in the structure. In fact, it is this semantic underspecification which gives rise to the polysemy exhibited by these predicates. By heading (or focusing) the initial event, associated with AGENTIVE, a causative template arises. By heading the final event, however, associated with FORMAL, an unaccusative structure arises (cf. Pustejovsky & Busa 1994 for details).

A similar analysis holds for verbs such as *commencer*, which exhibit a logical polysemy between control and raising senses. We will view *commencer* as the lexical version of an unaccusative marker, but for events rather than for entities.[17] Underlying the lexical representation for verbs that exhibit control and raising behavior is a deep or underlying causative. The alternation displayed above is licensed by the headless nature of the event structure representation of the predicate *commencer*. Whether it surfaces as a raising verb or a transitive control verb will be determined by which subevent is headed. In this view, then, the core lexical representation for *commencer* is given below, where the variables P and R are unspecified predicates, and there is no headed event.[18]

(36) $\lambda x \lambda P \lambda e_2 \lambda e_1 \exists R \exists P$[commencer: ES $= e_1 <_{\infty} e_2 \wedge$ FORMAL $= [P(e_2, x)]$
$\wedge$ AGENTIVE $= [R(e_1, x, e_2)]]$

If the initial event is headed, a control structure results. If, however, the final event is headed, a raising construction results. In the next section, we demonstrate how this underspecified semantic representation is responsible for both control and raising constructions for aspectual predicates such as *commencer*, and the constraints on coercion in these constructions.

6 THE SEMANTICS OF ASPECTUAL COERCION

Let us now examine in more detail the semantics of aspectual raising and control constructions. We assume that there are two typings for *commencer*, as shown above in (28), and that they are logically related senses by virtue of the semantic representation given above in (36).

The phenomenon of coercion described above is similar, in some respects, to *subtyping* polymorphism as encountered in examples such as (37) below.[19]

(37) a. Mary drives a Honda to work.
b. Tom read the *Tractatus* on holiday.

Assuming that the internal type selected by the verb *drive* in sentence (37a) is *vehicle*, as illustrated in the typing for the verb:

TYPE(drive) = $\langle$*vehicle*, $\langle$*person*, $\varepsilon^{\sigma}\rangle\rangle$

then the selectional requirements can be satisfied just in case there exists a subtyping relation, *Honda* $\leqslant$ *vehicle*, formally relating the type of the actual object to the lexically specified type.

Let us call G the typing judgements with respect to a grammar. Then, by convention, $G \exists \alpha : \tau$ represents a type assignment of τ to the expression α. The typing relation between the subtype *Honda* and the type selected by the governing verb *drive* is respected by the coercion relation Θ, giving Θ [*Honda* $\leqslant$ *vehicle*] : *Honda* $\rightarrow$ *vehicle*.[20] Similarly, in (36b), *Tractatus* $\leqslant$ *book* $\leqslant$ *text* defines a relation between the type selected by the verb *read* and the actual individual. This is an instance of the more general subtyping coercion operation, illustrated below:

$$(38)\quad \frac{G \vdash \alpha : \sigma_1,\ G \vdash \Theta[\sigma_1 \leqslant \sigma_2] : \sigma_1 \rightarrow \sigma_2}{G \vdash \Theta[\sigma_1 \leqslant \sigma_2](\alpha) : \sigma_2}$$

This says that, given an expression α of type σ_1, which is a subtype of σ_2, there is a coercion possible between σ_1 and σ_2, which changes the type of α in this composition, from σ_1 to σ_2 (cf. Beierle *et al*. 1992). We will illustrate the further application of this coercion operation below, in conjunction with metonymic reconstruction coercion.

It should be pointed out that, although subtyping polymorphism and metonymic reconstruction coercion are similar, in that they enable the variable functionality of a lexical item to be expressed in a single form, they are formally quite different. Subtype coercion follows the inferences available in a singly-typed lattice, while metonymic reconstruction requires reference to a multiply-typed lattice or feature structure, making use of information available through the qualia.

Given that event-headedness acts to foreground or 'focus' a single quale of the verbal semantic representation, let us first consider the effects of heading the final event from the lexical structure in (35), namely, that in the FORMAL role. This corresponds to the raising interpretation, where what is asserted is simply the initiation of an event, without reference to causal or control preconditions to the event. Consider once again the sentence in (26a), repeated below:

(26) a. L'acide commence à corroder le marbre.
The acid is beginning to corrode the marble.

