Aspectual Coercions in Content Composition

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Abstract This paper investigates a formal problem with the compositional calculation of meaning for temporal expressions, the problem of coercion. We look at three different versions of the problem and provide a formalism based on Asher (2011) that handles them.

1 Introduction

Coercions occur when a predicate appears to shift the semantic nature or type of one of its arguments. For instance, the natural interpretation of

(1)   James enjoyed the book.

is that James enjoyed *doing something* (presumably reading or writing) with the book. In other words, the argument of *enjoy* appears to shift from something of type PHYSICAL OBJECT to something of type EVENTUALITY. Thanks to the work of Pustejovsky (1995), these coercions have received extensive study, though their exact formal analysis remains still a matter of debate.

This paper examines a specific kind of coercion known as aspectual coercion, which affects the temporal interpretation of a sentence or text. If one assumes that temporal information is carried by spatio-temporal entities like eventualities (events and states) or by temporal entities like times or temporal intervals, then aspectual coercion involves transforming the argument of some temporal predicate in a way that would be unexpected from a simple compositional calculation of meaning. We will look at three types of related aspectual coercions in this paper.

In contrast to many of the papers in this volume that adopt a cognitive grammar approach to the interpretation of temporal or spatial expressions in language, our approach is couched within the framework of formal compositional semantics and uses tools like the lambda calculus that are standard in this area. While formal approaches have considerable predictive power precisely because of the demands of formalisation, coercions pose a problem because the standard homomorphic

mapping from syntax to semantics and the simple use of function application does not suffice for an adequate analysis. We show that nevertheless a precise account of lexical meaning can do justice to such phenomena and has the expressive power to provide analyses for the rich set of empirical data discussed in this volume.

1.1 Coercions with Progressive Aspect

One of the truisms about progressive aspect is that it doesn't apply to stative constructions – (2a), for instance, supports this generalisation. Nevertheless, (2b-d), which are progressivisations of the stative *John is silly*, *John is John*, *John is an asshole*, are perfectly unproblematic.

(2)   a.   # John is knowing French

        b.   John is being silly.

        c.   John is just being John.

        d.   John's being an asshole.

(2b-d) no longer describe a state but an activity that results in the state of being silly. The coercions in (2b-d) are a language-specific phenomenon. Languages like French that lexicalise progressive aspect do not seem to support this meaning shift:

(3)   a.   Jean est idiot.

        b.   #Jean est en train d'être idiot.

        c.   Jean est en train de faire l'idiot.

This type of coercion is therefore not the result of a general cognitive principle of strengthening or weakening due to Gricean or Neo-Gricean constraints on communication.

1.2 Aspectual coercion and modality

Another sort of aspectual coercion results when a perfective aspectual operator applies to VPs containing an ability modal. Consider the following French examples.

(4)   a.   Jeanne a dû prendre le train. → Jeanne a pris le train

        b.   Jeanne devait prendre le train. ↛ Jeanne a pris le train

(5)   a.   Jeanne a pu prendre le train. → Jeanne a pris le train

        b.   Jeanne pouvait prendre le train. ↛ Jeanne a pris le train

The '→' signifies what is known in the literature as an *actuality entailment*.

Why are the actuality entailments interesting? Treating ability modals as true modals—i.e. as symbolised by □ and ◇—provides the following formalisation of the actuality entailment:

(6)   a. $\Box\phi \to \phi$

        b. $\Diamond\phi \to \phi$ or $\phi \to \Box\phi$.

which implies a collapse of the modality (Bhatt 1999). With the imperfective aspect, however, these inferences vanish. There is no collapse. The puzzle is, why does the use of the aspectual perfect collapse the modality? This is unpredicted and indeed bizarre on a Montagovian view of composition.

Actuality entailments with the perfective aspect are also a language-specific phenomenon. In English, for instance, the actuality entailment is at least not a hard entailment, as the following sentences are coherent:

(7)   John was able to take the train, but he ended up taking the bus instead.

(8)   John refused to go to the meeting because he had to take the train to get to it.

(9)   ?John has been able to take the train for years, but he never does.

None of these have the actuality entailment, though the ability modal clauses might have what one could call an *actuality implicature*. Thus, the actuality entailment cannot be the result of some general cognitive but non-linguistic principle of strengthening.

1.3   Temporal adverbials and aspectual coercion

Matters are still more complex in the interaction of aspect because of the way temporal adverbials interact with modality and aspect to produce or to block actuality entailments. In (10) the actuality entailment seems to hold, even though it is generally agreed that the imperfective does not license the actuality entailment. Thus, the actuality entailment's existence must be due to the interaction between the adverbial and aspect.[1] Similarly, it appears that certain adverbials can block the actuality entailment as in (11), as argued by Mari & Martin (2007).

(10)   #Soudain, Jean pouvait ouvrir la porte, mais il ne l'a pas fait.

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1 These observations are due to Vincent Homer; a discussion of them can be found in his paper for *Journées de Sémantique et Modélisation*, 2010, Nancy.

(11)   Le robot a même pu repasser les chemises à un stade précis de son développement mais il ne l'a pas fait.

We believe the coercions we have discussed should receive as uniform a treatment as possible within a semantic/pragmatic framework of lexical meanings and how they combine together to form meanings for larger semantic constituents like propositions or discourses. But we can only address this issue adequately within a larger view of how context affects interpretation. This will give us the tools with which to understand contextual effects at the level of clausal content composition and apparent meaning shifts. We then apply the machinery to aspectual coercions.

2   Background

Almost all words that function as predicates introduce constraints on their arguments in the form of selectional restrictions. For instance, the verb *try* requires that its subject be an intentional agent; a verb like *hit* imposes the restriction that its object or internal argument must be a physical object. Thus,

(12)   Mary hit John's idea.

is predicted to be difficult to interpret unless the context allows us to interpret *John's idea* as some sort of physical object.

Selectional restrictions of an expression ϵ, unlike syntactic constraints of number and gender agreement, pertain to the type of object denoted by the expression with which ϵ must combine. However, this information about the type of argument is not of a piece with the asserted content of the predication but is rather a type of pre-supposed content.[2] Selectional restrictions resemble presuppositions because their satisfaction seems to be a prerequisite for any expression containing them to have a well-defined semantic value. Their demands for satisfaction or justification percolate up the semantic construction very much in the way that ordinary presuppositions do.

In dynamic semantics, presuppositions constitute a particular sort of test on the *input* context. Consider a sentence like

(13)   Jack's son is bald.

The presupposition generated by a definite noun phrase like *Jack's son* (namely, that Jack has a son) must be satisfied by the input context, if the interpretation of the rest of the sentence containing the definite is to proceed. One way of satisfying the presupposition in (13) is for it to be already established in the context of utterance of (13) that Jack has a son. This can occur, for instance, when (13) is preceded by an

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2 That selectional restrictions are type presuppositions is a fundamental principle of Asher (2011).

assertion of *Jack has a son*. Presuppositions can also be satisfied by contexts within the scope of certain operators, as in (14), even though it has not been established in the discourse context that Jack has a son:[3]

(14)   If Jack had a son, then Jack's son would be bald.

