Inchoative verbs and adverbial modification: Decompositional and scalar approaches

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To my parents, Keith and Joanne.

ABSTRACT

This dissertation provides an in-depth comparison of the `BECOME`/small-clause and scalar approaches to the syntax and semantics of inchoative verbs. It is argued that the traditional `BECOME`/small-clause approach faces a number of insurmountable problems; these include, among others, the overgeneration of adverbial ambiguities, incorrect truth-conditions for sentences with adverbs in decomposition-internal attachment sites, and incompatibility with certain kinds of modifiers (like directional measure-phrases). A scalar approach, which does not require positing multiple clausal levels in the representation of what on the surface appears to be a monoclausal sentence, is shown to avoid many of the problems inherent in the decompositional approach. However, moving from a decompositional analysis of inchoative verbs to a scalar one requires new explanations for phenomena, like *again*-ambiguities, that were previously handled in decompositional terms. It is shown that, in many ways, scale-sensitive meanings can take the place of decompositional structures in the explanations of such phenomena, resulting in analyses that are preferable on both empirical and theoretical grounds.

RÉSUMÉ

Cette dissertation présente une comparaison détaillée de deux approches de la syntaxe et sémantique des verbes inchoatifs: l'approche `BECOME`/proposition réduite et l'approche scalaire. J'affirme que l'approche traditionnelle de `BECOME`/proposition réduite fait face à des problèmes insurmontables; ceux-ci incluent la génération d'ambiguïté adverbiale inexistante, des conditions de vérité erronées pour les propositions avec un adverbe à l'intérieur de la structure décomposée, et l'incompatibilité avec certains modificateurs, tels que les syntagmes de mesures directionnels. Je démontre qu'une approche scalaire, qui n'exige pas plusieurs niveaux propositionnels dans la représentation des phrases apparement simples, échappe à beaucoup des problèmes inhérentes à l'approche décompositionelle. Cependant, une approche scalaire des verbes inchoatifs nécessite une nouvelle analyse de certains phénomènes, comme l'ambiguïtés avec *again*, qui recevaient une explication sous l'analyse décompositionnelle. Je démontre que des interprétations sensibles aux échelles peuvent remplacer des structures de décomposition pour expliquer de tels phénomènes, et que ces explications sont préférables pour des raisons empiriques et théoriques.

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CONTENTS

Chapter 1

Introduction

Pedersen (2014) The question often arises in theoretical linguistics, when attempting to analyze some linguistic phenomenon, whether one should enrich the syntactic representation of a sentence in some way, or instead whether one should posit more enriched denotations for the expressions involved. A case in point is the 'result-state' inferences that inchoative verbs like *open* give rise to. For example, an utterance of (1a) leads one to naturally infer that (1b) is true.

(1) a. The door has opened.
  b. The door is or was open.

An early but highly influential approach to result-state inferences like the above was to posit that the syntactic representation of sentences like (1a) contain unpronounced material that make the inferential link between that sentence and another a matter of 'syntactic containment'. This approach, referred to here as SYNTACTIC PREDICATE DECOMPOSITION, dates back to the time of the Generative Semantics movement (e.g. Morgan 1969; McCawley 1971). The most influential decomposition of inchoative verbs is what can be called a 'BECOME/small-clause' decomposition; when given an analysis of this kind, a sentence like (1a) is assigned a syntactic analysis something like that in (2).

(2) $[_{\mathrm{S}}\ [_{\mathrm{NP}}\ \texttt{The door}\ ]_1\ [_{\mathrm{VP}}\ [_{\mathrm{V}}\ \texttt{BECOME}\ ]\ [_{\mathrm{SC}}\ t_1\ \texttt{open}_{\mathrm{ADJ}}\ ]\ ]\ ]$

In this type of analysis, the verb-phrase of the sentence is 'decomposed' into a BECOME operator and a small-clause consisting of the adjective *open* and the subject of the sentence; a transformation of some kind raises the small-clause subject to the subject-position of the matrix clause (the original small-clause position of the subject is shown in (2) with a trace t_1). The important thing to note about this type of analysis is that result-state inferences like the one described above result from a kind of 'syntactic containment'; the stative clause that characterizes the result-state of a sentence is assumed to be an actual syntactic constituent of that sentence.

Evidence in favor of a `BECOME`/small-clause decompositional analysis of inchoative verbs has been argued to come from certain kinds of sentences involving adverbial modification, where the interpretation of a particular sentence can apparently be explained with a decompositional-internal position for the adverb involved (e.g. Morgan 1969; McCawley 1971, 1973b; von Stechow 1996). One adverb which is claimed to appear both decomposition-internally (i.e. below `BECOME`) and decomposition-externally (i.e. above `BECOME`) is *again*; these different attachment sites for *again* are used to explain the two readings of a sentence like (3), which is claimed to be ambiguous between a 'repetitive' reading and a 'restitutive' reading.

(3) The door opened again.

a. REPETITIVE: The door opened, and the door opened before.

b. RESTITUTIVE: The door opened, and the door has been open before.

(4) a. REPETITIVE:

$[_{S}\ [_{NP}\ \texttt{The door}\ ]_1\ [_{VP'}\ [_{VP}\ [_{V}\ \texttt{BECOME}\ ]\ [_{SC}\ t_1\ \texttt{open}_{ADJ}\ ]\ ]\ \texttt{again}\ ]\ ]$

b. RESTITUTIVE:

$[_{S}\ [_{NP}\ \texttt{The door}\ ]_1\ [_{VP}\ [_{V}\ \texttt{BECOME}\ ]\ [_{SC}\ [\ t_1\ \texttt{open}_{ADJ}\ ]\ \texttt{again}\ ]\ ]\ ]$

When *again* attaches below `BECOME` and modifies the small-clause, a restitutive reading results; when *again* attaches above `BECOME` and modifies the whole verb-phrase, a repetitive reading results. The fact that a `BECOME`/small-clause decomposition makes available attachment sites for adverbs like *again* – attachment sites which actually appear to be utilized – is taken to be strong corroborating evidence for a decomposition approach to inchoative verbs (c.f. von Stechow 1996).

Decompositional analyses like the `BECOME`/small-clause analysis were developed before the widespread adoption of formal semantics in linguistics research; at the time, 'syntactic containment' was viewed as the main method for generating inferences between sentences. With the advent of the application of formal semantics to natural languages (e.g. Montague 1970a), it become possible to approach phenomena like ambiguity and inter-sentential inferences in ways that did not require positing substantial abstract syntactic structure. Regarding inchoative verbs specifically, one type of semantic analysis that has emerged in more recent times is what can be called a SCALAR analysis (see e.g. Hay et al. 1999; Winter 2006; Kennedy and Levin 2008). In this type of analysis, inchoative verbs are assigned formal denotations that involve SCALES consisting of an ordered set of DEGREES, as well as a function that maps an object (e.g. the door) to a degree (or pair of degrees) that represents the extent to which that object's measurement has changed on some scale (e.g. on the scale of openness). In a scalar approach to verb-meaning, it is assumed that the denotations of both an adjective and a morphologically-related verb share common elements; in particular, they both relate objects to degrees on the same scale. This means that, in such an approach, phenomena such as result-state inferences can be approached in primarily semantic terms by referring to the shared components of verb/adjective meaning; positing the syntactic presence of an adjectival small-clause in a decomposed verb phrase is no longer necessary. In other words, in a scalar approach to verb-meaning, multi-clausal verb-phrase decompositions are replaced with enriched formal denotations for verbs and adjectives that involve scales and associated concepts.

This dissertation provides an in-depth comparison of the `BECOME`/small-clause and scalar approaches to the syntax and semantics of inchoative verbs. It is argued that the traditional `BECOME`/small-clause approach faces a number of insurmountable problems; these include, among others, the overgeneration of adverbial ambiguities, incorrect truth-conditions for sentences with adverbs in decomposition-internal attachment sites, and incompatability with certain kinds of modifiers (like directional measure-phrases). A scalar approach, which does not require positing multiple clausal levels in the representation of what on the surface appears to be a monoclausal sentence, is shown to avoid many of the problems inherent in the decompositional approach. However, moving from a decompositional analysis of inchoative verbs to a scalar one requires new explanations for phenomena, like *again*-ambiguities, that were previously handled in decompositional terms. It is shown that, in many ways, scale-sensitive meanings can take the place of decompositional structures in the explanations of such phenomena, resulting in analyses that are preferable on both empirical and theoretical grounds.

1.1 Overview of the dissertation

The following is an outline of what to expect in subsequent chapters of this dissertation.

Chapter 2 presents an overview of the history of predicate decomposition, and of the role it has played in modern generative/transformational linguistic theory. It is shown that the idea of syntactically decomposing predicates has survived numerous changes in framework, beginning with Generative Semantics and continuing through to Y-model approaches to grammar such as Government and Binding Theory and Minimalism.

Ambiguity, especially ambiguity arising from adverbial modification, has formed a central argument in favour of the syntactic decomposition of inchoative verbs. Chapter 3 reviews the notion of ambiguity, demonstrates how it is defined in a Y-model approach to syntax, and discusses how it differs from indeterminacy, vagueness and deixis. This chapter is mainly intended to provide some background for Chapters 4, 5 and 7, where particular cases of ambiguity are discussed in greater detail.

Chapter 4 provides an in-depth look at the syntax and semantics of the most influential decompositional approach to inchoative verbs, in which a verb-phrase is decomposed into a `BECOME` operator and a stative small-clause. This approach has been proposed as a way to explain both result-state inferences and 'decomposition-internal' readings of various adverbs. However, as discussed in this chapter, the `BECOME`/small-clause approach to inchoative verbs faces a number of serious problems; these include, among others, ambiguity overgeneration and the assignment of incorrect truth-conditions to sentences with decomposition-internal adverbs.

The scalar analysis of inchoative verbs, which is argued to be superior to a `BECOME`/small-clause approach, has as its starting point observations and proposals relating to gradable adjectives. Chapter 5 introduces and discusses a particular formal approach to the study of gradability in natural language semantics. It is proposed that an algebraic structure called an 'infinite difference system', defined in the measurement-theoretic work of Suppes and Zinnes (1963), can be used as the formal foundation for the study of various phenomena relating to gradability. It is shown that such a structure can be seen as underlying a more traditional presentation of gradability in terms of scales and degrees.

Chapter 6 presents the scalar approach to the syntax and semantics of inchoative verbs. The particular scalar analysis developed here builds on earlier analyses of a similar kind (e.g. Kennedy and Levin 2008), but differs from them in that it makes central use of degree pairs rather than difference degrees. The resulting analysis is shown to cover a wide range of empirical phenomena, including result-state inferences and modification with various kinds of adverbial modifiers, without suffering from the problems inherent in a `BECOME`/small-clause decompositional analysis.

Chapter 7 presents a scalar analysis of the adverb *again* and the ambiguities it gives rise to when it modifies inchoative verbs. *Again*-ambiguities have been claimed to provide a strong argument in favor of `BECOME`/small-clause decompositions (e.g. von Stechow 1996); in this chapter it is shown that multi-clausal decomposition is not necessary for a convincing explanation of *again*-ambiguities. A polysemy analysis of *again* is proposed, which assigns *again* a scale-sensitive meaning; this analysis is shown to cover the same ground as a decompositional one, and to actually provide a better explanation of the observed cross-linguistic and cross-speaker variation in the availability of restitutive readings for sentences.

Finally, Chapter 8 provides a conclusion to this dissertation, and discusses some open questions for future research.

Chapter 2

Predicate decomposition in linguistic theory

The term 'decomposition' as it is used in linguistics refers to the process or result of analytically breaking down some linguistic object (i.e. a word, phrase, syllable, word meaning etc.) into more basic elements; the use of this term is borrowed from other areas of scientific inquiry, e.g. in chemistry, the term is used to describe the separation of chemical compounds into elements or simpler compounds.

This chapter deals with a particular kind of linguistic decomposition that has been proposed on occasion – what will be called SYNTACTIC PREDICATE DECOMPOSITION, or 'PD' for short. This is the idea that, in order to capture certain syntactic or semantic generalizations, one analyzes a predicate whose surface form consists of n morphemes as containing more than n syntactic elements. One famous proposal of this kind is the proposal that the apparently monomorphemic verb *kill* should be syntactically decomposed into separate morphemes with roughly the meaning of *cause*, *become*, *not* and *alive*. Also discussed here will be one proposed alternative to PD, what will be termed METALINGUISTIC EXPANSION. This is the idea that, rather than syntactically decomposing a predicate, one should introduce new logical terms into the metalanguage used to specify the meanings of those predicates; this approach allows one to maintain that the 'logical form' of a sentence closely resembles its surface form.

This chapter briefly traces the history of predicate decomposition and metalinguistic expansion in modern linguistic research.[1]

[1]The modern history of formal semantics provided by Partee (2014) was much referred to in the writing of this chapter.

2.1 Semantic markers

Regarding concepts or word meanings specifically, the possibility of decomposition does not seem unnatural; a much used example is how the meaning of *bachelor* intuitively 'contains' the meaning of *unmarried* and the meaning of *male* as components. In *The critique of pure reason*, Kant (1781 [1998], A7) states, regarding a 'subject concept' A and predicate concept B, that

> Either the predicate B belongs to the subject A as something that is (covertly) contained in this concept A; or B lies entirely outside the concept A, though to be sure it stands in connection with it. In the first case, I call the judgment analytic, in the second synthetic.

This distinction between analytic and synthetic judgments is often taken to underlie the difference between sentences like those in (1) and those in (2).

(1) a. All bachelors are unmarried.
 b. All opthamologists are doctors.

(2) a. All bachelors are happy.
 b. All opthamologists are rich.

Knowing whether the former pair of sentences is true or not does not seem to be contingent on knowledge of facts about the world; these sentences intuitively seem true based solely on the meanings of the words involved. That is, the meaning of *unmarried* seems to be somehow contained in the meaning of *bachelor*; one does not need to check each bachelor individually to know that (1a) is true. The same is not the case for the latter pair of sentences; knowing the truth or falsity of these sentences does seem contingent on knowing facts about the world; for example, to know whether (2a) is true, one would need to inquire into the state of each bachelor individually.

An explication[2] of Kant's notion of 'containment' in terms of a semantic theory for natural language (in particular, for language as viewed through the lens of generative transformational syntax) was proposed by Katz and Fodor (1963) (see also Katz and Postal 1964; Katz 1972). Katz & Fodor proposed that each 'sense' of a word is decomposable into component concepts, called 'semantic markers'. For example, it is proposed that the word *ball* has three senses, which specify the following semantic markers (Katz and Fodor 1963, p.198):

[2] Carnap (1947, p. 8–9): "The task of making more exact a vague or not quite exact concept used in everyday life or in an earlier stage of scientific or logical development, or rather of replacing it by a newly constructed, more exact concept, belongs among the most important tasks of logical analysis and logical construction. We call this the task of EXPLICATING, or of giving an EXPLICATION for, the earlier concept."

(3) i. Noun Concrete → (Social activity) → (Large) → (Assembly) → [For the purpose of social dancing]
ii. Noun concrete → (Physical object) → [Having globular shape]
iii. Noun concrete → (Physical object) → [Solid missile for projection by an engine of war]

Katz & Fodor then propose 'projection rules', whereby the semantic markers of daughter expressions are projected to the head of phrases, and ultimately to the sentence level. These projection rules are viewed as 'paths'; the presence of an ambiguous expression like *ball* will result in the projection rules producing multiple paths for phrases containing the ambiguous expression. Using such rules, Katz & Fodor intend to explain certain semantic properties and relations, including the ambiguity of a sentence like (4a) and the inference from (4a) to (4b).

(4) a. A ball will be held in this room.
b. A physical object will be held in this room or a social activity will be held in this room.

The ambiguity of (4a) is proposed to be a result of the projection rules assigning multiple sets of semantic markers to the sentence; the inference from (4a) to (4b) could be explained in virtue of the fact that the set of markers assigned to each coordinated sentence in (4b) is a subset of the set of markers assigned to a sense of (4a).

A semantic marker approach to natural language semantics has been criticized on a number of grounds. One objection begins with the observation that (as proponents of semantic markers will admit), a theory like that of Katz & Fodor is essentially a translation procedure for converting natural language expressions to expressions in another language, a 'semantic markerese' or a 'language of thought' (LOT). For those who believe the purpose of semantics is to specify truth-conditions for sentences by specifying the relation between linguistic expressions and something non-linguistic or non-mental in nature (e.g. objects in the world), the semantic markerese or LOT approach will fall short as a semantic theory.[3] Of course, it is possible that the link between linguistic meaning and truth is indirect; this is the position of Pietroski (2013), who follows a line similar to Katz & Fodor in arguing that human languages are instructions for building complex concepts and thoughts. Pietroski, following Strawson (1950), states:

> In the right settings, humans can use these sentences to make and express truth-evaluable judgments, given suitable concepts. But truth/falsity may be down-

[3]See Lepore (1983) for a summary of this type of criticism.

> stream of linguistic meaning, in that certain acts of using meaningful linguistic expressions are candidates for being true-or-false, subject to further constraints.

According to Pietroski, one should not necessarily hold against a semantic theory the fact that it does not generate truth-conditions for sentences; one may understand the goal of semantic theory as specifying how linguistic structure-building maps to conceptual combination, with the understanding that in a complete picture one would like to have a theory of how conceptual representations are involved in truth-judgements.

The semantic marker approach to intepretation can be viewed as one of the first systematic attempts to incorporate predicate decomposition into generative transformational theory; the proposed decomposition in the semantic marker approach is by definition semantic, not syntactic. Subsequent developments, however, led to the proposal that a good portion of predicate decomposition should be located in the underlying syntactic representation of a sentence.

2.2 Generative semantics

Quine (1951) distinguished between two types of analytic statements, those which might be called 'logical truths' and those which might be called 'analytic truths'. Quine says:

> Statements which are analytic by general philosophical acclaim are not, indeed, far to seek. They fall into two classes. Those of the first class, which may be called logically true, are typified by:
>
> (i) No unmarried man is married.
>
> The relevant feature of this example is that it is not merely true as it stands, but remains true under any and all reinterpretations of 'man' and 'married.' If we suppose a prior inventory of logical particles, comprising 'no,' 'un-' 'if,' 'then,' 'and,' etc., then in general a logical truth is a statement which is true and remains true under all reinterpretations of its components other than the logical particles.
>
> But there is also a second class of analytic statements, typified by:
>
> (ii) No bachelor is married.
>
> The characteristic of such a statement is that it can be turned into a logical truth by putting synonyms for synonyms; thus (ii) can be turned into (i) by putting 'unmarried man' for its synonym 'bachelor.' We still lack a proper characterization of this second class of analytic statements, and therewith of analyticity

> generally, inasmuch as we have had in the above description to lean on a notion of 'synonymy' which is no less in need of clarification than analyticity itself.

Beginning in the mid-1960s, semantically-minded research in the generative transformational tradition began to focus more on 'first-class' analyticities, and it was proposed that, in many cases, what appear to be second-class analyticities should in fact be seen as analycities of the first class; pursuing this proposal involved relocating a good portion of predicate decomposition to the syntactic realm.

The 'semantic markerese' described by Katz and Fodor (1963) was intended to be combined with a transformational syntax of the kind proposed by Chomsky (1957, 1965). According to standard assumptions of the time, transformations were involved in generating a wide range of sentence types (such as questions and imperatives), and also for introducing elements such as negation into sentences. In order to have semantic projection rules that were compatible with these sorts of assumptions, Katz & Fodor assumed that the entire transformational history of a sentence must be taken into account when determining the meaning of a sentence; in other words, transformations were assumed to affect the meaning projected by a sentence.

In a subsequent development that proved highly influential, Katz and Postal (1964) put forth the proposal (the 'Katz-Postal Hypothesis') that transformations were meaning-preserving, and that semantic interpretation needed only to consider the 'Deep Structure' of a sentence (the stage in the syntactic derivation before transformations were applied); spelling out this proposal required positing that various abstract yet meaningful morphemes (such as a question morpheme and negation morpheme) were present in deep structure, and were subsequently deleted or altered by (meaning-preserving) transformations. However, as described by Partee (2014), the hypothesis that all transformations could be meaning-preserving became tenuous when quantified noun phrases began to be taken into consideration. For example, a transformation which derived (5b) from (5a) could plausibly be considered meaning-preserving; however, the same could not be said for a transformation which derived (6b) from (6a) (c.f. Partee 2014, §4.1).

(5) a. John wanted John to win.
    b. John wanted to win.

(6) a. Everyone wanted everyone to win.
    b. Everyone wanted to win.

Within the generative transformational tradition, there were two lines of response to this observation. The first line of response ('interpretive semantics') retained the idea that syntactic structures were interpreted by a separate set of semantic rules, but gave up the idea that all semantic interpretation must occur at a particular stage of a syntactic derivation (Chomsky 1970; Jackendoff 1972); for example, the 'functional' component of semantic interpretation (e.g. the assignment of 'thematic roles') might occur at Deep Structure, whereas the scope of quantifiers and negation might be determined at Surface Structure.

The second line of response was to maintain the Katz-Postal Hypothesis regarding the idea that transformations are meaning-preserving, and to push Deep Structure as 'deep as possible'; in effect, this response involved eliminating the distinction between semantics and syntax, and positing a 'lowest' level of representation that directly represented the meaning of a sentence. This position is summarized in the following quote by McCawley (1967, p.105):

> As an alternative to Chomsky's conception of linguistic structure, one could propose that in each language there is simply a single system of processes which convert the semantic representation of each sentence into its surface syntactic representation and that none of the intermediate stages in the conversion of semantic representation into surface syntactic representation is entitled to any special status such as that which Chomsky ascribes to 'deep structure'.

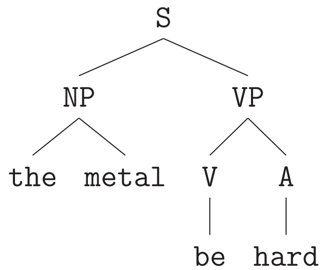
The line of research which pursued the characterization of underlying semantic representations and their conversion to surface structures became known as 'Generative Semantics' (GS); some representative works include Lakoff 1963, 1970; McCawley 1968, 1971; Lakoff and Ross 1977. GS research was characterized by highly abstract underlying representations, and various 'unusual' transformations that were used to convert these abstract representations to surface structures. It was in the work of the Generative Semanticists that semantically-inspired decomposition, especially of predicates, came to be located in the same system in which phrases and sentences were constructed.

Decomposition in GS was often used to explain what appear to be 'first-class' analyticities, in the sense described above. For example, Lakoff (1970) examined groups of sentences like the following:

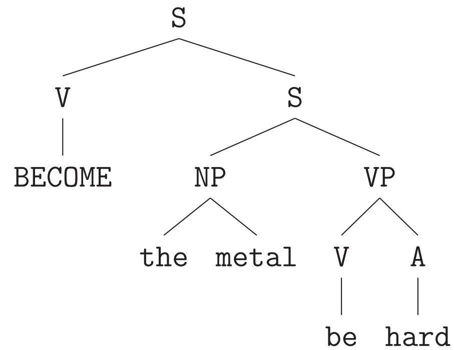
(7) a. The metal was hard.
b. The metal became hard.
c. The metal hardened.
d. John brought it about that the metal hardened.
e. John hardened the metal.

(7b) and (7c) are arguably synonymous, as are (7d) and (7e); in addition, from (7d)/(7e) one can infer (7b)/(7c), and from (7b)/(7c) one can infer (7a). A GS-style proposal for dealing with these inter-sentential relations is to assign synonymous sentences identical underlying representations, and to explain the inferential relations between sentences in terms of 'syntactic containment'. Simplified GS-style underlying representations for the sentences in (7) are shown below.