We will assume that raising is accomplished by function composition (FC), in the manner of Jacobson (1990). In particular, the raising verb *commencer*, of type $\langle \varepsilon^{\sigma}, \varepsilon^{T}\rangle$, imposes the type ε^{σ} on its complement. Assuming the VP *to corrode the*

marble, for example, in (26a), is $\langle e, \varepsilon^P \rangle$, then, $FC(begin, VP) = \lambda\mathscr{P}[begin(corrode(\mathscr{P}, the\text{-}marble)]$. Following Pustejovsky (1994b) we can view the basic composition of the sentence in (26a) as type inference, where $\oplus$ represents type application as inference according to the typing judgements, G, in the grammar. The type inference tree for this construction is shown in (39).

$$(39)\quad \frac{L'acide : e \oplus \dfrac{\mathrm{FC}(commencer : \varepsilon^{\sigma} \rightarrow \varepsilon^{T},\ corroder\ le\ marbre : e \rightarrow \varepsilon^{\sigma})}{commencer\ à\ corroder\ le\ marbre : e \rightarrow \varepsilon^{T}}}{L'acide\ commencer\ à\ corroder\ le\ marbre : \varepsilon^{T}}$$

In Pustejovsky & Boguraev (1993) a general mechanism is defined which makes the appropriate type available for a coercion operation. The qualia can be seen as partial functions, returning the value of a particular quale for an NP. The combined set of qualia provide a set of *type aliases* for the expression containing them. One particular mechanism, *type pumping*, has been explored as a means to generating the alias set, and we will make use of this device below.

Thus for example, the type available to an expression α with quale Q_i of type τ, can be seen as the following type inference:

$$(40)\quad \frac{\alpha : \sigma \oplus Q_i[\sigma, \tau] : \sigma \rightarrow \tau}{Q_i[\sigma, \tau](\alpha) : \tau}$$

This says that, given an expression α of type σ, there is a coercion possible between σ and τ, which changes the type of α in this composition, from σ to τ. We will illustrate the further application of this coercion operation below, as used in the *commencer* examples. In (41a) we see how the aspectual verb *commencer* selects the complement VP, and how in (41b) an NP is coerced into an event interpretation. Both sentences involve left-headed event structures, resulting in a control interpretation for the verb *commencer*.

(41) a. Marie a commencé à lire le livre. (VP)
Mary began to read the book.
b. Marie a commencé le livre. (NP)
Mary began the book.

The type inference tree for (41a) is given below:

$$(42)\quad \frac{Marie : e \oplus \dfrac{commencer : (e \rightarrow \varepsilon^{T}) \rightarrow (e \rightarrow \varepsilon^{T}) \oplus à\ lire\ le\ livre : e \rightarrow \varepsilon^{T}}{commencer\ à\ lire\ le\ livre : e \rightarrow \varepsilon^{T}}}{Marie\ commencer\ à\ lire\ le\ livre : \varepsilon^{T}}$$

For the derivation of (41b), reference is made to the qualia structure of the noun *book*, as shown below, where ARGSTR refers to the argument structure of the nominal *book*, treated as a type of implicit relational noun (cf. Nunberg 1979 and Pustejovsky 1994b):

$$(43)\quad \begin{bmatrix} \textbf{book} & \\ \text{ARGSTR} = & \begin{bmatrix} \text{ARG1} = \text{x} : \text{information} \\ \text{ARG2} = \text{y} : \text{phys\_obj} \end{bmatrix} \\ \text{QUALIA} = & \begin{bmatrix} \textbf{information-phys\_obj-container-lcp} \\ \text{FORM} = \mathit{hold}(y, x) \\ \text{TELIC} = \mathit{read}(e^T, w, x) \\ \text{AGENT} = \mathit{write}(e^T, v, y) \end{bmatrix} \end{bmatrix}$$