In dynamic semantics the content of the antecedent of a conditional is added hypothetically to the input context, and it is this hypothetical context that serves to interpret the consequent and the presupposition it generates. Thus, the satisfaction of the presupposition by the antecedent of the conditional in (14) means that the presupposition places no requirement on the *actual* input context to the whole conditional, the context of utterance. The satisfaction of the presupposition by elements of the discourse context entails that the presupposition does not "project out" as a requirement on the context of utterance. Thus (14) is consistent with the assertion that in fact Jack has no son. On the other hand, dynamic semantics predicts that if we change (14) just slightly so that the antecedent does not provide a content that satisfies the presupposition, the presupposition will project out as a requirement on the input context to the whole conditional:

(15)   If Jack were bald, then Jack's son would be bald too.

Selectional restrictions act in the same way in similar contexts. For instance, to say something like

(16)   The number two is blue.

is to invite at the very least quizzical looks from one's audience, unless the context makes clear that *the number two* refers to some sort of physical object and not the only even prime. However, a counterfactual with an admittedly bizarre antecedent can satisfy the type presupposition projected from (16) in much the same way as the antecedent of (14) satisfies the presupposition of the consequent:

(17)   If numbers were physical objects, then the number two would be blue.

What happens when a presupposition cannot be satisfied by the discourse context? It depends on what sort of presupposition is at issue. Some presuppositions, such as many introduced by definite noun phrases, are easily "accommodated". In dynamic semantic terms this means that the input context is altered in such a

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3 One of the great successes of dynamic semantics has been to show that the behaviour of presuppositions introduced by material within the consequent of a conditional follows straightforwardly from the conception of the conditional as a complex test on the input context and thus offers a solution to the so-called *projection problem*.

way that the presupposition is satisfied, as long as the result is consistent. Other presuppositions, such as that generated by the adverbial *too*, are much less easily accommodated. Given that operators like conditionals can add "intermediate" contexts between the context of utterance and the site where the presupposition is generated, we need a theory of where and how to accommodate in case the input context does not satisfy the presupposition. In some theories of presupposition that operate on semantic representations, like that of van der Sandt (1992), accommodation simply involves adding a formula for the presupposition to an appropriate part of the representation for the discourse.[4] Van der Sandt stipulates a particular procedure for handling the binding and accommodation of presuppositions: one tries to bind a presupposition first, and one tries first to bind it locally and then in a more long distance way. Then, if binding fails, one tries to accommodate at the outermost context first and if that fails then one tries to accommodate at the next outermost context. The constraint on accommodation is that the addition of the presuppositional material be consistent with the discourse context. So, for instance, one cannot add the presupposition that Jack has a son to a context where it is established that Jack does not have a son.

Something similar happens with selectional restrictions. In effect selectional restrictions are *type presuppositions*. Type presuppositions in normal circumstances are bound or justified in that the type of the argument expression matches the type presupposition of its predicate. But they can sometimes be accommodated. Consider the noun *water*. It can combine with determiners that require either a noun that denotes something of type MASS (18a) or with determiners that are intuitively count determiners:

(18)   a.   some water

          b.   a water

One way of accounting for this is that *water* itself does not determine its denotation to be either of a subtype of type MASS or of type COUNT. If that is the case, then we can accommodate the requirements of the determiner simply by applying the type COUNT or MASS to the type of the expression *water*— in simplified terms, *a water* ends up denoting a property of properties that have a non-empty intersection with the collections of portions of water.[5]

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4 In other theories like Heim (1983) the accommodation procedure is not really well developed; see Beaver (2001) for a detailed account of accommodation in a Heimian approach to presupposition.

5 Not all mass nouns work so well.

3 From Type Presupposition to Coercion

Sometimes the argument does not satisfy the type presupposed by its argument and cannot be accommodated or bound in the given context. In that case, semantic composition crashes and there is no well-defined value for the semantic composition, as in (12). What is not so obvious is what the principles are for accommodating type presuppositions that sometimes permit the rescue of a predication in those cases where the argument's type does not satisfy the predicate's type presuppositions. Examining this issue takes us to the heart of coercion.

Consider the following example, discussed at length in the literature, in particular by Pustejovsky (1995).

(19)   Julie enjoyed the book.

The intuition of many who work on lexical semantics is that (19) is equivalent in meaning to:

(20)   Julie enjoyed doing something (e.g. reading, writing, ...) with the book.

The idea is that *enjoy* requires an event as its direct object as in *enjoy the spectacle*, *enjoy the view*. When the direct object of a transitive use of *enjoy* does not denote an event, it is "coerced" to denote some sort of eventuality. It is difficult, however, to understand what coercion is. Is it, for instance, just the transformation of the denotation of the noun phrase, such as *the book*, into some sort of eventuality-denoting expression? Asher (2011) shows that neither the meaning of the predicate nor the argument shifts. What shifts is how these two combine. In effect the predicational relation changes, and this change is governed by lexical content and the composition process. In other words, many coercions result from a semantic rather than pragmatic process. That is the approach we adopt here.

Our view requires the background assumptions that (a) verbs, and predicates more generally, distinguish between arguments that denote eventualities and those that denote, say, physical objects and (b) there is a clear distinction between physical objects and eventualities. But both of these assumptions are cogent and well supported linguistically across a wide spectrum of languages (Asher 2011). In the next section, we sketch a formal system that works out our view technically.

4 A Sketch of a Formal Theory of Lexical Meaning

We now turn to implement talk of type presuppositions in a formal framework. Predicates impose two sorts of type constraints on the context to come and the types of their arguments: one is an absolute requirement; the other, which doesn't always hold, licenses a modification of the predicational environment between the

predicate and its argument. We code these type constraints in a store π, so that presupposition justification mechanisms can operate on this store independently of the basic rules of the λ calculus. This means complicating the lexical entry of all words to include a context parameter in which these type presuppositions can be encoded. This parameter functions as a locus of constraints on the context to come within the framework of continuation semantics, and it reflects our hypothesis that type presuppositions are a constraint on the context to come. The type parameter in continuation semantics can be an arbitrary data structure on which various operations may be performed separately from the operations of β reduction in the λ calculus. This is the sort of flexibility we need in order to handle various operations of presupposition justification at the lexical level.

There are three operations on type presuppositions. Binding occurs when the type presupposition is a super type of the type of the argument and thus satisfied by subtyping; in this case the type presupposition is met and the more specific type information is simply carried forward in the context. Simple Accommodation occurs when the two types are compatible in that they have a meet that is not $\perp$; the result is to take the meet as the result of the operation. The third sort of operation consists of those that allow the readjustment of the predicational relation, one of which we will consider in detail below. These operations together with the standard lambda calculus comprise the relevant fragment of *type composition logic* or TCL, the system of Asher (2011), that we need to look at aspectual coercions.

While Asher (2011) details a general architecture for the passing of type presuppositions from predicate to argument, we will look here only at how verbs and their projections make use of type presuppositions. The lexical entries chosen determine how presuppositions percolate through the derivation tree, and they predict that presuppositions will typically be justified locally to the argument's typing context (the π that determines the typing of the argument). In general, predicates must pass their typing presuppositions onto their arguments. More specifically, a VP should pass typing presuppositions to its subject, and a transitive verb should pass its typing requirements to its object. For example, in *the book is heavy*, the type requirements made by the verb phrase on its subject argument should be satisfied or accommodated in order for the predication to succeed. In keeping with standard assumptions about the syntax-semantics interface, this means we must rethink our lexical entries to track these presuppositions and to put them in the right place.