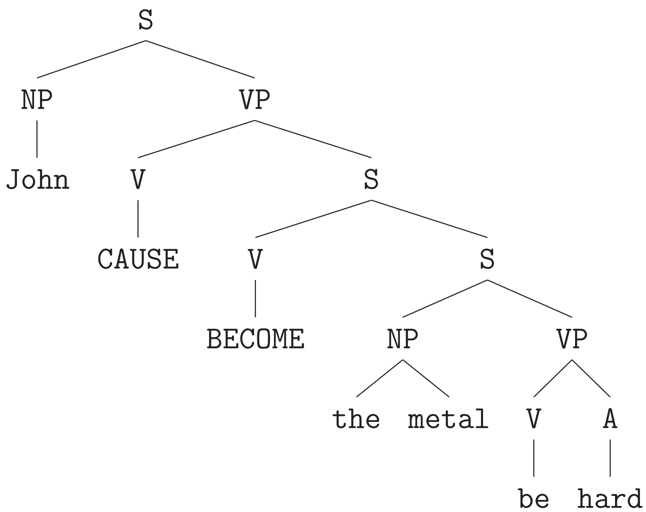
(7a′)



(7b′/7c′)



(7d′/7e′)



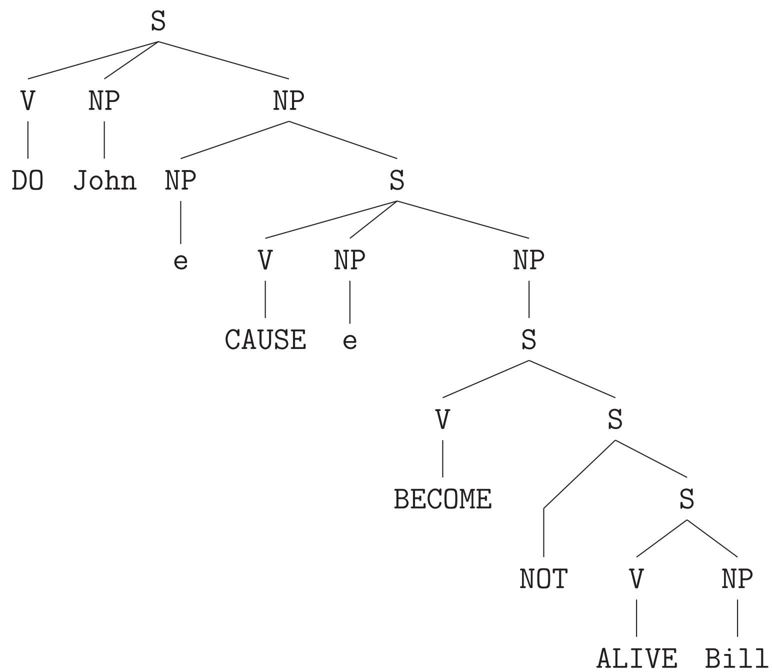
Note that the syntactic tree in (7a′) is a constituent of (7b′/7c′), which in turn is a constituent of (7d′/7e′). The difference in surface structure between (7b) and (7c) and between (7d) and (7e) is explained in terms of optionality as to which particular 'lexical insertion' rules apply, i.e. which lexical items replace the abstract elements `CAUSE` and `BECOME` – for example, either *-en* or *become* can replace `BECOME` in (7b′/7c′). Entailment relations between sentences were thus explained in terms of 'syntactic containment', and synonymy in terms of identity of underlying representations.[4]

The inferential relations that hold between the sentences in (7) are ones which might reasonably be described as 'first-class' analyticities, given that a common element (*hard*) appears in the predicate in each sentence; the GS analysis makes the analytic relationship

[4]Note that this presentation of a GS derivation is greatly simplified, and much thought went into how abstract underlying representations were converted to surface structures; see e.g. McCawley 1968, 1971.

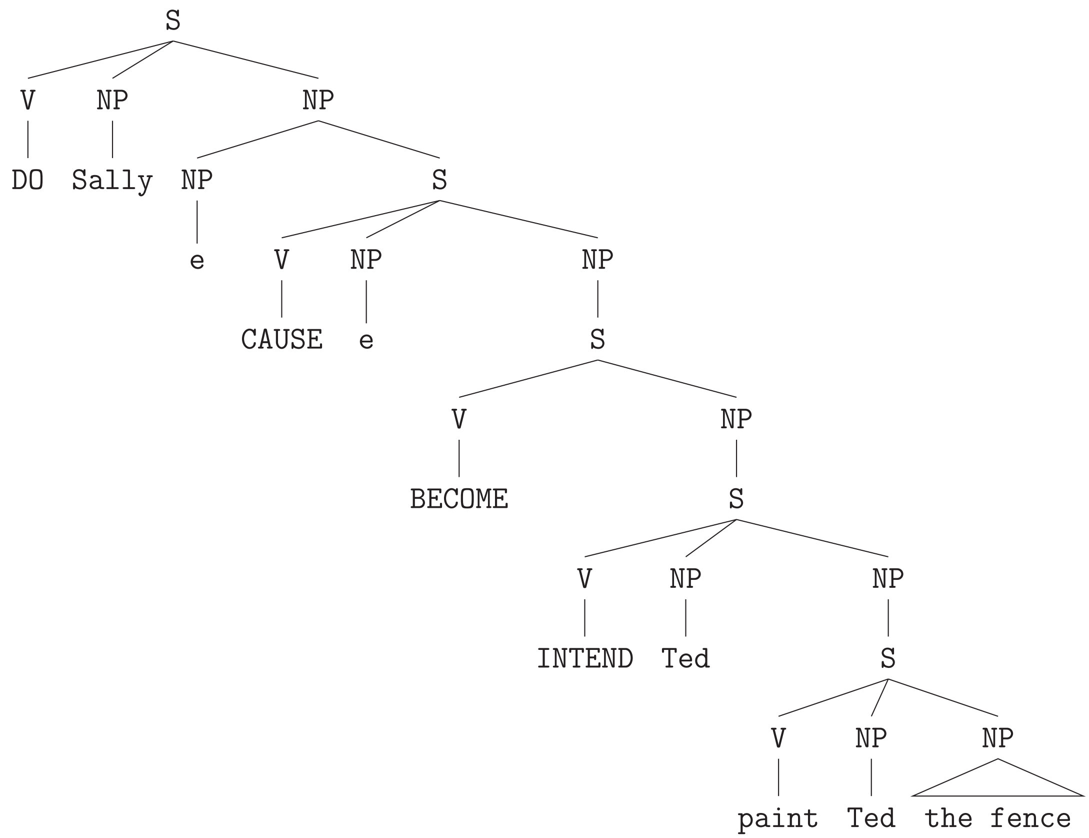
between the sentences transparent. As research in GS progressed, underlying representations became more abstract and the transformations linking these representations to surface structures became more involved. For example, it was famously proposed that a sentence like *John killed Bill* would have a decomposition like the following (see e.g. McCawley 1968):

(8)



Another example comes from McCawley (1971), who proposed that a sentence like *Sally persuaded Ted to paint the fence* might have a decomposition like the following:

(9)



GS-style analyses require a quite involved sequence of transformations to derive the correct surface structures from such abstract underlying representations, and a substantial amount of research in GS was devoted to the goal of characterizing these transformations (see e.g. Lakoff 1970; McCawley 1968, 1971).

Generative Semantics in its original form – with proposed derivations proceeding from semantic representation to surface structure – has for various reasons long since ceased to be pursued as a unified research project. As discussed below, most researchers in the generative transformational tradition now hold that a derived tree structure produced in the final stages of a syntactic derivation (a 'Logical Form', or 'LF') is the input to semantic interpretation; other researchers (usually working in non-transformational frameworks) follow the tradition of Montague (1970b, 1973), and hold that each syntactic rule used to build a complex expression can be paired with a corresponding semantic interpretation rule. Despite the disappearance of GS in its original form, however, many analyses and ideas first put forth by Generative Semanticists have been incorporated into later work in other frameworks.

2.3 Montague Grammar and metalinguistic expansion

In the 1970s, the formal (logical) approach to Natural Language Semantics proposed by Montague (1970a,b, 1973) began to rise in prominence. Montague's approach was to apply methods of semantic interpretation developed in mathematical logic to the semantics of natural language. Each syntactic rule used to build a complex expression in the object language is paired with a corresponding semantic interpretation rule, which specifies how the meaning of the complex object-language expression is derived from the meaning of the constituent expressions; adhering to the principle of compositionality requires there to be a homorphism between the syntactic algebra used to build expressions and the semantic algebra used to specify model-theoretic meanings.[5] One result of Montague's work is that the term 'semantics' came to be used in linguistics in much the same way as it is used in logic, as a system of formal rules (a 'formal semantics') for the assignment of values to expressions; this use of the term 'semantics' contrasts with the informal use which refers to any intuitive characterization of the meaning of an expression.

One influential aspect of the Montagovian approach to semantics was the view that the meaning of a sentence pertained to its truth-conditions (see also Davidson 1967, whose proposals for truth-conditional semantics did not involve the use of model theory); the meanings of other constituent expressions could then be viewed in terms of their compositional contribution to the truth-conditions of a sentence. Adopting a formal semantics that made use of model-theoretic methods also allowed one to move beyond the idea (implicitly assumed in much generative transformational work that followed Katz and Postal 1964) that sameness of meaning implied sameness of syntactic form at some point in a syntactic derivation; given a formal semantics, it became possible to assign meanings to basic expressions so that two sentences with no derivational history in common could be assigned the same truth-conditions. This meant that syntactic analyses no longer needed to posit deep structures which looked wildly different from surface structures in order to capture inter-sentential semantic relations like entailment and synonymy; these relations could be explained in terms of formal semantic interpretation, rather than directly in terms of syntactic structure.

Although decomposition was no longer required to explain inter-sentential semantic relations, attempts were nonetheless made to translate certain insights and analyses of the GS movement into a form compatible with a Montagovian framework, most notably in the work of Dowty (1979). Dowty's idea was to take the decompositional structures proposed by the Generative Semanticists out of the object-language, and put them into the semantic metalanguage; in pursuing this goal, Dowty took advantage of the translational approach

[5]See Lewis 1970 for a gentle introduction to the approach, Dowty et al. 1981 for a more complete treatment.

to semantics of Montague (1970b, 1973). In earlier work (Montague 1970a), Montague provided a direct model-theoretic interpretation of English expressions, using an informal metalanguage. In subsequent work (Montague 1970b, 1973), Montague provided a systematic translation from English expressions to expressions of a formalized intensional logic, the latter of which were then provided with a model theoretic interpretation; by composing the translation function and interpretation function, a model-theoretic interpretation of English sentences was obtained. Dowty's (1979) proposal was to locate GS-style decompositions in the metalanguage rather than the object language; this involved what might be called METALINGUISTIC EXPANSION – adding various logical terms to the logical translation language, which were then used to assign complex translations to simple object-language expressions.

The following is a simplified example of how Dowty (1979) recast GS-style predicate decomposition in terms of metalinguistic expansion, with a non-intensional metalanguage used for simplicity. The object language syntax used in Montague grammar assigns to each expression of the object language a phonological string `s` and a syntactic category `c`; the syntactic representation of an object language expression will be written here as `s::c`. In the translational version of Montague grammar, a translation function $\lceil\!\lceil\ \rceil\!\rceil$ assigns to each expression in the object language a term or expression in the logical language; this logical expression is then model-theoretically interpreted by an interpretation function $[\![\ ]\!]$. Thus, the adjective expression `alive::ADJ` might receive the following translation and interpretation (p can be considered to be the type of propositions, e the type of entities).

(10) a. $\lceil\!\lceil$`alive::ADJ`$\rceil\!\rceil = \textsc{alive}$ (an expression of type $\langle e, p\rangle$)
b. $[\![\textsc{alive}]\!]$ is a function from objects to propositions

Recall that a GS-style decomposition would regard *Mothra dies* as having an underlying syntactic representation like `[S Mothra [S BECOME [S NOT [S Mothra ALIVE ] ] ] ]`. In place of introducing decompositional heads like `BECOME` into the syntactic representation, Dowty (1979) expands the metalanguage to include new logical terms (like BECOME), which allow syntactic decomposition to be replicated in the metalanguage. For example, the intransitive verb `die::IV` will receive a metalinguistic translation like the following:

(11) $\lceil\!\lceil$`die::IV`$\rceil\!\rceil = \lambda x.\textsc{become}(\neg\textsc{alive}(x))$ (an expression of type $\langle e, p\rangle$)

In Dowty's analysis, the BECOME expression in this translation receives a model-theoretic interpretation as a function that takes a proposition and returns a proposition. To take another example, recall that a GS-style proposal holds that *Godzilla killed Mothra* has an underlying syntactic representation like `[S Godzilla [S CAUSE [S BECOME [S NOT [S Mothra`

`ALIVE ] ] ] ] ]`; Dowty recasts this decomposition as a metalinguistic expansion of the translation of the verb `kill::TV`:

(12) $[\![\texttt{kill::TV}]\!] = \lambda x.\lambda y.\textsc{cause}(\textsc{become}(\neg\textsc{alive}(x)))(y)$
(an expression of type $\langle e, \langle e, p\rangle\rangle$)

For simplicity, the CAUSE expression is assumed here to have a model-theoretic interpretation as a relation between propositions and individuals.

In Montague grammar, each syntactic-structure building rule is paired with a translation rule. To construct a simple sentence with a transitive verb, two syntactic rules are required, one which combines a transitive verb with a noun phrase to produce an intransitive verb, and another which combines an intransitive verb with a noun phrase to produce a sentence.[6] These two rules are shown below; both receive translations in which a functional symbol is concatenated with an argument (i.e. translations which are model-theoretically interpreted as function application).

(13) a. $\mathrm{R}_1(\texttt{s::NP}, \texttt{t::IV}) = \texttt{s\^{}t::S}$
b. $[\![\mathrm{R}_1(\texttt{s::NP}, \texttt{t::IV})]\!] = [\![\texttt{t::IV}]\!]([\![\texttt{s::NP}]\!])$

(14) a. $\mathrm{R}_2(\texttt{s::TV}, \texttt{t::NP}) = \texttt{s\^{}t::IV}$
b. $[\![\mathrm{R}_2(\texttt{s::TV}, \texttt{t::NP})]\!] = [\![\texttt{s::TV}]\!]([\![\texttt{t::NP}]\!])$

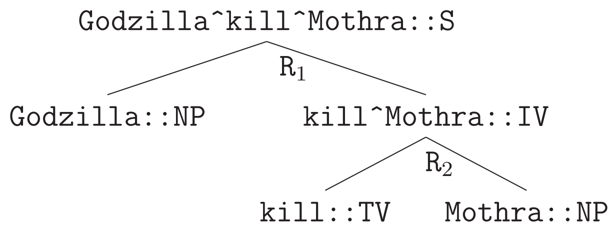
The sentence *Godzilla killed Mothra* can be derived using these two rules (with tense being ignored), as shown below in (15a); given the translation for `kill::TV` in (12), `Godzilla^kill^Mothra::S` will receive the logical translation in (15b), after Beta conversion.

(15) a. $\mathrm{R}_1(\texttt{Godzilla::NP}, \mathrm{R}_2(\texttt{kill::TV}, \texttt{Mothra::NP})) = \texttt{Godzilla\^{}kill\^{}Mothra::S}$
b. $[\![\texttt{Godzilla\^{}kill\^{}Mothra::S}]\!] = \textsc{cause}(\textsc{become}(\neg\textsc{alive}(\textsc{m})))(\textsc{g})$

The derivation tree below shows how the two rules $\mathtt{R}_1$ and $\mathtt{R}_2$ were used to construct this sentence.

[6] Note that for Montague, intransitive verbs and transitive verbs which have been combined with a direct object are both assigned the same category, written here as IV (for 'intransitive verb'); this category corresponds to the common notion of a verb phrase.

(16)



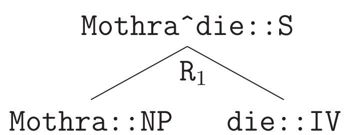
By expanding the metalinguistic translations in this way, inter-sentential relations such as entailment can be captured without positing syntactic containment. Thus, the sentence *Mothra died* can be constructed as in (17a); given the translation for `die::IV` in (11), `Mothra^die::S` will receive the logical translation in (17b)

(17) a. R_1(`Mothra::NP`, `die::IV`) = `Mothra^die::S`

b. $[\![$`Mothra^die::S`$]\!]$ = BECOME(¬ALIVE(M))

This sentence has the following derivation tree:

(18)



As one can see by examining the translations in (15b) and (17b), the translation associated with *Mothra died* is contained in the translation associated with *Godzilla killed Mothra*; given a suitable model-theoretic interpretation for CAUSE, the inference from *Godzilla killed Mothra* to *Mothra died* will be predicted. However, as one can see from comparing the analysis trees in (16) and (18), *Mothra died* cannot in any way be said to be syntactically contained in *Godzilla killed Mothra*; thus, unlike in the original GS proposal, syntactic containment in the object language is not required to explain the entailment from the latter sentence to the former.

For inchoative (i.e. change-of-state) verbs which are morphologically derived from adjectives (like `hard-en::IV`), Dowty (1979, §4.3) proposes a rule that takes an adjective as input and returns an intransitive verb; note that the metalinguistic translation of the derived intransitive verb contains BECOME.[7]

[7] Dowty notes that whether or not the suffix *-en* is appended to an adjective seems to be (at least in part) phonologically conditioned; verbs formed from adjectives that end with a non-nasal obstruent usually have the *-en* suffix appended (*damp-en*, *short-en*, *weak-en*, etc.), while verbs formed from adjectives that end with a nasal or vowel do not (*slim*, *thin*, *free*, *slow*).

(19) a. R_3(`s::ADJ`) = `s^-en::IV`

b. $[\![$ R_3(`s::ADJ`) $]\!]$ = λx.BECOME($[\![$`s::ADJ`$]\!](x)$)

Applying this rule to `hard::ADJ` yields the intransitive verb `hard-en::IV`, with the translation in (21).

(20) $[\![$`hard::ADJ`$]\!]$ = HARD (an expression of type $\langle e, p\rangle$)

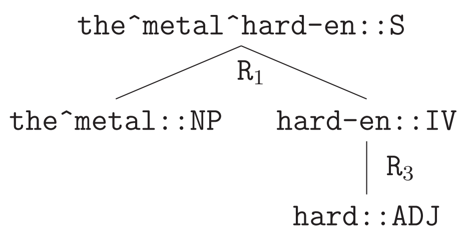
(21) $[\![$`hard-en::IV`$]\!]$ = λx.BECOME(HARD(x)) (an expression of type $\langle e, p\rangle$)

The sentence *the metal hardened* is constructed using R_1 and R_3, as shown in (22a); this sentence receives the translation shown in (22b), after Beta conversion (for simplicity, `the^metal::NP` is translated as the logical constant M).

(22) a. R_1(`the^metal::NP`, R_3(`hard::ADJ`)) = `the^metal^hard-en::S`

b. $[\![$`the^metal^hard-en::S`$]\!]$ = BECOME(HARD(M))

(23)



Once BECOME receives a suitable model-theoretic interpretation, Dowty's type of analysis will be able predict an inference from *The metal hardened* to *The metal was hard*.[8] Note, however, the difference between the pair `hard::ADJ`/`hard-en::IV` on the one hand and the pair `die::IV`/`kill::TV` on the other. In both pairs, the logical translation of the first expression is contained in the translation of the second; however, only in the first case is the first member of the pair (`hard::ADJ`) contained in the derivation tree of the second (`hard-en::IV`). Thus, in the case of `hard::ADJ`/`hard-en::IV`, the meaning relation between the two expressions is a result of the syntactic derivation; in the case of `die::IV`/`kill::TV`, the meaning relation is simply stipulated in the logical translations for the two terms.[9] The difference between derived and stipulated meaning relations can be seen as corresponding to Quine's distinction between first- and second-class analyticities, discussed in §2.2.

[8]Showing this more concretely requires introducing reference to times or events, and is thus put aside until the following Chapter 4.

[9]Note that, model-theoretically, stipulating a meaning relation between two expressions in terms of their logical translation amounts to placing a constraint on the admissible models for the object language.

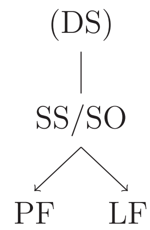
The metalinguistic expansion that Dowty proposed as an alternative to syntactic predicate decomposition proved to be very influential. Dowty's particular metalinguistic analysis involved the construction of an 'aspect calculus', in which Vendler's (1957) fourfold classification of 'time schemata' (the classification of eventualities into states, activities, achievements and accomplishments) is formalized using three logical expressions – CAUSE, BECOME and DO – that are introduced into the metalanguage. In Dowty's account, the interpretations of these and other metalinguistic expressions are relativized to time intervals. Due to the increasing influence of Davidson's (1967) event-based approach to sentence meaning, many subsequent metalinguistic expansion proposals replaced reference to time intervals with reference to events; these approaches often proposed translations which relate events to subevents in various ways (see e.g. Parsons 1990; Rothstein 2004 and many others). Despite these subsequent developments, Dowty's account can be taken as representive of the general idea of recasting syntactic decomposition in terms of an expanded set of logical expressions in the metalanguage.

2.4 The Y-model: Logical Form and Phonetic Form

While Montague's logical approach to semantics was instrumental in the development of formal semantics as it is practiced today, his algebraic approach to syntax was less widely adopted, and for the most part was pursued separately from generative transformational syntax (although attempts were made by e.g. Partee (1973b) to incorporate generative transformations into Montague Grammar).

In the generative transformational tradition, thought gradually moved back towards the idea that there was a single point in a syntactic derivation where semantic interpretation took place; this point came to be called 'Logical Form' ('LF'), and was posited in part because the development of trace theory led to certain parallels being noticed between *wh*-movement and quantifier scope (see e.g. May 1977, 1985; Chomsky 1981; Higginbotham 1980, 1985; Hornstein 1995 for details). In the earlier years of generative transformational grammar, it was assumed that semantic interpretation occurred at (or, in the case of GS, was) deep structure; according to the later assumptions of Government & Binding Theory (GBT) and the Minimalist Program, a syntactic derivation reaches a point ('S-structure' in GBT, 'Spellout' in Minimalism) where a derivation splits into two streams – one leading to Phonetic Form (PF), and one leading to LF. The shape of a syntactic derivation in current generative transformational thinking can be depicted with a 'Y-model' diagram like that in (24); LF is now taken to be one of the two terminative points of a syntactic derivation.

(24)



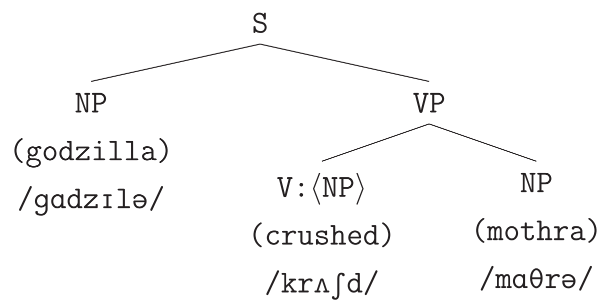
(DS = D-structure in GBT; SS = S-structure in GBT; SO = Spellout in Minimalism)

The idea in both GBT and Minimalism is that all ‘overt’ syntax operations (i.e. all syntactic operations that effect the pronunciation of a sentence) occur either prior to S-structure/ Spellout, or on the path from S-structure/Spellout to PF; syntactic operations that occur on the path from S-structure/Spellout to LF (e.g. quantifier raising) are ‘covert’, and do not have any phonological effect. GBT and Minimalism differ from each other in the following respects. In GBT, D-structure is built with phrase structure rules, and the path from D-structure to S-structure involves transformations operating on this antecedently built structure; in addition, in GBT it is assumed that certain well-formedness conditions on syntactic structures can be checked at both D-structure and S-structure (c.f. Chomsky 1981). In Minimalism, there is no notion of D-structure and no phrase-structure rules; two operations – ‘merge’ and ‘move’ – operate together to build syntactic structures. The ‘minimal’ in ‘Minimalism’ comes from the assumption that there are no syntax-specific well-formedness constraints placed on linguistic constructions; this amounts to the assumption that well-formedness constraints cannot be checked at the point in the Y-model where the derivation splits (i.e. at Spellout), but only at the ‘interfaces’ with the sensori-motor system and the conceptual-intensional system, i.e. only at PF and LF (c.f. Chomsky 1995).