This representation illustrates how the qualia make reference to two events associated with the noun, *reading* and *writing*. As illustrated below in (44), coercion applies to the complement NP, where reconstruction with either the TELIC or AGENTIVE qualia will result in the appropriate type selected by the verb. We illustrate the derivation with the TELIC role selected.[21]

$$(44)\quad \dfrac{\mathit{Marie} : e \oplus \dfrac{\mathit{commencer} : (e \rightarrow \varepsilon^T) \rightarrow (e \rightarrow \varepsilon^T) \oplus \dfrac{\mathit{le\ livre} : e \oplus Q_T[e, (e \rightarrow \varepsilon^T)]: e \rightarrow (e \rightarrow \varepsilon^T)}{Q_T[e, (e \rightarrow \varepsilon^T)](e) : (e \rightarrow \varepsilon^T)}}{\mathit{commencer\ le\ livre} : e \rightarrow \varepsilon^T}}{\mathit{Marie\ commencer\ le\ livre} : \varepsilon^T}$$

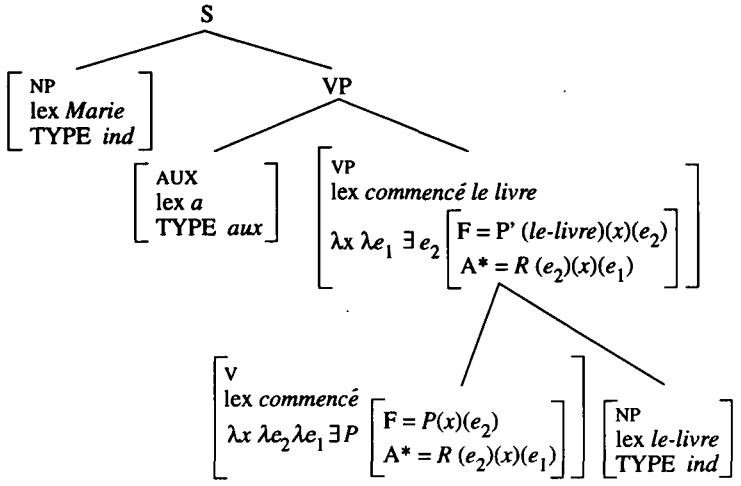
This states that the TELIC role of *le livre*, $\lambda x \lambda e^T[\mathit{read}(e^T, x, \mathit{le\text{-}livre})]$, is available as an alias for shifting the type of the NP. This metonymically reconstructed type, $\langle e, \varepsilon^T \rangle$, is identical to that selected by the verb *commencer* in complement position. After the coercion operation, the derivation proceeds as before in (42).

A more conventional semantic derivation associated with the type inference tree in (44) is given in (45) below.[22]

(45) a. Marie commence le livre.
b. $\lambda e^T[\textbf{commencer'}(Q_T(\textbf{le livre}))(\textbf{Marie})(e^T)] \Rightarrow$
c. $\lambda e^T[\textbf{commencer'}(\lambda x, e[\mathit{lire}(\textbf{le livre})(x)(e)])(\textbf{Marie})(e^T)] \Rightarrow$
d. $\textbf{Marie}\{\lambda x, e^T[\textbf{commencer'}(\lambda x, e[\mathit{lire}(\textbf{le livre})(x)(e)](x^*)(x^*)(e^T)]\} \Rightarrow$
e. $\textbf{Marie}\{\lambda x, e^T[\textbf{commencer'}(\lambda e[\mathit{lire}(\textbf{le livre})(x^*)(e)])(x^*)(e^T)]\} \Rightarrow$
f. $\exists e^T[\textbf{commencer'}(\exists e[\mathit{lire}(\textbf{le livre})(\textbf{Marie})(e)])(\textbf{Marie})(e^T)]$

The syntactic structure associated with this sentence can be illustrated in (46):

(46) Control (left-headed transition):



Let us now return to the discussion of raising constructions and coercion in such structures. We observed in sentence (6a) that type coercion is unacceptable with this predicate:

(6) a. *L'acide commence le mabre. (*corroding*)
*The acid is beginning the marble.

There would appear to be a possible derivation involving type coercion in this sentence where we choose the raising sense of *commencer*, imposing the type ε^o on the complement. But notice that coercion will be successful only if the appropriate type exists in the alias set of the complement. Metonymic reconstruction on the complement in (6a) returns an eventual function of type $\langle e, \varepsilon^T \rangle$ rather than the type selected by the verb, ε^o. Since function composition is an operation at the level of the VP, there is no point in the derivation at which the appropriate type is available for the rule to apply, and the sentence is not semantically well-formed. As we saw above, this is not the case with control verbs.

Having outlined the basic mechanism of coercion under constraints, we can explain now why examples like (47) are ungrammatical.