Consider an intransitive verb like *fall*. We want its type presuppositions to percolate to the subject. We can do this by assuming that an intransitive verb, or more generally a VP, is a function from DP denotations to propositions.[6] This function will feed the appropriate type presuppositions to the subject DP in the

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6 This applies the same trick used to handle transitive verbs taking generalised quantifier arguments—which makes the latter functions from DP denotations to VP denotations.

same way that nouns feed their presuppositions to their modifiers. In order to do this properly, we must make our verbal predicates be relatively catholic as to the type of DP they accept. The specific type requirements that verbs will place on their arguments will *not* be placed on the DP itself, but be placed rather in the presupposition slot so that it may be propagated to a local justification site and justified there—i.e. on the individual argument term furnished by the DP, if that is possible.

Thus, for an intransitive verb like *fall*, we have the lexical entry in (21). Recall that π is the parameter that encodes type information. $\pi * \text{ARG}_1^{\text{fall}} : \text{P}$ specifies the type assignment for *fall* on its first argument place to be of type P or of physical type. This first argument place is ultimately filled by the object level variable or constant introduced by the translation of the DP in subject position but may be filled by other variables as well. In particular, the variable introduced by the DP Φ will be one and y is one as well in (21). (22) shows the result of applying *fall* to the DP *John*; we assume that John introduces a constant of type PERSON.

(21) $\lambda\Phi\lambda\pi\ \Phi(\pi * \text{ARG}_1^{\text{fall}} : \text{P})(\lambda y\lambda\pi'\ \text{fall}(y,\pi'))$.

(22) $\lambda\pi\ \lambda P\lambda\pi''\ P(j,\pi'' * \text{PERSON})(\pi * \text{ARG}_1^{\text{fall}} : \text{P})(\lambda y : \text{P}\lambda\pi'\ \text{fall}(y,\pi'))$

(22) reduces to:

(23) $\lambda\pi\ \lambda y\lambda\pi'\ \text{fall}(y,\pi'))(j,\pi * \text{ARG}_1^{\text{fall}} : \text{P} * \text{PERSON})$

and then to:

(24) $\lambda\pi\ \text{fall}(j,\pi * \text{ARG}_1^{\text{fall}} : \text{P} * \text{PERSON})$

We can now justify the presupposition of *fall* via binding if we assume that persons are physical objects or via accommodation if not. The final result is:

(25) $\lambda\pi\ \text{fall}(j,\pi * \text{ARG}_1^{\text{fall}} : \text{PERSON})$

The type of an intransitive verb or a VP, which in Montague Grammar has the type $\text{E} \Rightarrow \text{T}$, now has the more complex type, $\text{DP} \Rightarrow (\Pi \Rightarrow \text{PROP})$, or the functional type from general DP types to propositional types. We shall come back to propositional types in a minute.

Transitive verbs look very similar. The presuppositions of the predicate must percolate to the internal (direct object) arguments as well as the external (subject) arguments. Let's look at an example of a transitive coercion verb, *enjoy*. It has the following entry:

(26) $\lambda\Phi\lambda\Psi\lambda\pi\ \Psi(\pi * \text{ARG}_1^{\text{enjoy}} : \text{AG})\{\lambda x : \lambda\pi''\Phi(\pi'' * \text{ARG}_2^{\text{enjoy}} : \text{EVT}-$
         $\epsilon(\text{HD}(\Phi),\text{HD}(\Psi)))(\lambda y\lambda\pi'\text{enjoy}(x,y,\pi'))\}.$

Coercion predicates like *enjoy* introduce a complex type restriction— an absolute type presupposition that its second argument be an event (indicated by the type EVT), and a type licensing a modification of the predicational environment. This modification, indicated by the polymorphic type $\epsilon(\text{HD}(\Phi),\text{HD}(\Psi))$ allows a functor to introduce an eventuality of a type to be determined by the "head" type of the objectual variables or constants introduced by the DPs Φ and Ψ. Polymorphic types are functions from types to types; their output value changes depending on the types that are their arguments. A familiar example comes from considering adjectives like *flat*. Its type is naturally construed to be a function from types to types and whose value changes given the input type. This reflects the intuition that *flat* changes its meaning rather dramatically depending on the noun it combines with:

(27)   a.   flat country

           b.   flat curvature

           c.   flat tire

           d.   flat beer.

With these preliminaries in place, here is a derivation of the meaning for a standard coercion. Let's look at an example where *enjoy* applies to a DP like *Anna Karenina* as in (28). For *book* we will use the complex type BOOK. Though artificial, this allows us to bypass the complexities of so-called dual aspect types that have generated considerable discussion (Pustejovsky 1995, Asher & Pustejovsky 2006, Asher 2011, Luo 2010).

(28)   George enjoyed Anna Karenina

Constructing a logical form for the DP and applying it to the entry for *enjoy* gives us:

(29) $\lambda\Phi\lambda\pi\ \Phi(\pi * \text{AG})\lambda v\ \lambda Q\ Q(\pi * \text{ARG}_2^{\text{enjoy}} : \text{EVT}-\epsilon(\text{HD}(\Phi) * \text{BOOK})(ak))$
         $(\lambda y_1\lambda\pi_1(\text{enjoy}(v,y_1,\pi_1)\wedge\ \text{ag}(y_1) = v(\pi_1)))$

Let us assume that polymorphic type presuppositions prefer a local justification, near the verb. Continuing the reduction and abbreviating our type constraints on x and y_1, we get:

(30) $\lambda\Phi\lambda\pi\ \Phi(\pi * \text{AG})(\lambda v\ \text{enjoy}(v,ak,\pi * \text{EVT}-\epsilon(\text{HD}(\Phi),\text{BOOK}))$
         $\wedge\ \text{ag}(x) = y_1(\pi * \text{EVT}-\epsilon(\text{HD}(\Phi),\text{BOOK})))))$

The presuppositions in the nuclear scope of the quantifier cannot be satisfied as they stand. But this particular verb licenses a transformation and the introduction of a *polymorphic type functor* with a polymorphic type that will serve to justify the basic type presupposition. The polymorphic type functor will apply to the λ abstract in the consequent given by the verb, $\lambda y_1 \lambda \pi_1 \, (\text{enjoy}(v, y_1, \pi_1) \wedge \text{ag}(y_1) = v(\pi_1))$. For type presuppositions, this is a general procedure for presupposition justification. The functor introduces a predicate related to the polymorphic type. For example if the polymorphic type maps a cigarette to an event of type SMOKE(AGENT, cigarette), then we need to use the predicate $\text{smoke}(e, x, y)$. When the polymorphic type is underspecified and of the form $\epsilon(\alpha, \beta)$ we take the predicate $\phi_{\epsilon(\alpha,\beta)}(e, x, y)$. The functor instantiated for this example looks like this:

(31) $\quad \lambda P \lambda u \lambda \pi'' \, (\exists z \colon \epsilon(\text{EVT}, \text{BOOK} \sqcap \text{CT}) \, \exists z_1 \colon \text{AG}(P(\pi'')(z) \wedge$
$\qquad\qquad \phi_{\epsilon(\text{AG},\text{BOOK}\sqcap\text{CT})}(z, z_1, u, \pi'')))$

Applying the functor on the designated λ term within (30) and using Substitution, Binding, Application, and Substitution, we get:

(32) $\quad \lambda \Phi \lambda \pi \, \Phi(\pi * \text{AG})[\lambda v \exists z \exists z_1 \, (\text{enjoy}(v, z, \pi) \wedge \text{ag}(z) = v \wedge$
$\qquad\qquad \phi_{\epsilon(\text{AG},\text{BOOK}\sqcap\text{CT})}(z, z_1, ak, \pi)))]$