One important point for present purposes is that, in the common conception of the Y-model, PF and LF are taken to be derived syntactic trees, with LF constituting the input to semantic interpretation. Note the contrast with Montague Grammar. In Montague Grammar, a semantic interpretation rule is paired with each algebraic syntactic rule, the latter of which takes a n-tuple of expressions and maps them to another expression (this typically involves concatenating the phonological strings of the input expressions); there is no notion of a ‘derived syntactic tree’ in Montague Grammar, only of a derivation tree, which displays the syntactic rules and expressions that were used to build an expression (examples of derivation trees were given in (16), (18) and (23)). Note also that in Montague Grammar, one needs the information encoded in an expression’s derivation tree in order to determine that expression's logical translation (and thus its model-theoretic interpretation);[10] this is not so in an LF approach, where the derivational history of the LF structure is not taken into consideration when interpreting the LF.

The general idea of the Y-model can be demonstrated with a few informal examples. A terminal node (i.e. lexical item) will be assumed to contain three types of information: a syntactic category, a semantic feature and a phonological feature. SEMANTIC FEATURES (not to be confused with logical translations or semantic values, which are the product of translating/interpretating semantic features) will be indicated with parentheses, e.g. `(godzilla)`. PHONOLOGICAL FEATURES will be indicated with slashes, e.g. `/gɑdzɪlə/`. Suppose now that the following pre-Spellout tree can be derived:

(25)



Here, the syntactic category V:⟨NP⟩ is the category assigned to verbs which require an NP complement to make a complete VP (c.f. Gillon 2012). The same structure can be also be indicated with the following labelled bracket notation, writing e.g. $[_{\text{NP}}$ godzilla] as an abbreviation for NP::(godzilla)::/gɑdzɪlə/.

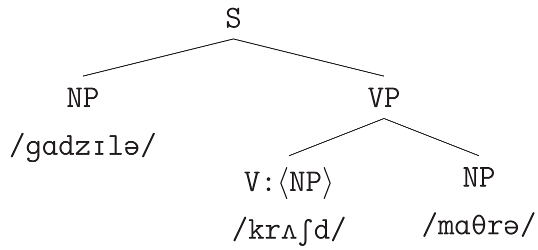
(26) $[_{\text{S}}$ $[_{\text{NP}}$ godzilla] $[_{\text{VP}}$ $[_{\text{V:}\langle\text{NP}\rangle}$ crushed] $[_{\text{NP}}$ mothra]]]

Now suppose the structure in (25) is 'spelled-out'; the derivation will then be split into two separate streams, one in which semantic features are removed, and one in which phonological features are removed. Assuming that no additional syntactic rules apply to either stream after Spellout, the derivation will terminate with the PF in (27) and the LF in (28).[11]

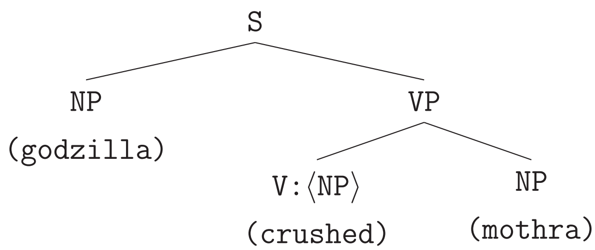
[10] Due to the possibility of ambiguity, one cannot generally determine an expression's logical translation in Montague Grammar without knowing its derivational history. For example, there will be two ways to derive the expression `eat^the^apples^on^the^floor::IV`, each of which results in a different translation for this expression (and thus a different model-theoretic interpretation).

[11] In a true Minimalist account, syntactic features would be absent from the PFs and LFs of a successful derivation, as all syntactic features would have been 'checked'. However, syntactic category labels will be retained on many of the PF and LF trees presented here to make the general form of the syntactic analyses considered more transparent.

(27)

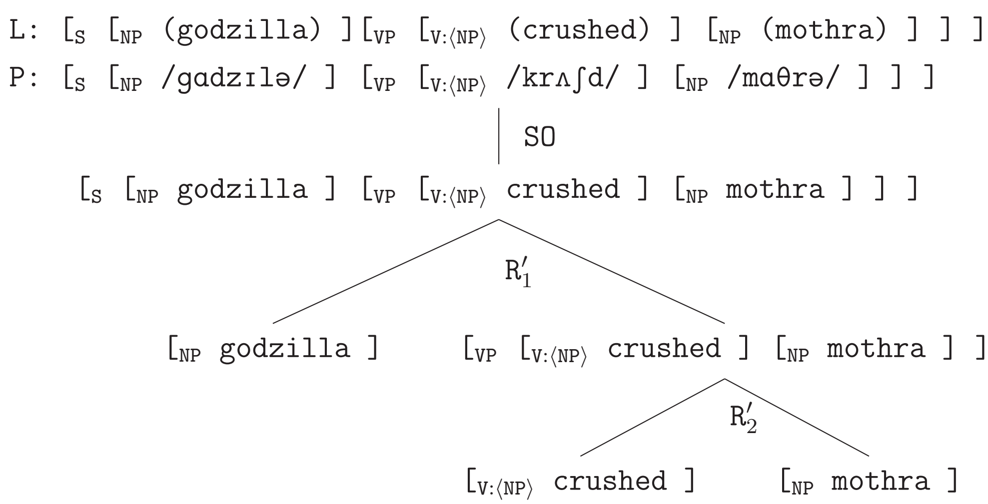


(28)



The derivation of a PF/LF pair like the one above can be shown in a derivation tree; being a pair of trees themselves, it is assumed that such a pair is derived by rules that operate on trees. The derivation tree below shows informally how the above PF/LF might be derived; $\mathtt{R}'_1$ and $\mathtt{R}'_2$ are rules that build trees from subtrees, analogous to $\mathtt{R}_1$ and $\mathtt{R}_2$ in §2.3, and `SO` is Spellout, which maps a single tree into a pair of trees.

(29)



The PHONOLOGICAL OUTPUT of the derivation will be the string yield of the PF, in this case `/gɑdzɪlə krʌʃd mɑθrə/`; submitting the phonological output to phonological rules will yield the PHONETIC OUTPUT, i.e. an expression of the language like *Godzilla crushed Mothra.* The LF tree itself will serve as the input to semantic interpretation.

2.4.1 Interpreting Logical Forms

According to the standard interpretation of GBT/Minimalism, a Logical Form is a derived tree that serves as the input to the semantic interpretation function. This means that, unlike in a Montagovian approach to semantics, interpretation rules corresponding to syntactic rules (e.g. $\mathtt{R}'_1$ and $\mathtt{R}'_2$ in (29)) are not needed; what is needed instead is a method for compositionally interpreting a complete tree on the basis of its constituent trees.[12] This means that a semantic interpretation must be assigned to each terminal node of the tree, and that each non-terminal node must receive a semantic interpretation that depends on the interpretations of its daughter nodes.

As in §2.3, interpretations will be assigned through an intermediary logical language. The syntactic category of a lexical item will determine the logical type of the translation it receives. For example,

(30) a. A terminal node of category $\mathtt{V{:}\langle NP\rangle}$ is translated as a function symbol of type $\langle e, \langle e, t\rangle\rangle$.
b. A terminal node of category $\mathtt{NP}$ is translated as a constant symbol of type $\langle e\rangle$.

A translation function which obeys the above constraints might assign the following translations to the terminal nodes of (28).

(31) a. $[\![\,\mathtt{[_{NP}\ (godzilla)\ ]}\,]\!] = \textsc{g}$ (a constant of type $\langle e\rangle$)
b. $[\![\,\mathtt{[_{NP}\ (mothra)\ ]}\,]\!] = \textsc{m}$ (a constant of type $\langle e\rangle$)
c. $[\![\,\mathtt{[_{V:\langle NP\rangle}\ (crushed)\ ]}\,]\!] = \textsc{crush}$ (a function symbol of type $\langle e, \langle e, t\rangle\rangle$)

The tree in (28) has two non-terminal nodes that also need to be assigned translations. For this purpose, construction-specific rules like the following might be provided. (In these rules, $\mathtt{[_X}\ s\ \mathtt{]}$ should be understood as a node with syntactic category $\mathtt{X}$, of which a terminal node is a special case.)

(32) a. $[\![\,\mathtt{[_{VP}\ [_{V:\langle NP\rangle}}\ s\ \mathtt{]\ [_{NP}}\ t\ \mathtt{]\ ]}\,]\!] = [\![\,\mathtt{[_{V:\langle NP\rangle}}\ s\ \mathtt{]}\,]\!]([\![\,\mathtt{[_{NP}}\ t\ \mathtt{]}\,]\!])$
b. $[\![\,\mathtt{[_{S}\ [_{NP}}\ s\ \mathtt{]\ [_{VP}}\ t\ \mathtt{]\ ]}\,]\!] = [\![\,\mathtt{[_{VP}}\ t\ \mathtt{]}\,]\!]([\![\,\mathtt{[_{NP}}\ s\ \mathtt{]}\,]\!])$

Adopting these rules, as well as the terminal node translations in (31), will result in (28) receiving the following translation.

(33) $[\![\,\mathtt{[_{S}\ [_{NP}\ godzilla\ ]\ [_{VP}\ [_{V:\langle NP\rangle}\ crushed\ ]\ [_{NP}\ mothra\ ]\ ]\ ]}\,]\!] = \textsc{crush}(\textsc{m})(\textsc{g})$

[12] Kobele (2006, Ch.2) provides a semantics for Minimalist Grammars that differs from the standard conception in that it does not involve interpreting a derived LF tree, but rather provides an interpretation for every step of a syntactic derivation, á la Montague.

Thus, the above rules and translations of terminal nodes result in (28) being translated as a well formed logical formula.

In the place of construction-specific translation rules like (32), it is now common practice in most LF approaches to use some sort of 'type-driven translation' procedure for assigning translations to non-terminal nodes (Klein and Sag 1985; Heim and Kratzer 1998). Assume for the moment that all binary branching nodes on a tree are interpreted via functional application; then the following type-driven rule (adapted from Heim and Kratzer 1998) can be used to provide a translation for any binary branching node whose daughter nodes have translations of the appropriate types.

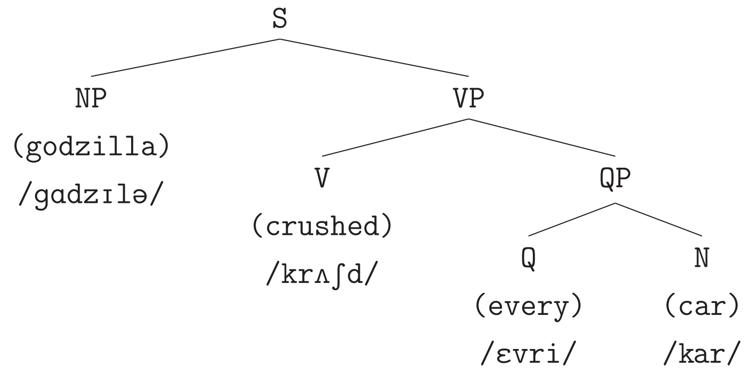
(34) Given a tree $\texttt{[}_{\texttt{X}}\ \texttt{[}_{\texttt{Y}}\ s\ \texttt{]}\ \texttt{[}_{\texttt{Z}}\ t\ \texttt{]}\ \texttt{]}$,
$[\![\ \texttt{[}_{\texttt{X}}\ \texttt{[}_{\texttt{Y}}\ s\ \texttt{]}\ \texttt{[}_{\texttt{Z}}\ t\ \texttt{]}\ \texttt{]}\ ]\!] =$
i. $[\![\ \texttt{[}_{\texttt{Y}}\ s\ \texttt{]}\ ]\!]([\![\ \texttt{[}_{\texttt{Z}}\ t\ \texttt{]}\ ]\!])$
(If $[\![\ \texttt{[}_{\texttt{Y}}\ s\ \texttt{]}\ ]\!]$ is of type $\langle \alpha, \beta \rangle$ and $[\![\ \texttt{[}_{\texttt{Z}}\ t\ \texttt{]}\ ]\!]$ is of type $\langle \alpha \rangle$)
ii. $[\![\ \texttt{[}_{\texttt{Z}}\ t\ \texttt{]}\ ]\!]([\![\ \texttt{[}_{\texttt{Y}}\ s\ \texttt{]}\ ]\!])$
(If $[\![\ \texttt{[}_{\texttt{Z}}\ t\ \texttt{]}\ ]\!]$ is of type $\langle \alpha, \beta \rangle$ and $[\![\ \texttt{[}_{\texttt{Y}}\ s\ \texttt{]}\ ]\!]$ is of type $\langle \alpha \rangle$)
iii. undefined otherwise

This type-driven rule will also result in (28) having the translation in (33). As pointed out by Heim and Kratzer 1998, making the interpretation procedure completely type-driven in this way renders syntactic category information (at least on non-terminal nodes) dispensible for semantic interpretation; once one has the translations for the terminal nodes, the translations of the non-terminal nodes can be determined without reference to syntactic categories.

The motivation for an LF approach to semantic interpretation is not apparent if one limits consideration to cases like (26). Given that the PF and LF in this example are isomorphic, one could just as easily have done away with the `SO` operation, and interpreted the pre-`SO` tree in (25) (using e.g. the rules in (32) or (34), as well as rules that assign a translation to each terminal node). However, possible motivation for positing something like LF becomes more apparent when sentences with quantifiers are considered.[13] Consider the sentence *Godzilla crushed every car*; assume this sentence has a pre-SO structure that looks like the following:

[13]See e.g. May (1977).

(35)

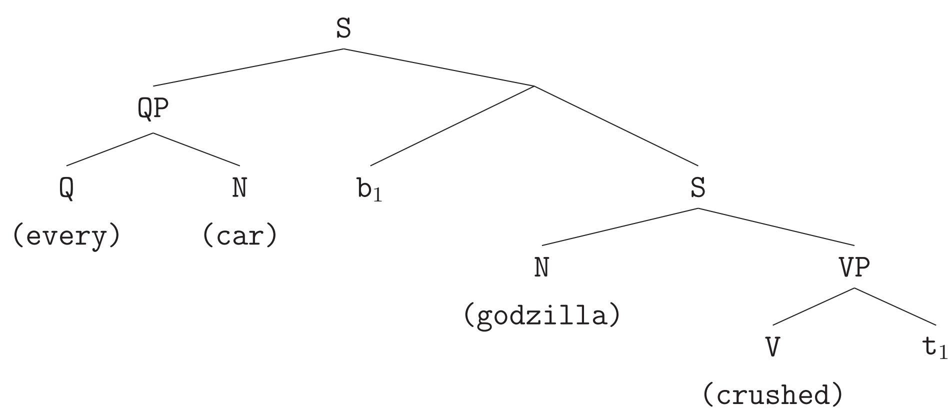


Now, assume that [$_{QP}$ [$_{Q}$ (every)] [$_{N}$ (car)]] is interpreted as a generalized quantifier, and thus has a translation like that in (36).

(36) $[\![$ [$_{QP}$ [$_{Q}$ (every)] [$_{N}$ (car)]] $]\!] = \text{EVERY}(\text{CAR})$
(an expression of type $\langle\langle e,t\rangle,t\rangle$)

If one also assumes that the rules of semantic interpretation are limited to type-driven function application, rules for handling the binding of traces, and possibly some other general type-driven rules (as in Heim and Kratzer 1998), then one might assume an LF constituent like [$_{VP}$ [$_{V}$ (crushed)] [$_{QP}$ (every) (car)]] to be uninterpretable; this is so because the types of $[\![$ [$_{V}$ (crushed)] $]\!]$ and $[\![$ [$_{QP}$ (every) (car)] $]\!]$ are not of a compatible form for type-driven function application to apply. As a result, a post-Spellout transformation would be required to create an interpretable structure. Given an analysis along the lines of Heim and Kratzer (1998), the sentence *Godzilla crushed every car* might have an LF like the following:

(37)



The above LF is obviously not isomorphic to the PF of the sentence, the former having been altered by a post-SO movement transformation ('Quantifier Raising', or 'QR'). In this LF, t_1 is the trace left behind by raising $[_{QP}$ $[_{Q}$ (every)] $[_{N}$ (car)]], and b_1 is the binder introduced by this operation. If one ensures that the translation rules handling traces and binders result in the translation in (38), then the QR-ed LF will be interpretable – it will receive the translation in (39).

(38) $[\![$ [b_1 $[_{S}$ $[_{NP}$ (godzilla)] $[_{VP}$ $[_{V}$ (crushed)] t_1]]] $]\!]$ = $\lambda x.\textsc{crushed}(x)(\textsc{g})$

(39) $[\![(37)]\!] = \textsc{every}(\textsc{car})(\lambda x.\textsc{crushed}(x)(\textsc{g}))$

Assuming a QR-analysis, the sentence *Godzilla crushed every car* will have a derivation tree that looks something like the following; note that the QR operation only affects the L branch of the derivation.

(40)

L: $[_{S}$ $[_{QP}$ (every) (car)] [b_1 $[_{S}$ $[_{NP}$ (godzilla)] $[_{VP}$ $[_{V}$ (crushed)] t_1]]]]]
P: $[_{S}$ $[_{NP}$ /gɑdzɪlə/] $[_{VP}$ $[_{V}$ /krʌʃd/] $[_{QP}$ /ɛvri/ /kar/]]]

QR

L: $[_{S}$ $[_{NP}$ (godzilla)] $[_{VP}$ $[_{V}$ (crushed)] $[_{QP}$ (every) (car)]]]
P: $[_{S}$ $[_{NP}$ /gɑdzɪlə/] $[_{VP}$ $[_{V}$ /krʌʃd/] $[_{QP}$ /ɛvri/ /kar/]]]

SO

$[_{S}$ $[_{NP}$ godzilla] $[_{VP}$ $[_{V}$ crushed] $[_{QP}$ every car]]]

R'_1

$[_{NP}$ godzilla] $[_{VP}$ $[_{V}$ crushed] $[_{QP}$ every car]]

R'_4

$[_{V}$ crushed] $[_{QP}$ every car]

Note also that the tree produced by R'_4, stripped of its phonological features, would not be interpretable in the present analysis, since the analysis by assumption limits semantic interpretation to type-driven function application and a few other rules. If one adopts a theory of syntax/semantics which allows for uninterpretable trees to be constructed as intermediary steps in a derivation, then one will need to move away from the 'direct compositionality' of the Montagovian approach and introduce some notion like LF to make semantic interpretation possible.[14]

The Y-model allows the semantic researcher a good deal of freedom when proposing semantic analyses of sentences. One might propose an analysis where LF and PF bear a close resemblance, and there is minimal or no use of covert transformations; alternatively, one might propose an LF which diverts substantially in form from the PF of a sentence, in which case motivation must be provided for the post-SO rules that are responsible for this divergence. Regarding the interpretation of LFs, one might propose construction-specific translation/interpretation rules, or more general type-driven rules. It should also be noted that one need not translate constituents into a logical language when interpreting an LF – denotations could be provided for constituents directly, without the use of an intermediate logical language. In adopting the general Y-model approach one does, however, give up the necessity for 'direct compositionality' (the assignment of an interpretation to every node in a derivation tree) that is part of the Montagovian approach, although one could strive to ensure that the proposed syntactic derivations are directly compositional, if so desired.[15]

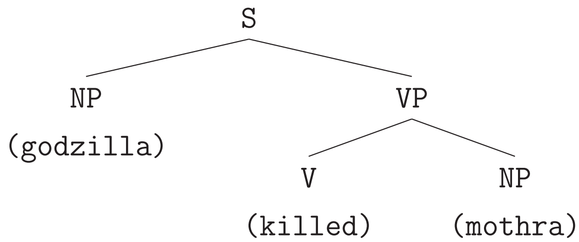
2.4.2 The Y-model and decomposition

The flexibility inherent in the Y-model will make it useful for comparing in a uniform way previous approaches to predicate decomposition and metalinguistic expansion, and for considering new approaches. For example, a metalinguistic approach to decomposition like that of Dowty (1979) can be construed in the Y-model as one in which the LF of a sentence does not contain abstract decompositional heads. Thus, ignoring tense, a metalinguistic approach to decomposition might result in a derivation for *Godzilla killed Mothra* that yields the following LF:

[14] This example is meant to demonstrate one type of semantic consideration that might motivate positing a level of LF. Of course, there are other ways to handle quantifiers in object position which do not require quantifier-raising (e.g. Cooper 1983; Jacobson 1999). The motivation for positing LF is thus much more involved than just the type-incompatibility that results from assuming a restricted set of semantic interpretation rules – it includes e.g. observed parallels between quantifier scope and *wh*-movement, and many other considerations. See e.g. May (1985); Hornstein (1995) for more details.

[15] See Barker and Jacobson (2007) for discussion and arguments in favour of direct compositionality. See Kobele (2006, Ch.2) for a semantics for Minimalist grammars that is directly compositional.

(41)



A metalinguistic expansion for `[`$_{\texttt{TV}}$ `(killed) ]` could then be provided in the translation language, in the way demonstrated in §2.3.

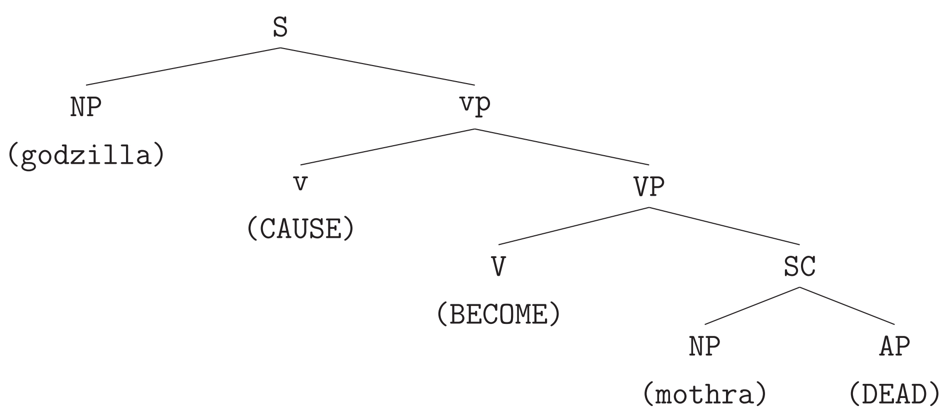
(42) $[\![$ `[`$_{\texttt{V}}$ `(killed) ]` $]\!] = \lambda x.\lambda y.\textsc{cause}(\textsc{become}(\textsc{dead}(x)))(y)$

(43) $[\![(41)]\!] = \textsc{cause}(\textsc{become}(\textsc{dead}(\textsc{m})))(\textsc{g})$

To make such an analysis complete, one would also need to provide suitable denotations for the logical expressions CAUSE and BECOME in the translation.

Alternatively, a GS-style analysis which features syntactic decomposition of predicates might assign the same sentence an LF like the following:

(44)



In such an analysis, suitable interpretations will have to be given to `[`$_{\texttt{v}}$ `(CAUSE) ]`, `[`$_{\texttt{V}}$ `(BECOME) ]` and `[`$_{\texttt{AP}}$ `(DEAD) ]`. Translations like the following will yield a tree interpretable with function-application:

(45) $[\![$ `[`$_{\texttt{AP}}$ `(DEAD) ]` $]\!] = \textsc{dead}$ (an expression of type $\langle e, p\rangle$)

(46) $[\![$ `[`$_{\texttt{V}}$ `(BECOME) ]` $]\!] = \textsc{become}$ (an expression of type $\langle p, p\rangle$)

(47) $[\![$ `[`$_{\texttt{v}}$ `(CAUSE) ]` $]\!] = \textsc{cause}$ (an expression of type $\langle p, \langle e, p\rangle\rangle$)

With translations like these, one can see how a syntactic decomposition analysis might yield the same interpretation as a metalinguistic expansion analysis; the interpretation of (44) will be analogous to that of (41).