(47) a. *Marie a commencé l'autoroute. (*driving on*)
*Mary began the highway.
b. *Jean a commencé le dictionnaire. (*consulting*)
*John began the dictionary.
c. *Jean a commencé le sommet. (*reaching*)
*John began the top of the mountain.
d. *Jean a commencé la symphonie. (*listening to*)
*John began the symphony.

e. *Jean commence le livre. (*destroying*)
*John began the book
f. *Jean commence le désert de Gobi. (*going through*)
*John began the Gobi desert.

The coercion in (47a) and (47b) is impossible for reasons already discussed; namely, if these sentences are examples of raising constructions, then they are ruled out according to our previous discussion. If they are control senses, then the metonymic reconstruction on the NP in each case produces a type (PROCESS) that is incoherent with that selected by the verb, namely an eventual function with a TRANSITION.

In (47e), the coercion is impossible as the qualia does not stipulate how you destroy an object, but rather its bringing about or what you do with it. Similar remarks hold for (47c) and (47f). One might argue that (47d) should be possible with a control interpretation (the event in the complement is controllable and bounded), and yet coercion is not possible. This example points to a somewhat different phenomenon, one involving the semantics of the nominal itself. The qualia representation of *symphonie* appears to make reference to both an event and an individual reading. It suggests that the semantic distinction between objects such as books and tapes on the one hand, and symphonies and sonatas on the other is responsible for the unavailability of such coerced readings. The qualia structure for event-objects (using Dowty's 1979 terminology) such as *sonate* and *symphonie* can be schematically given as follows:

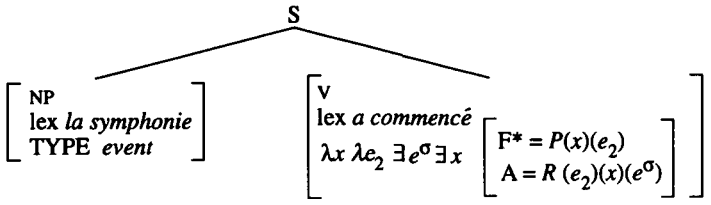
(48)
$$\left[\begin{array}{l} \textbf{sonate} \\ \text{ARGSTR} = \left[\begin{array}{l} \text{ARG1} = \text{e} : \text{event} \\ \text{ARG2} = \text{x} : \text{abstract\_obj} \end{array}\right] \\ \text{QUALIA} = \left[\begin{array}{l} \textbf{performance-lcp} \\ \text{FORM} = \textit{music}(x) \\ \text{TELIC} = \textit{perform}(e, w, x), \textit{listen}(e', z, e) \\ \text{AGENT} = \textit{compose}(e'', y, x) \end{array}\right] \end{array}\right]$$

The first thing to notice is that the lexical item directly denotes an event, as well as an individual sortally restricted to *music*. As pointed out by psychologists such as Miller (1991), social artefacts are very different from simple physical artefacts, in that their function is defined in a more complex manner. For example, in defining the TELIC role for an event object such as *symphony*, one cannot ignore the role of the listener (the experiencer). That is, music is performed *for* an audience. This must be reflected in the qualia structure as a conjunction of relational values, i.e. *perform* and *listen*. Recovering the event *listen* in the metonymic reconstruction due to coercion without also recovering *perform* is similar to binding a variable with a partial value; that is, *listen* is a

dependent event while *perform* is independent, being projectable through coercion by itself.

We can see how, with a raising sense, as in the sentence *La symphonie a commencé*, nouns such as *symphonie* and *sonate* are directly selected by the verb since they are able to denote events; hence, no coercion is involved (cf. (49)):[23]

(49) 'Raising' (right-headed transition):



Let us now turn briefly to the semantics of the verbs *finish* and *finir*. These verb patterns are the same as *commencer* and *begin* with respect to coercion (cf. (15)–(18) repeated below),

(15) a. He finished reading the book. (VP[+PRG])
b. He finished the book. (NP)
(16) a. Il a fini de lire son livre. (VP[+INF])
b. Il a fini le livre. (NP)
(17) a. *I finished the symphony. (*listening*)
b. I finished the chocolate. (*eating*)
c. *I finished chocolate. (*eating*)
18. a. *J'a fini la symphonie.
b. J'ai fini le chocolat.
c. *J'ai fini du chocolat.