We can now integrate the subject into (32) and exploit the fact that ag is a function to get the finished result:

(33) $\quad \lambda \pi \exists y (y = g(\pi) \wedge \exists z \colon \text{AG}(\text{enjoy}(y, z, \pi) \wedge \text{ag}(z) = y \wedge$
$\qquad\qquad \phi_{\epsilon(\text{AG},\text{BOOK}\sqcap\text{CT})}(z, y, ak, \pi)))$

The type of functor in (31) suffices to handle all cases of event coercion with verbs whose type presuppositions are sensitive to the type of both the subject and object. We'll call this the $\mathcal{E}$ functor. Polymorphic types in event coercion describe a morphism from types of objects to polymorphic types of eventualities involving those objects, and the $\mathcal{E}$ reflects that morphism from objects to eventualities in logical form. Why should this transfer principle and type shift from objects to eventualities be sound? The answer has to do with the presuppositions of the particular words that allow for this morphism, like e.g. the aspectual verbs and *enjoy*. Enjoying a thing, for instance, presupposes having interacted in some way with the thing, and that interaction is an event. The verb *enjoy*, however, doesn't specify what that event is. The event could be just looking at the object as in *enjoy the garden* or perhaps some other activity. Similarly, one can't finish an object unless one is involved in some activity with that object, whether it be creating it or engaging in some other activity towards it. That is why such transformations are lexically based; it is the lexical semantics of the words that license the coercion and that make the rules sound.

Semantics gets us only so far. We now need to specify the underspecified type $\phi_{\epsilon(\text{HUMAN,BOOK})}$. The type specification logic allows us to write appropriate axioms for defeasibly specifying underspecified types.[7]

- $(\alpha \sqsubseteq \text{HUMAN} \wedge \beta \sqsubseteq \text{BOOK}) > \epsilon(\alpha,\beta) = \text{READ}(\alpha,\beta)$

- $(\alpha \sqsubseteq \text{AUTHOR} \wedge \beta \sqsubseteq \text{BOOK}) > \epsilon(\alpha,\beta) = \text{WRITE}(\alpha,\beta)$

- $(\alpha \sqsubseteq \text{GOAT} \wedge \beta \sqsubseteq \text{BOOK}) > \epsilon(\alpha,\beta) = \text{EAT}(\alpha,\beta)$

One of the advantages of the higher-order system is that we can reflect on the type of entries that we want for various words. It has been standard practice since Davidson (1968/69) to introduce additional eventuality arguments to predicates derived from verbs as we have done for the verbal predicates that characterise coerced eventualities. But one need not do this. Instead we could have characterised an event object more abstractly via a realisation function. This permits a much more precise characterisation of eventualities and requires the theory to be more precise about what requirements lexical meaning and composition make on the characterisation of various types of entities, in particular eventualities. We will come back to this point in the next section.

5   Modality, aspect, and the verbal complex

The interpretation of the verbal complex, which includes the verb and its arguments as well as the projections that include tense, modality, and aspect, is a rich area of study for linguists and has many philosophical implications. Many linguists, Vendler (1967), Dowty (1979), Smith (1991), *inter alia*, have observed that certain meaning shifts occur on the type of object denoted by the verbal complex when aspect and tense are applied. Since Vendler's work in the 1950s, it has been customary to distinguish between different types of denotations of verbs and their projections. Vendler and most of those following him (with the notable exception of Dowty) have talked of these denotations as types of eventualities, which include events of different types and states. Combined with Davidson (1968/69)'s treatment of action sentences, this has led to the received view of verbal modification by various projections, according to which verbal modification involves predication of an eventuality introduced by the verb (and bound by tense). If the modification applies at a node above Tense, for example with an adverb like *allegedly* or *probably*, then the eventuality is no longer available as an argument and so such modifications are customarily treated as modifications of some sort of abstract entity like an intension.

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7 The > connective is a weak conditional connective used to encode defeasible generalisations in Asher (2011).

On the other hand, nominal modification is much more heterogeneous, depending on whether the modifier is intersective, subsective, or non-subsective.

TCL treats verbal and nominal modification on a par. Some modifiers, though not all, take the VP as an argument, as in Montague Grammar. Temporal and locative modifiers seem to fall into this class. Such modifiers behave both syntactically and semantically like adjuncts. For instance, we expect to be able to add adjuncts *ad libidem* to the verbal complex and this seems to be true for temporal and spatial modifiers. We can have several temporal modifiers that simply narrow down the time at which the event described by the verbal complex took place. Locative modifiers work similarly.

(34)   a.   On Monday Isabel talked for two hours in the afternoon between 2 and 4.

        b.   In Paris John smoked a cigarette on the train in the last second class compartment in seat number 27.

The assumption that temporal modifiers take the VPs as arguments makes predictions in TCL. Predicates pass their type presuppositions onto their arguments in TCL, not the other way around. So TCL predicts that temporal adverbials can affect the type of the verbal complex, as seen in (35) below. The temporal modifiers can change the aspect of the verbal complex from an achievement or accomplishment in (35a,c) to an activity in (35b,d).

(35)   a.   John wrote a letter in an hour.

        b.   John wrote a letter for an hour.

        c.   John kissed Mary at 10 in the morning.

        d.   John kissed Mary for an hour.

For an hour takes a VP like *wrote a letter* as an argument and imposes the type presupposition that the variable of complex and polymorphic type that it modifies must be of type ACTIVITY. We now have a case of coercion since WRITE(P, P) is a subtype of ACHIEVEMENT. A version of $\mathcal{E}$ licenses an accommodation of the ACTIVITY type presupposition by inserting an iteration operator over the VP, yielding an appropriate interpretation of *wrote a letter for an hour*.

TCL also predicts that temporal modifiers may lead to fine-grained shifts in meaning in the verbal complex. For example, consider:

(36)   a.   She left her husband at the airport 5 minutes ago.

        b.   She left her husband at the airport two years ago.

In (36b), we have a very different sense of *leave* than in (36a). (36a) interprets *her husband* in a physical object or location sense whereas (36b) interprets *her husband* in a more institutional sense; that is, (36b) means that the subject has left her marriage. Conditional type constraints in the type specification logic can model the effects of the temporal adverbials on the predication.

The next step to figuring out how the construction and modification of the verbal complex works is to investigate the nature of the verbal complex itself. With Neo-Davidsonians, we could stipulate that the verb projects an event variable to the tense and aspect projections. However, we need not do this. Some sentences intuitively don't denote anything like an eventuality. Whatever is bound by the tense projection of the verbal complex is not an event or a state, at least if we take states and events to have some sort of spatio-temporal location (and if we do not, it's unclear why we should call such entities states or events in the first place). Consider

(37)   Two and two make four.

What (37) describes is not a state of the concrete physical world but rather a fact or a true proposition, a collection of possible worlds that contains the world of evaluation.[8]

TCL countenances fine-grained types not only for words but also, thanks to the use of polymorphic types, for more complex expressions, even clauses; and these types for the verbal complex need not all be eventualities. In fact, a more uniform approach is to take the type of the verbal complex when saturated with its syntactically given arguments to be a subtype of PROP. In effect there is no need to introduce a Davidsonian event argument (and in fact neo-Davidsonian proposals are easily translated into the higher type framework); stative sentences, or rather the verbal complexes they express, simply have propositional denotations (subtypes of PROP) that are true at times and worlds. When needed, as in nominalisation, we can isolate this spatio-temporal region via a realiser.[9] This minimises event promiscuity in one's ontology and also takes care of the nasty problem of eventuality projection across quantifiers and operators like negation or modals as well as eventualities of such timeless sentences as $2 + 2 = 4$. Since verbs don't introduce events, there isn't any problem about projecting them through the logical structure of the asserted content.