(48) $[\![(44)]\!] = \textsc{cause}(\textsc{become}(\textsc{dead}(\textsc{m})))(\textsc{g})$

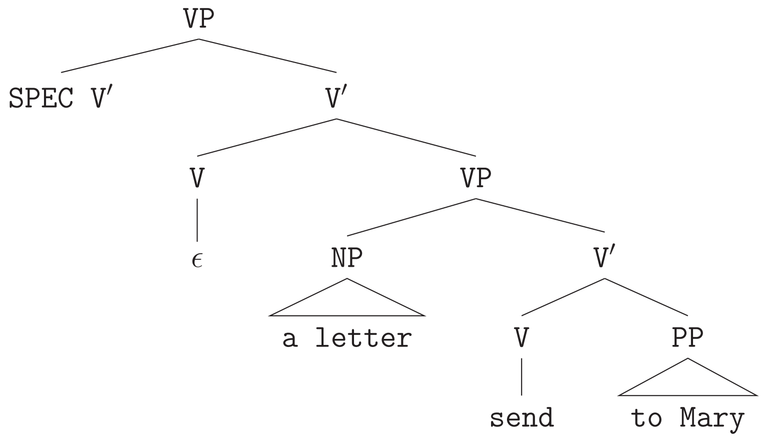
While both metalinguistic expansion and syntactic decomposition could thus in principle yield equivalent interpretations, one result of proposing the more abstract LF is that a more involved story must be told for how this LF is produced by a derivation that also yields the correct PF for the sentence; this is the mirror image of the problem faced by the Generative Semanticists when they attempted to explain how lexical insertion rules could apply to highly abstract underlying syntactic representations. All other things being equal, an abstract syntactic decomposition places more explanatory demands on the researcher; one would thus want convincing reasons for preferring syntactic decomposition over metalinguistic expansion. Some reasons which have been offered are considered below, and in Chapter 4.

2.5 Syntactic predicate decomposition in GBT/ Minimalism

With the advent of formal semantics and the new ways it offered for thinking about relations like synonymy and entailment, it was no longer considered necessary to capture intersentential relations using syntactic decomposition; that is, the fact that *Godzilla killed Mothra* entails *Mothra died* is not considered reason enough to assume that *killed Mothra* is syntactically decomposed as something like $[_{vp}$ `CAUSE` $[_{VP}$ `BECOME` $[_{SC}$ `Mothra DEAD ] ] ]`.

Syntactic decomposition of predicates continued, however, to be pursued for various other reasons. One such reason was the issue of argument realization – how to best explain how and where the arguments of surface verbs are projected in the syntactic structure. There are many analyses relating to argument realization which posit that multiple syntactic heads (rather than just a single verbal head) are needed to correctly realize what appear on the surface to be arguments of a single verb (e.g. Larson 1988; Hale and Keyser 1993, 1998; Kratzer 1996; Pylkkänen 2002; Travis 2000; Borer 2005; Ramchand 2008 and many others). For example, Larson (1988) famously argued that a predicate like *send a letter to Mary* contains two VPs, as shown below:

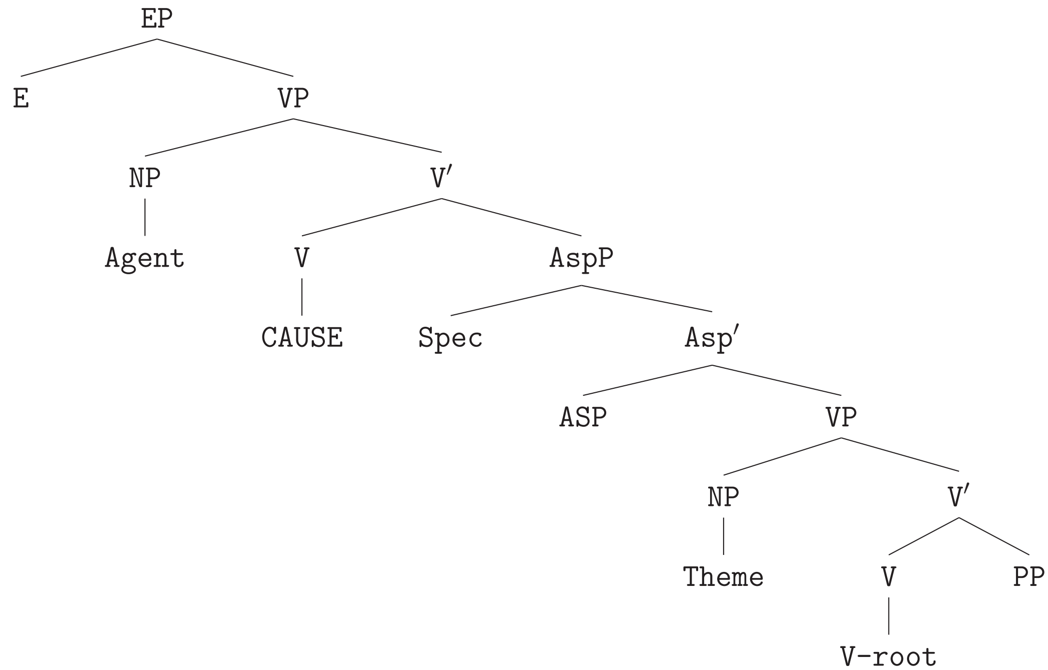
(49)



According to Larson, this structure is preferred over a ternary branching structure (where both the direct object NP and the indirect object PP are sisters to verb), because it allows the direct object to C-command the indirect object without relying on the structure of the PP; it also allows for a straightforward derivation of surface VPs like *send to Mary a postcard from Peru* in terms of the lower V′ raising to ϵ. Thus, the motivation for predicate decomposition in this case receives support from considerations that are not purely semantic.

Inspired by Parsons's (1990) event-decomposition approach to the logical representations of sentences, the syntactic heads present in decompositions that were proposed for primarily syntactic reasons came to be viewed by some as the syntactic reflexes of semantic distinctions amongst subparts of events; this led to what might be called the 'event-structure' approach to predicate decomposition (e.g. Travis 2000; Borer 2005; Ramchand 2008). Given that Parson's event decompositions were inspired by proposals made by the Generative Semanticists (e.g. by making similar use of logical terms like CAUSE and BECOME, now defined as functions on events), event-structure approaches to predicate decomposition often bear a marked resemblance to the original GS decompositional analyses. For example, Travis (2000) proposes that the upper and lower VPs in a Larsonian 'VP-shell' represent, respectively, a causing event and a resulting state. Travis also argues that above these two VPs there is a phrase (EP) headed by a morpheme that marks the edge of a syntactic event-structure (i.e. a phrase that will be semantically represent a single event or event-type), and between the two VPs there is a phrase (AspP) headed by an aspectual morpheme. Travis' proposed event-structure decomposition is shown below.

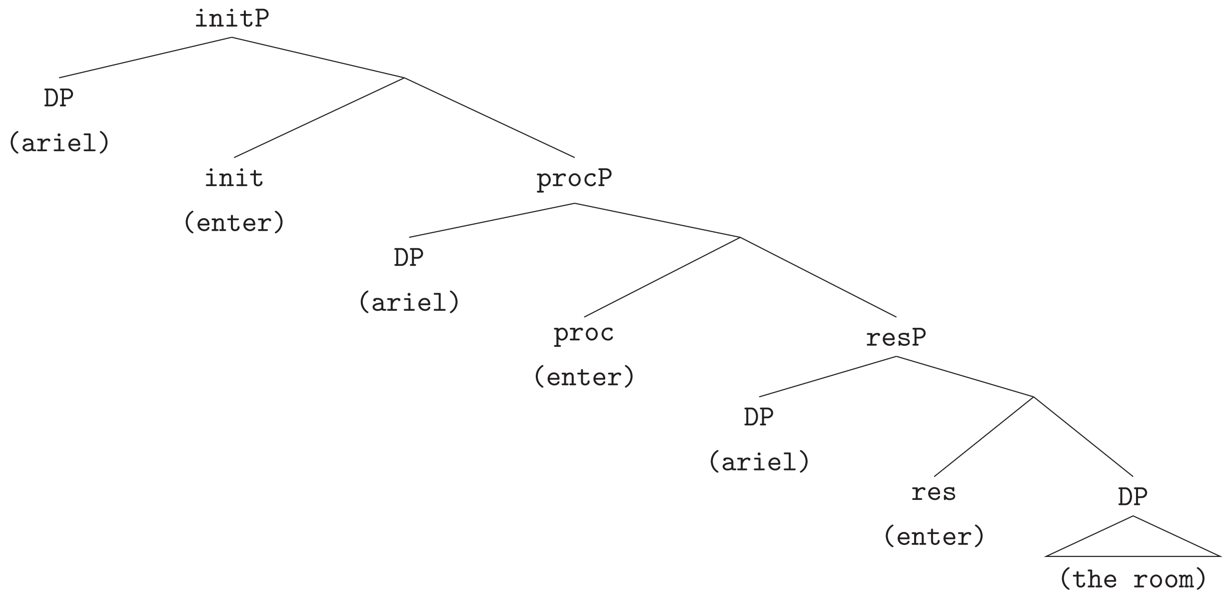
(50)



As evidence for this event-structure decomposition, Travis provides data from Malagasy and Tagalog, where the abstract heads E, CAUSE and ASP are argued to be realized by phonologically overt morphemes that occur in the sequence and with the scope predicted by the decomposition structure.

A different sort of event-structure decomposition is provided by Ramchand (2008) in a Minimalist framework; Ramchand's decomposition is guided more by semantic considerations than by syntactic or morphological ones. According to Ramchand, the LF of the sentence *Ariel entered the room* will include the following tree as a constituent:

(51)



In this decomposition, the head of `initP` introduces reference to an initiating subevent, the head of `procP` introduces reference to a process subevent, and the head of `resP` introduces reference to a result-state subevent. In Ramchand's framework, the same lexical item can be present in multiple locations in an LF, with only the structurally-highest copy being present in the PF of the sentence.

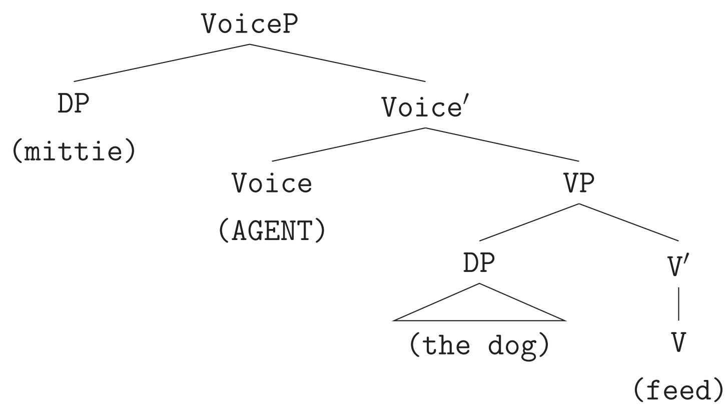
One final proposal relating to predicate decomposition that deserves mentioning is Kratzer's (1996) proposal for 'severing the external argument'. Kratzer's proposal takes its cue from the observation by Marantz (1984) that a particular interpretation of a verb can be triggered by a particular internal argument (i.e. direct object), and that external arguments (typically subjects) do not seem to have this capability. The kind of examples that Marantz points to are the following; the verb *throw* is understood in a different way in each VP.[16]

(52) a. throw a baseball
b. throw support behind a candidate
c. throw a boxing match
d. throw a party
e. throw a fit

[16]Borer (2005, p.63, fn.29) argues that, contra Kratzer and Marantz's claim, external arguments have the same capability as internal arguments to affect the construal of the verb; Borer points to examples like *The wall touched the fence* vs. *John touched the fence* and *Your attitude is killing me* vs. *The illness is killing me*.

Kratzer follows Marantz in taking the ubiquity of this sort of data as indication that internal arguments are true arguments of verbs, and the paucity of analogous data involving external arguments as indication that external arguments are not true verbal arguments. Instead of being licensed by verbs, Kratzer proposes that external arguments are licensed by a separate head, called 'Voice'; for example, in Kratzer's analysis, the LF of the sentence *Mittie fed the dog* would contain the following tree as a constituent:

(53)



In informal terms, Kratzer proposes that the Voice head semantically relates a VP to the DP in spec VoiceP by identifying the latter as an agent of the sort of event delineated by the former. Pylkkänen (2002) expands upon Kratzer's proposals, arguing that in certain languages (including English), the abstract decompositional element CAUSE is also located in the Voice head. Borer (2005) takes Kratzer's proposal for 'severing' arguments to its logical limit, arguing that verbs do not take any true arguments at all, and that all cases of what appear on the surface to be verbal arguments are in fact introduced by separate functional heads.

Aside from the considerations described above, there is one additional persistent argument for positing the syntactic decomposition of predicates, which has not yet been discussed; this argument pertains to how adverbial modifiers might be expected to interact with the heads in a syntactically decomposed structure. Decomposition structures which include multiple VPs or clauses in their decompositions would appear to offer the possibility of both decomposition-internal and decomposition-external attachment-sites for adverbial modifiers; furthermore, due to the abstract nature of predicate decomposition, these different attachment sites might allow for the generation of LFs that differ in adverbial scope, but which are nonetheless paired with the same PF. Thus, a proposal for the syntactic decomposition of predicates often goes hand-in-hand with a prediction about adverbial scope ambiguities. An assessment of these predictions forms the topic of chapter 4; in the following chapter, the theoretical notion of ambiguity is discussed more generally, in the context of the derivational Y-model in which most modern decompositional analyses are couched.

Chapter 3

Ambiguity and the Y-model

Although the notion of ambiguity is often appealed to in the linguistics and philosophy literature when presenting data and offering analyses, and although various tests have been proposed for detecting ambiguities, the notion itself is not always defined in a uniform or precise way. Following Gillon (1990, 2004), ambiguity will be thought of here in terms of a one-to-many relation between expressions (i.e. phonetic strings) and syntactic entities (in this case, Logical Forms).

According to the derivational Y-model described in Chapter 2, a syntactic derivation produces two trees, a Phonetic Form and a Logical Form. The string yield of the PF can be seen as the phonological output of the derivation; subjecting this output to phonological rules will yield an expression of the language. Under this characterization of the grammar, ambiguity can be defined more precisely as follows:

(1) An expression is AMBIGUOUS iff it is the phonetic output of at least two derivations which yield distinct LFs.

Ambiguity so defined is a theoretical notion, not a descriptive one, which can be put to use in explaining certain kinds of speaker judgments; in particular, ambiguity provides an explanation of how it is that a particular expression can be alternately judged true and not true with respect to a single situation.

3.1 Ambiguity and the 'alternate truth value judgment test'

As pointed out by Hockett (1954) and re-iterated by Gillon (2004), the experience of alternately judging a single expression as true and not true is similar to the experience of looking at the Necker cube, shown in B in Fig. 3.1; one can perceive this cube as alternately (but not simultaneously) having its bottom left corner tilted downward like A, or as having its bottom left corner tilted upward like C.

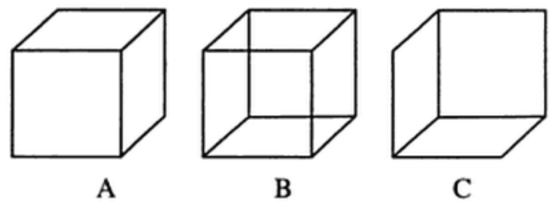


Figure 3.1: The Necker Cube (image from Hockett 1954)

Similarly, some sentences can alternately (but not simultaneously) be judged true and not true with repect to a single situation. The following are some such sentences (the first three are written in informal IPA notation, the third being written without indication of word boundaries).

(2) [mɛri hæz ə stejk]

(3) [bɪl ɪz wɑtʃɪŋ θə bɪrdz sor]

(4) [ájwɑ́nərʌ́brhɛ́d]

(5) Robocop caught a thief with a net.

(6) A zookeeper tranquilized every lion.

The sentence in (2) is judged alternately true and not true in a situation where Mary posseses a cut of meat for grilling, but not a pole with a sharp point. (3) is judged alternately true and not true in a situation where Bill is watching a group of birds flying high in the air, none of which have an external lesion on their body. (4) is judged alternately true and not true in a situation where I have the desire to rub the head of a contextually-salient female cat, but I have no desire for my own head to be made of rubber, nor to possess any kind of head made of rubber. (5) is judged alternately true and not true in a situation where Robocop uses a net to catch a thief, but the thief who is caught does not himself possess a net. The judgment regarding (6) is perhaps not as crisp as the other sentences, but this sentence is arguably judged alternately true and not true in a situation where each lion was tranquilized by a different zookeeper.

As discussed by Gillon (1990, 2004), these judgments can be explained if each of the sentences involved is ambiguous, i.e. if each of the phonetic strings involved can receive multiple syntactic analyses. Gillon (2004) discusses how such an explanation relies on three g eneral assumptions. First of all, there is the assumption – traceable to Pāṇini – that a sentence can be analyzed into minimal constituents, and that the senses (i.e. meanings) of the minimal consituents and their hierarchical ogranization determine the sense of the whole sentence. Second, there is the assumption that the minimal constituents of a sentence can only have a single sense for each act of construal; this assumption is found in Hockett (1954). Lastly, there is assumption, attributed to Frege, that sense determines reference (and truth-conditions, in the case of a sentence). According to these assumptions, if a sentence can be alternately judged to be true and not true, then that sentence must have more than one set of truth-conditions, and thus must have more than one sense associated with it; this in turn implies that the sentence can receive more than one constituency analysis, which differ either in terms of the minimal elements involved, how those elements are put together, or both.

The assumptions which link the phenomenon of alternating truth-judgments to the theoretical notion of ambiguity can be rephrased in terms more immediately compatible with the derivational Y-model adopted here; the assumptions needed are given in A1–A3.

(A1) A derivation which has a sentence as its phonetic output pairs that sentence with a single LF, from which a semantic interpretation of the sentence is obtained.

(A2) An LF contains terminal nodes consisting of semantic features, and the identity of these terminal nodes, along with their constituency structure, determine the semantic interpretation of the LF.

(A3) The semantic interpretation of an LF determines the reference of the LF.

These three assumptions are standard assumptions about the structure of LFs and the methods for interpreting them;[1] from these assumptions, one can conclude that if a sentence allows for alternating truth-judgments with respect to a single situation, then that sentence must be ambiguous according to the definition in (1). To see that this is the case, suppose that S is a sentence which allows for alternating truth-judgments with respect to a particular situation. A1 and A3 together imply that if two sentences are derivationally paired with LFs that receive the same semantic interpretation, then those two sentences have the same truth-conditions. This means that if one sentence is true with respect to a situation and another is not true, then those sentences must be derivationally paired with LFs that have different semantic interpretations. This in turn implies that S must be derivationally paired with

[1]See e.g. Heim and Kratzer (1998, Ch.2). Assumption A3 is the most controversial of the three assumptions. As discussed above in §2.1, some semanticists believe that truth/falsity is (in the words of Pietroski 2013) "downstream of linguistic meaning"; according to this view, certain acts of using sentences might be candidates for being true-or-false, but not the sentences themselves.

two LFs that have different semantic interpretations. But, by A2, in order for two LFs to have different semantic interpretations, they must differ either in the identity of one or more terminal nodes, in their constituency structure, or both. If two LFs differ in any of these ways, then the two LFs are distinct. Thus, S must be derivationally paired with distinct LFs. Since, in the Y-model, each derivation pairs a single phonetic output with a single LF, S must be the phonetic output of two derivations with distinct LFs. By (1), S must be ambiguous.

The phenomenon of being able to alternately judge a particular sentence true and not true with respect to single situation thus provides a *prima facie* sufficient condition for ascribing ambiguity to that sentence. For this reason, an ALTERNATE TRUTH VALUE JUDGMENT TEST (or 'ATV test') is often considered to be an important test for detecting ambiguity (Zwicky and Sadock 1975; Gillon 2004). A substantial number of other tests for detecting ambiguity have been proposed (see Gillon 2004 for extensive discussion); these include tests involving synonymy, antonymy, coordination, pro-forms like *one* and *did so*, and ellipsis. After closely examining these additional tests and the assumptions underlying them, Gillon (2004) concludes that none of them can be used to provide evidence for an ambiguity that cannot be independently inferred using an ATV test; moreover, they typically rely on assumptions that are less well-grounded than those involved in the ATV test. For this reason, the ATV test will be the main test used for detecting ambiguities in this and subsequent chapters.

As pointed out by Gillon (1990, 2004), passing the ATV test is not a necessary condition for an expression, or even a sentence, to be considered ambiguous. Gillon points to examples like (7) as indication that this is so.

(7) If Robocop caught a thief with a net, then Robocop caught a thief.

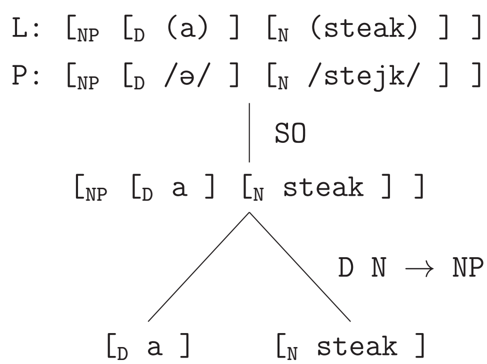
One would likely want to regard (7) as ambiguous, given the fact that (5) passes the ATV test and is a proper part of (7); however, (7) is a tautology, and thus by definition cannot pass the ATV test. Thus, not all ambiguous sentences can be expected to pass the ATV test. Furthermore, as it involves judgements of truth and falsity, the ATV test is only applicable to sentences, i.e. to expressions which are liable to be judged true or false. However, one would likely want to regard questions and commands like the following as ambiguous as well, given their close correspondence to (5).

(8) a. Did Robocop catch the thief with a net?
b. Catch the thief with the net!

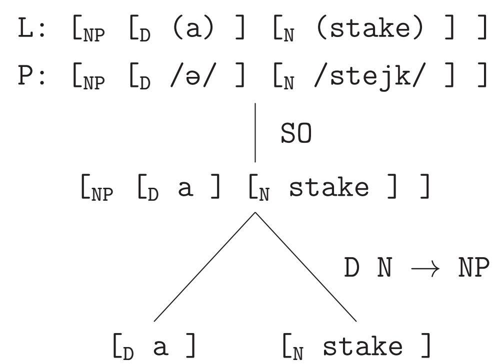
The ATV test cannot apply in these cases, since neither questions nor commands can form the subject of a truth-judgment. The ATV test can also not be applied to sub-sentential expressions on their own.

Although the ATV test is only applicable to sentences, the definition of ambiguity in (1) is general enough to apply to all types of expressions. Assume that any derived tree which has both phonological and semantic features (even a tree that consists of just a terminal node) can be spelled-out; that is, let it be assumed that completed derivations need not yield what speakers judge to be a complete sentence. Under this assumption, nothing would inherently rule out derivations like the following:

(9)

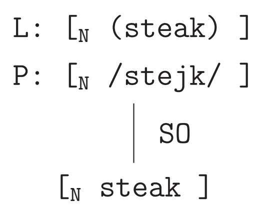


(10)

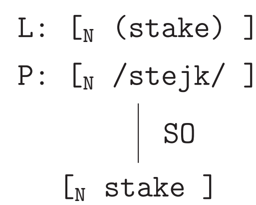


By the definition in (1), the expression `[ə stejk]` is ambiguous. Similarly, if the following two derivations are assumed to be acceptable, then the string `[stejk]` is also ambiguous by the definition in (1).