The ungrammaticality of (17a) and (18a, c) will follow from the same analysis given for *begin* above. Notice, however, that *finish* differs from *commencer* and *begin* in that it is not logically polysemous, having only a control sense. That is, the raising examples in (50) are ungrammatical.

(50) a. *It has finished raining.
b. *The sun has finished shining in my eyes.
c. *The acid finished corroding the marble.

This would suggest that *finish* is not lexically underspecified with respect to headedness, as is *begin*, but is already specified with a head. It is this lexical specification which gives rise to the control reading only.

Interpreting Dowty's (1979) analysis of *finish* within our framework, we can analyze this verb as making reference to two events: (1) that subevent which brings about, *sine qua non*, the culmination of the event as a whole; and (2) an

assertion that the entire event has occurred. As Dowty makes clear, this presupposes that the event has a natural division into two subparts. This would seem to indicate that *finish* is an aspectualizer which type-shifts the complement event into an achievement (i.e. a right-headed transition). It does this, however, by preserving the integrity of the complement event, for notice how *finish*-sentences behave in many respects as both accomplishments and achievements:

(51) a. Mary finished building the house in 3 months.
b. Mary finished building the house at 3:00 pm today.

Hence, even lexical accomplishments (left-headed transitions) can be interpreted as achievements (right-headed transitions) when complements of *finish*. In order to capture this intuition while still satisfying Dowty's fundamental interpretation of *finish*, we define a general relation of logical culmination, *cul*, between an event and one of its subevent:

(52) $\forall e_1 \forall e_2 [cul(e_1) = e_2 \leftrightarrow \neg\exists e [e_2 \leq e_1 \wedge e_2 < e \wedge e \leq e_1]]$

we can build this relation directly into the event structure itself, in which case it would be a relation on event trees. This should essentially be a logical culmination relation between events; $cul_\propto(e_1, e_2)$. Now we can express the semantics of *finish* as a right-headed transition, where the subevent standing in the culminating relation with the larger event is seen as the AGENTIVE of the overall aspectual event. Furthermore, the FORMAL or result of the aspectual event is the assertability of the entire transition, of which the AGENTIVE is a part.

(53) $\lambda x \lambda e_2^T \exists e_1 \exists R \exists P [\text{finish: ES} = e_1 cul_\propto e_2 \wedge \text{FORMAL} = [P(x)(e_2^{*T})]] \wedge \text{AGENTIVE} = [R(e_1, x)]]$

Consider now the sentences in (54) and (55), which appear to be raising constructions and are grammatical in French and marginally acceptable in English.

(54) a. ?The leaves have finished falling.
b. ?The paint has finished drying.
(55) a. Les feuilles finissent de tomber.
b. Le peinture a fini de secher.

These data would suggest that raising construction is possible with *finish* and *finir* with some nominals. But in fact, the sentences in (54) and (55) are best analyzed as pseudo-control cases, and they are restricted to a certain well-defined class of nominals. In general, these verbs do not pass the standard raising tests, but nouns such as *paint* and *leaves* are exceptions because they carry qualia information indicating a kind of 'autonomy of behavior' relative to

certain predicates. Hence, *paint*, for example, is construed as a pseudo-agent in the control relation because of this property; i.e. it can dry on its own.

It is interesting to observe that even in English an intransitive construction is possible; namely, if the event nominal in subject position has an agentive component (cf. (56b) and (56c)), then a control interpretation is possible in what would otherwise appear to be an intransitive (i.e. raising) construction. We will refer to these as *intransitive control* constructions.

(56) a. ??The party finishes at midnight.
b. Class will finish at 2:00 pm.
c. The talk will finish by noon.
(57) a. *The rain will finish by noon.
b. The rain will stop by noon.

While *classes* and *talks* have an apparent agentivity and controllable component to them, *parties* are less controllable, resulting in the less acceptable (56a). Since *rain* is completely uncontrollable, it is ungrammatical in an intransitive control construction with the verb *finish* (cf. (57a)). The verb *stop*, as we see below, allows a raising interpretation and permits the intransitive raising construction in (57b).

The semantics of *arrêter* and *stop* are interesting because they have both control and raising senses, yet do not allow complement coercion at all (cf. (19) and (20) repeated below).

(19) a. Madame arrête de verser le thé.
?Madame is stopping steeping the tea.
b. *Madame arrête le thé.
*Madame is stopping the tea.
(20) a. J'arrête de lire le livre.
?I am stopping reading the book.
b. *J'arrête le livre.
*I am stopping the book.