In TCL the verbal complex is a subtype of PROP; the specific type is determined by

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8 It is important to note that such facts also have temporal modifications.

(i) Two and two make four, and two and two will always make four.

But we will not go into this here.

9 The type of the realiser is polymorphic upon the fine-grained type of its argument as well as on parameters of evaluation. Thus, REALISER is another example of a polymorphic type.

the appropriate instance of the polymorphic type with its type parameters specified by the verb's arguments. Thus, the type of an intransitive verb IV in (38) is a generalised function from subtypes of a DP type and a presuppositional context type to a subtype of PROP. This is a refinement of the type in (38b) that a more Montagovian version of TCL would assign.

(38)   a. $\text{DP} \rightarrow \pi \rightarrow \text{IV}(\text{HD}(\text{DP}))$

       b. $\text{DP} \rightarrow \pi \rightarrow \text{T}$

A similar story holds for transitive and ditransitive verbs.

The "tail" of the type or value of the verb type in (38a) may take different fine-grained values for different values of its parameters; it is also subject to modification by operators that take the verbal complex in its scope. Temporal adverbials, tense, and aspect modify this proposition, for instance; perhaps other modifiers do too. Some of these modifiers may, if we wish, force the introduction of an eventuality or a fact that realises the propositional content.[10] For simple action sentences, modification by, for example, manner adverbials produces a realising eventuality for the content given by the verbal complex that the manner adverbial then modifies. But if a verbal complex is modified by negation, then tense or the presence of a locating adverbial like that in (39) may introduce a realiser that is a fact.

(39)   No one danced at the party.

Similarly, if the type of the verbal complex contains no action verbs but expresses simply a relation between informational objects as in (37), temporal adverbs or tense force a coercion that introduces a realiser of the content that must be a fact. This would predict that the temporal modification of (i) in footnote 8 means something like it will always be true that 2 and 2 makes 4. Thus, most modifications involve a coercion from the verbal complex's internal semantic value, which is a subtype of PROP, to an event or fact realiser.

This allows us to use TCL to predict that certain eventuality types may be derived from others. For instance, *walk* is an activity but *walk to the store* with a goal PP is an accomplishment. The type system predicts that accomplishments should consist of an activity together with a natural endpoint or telos (given by the goal PP). TCL supposes that goal PPs are in fact part of the verbal complex, attaching directly to the verb or verb plus direct and indirect object arguments, and so occupy a position prior to any coercion to a realiser. Thus, such goal PPs contribute to the overall type of the verbal complex, and as realisers are a function of this type, it is no surprise that *walk* has a realiser that is an activity but *walk to the store* has a realiser that is an accomplishment.

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10 For a discussion of facts versus eventualities, see Asher (1993).

5.1 Coercions with progressive aspect

With this sketch of TCL's view of verbal modification, let us return to aspectual coercion in the examples (2), one of which we repeat below.

(2b)   John is being silly.

Because the types of the verbal complexes can be quite fine grained, we can distinguish between verbal complex types whose realisers are facts, those whose realisers are events (here we have in mind paradigmatic event sentences like *John kissed Mary*), and verbal complex types whose realisers are facts or states but have a close connection with eventualities. Included in this class are examples that have been described as statives that accept progressivisation—for instance, copular sentences that involve some stage-level predicate like *is silly*, *is stupid*, *is an asshole,....* (40) illustrates that these have a natural link to certain activities:

(40)   a.   John was ridiculous to insist on fighting that guy.

         b.   John was stupid/insane/silly to give his money to that woman.

         c.   John was an asshole in being so rude to that student.

This construction doesn't work with other stative predications like

(41)   #John knew French to give that speech/in making that speech.

These constructions indicate that copular predications with stative adjectives form a particular subtype of PROP. While these predications are usually classified as statives by the usual tests of adverbial modification, they are special in that they have a very tight connection with activities of which they describe the result. This subtype is an argument to the progressive and then produces a particular kind of realiser after tense is applied. The progressive introduces a functor that describes some process that leads at least in the normal instances to the appropriate realiser of the proposition given by the verbal complex (Dowty 1979, Asher 1992, *inter alia*). While the progressive does not apply to what one might call "pure statives" like *John knows French*, the progressivisation of this special subclass of statives introduces an eventuality realiser of the verbal complex given by a VP produced from a copula with adjective complement.

When it combines with an adjective, the copula passes the presuppositions of the predicate to its DP argument. We'll assume *John is silly* has a perfective or completed aspect that introduces a realiser. This realiser is of type STATE because of the presence of the copula which affects the fine-grained type of the verbal complex. We give the aspectual operator's contribution first and then the end result. Below $\mathcal{P}$ is the type of the adjectival VP and Φ as usual is a variable of type DP.

(42) a. $\lambda \mathcal{P} \lambda \Phi \; \lambda \pi \exists z \colon \textsc{state} \; \text{realises}(z,^{\wedge}\{\Phi(\text{Pre}(\text{ARG}_1^{\mathcal{P}})(\pi))(\mathcal{P}(\pi))\})$

   b. $\lambda \pi \exists z \colon \textsc{state}(\text{realises}(z,^{\wedge}\{\text{silly}(j,\pi)\})$

Now let us turn our attention to (2b). After constructing the logical form of the VP, we apply the progressive operator in Aspect. The progressive aspect also introduces a realiser but it must be an event type that is non-stative. So it demands a realiser that is an activity. At this point local justification is attempted by introducing a realising eventuality for the verbal complex. A coercion takes place when the aspectual information combines with the verbal complex, prior to Tense, but here the coercion is more complex because the verbal complex still requires that any realiser be stative (it is a type presupposition of the verbal complex itself). So we need Aspect together with the fine-grained type of the verbal complex, which reflects the copula + adjective construction, to license a polymorphic type of the form $\textsc{activity}(\sigma,\alpha)$ whose parameters are $\sigma \sqsubseteq \textsc{state}$ and the bearer of the state. The output or value of the polymorphic type is a type of activity or process involving an object of type α that results in a state of type σ. The associated functor for this polymorphic type is:

(43) $\lambda P \lambda e \lambda x \lambda \pi \exists s \; (\phi_{\textsc{activity}(\text{HD}(P),\text{HD}(x))}(x,e,\pi) \wedge \; \text{result}(e,s,\pi)$
  $\wedge \; P(\pi)(s)(x))$

We now use a version of event coercion to justify the progressive's type presuppositions, and we get the following meaning for (2b):

(44) $\lambda \pi \exists e \colon \textsc{activity} \; (e \circ \text{now} \; \wedge \exists s \; (\phi(j,e) \wedge \; \text{result}(e,s) \wedge$
  $\text{realizes}(s,^{\wedge}\text{silly}(j,\pi))))$

In words this says that John is doing some activity whose result state is s and s includes the temporal span of some aspect of John in which he is silly. The assumption that there is no aspect in *John is silly* leads to essentially the same logical form, but this time we have a direct coercion to the result state interpretation from the propositional content $^{\wedge}\text{silly}(j,\pi)$. These are the intuitively right truth conditions for such a sentence. Our discussion has shown how aspectual coercion falls within the TCL approach to coercion.[11] This discussion also shows us what is behind the polymorphic types that we used for simple event coercion; they are introducers of event realisers for an underspecified verbal complex.