(11)



(12)



This last case, where two trees each consisting of a single terminal node yield identical phonetic output and distinct LFs, is the limiting case for the definition of ambiguity to apply; it is a case of LEXICAL AMBIGUITY.

3.2 Sources of ambiguity

In the Y-model, a sentence can be ambiguous for a variety of reasons. Applying the ATV test may demonstrate that a particular sentence is ambiguous, but it will not locate the source of the ambiguity; in order to determine the source of an ambiguity, additional evidence must be considered.

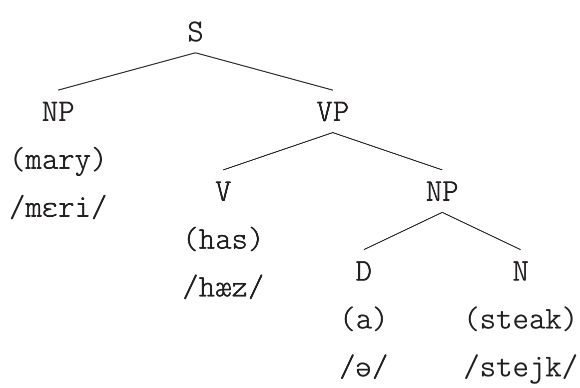
One way in which ambiguity can arise is if the lexicon of the language contains two or more items with identical phonological and syntactic features, but different semantic features – i.e. contains lexical ambiguity of the kind just discussed. (2) is an example of an ambiguity that can be traced to lexical ambiguity; recall that this sentence is judged alternately true and not true in a situation where Mary posseses a cut of meat for grilling, but not a pole with a sharp point.

(2) `[mɛri hæz ə stejk]`

Evidence that lexical ambiguity is the source of the ambiguity of (2) comes from lexicographic research on English, which assigns the string `[stejk]` two different entries with different etymologies. According to the OED,[2] this string has an entry under *steak*, where it is assigned the sense "a thick slice or strip of meat cut for roasting by grilling or frying"; it also has an entry under *stake*, where it is assigned the sense "a stout stick or post, usually of wood, with a pointed end for driving into the ground".

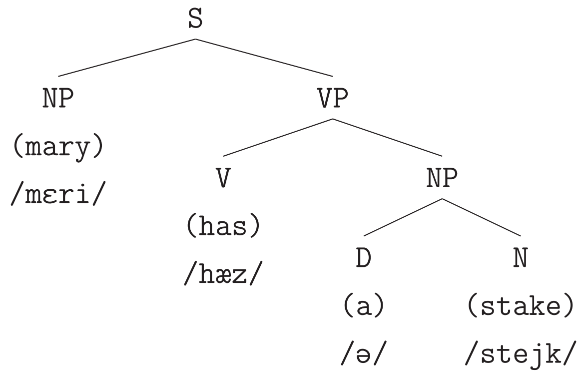
If one attributes the ambiguity of (2) to the lexical ambiguity of `[stejk]`, then the sentence would be expected to be the phonetic output of two derivations which (ignoring tense) produce pre-Spellout trees that look something like the following:

(13)



[2]The Oxford English Dictionary. `http://www.oed.com/`

(14)



These two trees differ in that the noun in the direct object DP in the first case has the semantic features `(steak)`, whereas in the second case it has the semantic features `(stake)`.

Lexical ambiguity is not the only way that a sentence can be rendered ambiguous. It is possible for a sentence to be derivationally paired with two LFs that are distinct even though they contain an identical inventory of terminal nodes; this is possible when the LFs involved have distinct constituent structures.[3] The sentence in (5) is an example where this situation obtains.

(5) Robocop caught a thief with a net.

There is much evidence that, in English, prepositional phrases like [$_{PP}$ with a net] can modify both noun phrases and verb phrases. In (15), this PP is modifying the NP [$_{NP}$ a thief]; in (16), it is modifying the VP [$_{VP}$ caught him] (note that [$_{NP}$ him with a net] is not a possible noun phrase in English).

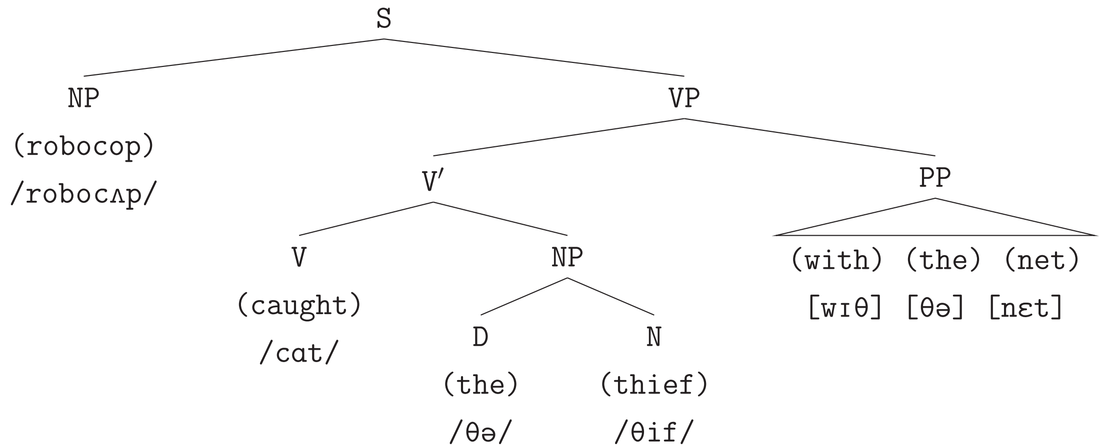
(15) A thief with a net tripped.

(16) Robocop caught him with a net.

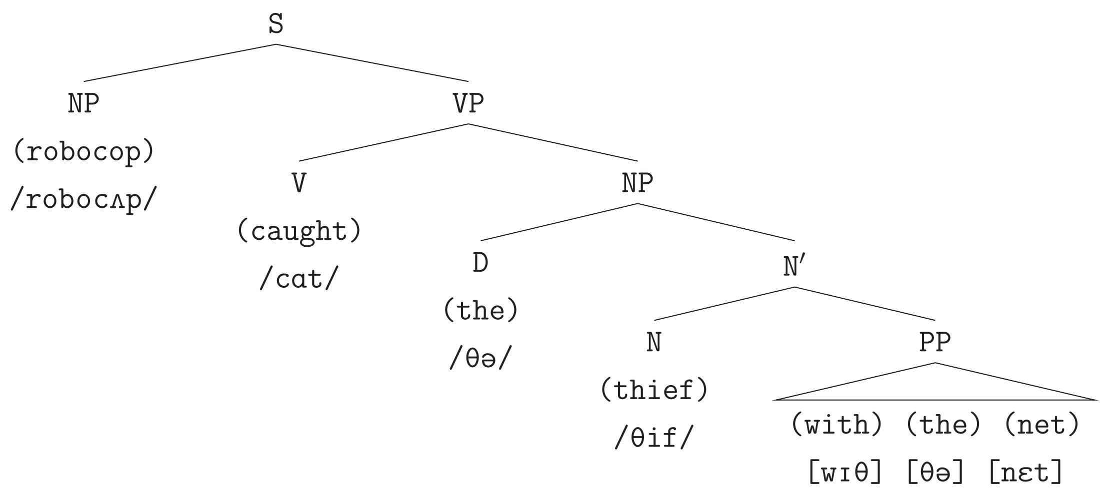
Given this capacity for PPs to modify both VPs and NPs, one might reasonably attribute the ambiguity of (5) to a difference in the constituent structure of the LFs associated with it, rather than to a difference in the identity of the terminal nodes of those LFs. The sentence in (5) would thus be expected to be the phonetic output of two derivations which produce pre-Spellout trees that look something like the following:

[3]The association of a single sentence with multiple constituent structures is sometimes referred to as AMPHIBOLY.

(17)



(18)



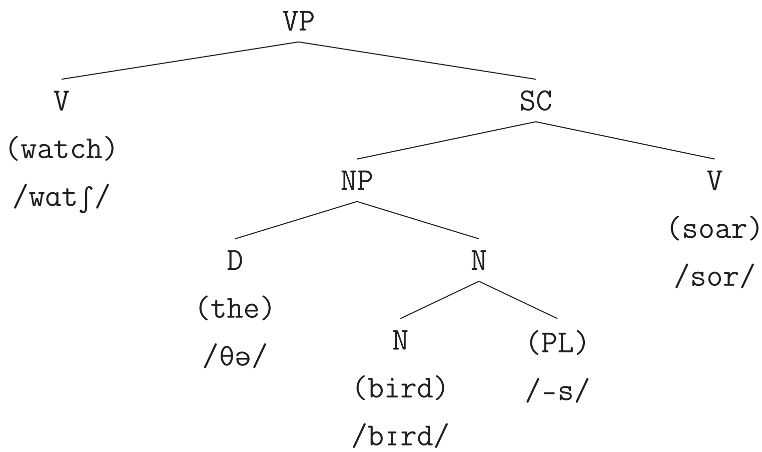
These two LFs differ with respect to where `[PP with a net ]` is located in the tree.

Ambiguity can also arise from a combination of lexical ambiguity and differences in constituency. This is the case for a sentence like (3).

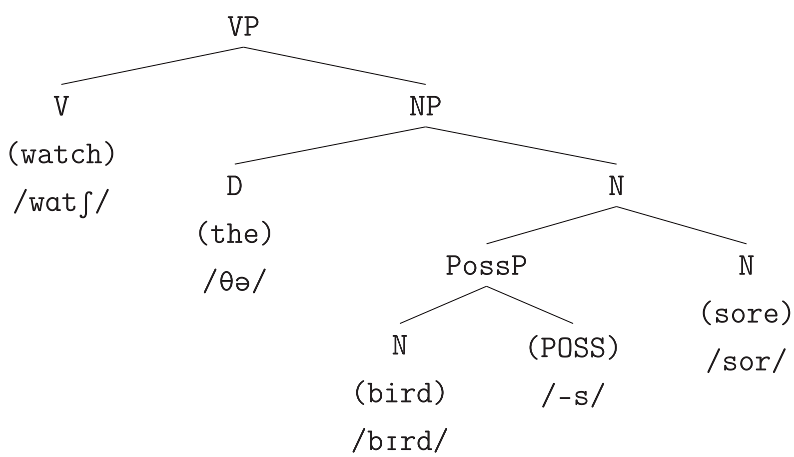
(3) `[bɪl ɪz wɑtʃɪŋ θə bɪrdz sor]`

The string `[sor]` is lexically ambiguous between a verb a noun; the OED lists the verbal entry under *soar* with the sense “to fly or mount upwards; to ascend to a towering height”, and the noun entry under *sore* with the sense “a place in an animal body where the skin or flesh is diseased or injured so as to be painfully tender or raw”. In addition, the string `[z]` is lexically ambiguous between the plural and the possessive suffix, resulting in the string `[bɪrdz]` being ambiguous between the plural and the possessive form of the noun `[N bird ]`. As a combination of these two lexical ambiguities, the string `[θə bɪrdz sor]` is expected to be ambiguous between the noun phrase `[NP the bird-POSS sore ]` and the small clause [$_{SC}$ the bird-PL soar]. Since the verb [$_V$ watch] permits either an NP or a SC complement, a sentence like (3) is expected to be ambiguous as well. The two VPs associated with (3) are shown below.

(19)



(20)



In the former tree, the verb [$_V$ watch] has a small clause complement; in the latter, it has a noun phrase complement.

The ambiguity of a sentence can also depend on the presence of certain phonological rules, if those rules lead to phonologically-distinct strings receiving the same pronunciation. This is evident in a sentence like (4).

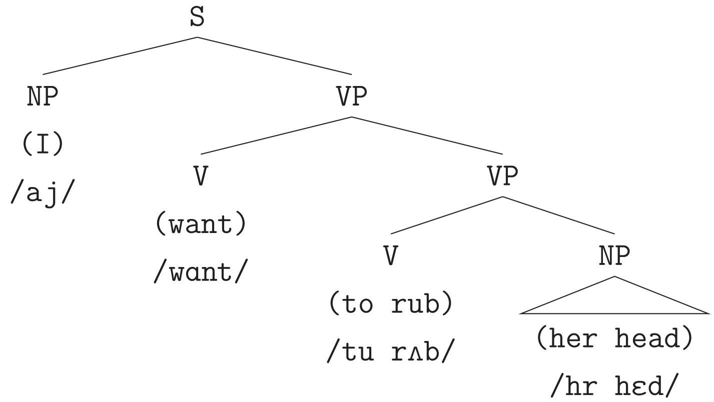
(4) [ájwánərʌ́brhɛ́d]

Phonological processes in English (e.g. syncope) typically result in the phonological strings /wɑnt tu/ (*want to*) and /wɑnt ə/ (*want a*) both being pronounced /wɑ́nə/; similar processes also result in the phonological string /rʌb hr/ (*rub her*) being pronounced [rʌ́br], which is also the pronunciation of the noun `[`$_N$` rubber ]`. These phonological processes are a necessary condition of the ambiguity of (4), as they result in the following two phonological strings receiving the same pronunciation.

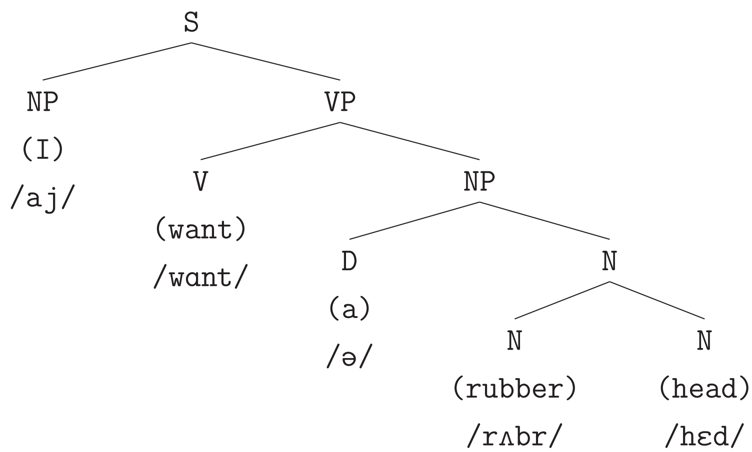
(21) a. `/aj wɑnt tu rʌb hr hɛd/`
b. `/aj wɑnt ə rʌbr hɛd/`

These phonological strings will be associated with distinct LFs; (21a) will be the phonological output of a derivation that has (22) as its pre-spellout structure, and (21b) will be the phonological output of a derivation that has (23) as its pre-spellout structure.

(22)



(23)



Although the phonological strings associated with these two structures are distinct, phonological rules will result in them both receiving the pronunciation in (4). Because of this, (4) will be the phonetic output of two derivations that produce distinct LFs, and will thus be ambiguous according to the definition in (1).

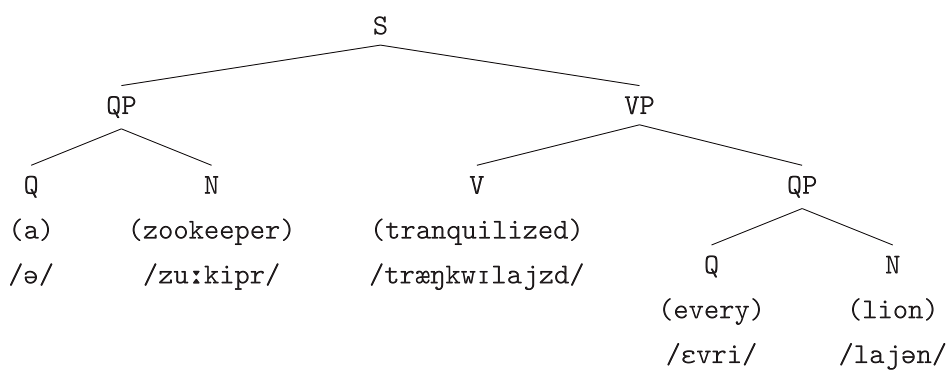
Finally, the Y-model allows for ambiguity to arise as a result of optional post-Spellout operations like quantifier-raising, which have no effect on the PF of a sentence. This is the explanation of the alleged ambiguity of (6).

(6) A zookeeper tranquilized every lion.

It is generally accepted that certain sentences containing both an existentially and a universally quantified noun phrase allow for two interpretations, which can be described in terms of the relative semantic scope of the two quantified noun phrases (see e.g. Barker 2002a). Thus, (6) is claimed to have two senses, which can be explained in terms of the relative semantic scope of [$_{qp}$ a zookeeper] and [$_{QP}$ every lion]. The sense where the [$_{qp}$ a zookeeper] takes semantic scope over [$_{QP}$ every lion] is one where a single zookeeper is responsible for tranquilizing all of the lions; the sense where [$_{QP}$ every lion] takes semantic scope over [$_{qp}$ a zookeeper] is one that allows for different lions to have been tranquilized by different zookeepers.

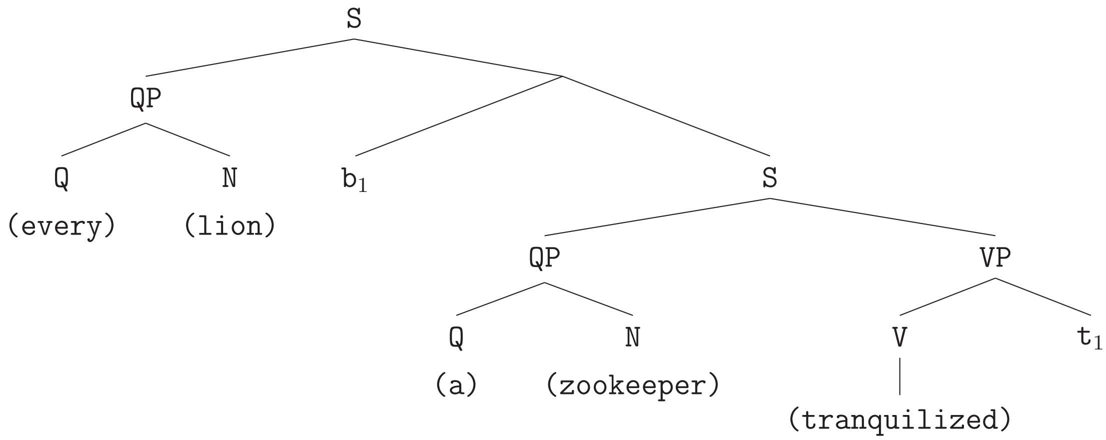
In the Y-model, semantic scope equates to syntactic scope at LF. Thus, in order for different scope possibilities to be realized, the syntactic position of a quantified noun phrase at LF must be able to differ from its syntactic position at Spellout. This is exactly what is accomplished with the post-Spellout operation of QR. The sentence in (6) will have a pre-Spellout structure that looks something like the following:

(24)



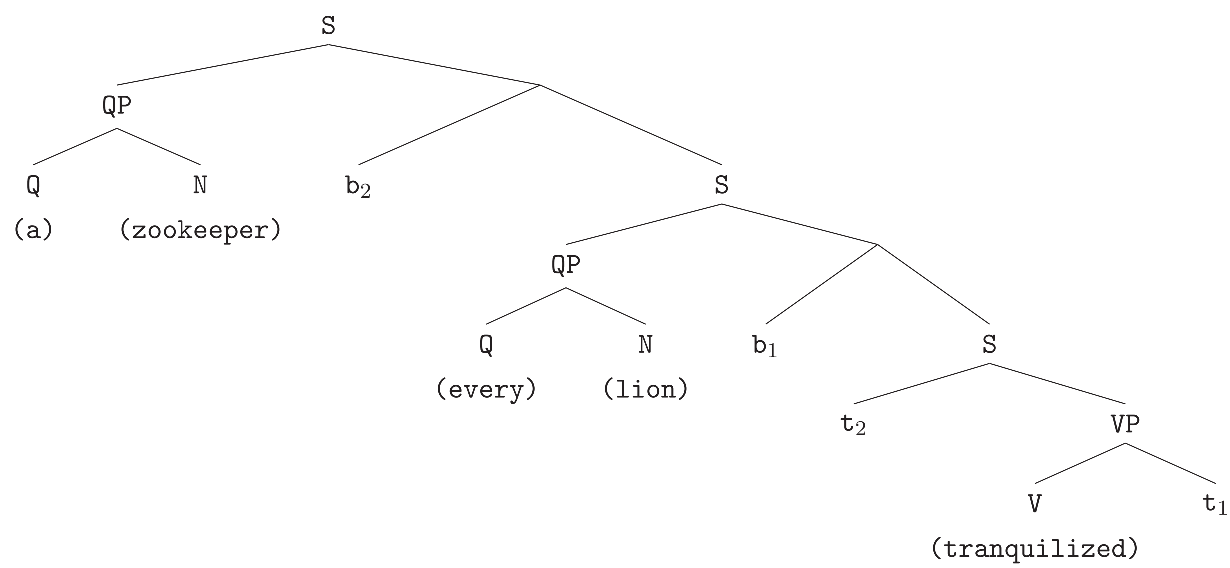
As discussed in §2.4.1, it is typically assumed in LF-approaches that object quantifiers must raise for interpretation. This will yield the LF in (25), in which [$_{QP}$ (every) (lion)] scopes over [$_{QP}$ (a) (zookeeper)].

(25)



The structure in (25) results from a single application of QR, and is an interpretable LF associated with (6). However, it is typically assumed that QR can optionally apply a second time, this time targeting `[QP (a) (zookeeper) ]`; this second application of QR will yield the LF in (26) (c.f. Heim and Kratzer 1998, §7.5.1).

(26)



In this LF, which is also derivationally associated with (6), `[QP (a) (zookeeper) ]` scopes over `[QP (every) (lion) ]`. Thus, the post-Spellout operation of QR allows for two distinct LFs to be derivationally paired with the sentence in (6), rendering (6) ambiguous according to the definition in (1).

3.3 Ambiguity vs. indeterminacy, vagueness and deixis

It is important to distinguish the notion of ambiguity from the notions of INDETERMINACY, VAGUENESS, and DEIXIS. Whereas sentential ambiguity obtains when a single sentence is derivationally associated with more than one LF, a sentence that is derivationally associated with just a single LF can display any of these three other properties, which are discussed briefly below.

3.3.1 Indeterminacy

Generally speaking, a sentence will be regarded as INDETERMINATE with regards to a proposition Q if, from the interpretation of (each of) its associated LF(s), one can infer neither Q nor $\neg Q$. As an example of indeterminacy, consider the sentence in (27).

(27) Rover is a mammal.

This sentences implies that Rover has a biological gender, i.e. is male or female; however, it is does not imply specifically that Rover is male, nor does it imply specifically that Rover is female. Rather, the sentence in (27) is indeterminate as to the gender of Rover. This can be verified with a truth-judgment test; the sentence in (27) is judged true in a situation where Rover is biologically male, and it is also judged true in a situation where Rover is biologically female. However, in neither case is (27) judged alternately true and not true, which would be the case if (27) were ambiguous between a meaning which implied masculinity and one which implied femininity. Hence, the simple fact that (27) is compatible with these two complimentary situations does not warrant the ascription of ambiguity (i.e. the assignment of distinct LFs) to (27); this compatibility can instead be attributed to the interpretation of the common noun $[_{\texttt{NP}}$ `(mammal) ]` not being sensitive to the biological gender of the entities which fall into its denotation.

Ambiguous sentences can also display indeterminacy (Gillon 2004). For example, one can ascertain through truth-judgments that the sentence `[mɛri hæz ə stejk]` is indeterminate with regards to whether Mary posseses a pink object or not; this sentence is judged invariably true both in a situation where one knows that Mary posseses no pink objects but does possess either a cut of meat for grilling or a pole with a sharp point, and in a situation where one knows that Mary posseses at least one pink object as well as (and possibly co-extensive with) either a cut of meat for grilling or a pole with a sharp point. From these judgments one can conclude that neither of the LFs associated with (2) have an interpretation that implies Mary's possession or non-possession of a pink object.[4]

3.3.2 Vagueness

Ambiguity must also be distinguished from VAGUENESS. A sentence is vague if there are situations with respect to which one can neither judge the sentence to be true nor judge it to be false, and where this inability to render a truth-judgement is not due to ignorance regarding the situation (Gillon 2004, §5). A prototypical vague sentence is one like (28).