Why then should coercion not be possible with what would appear to be a verbal form almost identical to that of *commencer* and *begin*? The answer to this question emerges from a closer examination of the data. Observe that *stop* appears in the sentences in (58) with a non-control construction, assuming the sense of 'prevent':

(58) a. John stopped Mary from smoking in his house.
b. Mary stopped the man from hitting her.
c. John stopped the bomb from exploding.

In fact, there is a kind of coercion possible in complement position with *stop*, essentially reconstructing an ellipsed predicate, as in (59).

(59) a. John stopped the car. (*from moving*)
b. The referee stopped the clock. (*from moving*)
c. Mary stopped the record. (*from playing/moving*)

While constructions such as (59) are possible in French, those in (58) are not. But there are data suggesting that *arrêter* does allow non-control complementation, as in (60), with the sense of *empécher* (*prevent*).

(60) a. J'arrête la bombe avant qu'elle explose.
I am stopping the bomb before it explodes.
b. J'arrête le moteur avant qu'il ne chauffe.
I am stopping the car before it overheats.

What these data suggest is that the complement type of *arrêter* and *stop* is not an eventual function, as with *commencer* and *begin*, but rather simply an event, where the type of verb is $\langle \varepsilon^o, \langle e, \varepsilon^T \rangle \rangle$. That is, these verbs are not strict obligatory control verbs, such as *try* and *begin*, but impose 'available controller' binding, as with verbs such as *want* (cf. Chomsky 1981; Dowty 1985; and Farkas 1988). Given that the complement of both *arrêter* and *stop* is ε^o, it is clear that coercion is not possible since this is not among the type aliases for the NP complements given in (19b) and (20b).

7 CONCLUSION

In this paper, we have attempted to illustrate how coercion operations are constrained by typing judgements and the structure of lexical semantic representations. Constraints on generative operations such as coercion are an integral component of the approach to semantics we have presented. In the process of this discussion, we have reiterated the advantages of a generative lexicon in the context of the larger theoretical and methodological issues in lexical semantics. More specifically, we have shown how *begin* and *commencer* exhibit both raising and control behaviour, and that this is an instance of the larger alternation class between causative and inchoative verbs, itself an example of logical polysemy. We have further shown why coercion is possible only with the control sense of *commencer* and *begin* and illustrated both the type inference involved and the semantic derivation of these constructions. We have also examined the behavior of two other classes of aspectual verbs, *arrêter* and *stop* and *finir* and *finish*, and have shown why *finir* and *finish* are unambiguous but do exhibit complement coercion, and do appear to allow raising constructions. Finally, we explained why *arrêter* and *stop* do not allow coercion, even though they have control readings. We believe that the advantages accompanying generative mechanisms and the characterization of languages as

polymorphic in well-defined ways allow us to overcome the explanatory inadequacies inherent in *word sense enumeration* approaches to lexical semantics. Although some of the details of the analysis have been omitted in order to concentrate on the general strategy of lexical analysis employed here, we have hopefully made clearer what some of the specific theoretical advantages of this approach are.

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NOTES

1 See, for example, the work reported in Buitelaar & Mineur (1994), which attempts to unify some of the notions from Generative Lexicon Theory with Categorial Grammar. Busa & Dini (1994) attempt to import the notions of coercion with qualia structure (see below) into HPSG for the handling of control phenomena, while Bouillon & Viegas (1994) handle cross-linguistic phenomena of adjective-noun collocations. Both Copestake (1993) and Sanfilippo (1990) are also interesting in how they model the projection of lexical semantic information to the syntax.

2 Qualia structure can be seen as providing the 'modes of explanation' for a concept, as lexicalized in a particular word.

3 This is not strictly true, as we shall see in Section 5 below, where we introduce the notion of an eventual function.

4 As one reviewer points out, we experience objects in any number of ways. That is, one need not read books in order to be bored by them. One can be bored by looking at them, shopping for them, writing them, or thinking about them. This is not in any way inconsistent with the GL approach. As discussed in Pustejovsky (1991a) and elaborated on in

Pustejovsky (1995), the qualia determine two types of information in the context of coercion:

i. type and sort information which the qualia must satisfy;
ii. specific qualia values which are the explanatory modes in understanding a word.