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11 See de Swart (1998) and Bary (2009) for a more extensive discussion of uses of coercion to describe different uses of the *passé simple* and *imparfait* in discourse. As far as we can tell, all of these coercions are of a piece with the story for aspectual coercion that we have spelled out here.

5.2 Aspectual coercion and modality

Let's now turn to the interaction of modals and aspect for another illustration of meaning shifts. Once again we will be interested in the contributions of aspect, but in order to understand how these contributions interact with the semantics of modals, we will have to use a more expressive framework, that of TY2, in which world and time evaluation variables become explicit parameters in the logical form and, accordingly, the type system countenances atomic types for worlds and times.

What, first, is the position of aspect with respect to modality? Which takes which as an argument? The answer to these questions seems to depend, as Hacquard (2009) and others have suggested, on which modality we are interested in. Consider first epistemic modals like *might* in English. Let's assume that the verbal complexes in the first sentences of (45a,b) license an event realiser. Using the mechanisms that discourse linguists like Roberts (1989) have used to analyze modal subordination, we predict a substantive difference between (45a) and (45b), which is born out.

(45)   a.   John might run the Marathon tomorrow. It would take him at most 3 hours.

        b.   John might run the Marathon tomorrow. It will take him at most 3 hours.

(45b) is worse than (45a), which is a classic case of modal subordination with events. This difference also shows that the eventuality given by the verb is within the scope of the modal. But what about the *might* claims themselves? Do they describe or introduce some sort of eventuality? If we suppose that a state is introduced by the epistemic modal, we should be able to temporally modify it anaphorically. But that isn't possible:

(46)   #John might run the Marathon. That will last for a couple of years. (where *that* should pick up the possibility of John's running the Marathon)

When we turn to adverbial modification, we have another indication that modals don't introduce states. For instance, *for* adverbials, which provide one test for statehood of (the realization of) the verbal complex, are infelicitous with epistemic modals.

(47)   a.   John was sick for two weeks.

        b.   John was sick at 2 pm.

        c.   # John might finish his dissertation for two years.

        d.   John might finish his dissertation at 2.

(47c) sounds really bad to us, but conceptually it should make sense. (47d) sounds fine but the adverbial modifies the VP under the scope of the modal, not a state introduced by the modal itself.

The story about spatial and temporal modifiers that hold of states seems much the same when we look at epistemic modals:

(48)   a.   John was sick at work.

        b.   John might finish his dissertation at Jean Nicod.

The last example is fine but the spatial modifier doesn't modify a state given by the epistemic modal but rather the event described by *finish*. The facts are quite different for ability modals. (The following examples are due to Vincent Homer p.c.)

(49)   a.   Hier, Jean devait rendre son devoir demain, mais les choses ont changé : il doit maintenant rendre son devoir aujourd'hui.

        b.   Pendant des semaines, Jean a dû rendre son devoir demain, mais les choses ont changé : il doit rendre son devoir aujourd'hui.

        c.   Il n'y a qu'en France que les gens peuvent aller adopter un enfant au Mali, c'est interdit partout ailleurs.

Davidson's theory regarding the introduction of eventualities to account for adverbial modification doesn't hold up for epistemic modals. The fact that it's also difficult to pick up these eventualities anaphorically suggests that perhaps they aren't there. It looks then as though epistemic modals take very wide scope; all temporal and aspectual modification takes place within the scope of the modality. Complicating this picture, however, is the observation that epistemic possibilities can shift with time, and thus are in some sense temporally located:

(50)   Two years ago, we might have taken that option, but not now.

(51)   Suddenly might we not need Google for much of our web browsing? (Benjamin Cohen on Technology, April 22, 2010)

(52)   Kendrick Meek suddenly might have a shot. (Atlantic Wire, May 11, 2010)

(53)   And in his palm he might hold this flower, examining the golden dainty cup, and in him suddenly might come a sweetness keen as pain. (Carson McCullers, *Ballad of the Sad Cafe*)

These examples show that epistemic modals can get situated in space or time, but not by VP-adjoining adverbs, only IP adverbs. Also they're difficult to modify with ordinary tense in English. This shows, we think, that like Homer we can take

epistemic modalities to have wide scope over tense and aspect, and over some higher projection of VP, and that the realiser of a modal statement is a fact. Temporal and spatial modifiers of epistemic modals follow the same analysis as the temporal and spatial modifications of other facts: they contribute parameters of realisation to facts.

In contrast, the data show that spatial and temporal VP modifiers can clearly modify an ability modal claim. So this would suggest that ability modals are much closer to the root verb position and so would fall within the scope of tense and aspect.

Aspect is traditionally understood to bind the event variable introduced by a verb phrase and Tense is supposed to locate the eventuality in time. But perfective aspect in many languages takes on an evidential function, which has not to do with events but with propositions Faller (2006). We provide a framework in which this is natural. Aspect can bind a parameter in the modality; it can also bind an eventuality or a fact. It is the binding of a parameter in the modality that gets us the actuality entailment. Note that in TY2, temporal modifiers automatically attach via a Davidson-like rule to the time parameter, thus not requiring the introduction of any eventualities on that score. Perhaps one might also countenance a space-time parameter directly in TY2 to account for spatial modifiers as well.

Given the type of worlds s and the type of times ti as basic types, we also have the type $s \to s$, which is the type of a modal transition. This allows us to rewrite basic possibility and necessity modalities as :

- $\lambda w \Diamond \phi(w) \mapsto \lambda \rightharpoonup : s \to s \ \lambda w \ \phi(\rightharpoonup (w))$

- $\lambda w \Box \phi(w) \mapsto \lambda \rightharpoonup : s \to s \ \lambda w (\phi(\rightharpoonup (w)) \land \neg \exists \rightharpoonup' \ \neg \phi(\rightharpoonup' (w)))$

When we are dealing with epistemic modalities, whose contribution does not fall under the effect of tense or aspect, we may assume the λ-bound variables of type *s rightarrows* to be existentially closed off. Assuming such existential closure gets us the right meanings for *cannot* (where the negation scopes over the modal) and must not (where the negation is within the scope of the modal). Furthermore, we get the right entailment from $\neg \Box \neg \phi$ to $\Diamond \phi$, if we assume that a modality always involves at least one transition and that they are existentially closed. When we are dealing with ability modals, it is aspect that contributes the existential closure. The payoff is that we will avoid the essentialist difficulties of Hacquard's solution as well as its difficulties with interpretation under negation.

Within TY2, we can be more explicit and economical than we were in the version of intensional logic we appealed to in the previous sections. Propositions now explicitly take worlds and times as arguments (or worlds and spatio-temporal parameters). So the temporal adverbials that apply to the verbal complex simply apply to the temporal parameter. There is no need for an eventuality realiser or a fact realiser for these. In effect, we will see that we can do without them altogether.

Perfective aspect still has a realising function, but here it is either with respect to worlds or times, depending on the language. In English it locates the truth of a proposition at a time that is right before some time specified by tense. In French and Italian it also does this but can also realise a modal transition of type $s \to s$. This realiser has the type ρ which we give below, coupled with the contribution to logical form of perspective aspect.