(28) Marvin is wealthy.

There are situations for which (28) is judged clearly false – for example, a situation where Marvin's net worth is 50 cents. There are also situations for which (28) is judged clearly true – for example, a situation where Marvin's net worth is six billion dollars. However, there also situations where one is hestitant to judge (28) true, and also hesitant to judge it false – perhaps, for example, if Marvin's net worth is one hundred thousand dollars.

Vague sentences are often liable to partake in what is called the 'sorites paradox' (paradox of the heap, from Greek *sōros* 'heap'), so-named because the original formulation of the paradox (attributed to the Ancient Greek philosopher Eubulus of Miletus) pertained to the concept of a heap. With regards to (28) one can set up an ordering on situations that produce truth-judgments indicative of the sorites paradox. Suppose there to be an ordering on possible situations that are ordered by Marvin's net worth, where in each situation adjacent in the ordering, Marvin's net worth differs by one cent. In the situation where Marvin's net worth is one cent, (28) is judged false. In the situation next in the ordering (where Marvin's net worth is two cents), (28) is also judged false. There is the intuition that the addition of a single penny will never suffice to turn a non-wealthy person into a wealthy person; this would seem to imply that if, starting from the the situation where Marvin's net worth is one cent, one continues to move stepwise up the ordering on situations, one should never reach a situation where (28) is judged true. Since the situation in which Marvin's net worth is six billion dollars will eventually be reached if one continues to moves up the ordering in this way, (28) should, by this reasoning, be judged false in this situation as well. However, the sentence is in fact judged true with respect to the situation where Marvin's net worth is six billion dollars, hence the paradox.

The meaning of the gradable adjective $[_{\texttt{ADJ}}$ `wealthy` $]$, which relates to monetary possession, allows for a linear ordering on relevant situations to be easily constructed, which is

[4]For more discussion on indeterminacy, see Gillon (1990, 2004).

necessary for the construction of a sorites paradox. However, vagueness is also evident in many sentences with predicative common nouns (e.g. the sentence *That is a poem*), where it is not always so clear how an ordering, and thus a sorites paradox, might be constructed (c.f. Gillon 2004, §5; cited examples of other vague nouns include $[_{N}$ `poem` $]$, $[_{N}$ `game` $]$ and $[_{N}$ `religeon` $]$).[5]

3.3.3 Deixis

Finally, ambiguity should be distinguished from DEIXIS (Gillon 2004). It is well-known that the interpretations of certain linguistic elements like personal pronouns, demonstrative adjectives and prounouns, and various temporal and locative adverbials (e.g. $[_{ADV}$ `today` $]$, $[_{ADV}$ `yesterday` $]$, $[_{ADV}$ `here` $]$, $[_{ADV}$ `there` $]$, etc.) are dependent on the context-of-utterance (c.f. Kaplan 1989). The context-of-utterance includes such information as the time and location of the utterance, the identity of the speaker and audience, contextually salient and previously-mentioned entities, and so forth. Context-of-utterance is to be distinguished from the situation with respect to which the truth of a sentence is to be judged (Gillon 2004, §4).

The sentence in (29) is an example of a sentence which clearly exhibits context-dependency, i.e. where varying the context-of-utterance clearly results in a variation in truth-judgment.

(29) Frege was born yesterday.

This sentence is judged true if uttered on November 9, 1848, but is judged false if uttered on any other date. This variation in truth-judgment with respect to different contexts-of-utterances can be traced to the meaning of the adverb $[_{ADV}$ `yesterday` $]$, which deictically refers to the day preceding the day on which the sentence is uttered (note that the past tense is also deictic, picking out all times that precede the time of the utterance). The context-dependency of an element like $[_{ADV}$ `yesterday` $]$ is taken to be a feature of its interpretation (c.f. Kaplan 1989), and thus context-dependency of the kind exhibited by (29) should not be taken as cause for positing distinct LFs; in other words, it is not assumed that there is a different semantic feature $[_{ADV}$ `(yesterday)` $]$ for every day, past, present and future, but rather that the interpretation of the single semantic feature $[_{ADV}$ `(yesterday)` $]$ makes reference to a particular feature of the context-of-utterance (namely, the time of utterance). The same can be assumed for the semantic features of other deictic elements. Thus, deixis and ambiguity are theoretically distinct, as ambiguity is defined as the association of distinct LFs with a single expression.

[5]For more discussion on linguistic vagueness, see e.g. Kamp (1976); Barker (2002b); Kennedy (2007).

Variation in truth-judgment resulting from deixis and variation in truth-judgment resulting from ambiguity can be distinguished in virtue of the fact that only the latter type of variation remains when the context-of-utterance is fixed (Gillon 2004). Thus, if one fixes the context-of-utterance of (29) to April 23rd, 2014, then the sentence is not alternately judged true and not true; it is only judged true. However, alternate truth-judgments for a sentence like `[mɛri wants ə stejk]` will remain even when the context-of-utterance is fixed.[6]

3.4 Summary

In this chapter, the theoretical notion of ambiguity was presented and discussed in the context of the derivational Y-model; ambiguity was defined as the association of distinct LFs with a single phonetic output. This definition of ambiguity, the ATV test, and the distinctions made between ambiguity on the one hand and indeterminacy, vagueness and deixis on the other, will prove to be useful in determining whether and how ambiguity can serve as evidence for syntactic predicate decomposition.

[6]For more discussion on deixis, see e.g. Fillmore (1997); Kaplan (1989).

Chapter 4

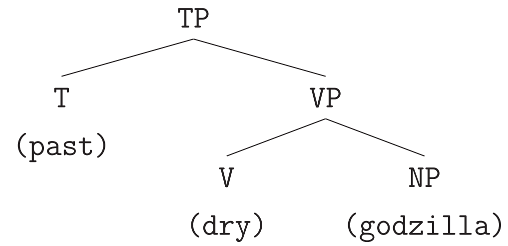
Syntactic decomposition of inchoative verbs

As discussed in Chapter 2, a number of different general approaches relating to decomposition have been proposed since the advent of generative grammar. A distinction was drawn between those analyses which posit the syntactic decomposition of predicates (e.g. Lakoff 1970; McCawley 1968; Travis 2000; Ramchand 2008 and many others), and those in which syntactic decomposition is foregone in favour of a kind of metalinguistic expansion (e.g. Dowty 1979). Both approaches might very well assign the same logical translation to sentence, though this translation will be obtained in different ways. For example, a metalinguistic expansion approach and a syntactic decomposition approach might both hold that a sentence like (1a) should have an LF that yields a translation like (1b), which contains a logical BECOME operator.

(1) a. Godzilla dried.
    b. PAST(BECOME(DRY(G)))

The difference between the two approaches can be observed in how this translation is obtained. In a translational approach, the translation of (1b) might be obtained with an LF like that in (2); the BECOME operator, though not the direct translation of any terminal node in the LF, is present in the translation of one of the terminal nodes, namely that of `[`$_V$ `(dry) ]`.

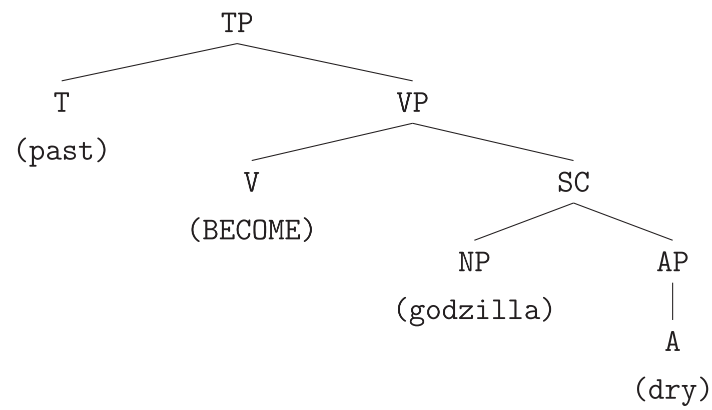
(2)



(3) $[\![\,$`[V (dry) ]`$\,]\!] = \lambda x.\textsc{become}(\textsc{dry}(x))$ (expression of type $\langle e, p\rangle$)

In contrast, on a syntactic approach, the BECOME operator would be the translation of a terminal node; the LF for (1a) would be something like that in (4), and `[V (BECOME) ]` and `[AP (dry) ]` would receive translations like those shown below.

(4)



(5) $[\![\,$`[A (dry) ]`$\,]\!] = \textsc{dry}$ (expression of type $\langle e, p\rangle$)

(6) $[\![\,$`[V (BECOME) ]`$\,]\!] = \textsc{become}$ (expression of type $\langle p, p\rangle$)

Note that the LFs in (2) and (4) will both receive the same interpretation (since they receive the same translations, after β-conversion).

As both a translational and a syntactic approach to decomposition are in principle capable of yielding the same interpretation for a sentence (and since additional explanation regarding PF is needed in a syntactic approach), one should want independent reasons for locating the elements of decomposition in the syntax. One recurrent argument that at least some decomposition should be located in the syntax stems from the observation that certain elements – in particular, adverbial modifiers – seem capable of taking scope with the logical heads in a decomposed structure. This observation was first made by Morgan (1969) in relation to decomposition proposals in the Generative Semantics framework; Morgan argued that certain sentences containing adverbials like *again*, *almost* and *for a few minutes* have multiple senses, which can be explained if the adverbials in question exhibit various scope possibilities with respect to decompositional elements like $[_V$ `(BECOME) ]` and $[_v$ `(CAUSE) ]`. The following examples are of the kind which are claimed to provide evidence of the relevant sort of ambiguity:

(7) a. Godzilla dried again.
b. The door opened for ten minutes.
c. Mothra almost died.

(7a) is claimed to have both a REPETITIVE and a REVERSATIVE reading; in the former, the entire action of drying is repeated, whereas in the latter an event of getting wet is reversed (or a prior state of being dry is restored). The following scenarios are meant to highlight these two readings.[1]

(8) a. REPETITIVE: Mothra dropped a bucket of water on Godzilla. It took a few hours, but eventually Godzilla dried. Then Mothra dropped three buckets of water on Godzilla. He thought for sure Godzilla wouldn't dry this time, but sure enough **Godzilla dried again**.
b. REVERSATIVE: Godzilla hated being wet. Not knowing this, Mothra threw a bucket of water on him. Realizing how angry Godzilla was, Mothra flew away and hid until **Godzilla dried again**.

A sentence like (7b) is also claimed to have more than one sense; here, the distinction is between a PROCESS reading where the durative PP *for ten minutes* describes the length of the opening process, and a RESULT-STATE reading where it describes the length of the result-state of being open.

(9) a. PROCESS: The door to the castle is very, very heavy and puts a strain on the machinery that is used to open and close it. Because of this, the door is opened once in the morning and then left open all day. Each morning, the machinery seems to get slower and slower. This morning, after the operator pulled the lever, **the door opened for (exactly) ten minutes**.
b. RESULT-STATE: The door to the castle, which opens instantly at the push of a lever, only stays open for a short time each day. Today, **the door opened for (exactly) ten minutes**, and thirty people were allowed to enter.

[1]It might be noticed that, given this characterization, a repetitive reading could be considered to be a special case of a reversative reading; two drying events entail a reversal of a getting wet event. This point is addressed in §7.1.1.

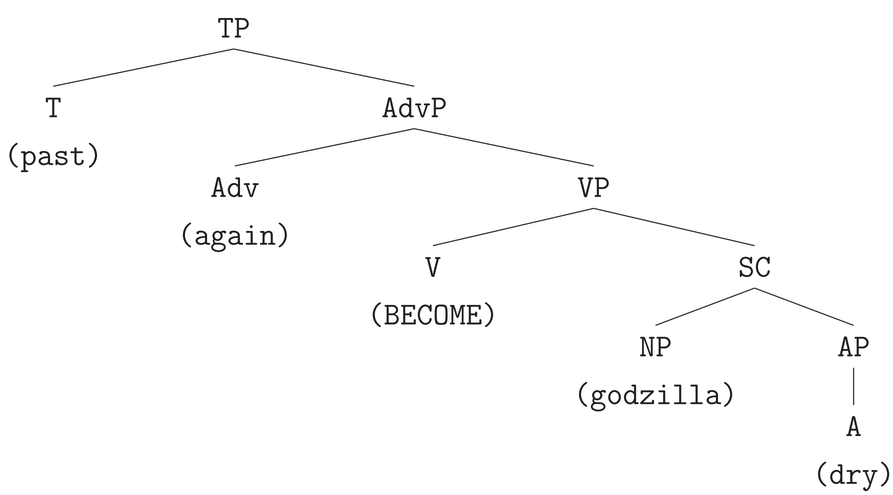
Finally, a sentence like (7c) is claimed to have both a COUNTERFACTUAL reading and a SCALAR reading. In the counterfactual reading, Mothra need not have ever been injured; in the scalar reading, Mothra must have been close to death.[2]

(10) a. COUNTERFACTUAL: **Mothra almost died** today. Godzilla ambushed him when he was asleep and threw a giant boulder at him. But the boulder missed him by just a few inches, and he was able to fly away unharmed.

b. SCALAR: Godzilla and Mothra had a big battle today. Godzilla was the clear winner. He tore both of Mothra's wings, then dropped a boulder on his head. **Mothra almost died**. But the doctors eventually stabilized him.

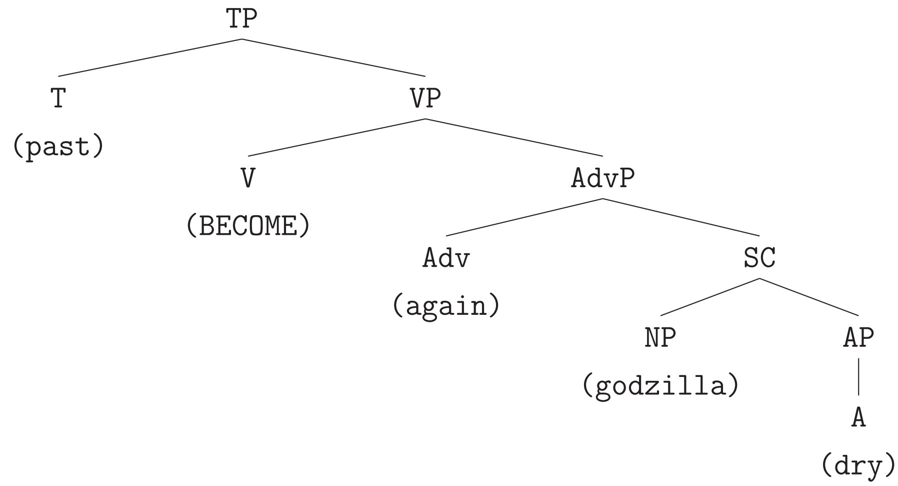
According to Morgan and other Generative Semanticists (e.g. McCawley 1971), the intuition that each of these sentences has more than one sense can be explained in terms of the scope that the adverbial takes with respect to [$_{V}$ (BECOME)] in the relevant decomposed structure. For example, the repetitive reading of (7a) would be generated by the LF in (11), and the reversative reading would be generated by the LF in (12). In the former case, [$_{Adv}$ (again)] scopes above [$_{V}$ (BECOME)], and thus semantically modifies the proposition that the door became open; in the latter case, [$_{Adv}$ (again)] scopes below [$_{V}$ (BECOME)], and thus semantically modifies only the 'result-state' small clause.

(11)



[2]The question of whether there are in fact two distinct readings for such a sentence is discussed briefly in Chapter 6, §6.3.2.2.

(12)



The two readings claimed to exist for (7b) and (7c) might also be obtained in a similar fashion. Thus, the process reading of (7b) would be obtained with an LF where [$_{AdvP}$ (for ten minutes)] scopes above the [$_{V}$ (BECOME)] in the relevant decomposition structure, and the result-state reading would be obtained with an LF where [$_{AdvP}$ (for ten minutes)] scopes below [$_{V}$ (BECOME)]; likewise, the counterfactual reading of (7c) would be obtained with an LF where [$_{Adv}$ (almost)] scopes above [$_{V}$ (BECOME)], and the scalar reading would be obtained with an LF where [$_{Adv}$ (almost)] scopes below [$_{V}$ (BECOME)] (perhaps modifying the adjective directly).

The intuition that sentences like those in (7) have multiple senses, and the ease and elegance of explaining them in terms of decomposition and adverbial scope in the way just described, has been taken as a point in favor of the syntactic decomposition of inchoative verbs. This chapter will examine in greater detail the predictions that the BECOME/small-clause and Metalinguistic Expansion analyses of inchoative verbs make regarding adverbial modification and adverbial-attachment ambiguities; it will be seen that a decompositional analysis of sentences like those just considered is not as straightforward as it first appears to be.

4.1 Inchoative verbs

An INCHOATIVE verb can be intuitively thought of as an intransitive verb that expresses a change from one state to another; inchoative verbs have been the subject of decompositional analyses since the early work of the Generative Semanticists. The following are examples of sentences containing what can be considered inchoative verbs.

(13)
a. The door opened.
b. The window closed.
c. The shirt dried.
d. The pole bent.
e. The sink emptied.
f. The theatre filled.
g. The image blurred.
h. The sweater stretched.
i. Hercules' shoulders broadened.
j. Mothra died.
k. The river widened.
l. The path narrowed.
m. The shadow lengthened.
n. The gap shortened.
o. The tree straightened.
p. The bump flattened.
q. The universe expanded.
r. The samurai aged.
s. Alice shrunk.
t. Godzilla grew.
u. The stock value rose.
v. The temperature fell.

The properties of inchoative verbs that are of primary interest here regard the grammatical status of the implied PRE-STATE and RESULT-STATE. The pre- and result-states that are implied by an inchoative verb can often be informally (and imperfectly) described using a 'simple' adjective in either its bare or comparative form; in many cases, the relevant adjective is one that is morphologically related to the inchoative verb.[3] The particular result-state implied by a sentence with an inchoative verb is perhaps most easily ascertained when the inchoative verb is put in the present perfect tense; the result-state can then be indicated with an implied sentence in the present tense. The particular pre-state implied by a sentence with an inchoative verb can be most easily ascertained when the inchoative verb is put in the future tense; an implied sentence in the present tense can then be taken as indication of the implied pre-state.[4]

For some of the verbs in (13), the implied result-state can be described with the bare form of the corresponding adjective, and the pre-state can be described with the negative of the same adjective.

(14)	a.	The door will open.	⇒	The door is not open.	PRE-STATE
		The door has opened.	⇒	The door is open.	RESULT-STATE

[3]'Simple' adjectives, like *open*, are to be distinguished from participle adjectives, like *opened*. A participle adjective has the same phonological form as the verbal passive or past-participle; a simple adjective often (but not always) has a different phonological form. Participle adjectives can often be prefixed with *un-*, simple adjectives often cannot (for example, *an unopened/*unopen door*, *an undried/*undry butterfly*, *an unstraightened/*unstraight tree*). A sentence like *There is the A N* containing a participle adjective presupposes a sentence like *NP was/has V-ed* with the corresponding verbal passive or past participle, but a sentence with a simple adjective usually does not; e.g. *That is the emptied sink* presupposes *That sink was emptied*, but *That is the empty sink* does not presuppose *The sink was/has emptied* (but c.f. *That is the dead moth*, which presupposes *That moth died*).

b.	The shirt will dry.	$\Rightarrow$	The shirt is not dry.	PRE-STATE
	The shirt has dried.	$\Rightarrow$	The shirt is dry.	RESULT-STATE
c.	The sink will empty.	$\Rightarrow$	The sink is not empty.	PRE-STATE
	The sink has emptied.	$\Rightarrow$	The sink is empty.	RESULT-STATE
d.	The image will blur.	$\Rightarrow$	The image is not blurry.	PRE-STATE
	The image has blurred.	$\Rightarrow$	The image is blurry.	RESULT-STATE
e.	Mothra will die.	$\Rightarrow$	Mothra is not dead.	PRE-STATE
	Mothra has died.	$\Rightarrow$	Mothra is dead.	RESULT-STATE

However, this is not the case for all of the inchoative verbs in (13); the target and/or pre-states that are implied by many inchoative verbs do not seem to be as strong as those characterized by the bare form of the corresponding adjectives.

(15)	a.	The river will widen.	$\not\Rightarrow$	The river isn't wide.
		The river has widened.	$\not\Rightarrow$	The river is wide.
	b.	The path will narrow.	?$\Rightarrow$	The path isn't narrow.
		The path has narrowed.	?$\Rightarrow$	The path is narrow.
	c.	The gap will shorten.	$\not\Rightarrow$	The gap isn't short.
		The gap has shortened.	$\not\Rightarrow$	The gap is short.
	d.	The universe will expand.	$\not\Rightarrow$	The universe isn't expansive.
		The universe has expanded.	$\not\Rightarrow$	The universe is expansive.

It is well-known that the bare forms of adjectives like *wide*, *narrow*, *short* and *expansive* are context-sensitive, and that an object can only be judged *wide* with respect to a contextually- or cotextually- provided comparison class (c.f. Bale 2011). With this in mind, note that a sentence like *The river has widened* does not seem to assert that the river has become wide with respect to the contextually-salient comparison class. The following dialogue shows that this is the case.

(16) A: The Amazon is wide, and so is the Nile. The Bow River is not wide.
B: That's true, but the Bow River has widened recently.

[4]Note that the present perfect of an inchoative verb strongly implies, but does not entail, that the implied result-state still holds at the present time. For example, if the listener knows that one of three closed doors has opened in the past, but does not know which one, the speaker could felicitously point to one door and say *This door has opened*; in this case, the implication is *This door had been open previously, and prior to that, had been not open.* The same can be said for the future of an inchoative verb, which strongly implies but does not entail that the pre-state holds at the present time; one could say of a currently open door that *This door will open*, in which case the implication is *This door will be not open, and after that it will be open.*

If the sentence *The Bow River has widened* asserted that the Bow River has become wide with respect to the salient comparison class (in this conversation, a class that includes rivers), then B's response should be heard as a contradiction; however, the response is not heard as contradictory. For *widen* and many other inchoative verbs, a more suggestive description of the implied pre- and result-states is found with the comparative form of the corresponding adjective, along with a *than*-phrase that includes a temporally-deictic adverb like *before*.

(17) a. The river has widened. ⇒ The river is wider than before.
b. The path has narrowed. ⇒ The path is narrower than before.
c. The gap has shortened. ⇒ The gap is shorter than before.
d. The universe has expanded. ⇒ The universe is more expansive than before.

These paraphrases suggest that, at least for inchoative verbs like *widen*, the implied pre-state and result-state are about comparative measurements in terms of a gradable dimension.

The inchoative verbs considered in (14) and (17) all have corresponding simple adjectives that they are clearly morphologically-related to; however, this is not the case for all of the inchoative verbs in (13). Some of these inchoative verbs do not have a morphologically-related simple adjective, but only a participle adjective (e.g. *rise/risen*, *fall/fallen*, *shrink/shrunken*, *grow/grown*). The implied result-states of sentences containing these verbs can still be described using a simple adjective; however, the adjective needed in such cases is not predictable based on the morphology of the verb.

(18) a. The stock value rose. ⇒ The stock value is higher than before.
b. The temperature fell. ⇒ The temperature is lower than before.
c. Alice shrunk. ⇒ Alice is smaller than before.
d. Godzilla grew. ⇒ Godzilla is bigger than before.

While providing linguistic paraphrases for the pre- and result-states implied by an inchoative verb is insightful, it is only a starting point for a theoretical analysis. In order to get a deeper understanding of the grammatical status (if any) of pre- and result-states, one must turn to less direct sorts of evidence.