For words such as *film* and *book*, the TELIC quale role value of *watch* and *read* respectively are not optional in any sense, but are part of the semantics of the words. When an NP enters into a coercive environment, such as here with experiencer verbs, the qualia values act only to determine the default assignment for how the type environment is reconstructed.

5 Strictly speaking, in terms of type satisfaction either TELIC or AGENTIVE is a possible target of the modification. Hence, it can also be interpreted as e.g. 'a book taking a long time to write'.

6 We follow Landman (1991) in making the distinction between the temporal relations in an event structure and the intensional relation between event parts.

7 Formally, the head is interpreted as a focus structure over the domain of events. This approach is explored in Pustejovsky (1995).

8 We will continue referring to the binding relation between the matrix subject and an argument position in the complement position as semantic control, although the analysis does not necessarily assume a syntactic reflex for this binding relation.

9 There are at least two other major properties of raising predicates that should be mentioned, but that are not as important to our discussion. These are: (a) the inheritance property, which ensures that any syntactic restrictions imposed by the embedded VP on the subject are inherited or reflected in the 'raised' position; and (b) the narrow scope interpretation of the raised NP relative to the raising verb. See Jacobson (1990) and Di Sciullo & Williams (1987) for discussion.

10 Further discussion of the syntactic patterning associated with aspectual predicates in English can be found in Freed (1979) and Rudanko (1989).

11 Other verbs in this natural class include *grope for*, *reach for*, and other conative verbs as well.

12 On this view, *Tense* is analyzed as a function from events to propositions, viz of type $\langle \varepsilon^{\sigma}, t \rangle$. We simplify this analysis here for ease of presentation. In fact, an eventual function is a function from individuals to sets of events: $([o, 1]\varepsilon)^{D}$. With this typing, *begin* as a control verb has the following type: $\langle\langle e, \langle \varepsilon^{T}, t\rangle\rangle, \langle\langle e, \langle \varepsilon^{T}\rangle\rangle\rangle$. Furthermore, under this analysis, *Tense* is treated as a generalized quantifier: $\langle\langle \varepsilon^{\sigma}, t\rangle, t\rangle$. For details see Pustejovsky (1995).

13 We will also refer to the typing assignments in (31) as $(e \rightarrow \varepsilon^{T}) \rightarrow (e \rightarrow \varepsilon^{T})$ and $(\varepsilon^{\sigma} \rightarrow \varepsilon^{T})$, respectively, for use in type inference trees below.

14 We follow Asher & Morreau (1991) and Asher & Lascarides (1993) in the use of the defeasible conditional > for specifying default lexical inferences.

15 Unless otherwise stated, the default event structure (ES) associated with the qualia for a TRANSITION is: ES $= [_{e:T}\ e^{P} <_{\alpha} e^{S}]$. Furthermore, the qualia structure interprets the negation of the FORMAL value as holding in the AGENTIVE as well. See Pustejovsky (1995) for discussion and justification of this move.

16 Notice that the representation of experiencer predicates given in (10) above is actually a specific form of this causative paradigm, where the relation in the AGENTIVE quale is sortally restricted to experiencing predicates.

17 This particular observation was suggested by Robert Ingria (personal communication).

18 We ignore for now the details of the lexical representation. Our concern in this paper is simply to illustrate the source

of the polysemy and how the two senses are logically related.

19 Cf. Pustejovsky (1994a, 1994b) for discussion.

20 See Gunther (1992) for explanation of formal mechanisms of type inference within the λ-calculus, and Morrill (1992), Copestake (1993), and Pustejovsky (1994b) for its application to lexical representation.

21 For the purpose of the present discussion, we will ignore the type distinction between individuals, e, and generalized quantifiers $\langle\langle e,t\rangle,t\rangle$. We assume, however, that they are related by a type shifting operation as discussed in Partee (1992).

22 See Pustejovsky (1993) for details on the control relation. We follow generally Klein & Sag (1985) for how binding is achieved in Equi-constructions such as *begin*.

23 Sentence (49) should be contrasted with sentences such as **The book began last week*, which are ungrammatical. In this sentence, the subject NP is not an event-denoting nominal such as *symphony*. The metonymic reconstruction resulting from coercion would make available a type alias of an eventual function, $\langle e, \varepsilon^o\rangle$ rather than a simple event, ε^o. Hence, such cases are ruled out because of a type mismatch.

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