- $\rho := \text{TIMES} \sqcup (s \to s)$

- $\lambda P \lambda t \lambda w \lambda \pi \, \exists x \colon \rho \, (f_2(x,w) \subseteq w \wedge \text{abuts}(f_1(x,w),t) \, \wedge$
  $[s \to s \, \exists\text{-Closure}]P(w,t',\pi))$

In the contribution to logical form, P has the type of functions corresponding to propositions in the version of TY2 we use here (a function from worlds and times to truth values); w is a variable for worlds while t is a variable for times and f_1 and f_2 are quasi-projection functions that combine x with w, depending on the type of x. If x is a time, $f_1(x,w) = x$ and $f_2(x,w) = w$, whereas if x is a modal transition $f_1(x,w) = $ some time t' abutting t and $f_2(x,w) = x(w)$. The existential closure over modal transitions is needed for English but not for French or Italian.

The basic idea is this. Perfective aspect typically takes a proposition that has an eventuality realisation and it realises this eventuality. However, when an eventuality realiser is not possible, that is, when we have a modal proposition as the argument of aspect and a modal transition is available for saturation, French and Italian aspectual operators select for and realise the transition argument. The situation is different for English and perhaps all Germanic languages: aspect simply selects for the fact realiser.

Forgetting about tense and type presuppositions for illustrative purposes, (55 shows what perfactive aspect does to $\Diamond_a$ take(train, j), which is the logical form for (54):

(54)   Jeanne a pu prendre le train. (Jean was able to take the train)

(55) $\lambda w \, \exists \to (\to (w) \subseteq w \wedge \text{take}(\text{train}, j)(\to (w)))$

This is the analysis for *Jeanne a pu prendre le train* (Jean was able to take the train).

This analysis involves no event essentialism because modality and perfective aspect doesn't have to do with events but rather with realisations, which is a much more general notion. Perfective aspect collapses the modality underneath it in a compositional way. Negation and conditionals work standardly and as predicted. So for example *Jeanne n'a pas pu prendre le train* yields

(56) $\lambda w \, \neg \exists \to (\to (w) \subseteq w \wedge \text{take}(\text{train}, j)(\to (w)))$

For imperfective aspect, we have the following entry in French. It does not force the truth of the sentence under its scope at the actual world.

(57) $\lambda P \lambda t \lambda w \lambda \pi \, \exists x \colon \rho \, P(f_2(x,w),t,\pi)$

When a modalised verbal complex is the argument of imperfective aspect, we simply have the true modal statement. That is, in an example like

(58)   Jeanne pouvait prendre le train.

the imperfective simply yields the fact that Jeanne has the ability to take the train; tense locates that fact in the past. We assume that prior to this, existential closure (EC) applies to the modal transition. This gives us the right predictions for French imperfective ability modal sentences. In the absence of an explicit modal, however, the imperfective seems to coerce the presence of an "inertial worlds" modality à la Dowty (1979), which we indicate by placing the index i on the transition $\rightarrowtail$. The inertial modality serves to capture the incompleteness of the action.

(59)   Jean a écrit une lettre.

(60) $\lambda w, t \, \exists t'(\text{écrire une lettre}(j,w,t') \wedge t' < t)$

(61)   Jean écrivait une lettre.

(62) $\lambda w, t \, \exists t' \exists \rightarrowtail_i (\text{écrire une lettre}(j, \rightarrowtail_i (w), t') \wedge \neg\exists \rightarrowtail'_i \neg\phi(\rightarrowtail'_i (w), t') \wedge t' < t)$

Our analysis indicates that the imperfective likes to have a modal of some sort in its scope. Technically, this means that the imperfective licenses the introduction of a modality functor; it coerces a modality, much in the same way that *enjoy* coerces the presence of an eventuality in logical form.

5.3   Temporal adverbials and aspectual coercion

Now that we have a story about the basics of aspectual coercion, we need to tackle the effects of adverbs on aspect. TCL already predicts that temporal adverbs can affect the readings of verbal complexes within their scope to make precise the effect of adverbials on aspect. Certain temporal adverbials in French like *soudain* license a coercion for inchoative readings. This observation by itself doesn't account for the actuality entailment; an inchoative reading entails only that the ability just started. However, we can ask what the grounds of such a change of state could be. To have the ability enabled strongly suggests that the ability has been just realised. This line of thinking would lead us to suggest that given a verbal complex type consisting of

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an imperfective applied to an ability modal, a type clash occurs when a temporal adverb like *suddenly*, which wants a proposition that has a just realised eventuality, is applied to it. We don't understand exactly why this occurs and we don't have the intuitions reported by Homer and Mari & Martin (2007) about these adverbial effects. Nevertheless, it does seem to us stranger to assert (63) than (64) in English, and our French informants concur that this is also the case in French:

(63)   Suddenly, John could open the door, but he didn't do it.

(64)   John could open the door, but he didn't do it.

Let us assume that the data are as Homer and Mari & Martin (2007) describe them and that we have cases of actual blocking of entailments with the requisite type clashes. Given that such a type clash takes place, then the coercion mechanisms in TCL can repair this clash and accommodate the type presuppositions of the predicate (in this case, the adverbial). The mechanism here is more complicated than the *enjoy* example. Once the clash is detected, we abstract over the problematic part of the logical form, so as to take off the imperfective aspect's contribution, and we then apply a functor to the verbal complex which has the effect of the perfective. The requisite functor looks like this and requires a modalised proposition to apply:

(65) $\lambda P \lambda \mathcal{P} \lambda P \lambda w \lambda t \lambda \rightharpoonup_1 \mathcal{P}(\exists \rightharpoonup_2 (\rightharpoonup_2 (w) \subseteq w \wedge P(\rightharpoonup_2, w, t)))$

This operator in effect cancels the effect of the imperfective. A similar cancellation operator would apply with coercions of the sort claimed in (11), though we are even less sure about the data in this area.

To be more explicit, here is a TCL sketch of a derivation for *soudain, Jean pouvait ouvrir la porte*.

- Applying the imperfective to the verbal complex we get:
  $\lambda w, \lambda t \lambda \pi \exists \rightharpoonup \text{Open}(j, d)(\rightharpoonup (w), t, \pi)$

- *Soudain* applies before tense and imposes a type requirement on its argument that says its propositional argument must have a punctual temporal realization:
  $\lambda P \lambda w, \lambda t \lambda \pi (\text{Soudain}(t) \wedge P(w, t, \pi * \text{PROP-EVT}))$

- The type of the propositional argument in the first line is by hypothesis not of PROP-EVT, and so we now abstract over the imperfective operator yielding:
  $\lambda \mathcal{P} \lambda w \lambda t \lambda \pi \mathcal{P}(\lambda \rightharpoonup \text{Open}(j, d)(\rightharpoonup (w), t, \pi))(\text{Imp})$.

- We now apply the functor in (65) which yields:
  $\lambda \mathcal{P} \lambda w \lambda t \lambda \pi \mathcal{P}(\lambda \rightharpoonup_1 \mathcal{P}(\exists \rightharpoonup_2 (\rightharpoonup_2 (w) \subseteq w \wedge \text{Open}(j, d)(\rightharpoonup_2 (w), t, \pi))))$ (Imp)

- Putting the imperfective aspect back on and eliminating the vacuous quantification gives us:

$$\lambda w, \lambda t \lambda \pi \exists \rightharpoonup_2 (\rightharpoonup_2 (w) \subseteq w \wedge \text{Open}(j,d)(\rightharpoonup_2 (w), t, \pi))$$

- which now by hypothesis has the right type to combine with *soudain*, and so the derivation terminates once we add on Past Tense.