One kind of evidence that has bearing on the issue is the compatibility of inchoatives with phrases, like *that way* or *in that state*, which can refer endophorically or exophorically to salient states, manners, or actions. Of particular interest are sentences like the following.

(19) a. The door opened, and remained that way until a passerby closed it.
b. The shirt dried, and remained that way until it rained.
c. The tree straightened, and remained that way until the first fruits formed.

d. The image blurred, and remained that way until the TV was fixed.
e. The river widened, and remained that way until the rain stopped.

In these sentences, the phrase *that way* refers deictically to the result-state implied by the first conjunct; the first four sentences can be paraphrased by replacing *that way* with the bare forms of the corresponding adjectives.[5]

(20) a. The door opened, and remained open until a passerby closed it.
b. The shirt dried, and remained dry until it rained.
c. The tree straightened, and remained straight until the first fruits formed.
d. The image blurred, and remained blurry until the TV was fixed.

The phrase *remained that way* is perhaps not quite as compatible with *widen* as it is with the other verbs in (19); (19e) seems slightly marked compared to the other sentences. The meaning of (19e) seems to be roughly the same as the following sentence, which is completely felicitous.

(21) The river widened, and remained at that width until the rain stopped.

The above sentence strongly suggests that the target width implied by the first conjunct is made salient enough for deictic reference.

The sentences in (19) suggest that the result-states implied by inchoative verbs are salient enough for deictic reference. However, there is an asymmetry between result-states and pre-states in this regard; the implied pre-states of inchoative verbs cannot be the subject of deictic reference. Consider the following examples.

(22) a. The door opened. #Before opening, it had been that way for at least three hours.
b. The shirt dried. #Before drying, it had been that way for a few days.
c. The tree straightened. #Before straightening, it had been that way for a few months.
d. The image blurred. #Before blurring, it had been that way for a few hours.
e. The river widened. #Before widening, it had been that way for a few months.

These examples all require additional context to assign a value to the deictic phrase *that way*. Although an inchoative verb implies some kind of pre-state, the implied pre-state cannot be

[5] See Dowty (1979, p.255) for the original observation that phrases like *there* and *that state* can refer deictically to implied result-states.

automatically picked out by *that way*; thus, the sentences in (22) cannot be understood as meaning the same as the sentences in (23) without additional contextual support.

(23) a. The door opened. Before opening, it had been closed for at least three hours.
b. The shirt dried. Before drying, it had been wet for a few days.
c. The tree straightened. Before straightening, it had been bent for a few months.
d. The image blurred. Before blurring, it had been crisp for a few hours.
e. The river widened. Before widening, it had been at its previous width for a few months.

The contrast in immediate felicity of (19) and (22) strongly suggests that result-states have a salience that pre-states lack.

Additional evidence of the asymmetry between pre-states and result-states can be seen in the possibility for certain adverbial modifiers to take result-states, but not pre-states, as arguments. One such modifier, identified by McCawley (1971, p.348) is *temporarily*. Consider the following sentences.

(24) a. The door opened temporarily.
b. The shirt dried temporarily.
c. The river widened temporarily.
d. The tree straightened temporarily.

The most salient readings of these sentences are ones which assert that the relevant result-state only held temporarily; that is, the most salient readings are ones that can be paraphrased as follows.[6]

(25) a. The door opened, but only remained open temporarily.
b. The shirt dried, but only remained dry temporarily.
c. The river widened, but only remained at that width temporarily.
d. The tree straightened, but only remained straight temporarily.

As was the case with the deictic reference of *that way*, the modifier *temporarily* cannot pertain to the pre-state implied by the inchoative verb. For example, (24a) cannot mean that the door was closed temporarily prior to opening. Other modifiers which appear to be able to take result-states as semantic arguments are those modifiers, discussed at the beginning of

[6]These sentences intuitively have an additional reading, in which the modified sentence has an interpretation relating to iterativity or potentiality. For example, (24a) can also be understood as conveying that the door was able to open for awhile, and then was unable to open.

this chapter, which have been argued to give rise to process/result-state ambiguities. These include *again*, *almost* and temporal *for*-PPs. These are all shown modifying *closed* below.

(26) a. The door closed again.
b. The door almost closed.
c. The door closed for ten minutes.

The relevant reading for each of these sentences (assuming for now that they are ambiguous) is paraphrased below.

(27) a. The door closed, and it had been closed before.
b. The door became almost closed.
c. The door closed, and remained closed for ten minutes.

As with the other modifiers, these adverbs are also unable to take a pre-state as a semantic argument. For example, (26c) cannot mean that the door was open for ten minutes before it closed. This lends further support to the claim that the result-state of an inchoative verb has more grammatical status than the pre-state.

There are two more features of inchoative verbs that should be mentioned here. The first is that many inchoative verbs can appear with 'degree' modifiers that express the amount of change that the subject underwent. Some examples are given below.

(28) a. The door has opened some more.
b. The shirt has dried a bit more.
c. The river has widened by five metres.
d. The tree has straightened six degrees.

The thing to note about these modifiers is that they can cancel the 'default' pre- and/or result-states of the inchoative verb. For example, (28b) does not imply *The shirt is dry*; in fact, it implies that this is not the case. Similarly, (28d) does not imply *The tree is straight*. While (28a) does imply *The door is open*, it also implies *The door had been open before*; note that the default pre-state inference (*The door had been closed*) is no longer present. These 'degree-of-change' modifiers will also be discussed further below.

The final feature of inchoative verbs that will be mentioned here is the fact that certain inchoative verbs can be used to express how extended objects change in space, in addition to their ability to express how objects changes over time (c.f. Jackendoff 1990; Gawron 2007). Some examples are given below.

(29) a. The door opens a bit from bottom to top.
b. The shirt dries towards the sleeves.
c. The river widens closer to the lake.
d. The tree straightens at the top.

A salient sense of each of these sentences is one which expresses not how an object changes over time, but how it varies across its physical extension; given an 'extent interpretation', the truth of each of the sentences in (29) can be judged at a single moment. These spatial readings are probably best seen not as an isolated phenomena, but rather as part of a more general metaphorical transfer of notions in the temporal domain to notions in the spatial domain. A possible analysis of these sentences (which will not be investigated in detail here) is that they involve a 'hypothetical journey' of the kind discussed by Cresswell (1978) with respect to sentences like *Spain is through the Earth from here.* Regardless of what the proper analysis may be, note that all of the modifiers discussed so far are compatible with extent readings, which further indicates that there is a more general process of domain transfer at work.

(30) a. The river widens again up ahead.
b. The river widens for a few miles between the lake and the ocean.
c. The river almost straightens up ahead.
d. The river straightens temporarily up ahead.

Subsequent sections will focus mainly on temporal readings for sentences with inchoative verbs, but it should be kept in mind that an analysis of these verbs should lend itself easily to an account of extent readings, given their naturalness.

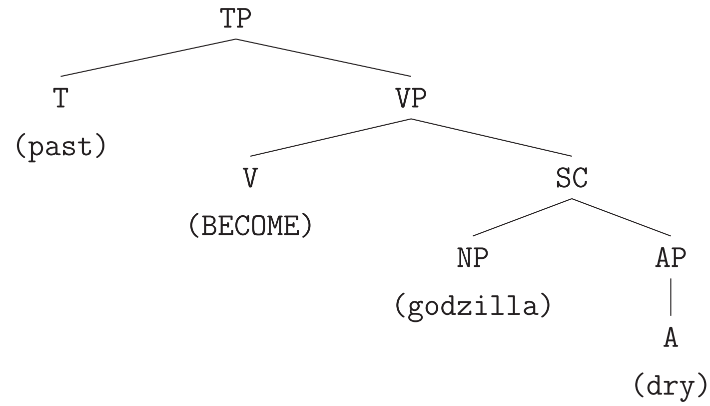
In the following few sections, a number of previous analyses of inchoative verbs will be looked at in detail, with their strengths and weaknesses being pointed out.

4.2 The `BECOME`/small-clause analysis

The `BECOME`/small-clause analysis (BC-SC) analysis of inchoatives has its roots in the earliest work on syntactic decomposition, dating back to the Generative Semantics movement (e.g. McCawley 1968). More recently, the analysis was revived by von Stechow (1995, 1996) in order to explain apparently ambiguous German sentences containing *wieder*, the counterpart to English *again*.

The BC-SC analysis was already informally presented in the opening section to this chapter. Under this analysis, the sentence *Godzilla dried* would have an LF like the following.

(4)



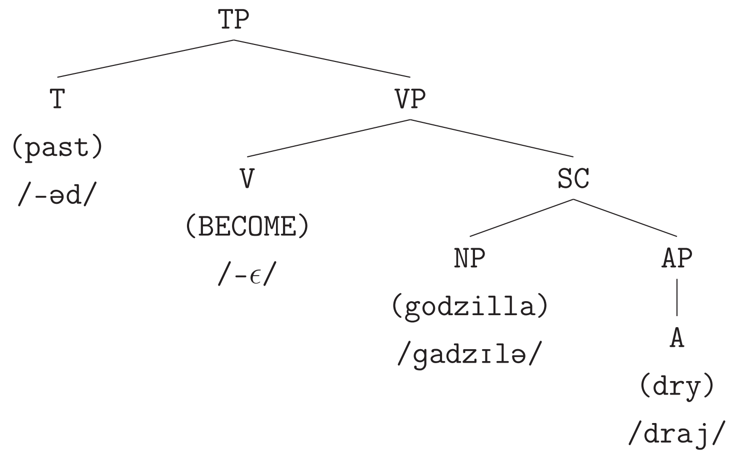
The complement of BECOME in this structure is what is called SMALL CLAUSE (c.f. Stowell 1981, p.256–267; Hoekstra 1988). A small clause is taken to be a non-finite subject-predicate structure consisting of a subject NP and a PP, AP or VP; one feature of a small clause is that when the predicate is an AP or PP, there is no copula present. Small clauses have been proposed to be present in sentences like the following (many of which are taken from Hoekstra 1988).

(31)
a. With [football on TV], there is hardly anyone at school.
b. With [his hands dirty], John…
c. I want [him off my ship].
d. He washed [the soap out of his eyes].
e. He hammered [the metal flat].
f. He shaved [his hair short].
g. They painted [the door green].
h. They pushed [him into the well].

The small clauses argued to be present in (31d-h) are taken to be small clause 'result-phrases' that are complements to an activity verb; the small clause in a BC-SC decomposition is similarly understood as a result phrase, however it is the complement of a verb or affix with a meaning close to that of the verb *become*.

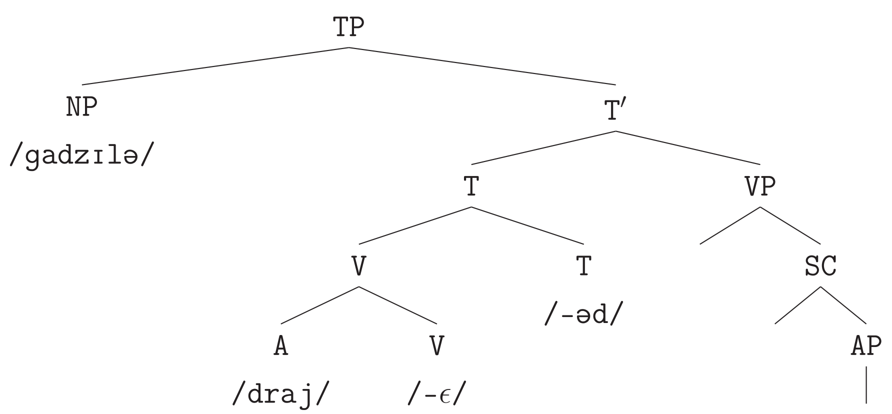
One major question which must be addressed by any decompositional analysis that is presented in the Y-model is how a decomposed LF is derivationally paired with a PF of the correct form; this is analogous to the problem of how 'lexical insertion' could apply to the Generative Semanticists' deep structures. Von Stechow (1996) offers one straightforward explanation for how the correct PF can be paired with an LF that has a decomposed inchoative verb; von Stechow's explanation relies on subject-raising, as well as on the head-movement/incorporation of Baker (1988). In von Stechow's analysis, *Godzilla dried* would have a pre-Spellout structure like the following.

(32)



After Spellout, head-movement and subject-raising would apply to the P-branch of the derivation. Head-movement would result in [$_A$ /draj/] incorporating with [$_V$ /-ϵ/], and the result of this incorporation would then incorporate with [$_T$ /-əd/]. Subject-raising would result in [$_{NP}$ /gadzɪlə/] raising to a position above T.[7] The resulting PF, shown below, will yield the correct phonological output for the sentence.

(33)



Although the phonological feature associated with (BECOME) is the null suffix [-ϵ] in the above example, it is often assumed that it is overtly realized in many cases as [-ən]. Dowty (1979, §4.3) notes that the distribution of [-ən] vs. [-ϵ] seems to be (at least in part)

[7] Von Stechow does not in fact propose that subject-raising is a PF operation; rather, he suggests that subject-raising occurs before Spellout, and that the semantic features of the subject 'reconstruct' in (i.e. move back to) the original small-clause position of the subject. This difference is not important for present considerations.

phonologically conditioned; verbs formed from adjectives that end with a non-nasal obstruent usually have the `[-ən]` appended (*damp-en*, *short-en*, *weak-en*, etc.), while verbs formed from adjectives that end with a nasal or vowel do not (*dry*, *slim*, *thin*, *free*, *slow*, etc.).

The syntactic operations (head-movement and subject-raising) that allow a decompositional LF like (4) to be paired with the correct PF are operations that are widely assumed in generative transformational grammar. They appear to be sufficient for handling cases of inchoative verbs that are overtly derived from (or phonologically identical to) corresponding adjectives, although (as discussed below) their sufficiency is more questionable when one considers those inchoative verbs (like *rise* or *die*) that do not have morphologically-similar adjectives, or those (like *widen*) that have 'comparative' meanings.

The above will suffice for an overview of the syntactic side of the BC-SC analysis of inchoative verbs; the semantic side of this analysis will be considered next.

4.2.1 Interval Semantics for BECOME

Assuming for the moment that the correct PFs can be paired with BC-SC decompositions, the question arises about how those decompositions are interpreted; in particular, there is the question of the semantic value of `(BECOME)`. The standard semantics for a BC-SC decomposition is due to Dowty (1979); although Dowty was technically proposing a metalinguistic expansion analysis, the semantic interpretations for metalanguage expressions that he proposed can be easily transferred to the elements in a syntactic decomposition.

As inchoative verbs by definition deal with change in an object that takes place over time (at least in their prototypical usages), the semantic framework underlying an analysis of such verbs must include reference to times. Dowty (1979) adopts the 'interval semantics' of Bennett and Partee (1978) in his semantics of inchoative verbs. Intervals are defined over a base set of points with a dense linear order, which can be considered to be temporal moments; an interval is a dense, gapless subset of such points.[8] Intervals may contain one or both of their bounding points, i.e. they can be closed or open, or closed on one side and open on the other (though these distinctions will not be important in what follows).

(34) Given an infinite set of points M and a dense linear ordering $\preceq$ on M,
i is an interval iff $i \subset M$ & $\forall m_1, m_2, m_3 \in M : (m_1, m_3 \in i \ \& \ m_1 \prec m_2 \prec m_3) \rightarrow m_2 \in i$

[8]The 'extent' readings of inchoative verbs discussed above could plausibly be handled by allowing for intervals composed of spatial points along some path. See Gawron (2005); Koontz-Garboden (2010) for examples of this sort of proposal.

Note that an interval can consist of a single point. 'I_M' will stand for the domain of intervals built from the domain M of points. A strict ordering on intervals can be derived straightforwardly from the ordering on points.

(35) $i_1 \prec i_2$ iff every point in i_1 precedes every point in i_2.

In an interval semantics, propositions are taken to be functions from intervals to truth-values; properties are taken to be functions from entities to propositions.

(36) a. A proposition is a function $\mathcal{P} : I_M \to T$
b. A property is a function $\mathcal{R} : E \times (I_M \to T)$

In the translation language, 's' will be the type corresponding to intervals, and the symbols 's_1, s_2, s_3' will be variables of type $\langle s \rangle$; the symbols 'i, i', i'', j, k' will be used as variables over intervals in the metalanguage used to describe semantic values. Suppose the expression HEXAGONAL is a property-denoting expression, i.e. an expression of type $\langle e, \langle s, t \rangle \rangle$. This expression can be thought of denoting a property that maps an object-interval pair to true only if the object is hexagonal for the entire course of the interval. The expression HEXAGONAL(STOP-SIGN) will then be a proposition-denoting expression, i.e. an expression of type $\langle s, t \rangle$. This expression will map to true just those intervals every moment of which the stop sign is hexagonal.

A few additional notions pertaining to intervals are required for spelling out the semantics of the BC-SC analysis. These include the notions of INFIMUM (greatest lower bound) and SUPREMUM (least upper bound). The infimum of a time interval can be thought of as the earliest moment in the interval if the interval is closed; if the interval is open, then the infimum is the latest moment that precedes all moments in the interval. A dual characterization can be given for supremum.

(37) Definitions of Infimum (INF) and Supremum (SUP)

$\forall i \in I_M$:

a. $m \in M$ is the infimum of i iff

$(\forall n \in i : \; m \preceq n) \;\&\; \neg(\exists x \in M : \forall n \in i : x \preceq n \;\&\; m \prec x)$

b. $m \in M$ is the supremum of i iff

$(\forall n \in i : \; n \preceq m) \;\&\; \neg(\exists x \in M : \forall n \in i : n \preceq x \;\&\; x \prec m)$

The last set of basic definitions that will be required are Dowty's (1979) relational definitions of INITIAL BOUNDARY INTERVAL and FINAL BOUNDARY INTERVAL. An initial boundary interval of an interval i is any interval which includes INF_i and whose other points (if it has any) are all less than all points in i. A dual characterization can be given for final boundary interval.

(38) Definitions of initial boundary interval and final boundary interval. Given $j, i \in I_M$,

a. $\textsc{ibi}_{j,i}$ iff $\exists k[k \in I_M \;\&\; k \prec i \;\&\; j = k \cup \{\textsc{inf}_i\}]$

b. $\textsc{fbi}_{j,i}$ iff $\exists k[k \in I_M \;\&\; i \prec k \;\&\; j = k \cup \{\textsc{sup}_i\}]$

Note that $\{\textsc{inf}_i\}$ and $\{\textsc{sup}_i\}$ are limiting cases for initial and final boundary intervals of i, respectively (the existential quantification in the definitions can be satisfied by the empty interval). Boundary intervals will be seen to be a key component of Dowty's (1979) interpretation of `(BECOME)`.

In a Dowty-style semantics, the small-clause complement to `(BECOME)` in decomposition structure denotes a STATIVE PROPOSITION for which the 'subinterval' property holds.

(39) The subinterval property holds of a proposition $\mathcal{P}$ iff $\forall i[\mathcal{P}(i) \rightarrow \forall i'[i' \subset i \rightarrow \mathcal{P}(i')]]$

The subinterval property holds of a proposition iff that proposition is true of an interval only if it is also true of all subintervals of that interval. As an example, consider the small-clause complement to `(become)` in (4). The translation of this small-clause would be DRY(GODZILLA), which would be an expression of type $\langle s, t\rangle$, i.e. a proposition-denoting expression; assuming this proposition is stative and exhibits the subinterval property, then it would be true of an interval only if Godzilla is dry for every moment of that interval.

The role of BECOME is to derive a dynamic (i.e. non-stative) proposition from a stative one; this is accomplished using the notions of initial and final boundary intervals. The denotation for BECOME shown below is essentially that of Dowty (1979).

(40) a. BECOME is an expression of type $\langle\langle s, t\rangle, \langle s, t\rangle\rangle$

b. $[\![\textsc{become}]\!](\mathcal{P})(i) = \mathrm{T}$ iff $\exists j, \exists k : \textsc{ibi}_{j,i} \;\&\; \textsc{fbi}_{k,i} \;\&\; \mathcal{P}(j) = \mathrm{F} \;\&\; \mathcal{P}(k) = \mathrm{T}$

This definition for BECOME requires that a proposition (in the intervalic sense) change from false to true over the course of an interval. Returning to the example at hand, the translation for the VP in (4) will be as follows:

(41) ⟦ `[VP (become) [SC [NP (godzilla) [AP (dry) ] ] ] ]` ⟧ = BECOME(DRY(G))

This VP will denote a proposition with the following truth-conditions.

(42) $[\![\textsc{become}(\textsc{dry}(\textsc{g}))]\!](i) = \mathrm{T}$ iff
$\exists j, \exists k : \textsc{ibi}_{j,i} \;\&\; \textsc{fbi}_{k,i} \;\&\; [\![\textsc{dry}(\textsc{g})]\!](j) = \mathrm{F} \;\&\; [\![\textsc{dry}(\textsc{g})]\!](k) = \mathrm{T}$

This proposition is true of an interval only if the interval has an initial boundary interval in which Godzilla is not dry, and a final boundary interval in which Godzilla is dry. To complete the semantic picture, something must be said about the semantic contribution of the past tense morpheme. One option is to assume that `(past)` is translated as a function PAST from propositions to truth-values, which maps a proposition to true iff it holds of an interval that precedes the utterance interval i^u.

(43) a. PAST is an expression of type $\langle\langle s, t\rangle, t\rangle$
b. $[\![\text{PAST}]\!](\mathcal{P}) = \text{T}$ iff $\exists i : i \prec i^u \;\&\; \mathcal{P}(i)$

With the above definitions, the LF in (4) will receive the following translation.

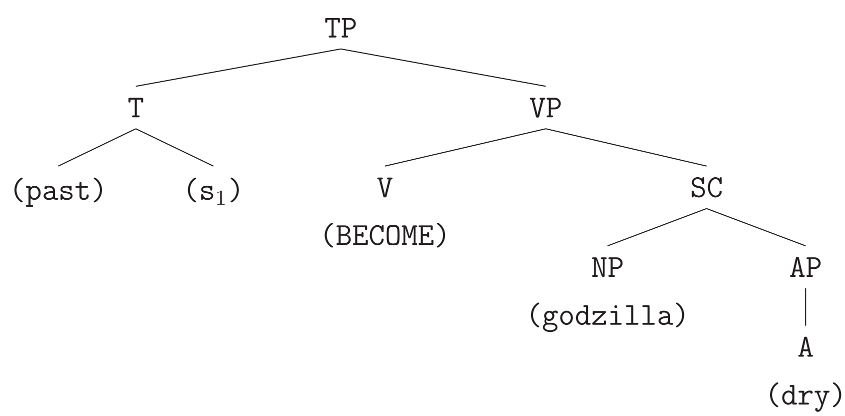
(44) $[\![(4)]\!] = \text{PAST}(\text{BECOME}(\text{DRY}(\text{G})))$

This translation denotes a truth value; it denotes true if the following condition holds.

(45) $\exists i : i \prec i^u \;\&\; \exists j, \exists k : \text{IBI}_{j,i} \;\&\; \text{FBI}_{k,i} \;\&\; [\![\text{DRY}(\text{G})]\!](j) = \text{F} \;\&\; [\![\text{DRY}(\text{G})]\!](k) = \text{T}$

Another option is to assume that temporal reference is akin to pronominal reference, as deictic, anaphoric and bound temporal reference all seem to be possible (Partee 1973a). Pursuing this option in the Y-model, one would assume that the LF for *Godzilla dried* contains a temporal pronoun in `T`, as well as `(past)`.

(46)



Here, $(\mathtt{s}_1)$ is translated as S_1, a variable of type $\langle s\rangle$. The role of `(past)` will now be to introduce a presupposition (in the form of a definedness condition) that the interpretation of this variable precedes the utterance interval (c.f. von Stechow 1996). In this pronominal conception of tense, `(past)` will be translated as PST, which denotes a function from intervals to intervals. With the introduction of variables into the translation language, semantic values will need to be assigned relative to a variable assignment function g.