We've made some headway on untangling the problem of aspectual coercion involving modals. Let us take stock. French, Italian, Spanish and English have specific, and different, type requirements on the arguments of aspect. In English the case is complicated. (66a) doesn't straightforwardly follow from (66b) or (66c)/

(66)   a.   John took the train.

        b.   John was able to take the train.

        c.   John has been able to take the train.

English seems to differ from French, Spanish, and Italian in that neither the simple past tense nor perfective aspect seems to generate the actuality entailment. It would appear that in English aspect simply realises the fact of an ability, whereas in French and Italian aspect must take the transition argument. Spanish, in which the simple past seems to generate the actuality entailment, would have a yet more complicated story in which an operator with the semantic contribution provided by our entry for perfective aspect in French and Italian would be coerced by the presence of the simple tense and null aspect marking. To account for the implicature in English, we suppose that such an operator is licensed but not required by aspect and by tense. This is technically not a coercion because there is no type clash. So in this case TCL requires supplementation to deal with optional coercion functor insertion. Clearly, this cannot be a general and unconstrained process, but we don't know what the constraints are.

In general, we believe that the licensing of the ability implicature in English at any rate (and, we suspect, in other languages) is a matter of discourse context and the predication involved in the verbal complex, not just the presence of a particular temporal adverbial. In the examples below, English *now*, like *suddenly*, introduces an incohative interpretation with various discourse effects (Hunter 2010), but these don't perforce generate the actuality entailment.

(67) a. John used to complain how his wife wouldn't let him travel. Then one day she left him. Suddenly, he was able to go anywhere he wanted to go. But he no longer had the desire to travel.

b. John couldn't open the door. He pulled and pulled. Suddenly, John was able to open the door.

c. John used to complain how his wife wouldn't let him travel. Then one day she left him. Now (after that) he was able to go anywhere. But he no longer had the desire to travel.

d. Soudain elle pouvait aller n'importe où.

e. L'impression que mes roues sont le prolongement de mes jambes et que soudain, je peux aller en toute liberté de la Concorde à Bercy en quelques minutes,... (*Google*)

f. John couldn't open the door. The key wouldn't work. Then he found a different key. Now he was able to open the door.

(67a,c,d,e) simply don't generate the actuality implicature. Even in the absence of the last sentence in (67a,c), it would be far-fetched to assume that he did in fact travel everywhere in the world, even if he had the capacity. Similarly, in (67e), the impression that he can go from the Place de la Concorde to Bercy doesn't mean that he has the impression that he did that. The predication has to be "reasonable" for the actuality entailment to hold. Given that the coercion mechanisms in TCL take the fine-grained type of the verbal complex into account, a fuller TCL account of the actuality entailment/implicature will be able to take the nature of the predication into account. This flexibility gives a TCL story a large advantage over other accounts of the actuality entailment/implicature in the literature.

6 Conclusion

In this paper we've shown how to use TCL, a system of meaning composition with a very rich set of basic types, to handle three examples of aspectual coercion. To handle interactions of aspect and modality, we've used TCL within the TY2 framework and provided a novel representation of modality. We believe that the system has the wherewithal to represent all aspectual coercions. However, we also recognise a danger in this expressive power: the system is in danger of losing predictive power. Coercion is constrained according to TCL by the lexical entries for predicates and the coercion functors they license. We believe that coercion functors reflect more basic facts of natural language metaphysics— the coercion from objects to events in which they participate, for example, is licensed by the very natural supposition that objects change or participate in changes on other objects. It is less clear to us exactly

what the metaphysical underpinnings of aspectual coercions are. But we hope that TCL at least makes clear what is at stake in these coercions and that future research will clarify the nature of the conceptual constraints on coercion functors.

References

Asher, Nicholas. 1992. A default, truth conditional semantics for the progressive. *Linguistics and Philosophy* 15. 463–508.

Asher, Nicholas. 1993. *Reference to abstract objects in discourse* (Studies in Linguistics and Philosophy 50). Dordrecht: Kluwer.

Asher, Nicholas. 2011. *Lexical meaning in context: A web of words*. Cambridge University Press.

Asher, Nicholas & James Pustejovsky. 2006. A type composition logic for generative lexicon. *Journal of Cognitive Science* 6. 1–38.

Bary, Corien. 2009. *The semantics of the aorist and imperfective in ancient greece*: University of Nijmegen dissertation.

Beaver, David. 2001. *Presupposition and assertion in dynamic semantics*. Stanford: CSLI Publications.

Bhatt, Rajesh. 1999. Actuality Entailments of Ability Modals. In Kimary Shahin, Susan Blake & Eun-Sook Kim (eds.), *Proceedings of the 17th west coast conference on formal linguistics*, 74–87. Palo Alto, CA: CSLI.

Davidson, Donald. 1968/69. The logical form of action sentences. In Peter Ludlow (ed.), *Readings in the philosophy of language*, 337–346. MIT Press.

Dowty, David R. 1979. *Word meaning and Montague Grammar: The Semantics of Verbs and Times in generative semantics and montague's ptq* (Studies in Linguistics and Philosophy 7). Dordrecht: Kluwer.

Faller, Martina. 2006. Evidentiality and epistemic modality at the semantics/pragmatics interface. URL `http://www.eecs.umich/ rthomaso/lpw06/fallerpaper.pdf`. Paper presented at the 2006 Workshop on Philosophy and Linguistics, University of Michigan.

Hacquard, Valentine. 2009. On the interaction of aspect and modal auxiliaries. *Linguistics and Philosophy* 32. 279–315.

Heim, Irene. 1983. On the projection problem for presuppositions. In Michael Barlow, Daniel Flickinger & Michael Westcoat (eds.), *Second Annual West Coast Conference on Formal Linguistics*, 114–126. Stanford University.

Hunter, Julie. 2010. *Presuppositional indexicals*: The University of Texas at Austin dissertation.

Luo, Zhaohui. 2010. Type theoretical semantics with coercive subtyping. In Bill Lutz (ed.), *Proceedings salt xx*, Cornell University.

Mari, Alda & Fabienne Martin. 2007. Tense, abilities and actuality entailment. In Maria Aloni, Paul Dekker & Florian Roelofsen (eds.), *Proceedings of the sixteenth Amsterdam Colloquium in Formal Semantics*, 151–156. ILLC Publications, University of Amsterdam.

Pustejovsky, James. 1995. *The generative lexicon*. Cambridge, MA: MIT Press.

Roberts, Craige. 1989. Modal subordination and pronominal anaphora in discourse. *Linguistics and Philosophy* 12. 683–721.

van der Sandt, Rob. 1992. Presupposition projection as anaphora resolution. *Journal of Semantics* 9. 333–377.

Smith, Carlota. 1991. *The parameter of aspect*. Dordrecht: Kluwer Academic Publishers.

de Swart, Henriette. 1998. Aspect shift and coercion. *Natural Language and Linguistic Theory* 16. 347–385.

Vendler, Zeno. 1967. *Linguistics in philosophy*. Ithaca, NY: Cornell University Press.