(47) a. $\textsc{pst}$ is an expression of type $\langle s, s\rangle$

b. $[\![\textsc{pst}(\textsc{s}_n)]\!]^g$ is defined only if $[\![\textsc{s}_n]\!]^g \prec i_u$. Where defined, $[\![\textsc{pst}(\textsc{s}_n)]\!]^g = [\![\textsc{s}_n]\!]^g$

The full translation for (46) will be as follows.

(48) $\lceil\!\lceil(46)\rceil\!\rceil = \textsc{become}(\textsc{dry}(\textsc{g}))(\textsc{pst}(\textsc{s}_1))$

This translation will have the following interpretation.

(49) $[\![\textsc{become}(\textsc{dry}(\textsc{g}))(\textsc{pst}(\textsc{s}_1))]\!]^g$

a. is defined only if $[\![\textsc{s}_1]\!]^g \prec i_u$

b. if defined, equals T only if $\exists j, \exists k : \textsc{ibi}_{j,[\![\textsc{s}_1]\!]^g}$ & $\textsc{fbi}_{k,[\![\textsc{s}_1]\!]^g}$ & $[\![\textsc{dry}(\textsc{g})]\!]^g(j) = \text{F}$ & $[\![\textsc{dry}(\textsc{g})]\!]^g(k) = \text{T}$

Both analyses of tense will be made use of in the following discussion. The temporal-pronoun analysis is more complicated than the propositional-operator analysis, as it requires the introduction of temporal variables in the translation language and temporal pronouns in the object language. However, it does allow for a more transparent analysis of certain adverbials, including *again*. The temporal-pronoun analysis of tense will thus be adopted when convenient.

This concludes the presentation of what is essentially the standard semantics for a BC-SC decomposition; there are slight variations in different accounts, but these variations are not important for present purposes (c.f. Beck 2005; von Stechow 1996 for some examples). The semantics provided has the straightforward consequence of transparently predicting pre-state and result-state inferences like those in (14b), assuming a semantics for the future and past perfect have been provided; recall that the existence of such inferences was one of the primary motivations for the initial BC-SC proposals made by the generative semanticists.

(14b)	The shirt will dry.	⇒	The shirt is not dry.	PRE-STATE
	The shirt has dried.	⇒	The shirt is dry.	RESULT-STATE

With the syntax and semantics of the BC-SC now specified, the predictions that the analysis makes regarding adverbial modification can now be considered.

4.2.2 BECOME/small-clause decompositions and adverbial modification

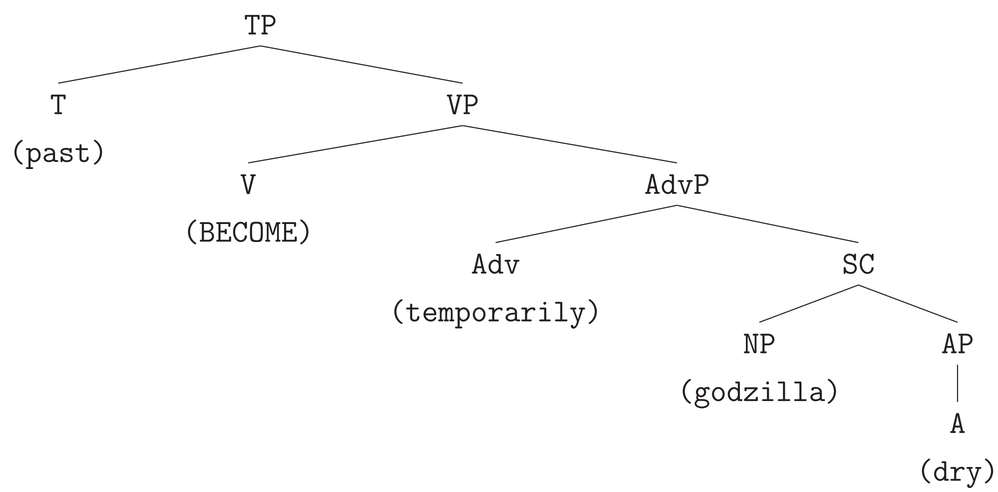
One advantage of the BC-SC analysis as it was spelled out above is that it would seem to predict there to be an asymmetry in the accessibility of result-states and pre-states for deictic reference. For example, since the stative result-state predicate `[`$_{\texttt{AP}}$ `dry ]` in (4) is syntactically represented as the head of a small-clause, it might be expected to be a highly salient antecedent for *that way* in a sentence like (19b).

(19b) The shirt dried, and remained that way until it rained.

Note that a pre-state is not syntactically represented in the BC-SC analysis, and thus might be expected to not be a salient antecedent for *that way*.

It might also appear that the BC-SC analysis predicts an asymmetry in the accessibility of result-states and pre-states for adverbial modification. However, this is not true; the semantics of BECOME will ensure that any adverb which appears in its scope will enter into both the pre-state and result-state components of a sentence's truth-conditions. Consider the adverb *temporarily*; it was remarked above that this adverb seems capable of affecting the result-state component of the truth-conditions. In a BC-SC analysis, this is easily achieved; the LF for the sentence *Godzilla dried temporarily* would look like the following; subject-raising and head movement will ensure that this LF is paired with a PF that produces the correct phonological output.

(50)



This LF can be assumed to have the following translation.

(51) $[\![(50)]\!] = \textsc{past}(\textsc{become}(\textsc{temporarily}(\textsc{dry}(\textsc{g}))))$

Suppose now that TEMPORARILY has a denotation like the following; this will result in (50) having the truth-conditions in (53).

(52) a. TEMPORARILY is an expression of type $\langle\langle s,t\rangle,\langle s,t\rangle\rangle$

b. $[\![\textsc{temporarily}]\!](\mathcal{P})(i) = \text{T}$ iff $\mathcal{P}(i) = \text{T}$ & $\exists i'[i \prec i'$ & $\mathcal{P}(i') = \text{F}]$

(53) $[\![\text{PAST}(\text{BECOME}(\text{TEMPORARILY}(\text{DRY}(\text{G}))))]\!] = \text{T}$ iff
$\exists i : i \prec i^u \;\&\; \exists j, \exists k : \text{IBI}_{j,i} \;\&\; \text{FBI}_{k,i} \;\&$
i. $\neg[\ [\![\text{DRY}(\text{G})]\!](j) = \text{T} \;\&\; \exists i'[j \prec i' \;\&\; [\![\text{DRY}(\text{G})]\!](i') = \text{F}]\ ] \;\&$
ii. $[\![\text{DRY}(\text{G})]\!](k) = \text{T} \;\&\; \exists i''[k \prec i'' \;\&\; [\![\text{DRY}(\text{G})]\!](i'') = \text{F}]$

As seen in (ii), the truth-conditions for this sentence require that there be an interval in which Godzilla was not dry that follows the result-state interval in which Godzilla is dry. Note that the semantic effect of the adverb is also present in the pre-state component of the truth-conditions in (shown in (53i)). This is not problematic in this particular case, as (53i) is equivalent to (53i′).

(53i′) $[\![\text{DRY}(\text{G})]\!](j) = \text{F} \;\vee\; \neg\exists i'[j \prec i' \;\&\; [\![\text{DRY}(\text{G})]\!](i') = \text{F}]$

Given the result-state component of the truth-conditions in (53ii), and the fact that $j \prec i''$, one can conclude that the first disjunct of (53i′) must hold if the sentence is true. Hence, the truth-conditions will require that Godzilla went from being not dry to being temporarily dry; the truth-conditions derived for the LF thus come out correctly. It will be seen shortly, however, that it is generally problematic for the BC-SC analysis that the semantic affect of an adverb affects the pre-state component of truth-conditions. Also, note that the sentence just considered has another reading: one in which Godzilla underwent a process of drying which was then interrupted. As discussed below, it is not obvious how this reading can be generated in a BC-SC analysis of inchoative verbs.

Von Stechow (1996) argues that a prime motivation for positing the syntactic presence of `(BECOME)` is that it predicts the existence of adverbial-attachment ambiguities, a prediction which is argued to be fulfilled by the adverb *again* in a sentence like *Godzilla dried again*. Von Stechow proposes the following meaning for AGAIN.

(54) a. AGAIN is an expression of type $\langle\langle s, t\rangle, \langle s, t\rangle\rangle$
b. $[\![\text{AGAIN}]\!](\mathcal{P})$ restricts the domain of $\mathcal{P}$ to
$\{i : \exists i' \exists i''[i'' \prec i' \prec i \;\&\; \mathcal{P}(i'') = \text{T} \;\&\; \mathcal{P}(i') = \text{F}]\}$

According to von Stechow, $[\![\text{AGAIN}]\!]$ takes a proposition as input and introduces a presupposition in the form of a definedness condition on intervals; in other words, AGAIN takes a function from intervals to truth-values, and returns a (possibly) partial function of the same type. A proposition that has been modified by $[\![\text{AGAIN}]\!]$ will only be defined for those intervals for which an earlier interval can be found in which the proposition does not hold, and an even earlier interval can be found in which the proposition does hold. As a simple example of the meaning contribution of `(again)`, suppose the sentence *Godzilla was dry* *again* is translated as AGAIN(DRY(G))(PST(S$_1$)). This sentence will then have the following interpretation.

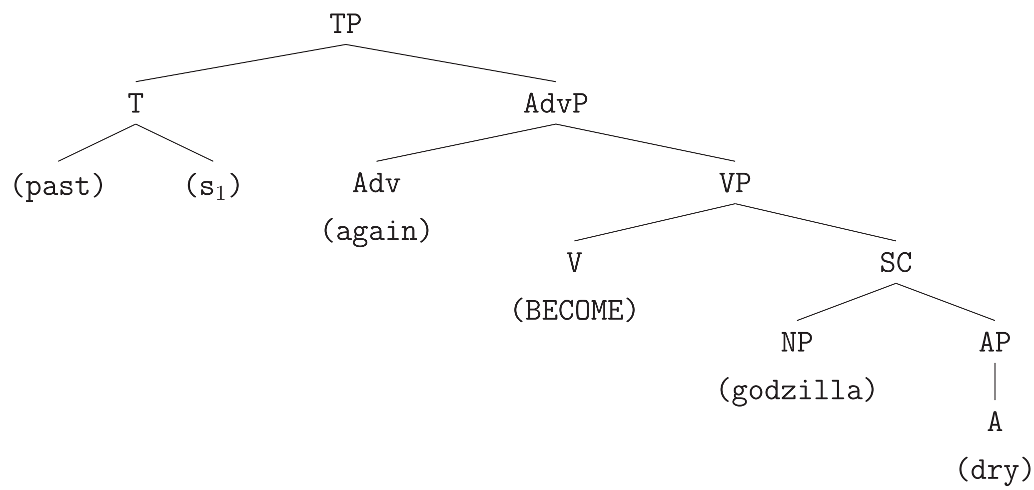
(55) $[\![$AGAIN(DRY(G))(PST(S$_1$))$]\!]^g$

a. is defined only if $[\![s_1]\!]^g \prec i_u$ &
$\exists i' \exists i''[i'' \prec i' \prec [\![s_1]\!]^g$ & $[\![$DRY(G)$]\!]^g(i'') =$ T & $[\![$DRY(G)$]\!]^g(i') =$ F$]$

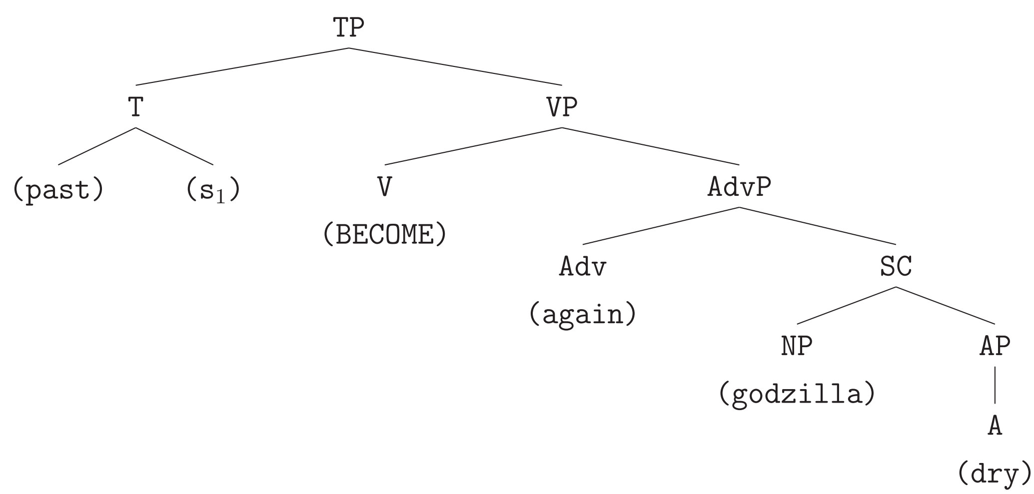
b. if defined, equals T iff $[\![$(DRY(G)$]\!]^g([\![s_1]\!]^g) =$ T

As discussed in the opening section to this chapter, the BC-SC analysis with its two propositional levels makes available two attachment sites for `[Adv again ]` that yield interpretable results; `[Adv again ]` can attach above `[V BECOME ]`, or below. The two possible LFs for *Godzilla dried again* are repeated below, with tense pronouns added.

(56)



(57)



The first of the above LFs receives the following translation and interpretation.

(58) $[\![\textsc{again}(\textsc{become}(\textsc{dry}(\textsc{g})))(\textsc{pst}(\textsc{s}_1))]\!]^g$

a. is defined only if $[\![s_1]\!]^g \prec i_u$ & $\exists i' \exists i''[i'' \prec i' \prec [\![s_1]\!]^g$ & $[\![\textsc{become}(\textsc{dry}(\textsc{g}))(i'') = \text{T}]\!]^g$ & $[\![\textsc{become}(\textsc{dry}(\textsc{g}))]\!]^g(i') = \text{F}]$

b. if defined, equals T iff $[\![\textsc{become}(\textsc{dry}(\textsc{g}))]\!]^g([\![s_1]\!]^g) = \text{T}$

According to these definedness/truth-conditions, this LF will only be mapped to true if there are two intervals prior to the utterance time in which Godzilla transitioned from not-dry to dry (corresponding to i'' and $[\![s_1]\!]^g$ in (58)). This LF produces the so-called 'repetitive' reading of the sentence, which is argued to be the salient reading in a context like (8a), repeated below.

(8a) REPETITIVE: Mothra dropped a bucket of water on Godzilla. It took a few hours, but eventually Godzilla dried. Then Mothra dropped three buckets of water on Godzilla. He thought for sure Godzilla wouldn't dry this time, but sure enough **Godzilla dried again**.

Regarding the second LF, because the presupposition introduced by AGAIN is given in terms of a definedness condition, and because `(again)` can appear below `(become)`, a definedness condition must be added to the definition of BECOME in order for the presupposition introduced by AGAIN to project through.

(59) $[\![\textsc{become}]\!](\mathcal{P})(i)$ is defined only if $\mathcal{P}(i)$ is defined.

The second of the above LFs now receives the following translation and interpretation.

(60) $[\![\textsc{become}(\textsc{again}(\textsc{dry}(\textsc{g})))(\textsc{pst}(\textsc{s}_1))]\!]^g$

a. is defined only if $[\![s_1]\!]^g \prec i_u$ & $\exists i' \exists i''[i'' \prec i' \prec [\![s_1]\!]^g$ & $[\![\textsc{dry}(\textsc{g})(i'') = \text{T}]\!]^g$ & $[\![\textsc{dry}(\textsc{g})]\!]^g(i') = \text{F}]$

b. if defined, equals T iff $[\![\text{BECOME}(\textsc{dry}(\textsc{g}))]\!]^g([\![s_1]\!]^g) = \text{T}$

According to these definedness/truth-conditions, this LF will only be mapped to true if there is an interval prior to the utterance time in which Godzilla transitioned from not-dry to dry, and prior to this interval there is an interval in which Godzilla was dry (though he need not have ever transitioned into this state). This LF produces the so-called 'reversative' reading of the sentence, which is argued to be the salient reading in a context like (8b), repeated below.

(8b) REVERSATIVE: Godzilla hated being wet. Not knowing this, Mothra threw a bucket of water on him. Realizing how angry Godzilla was, Mothra flew away and hid until **Godzilla dried again**.

The nature of AGAIN-ambiguities will be discussed in detail in Chapter 7; let it be assumed for the moment that the BC-SC does an adequate job of capturing the multiple interpretations of *Godzilla dried again*. One prediction that the BC-SC analysis makes regarding *again*-ambiguities is that a reversative reading should not be possible when `(again)` is 'too far' from the stative small-clause predicate, i.e. when it scopes above BECOME. As evidence that this in fact the case, McCawley (1971) points out that fronting *again* eliminates the possibility of a reversative reading. Thus, (61a) is an acceptable continuation to the following, but (61b) is odd if one does not have knowledge of a prior instance of Godzilla drying.

(61) Godzilla got wet, but...

a. ... Godzilla dried again.

b. #... again Godzilla dried.

The loss of a reversative reading with a fronted *again* is expected if, in a sentence like (61b), `(again)` is interpreted in a position above the landing site of the subject, and thus above `(BECOME)`.

The BC-SC analysis thus seems, at first glance, to offer a promising way of analyzing inchoative verbs; it offers a straightforward and elegant explanation of pre-state/result-state inferences and result-state deixis, and predictions regarding adverbial-attachment ambiguities that seem to be borne out. However, this first glance is misleading, as the analysis also faces seemingly insurmountable problems, discussed in the next section.

4.3 Issues with the `BECOME`/small-clause analysis

In this section, numerous problems faced by the `BECOME`/small-clause analysis are discussed; these problems pertain to adverbial modification, gradability and phonological form.

4.3.1 Ambiguity overgeneration

The first problem faced by the BC-SC analysis is the potential for ambiguity overgeneration.[9] One might think *a priori* that if the BC-SC analysis of inchoative verbs were correct, then all adverbial modifiers that are compatible with both stative and dynamic predicates should be able to attach both above and below `(BECOME)`, yielding ambiguous sentences; indeed, this would be strong confirming evidence for the BC-SC proposal. However, there are many adverbs which are compatible with both stative and dynamic predicates that do not give rise to the sorts of ambiguities expected under a BC-SC approach. For example, adverbs of frequency (e.g. *always*, *often*, *seldom*, *never*), do not yield ambiguous sentences of the kind expected, even though they are compatible with both stative and dynamic predicates. That these adverbs are compatible with both types of predicates is evidenced by the following examples.

(62) a. Godzilla is always/often/seldom/never dry.
b. Godzilla always/often/seldom/never runs.

Now consider the sentences where these adverbs modify the inchoative verb *dry*.

(63) Godzilla always/often/seldom/never dried.

The predicted readings for these sentences can be paraphrased with sentences containing the verb *become*. Even though the meaning of `(BECOME)` might differ in some ways from that of `(become)`, it can be safely assumed that they both entail the basic meaning given in (40); that is, both can be assumed to require an input proposition to change from false to true over the course of an interval. The predicted readings for the sentences in (63) that do exist are those which have the following paraphrases, with the adverb preceding *become*.

(64) Godizilla always/often/seldom/never became dry.

The predicted readings for the sentences in (63) that do not exist are those which have the adverb following *become*.

(65) Godizilla became always/often/seldom/never dry.

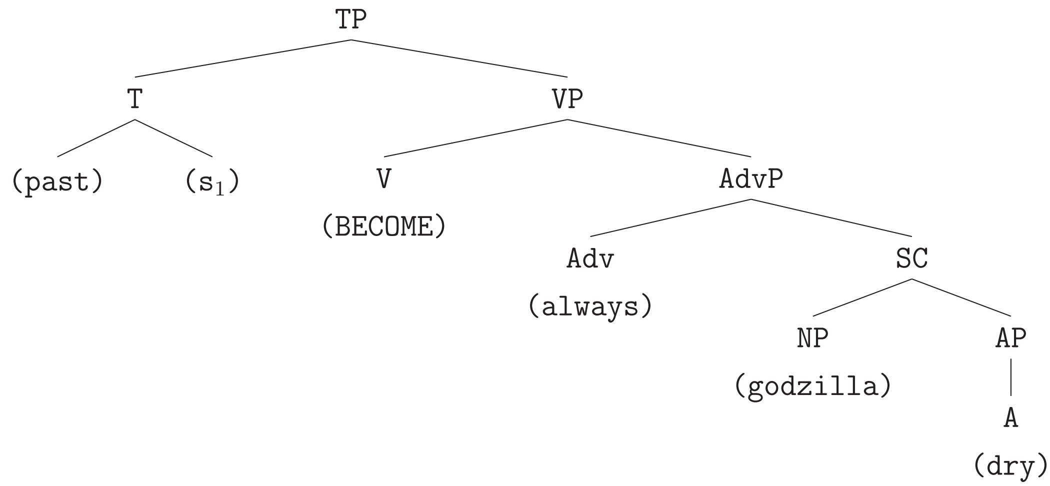
For example, *Godzilla always dried* cannot be used in the following context, whereas *Godzilla became always dry* can.

(66) Godzilla hated being wet. He asked Merlin the wizard for help. Merlin cast a spell on Godzilla that created a force field which prevented water from ever coming into contact with his skin. Thanks to Merlin, ...
a. ... Godzilla became always dry.
b. #... Godzilla always dried.

[9] The general argument that syntactic decomposition leads to an overgeneration of ambiguities has its roots in Fodor (1970), who used it to argue against analyzing *kill* as `[ CAUSE [ to die ] ]`. Fodor and Lepore (2000) extend the argument to the decompositions of denominal verbs proposed by Hale and Keyser (1993).

The non-existent readings for the sentences in (63) are those where the adverb scopes below `(BECOME)` in the decomposition, and modifies the stative adjectival predicate; thus, (67), which would yield a reading compatible with the context in (66), is not a possible LF.

(67)



The question is whether there is any principled way in a BC-SC analysis for ruling out LFs like (67) for sentences containing these adverbs. One possibility might be to assume that these adverbs require functional structure (perhaps tense) that is not present in a decompositional small-clause but is present in the small-clause complement to `(become)`. This possibility will not be considered here; as will be seen, there are numerous other problems with the BC-SC analysis which are more insurmountable.

4.3.2 Cross-linguistic and cross-speaker variation

The BC-SC approach to inchoative verbs in its strongest form posits a decompositional structure which makes very strong predictions. Since analogues to inchoative verbs are found across languages, one would expect similar decompositions to be present in the analyses of verbs of other languages as well, with similar predictions regarding adverbial ambiguities. For example, it is expected that adverbs in other languages with meanings similar to *again* should generally give rise to a repetitive-reversal ambiguity like the one found in English. However, there seems to be substantial cross-linguistic variation in this regard; a cross-linguistic survey undertaken by Beck (2005) finds that certain cross-linguistic analogues of *again* do not permit reversal readings (i.e. they only permit readings which can be analyzed as having the adverb scope outside of the decomposition). Even more surprisingly, Beck et al. (2009) observe that in English, *again* does not permit reversal readings for all speakers, a trend which has apparently been increasing over time.[10] In addition, near synonyms in a single language – like German *wieder* 'again' and *erneut* 'anew' – may differ in their ability to license reversal readings.

These cross-linguistic and cross-speaker facts, along with the observation that something must be done to prevent adverbs like those in (63) from attaching below `(BECOME)`, led Rapp and von Stechow (1999) and Beck (2005) to propose that adverbs must be individually marked for whether or not they can attach within a decomposition structure, via the appropriate setting of what they call a 'Visibility Parameter' in an adverb's lexical entry. The default setting of the parameter is one where the adverb cannot 'see' material inside the decomposition; in the case of English *again*, the Visibility Parameter would be set so that the adverb can see inside decomposition structures. In other languages and dialects, analogues to *again* may instead have the negative setting, allowing for cross-linguistic and cross-speaker variation of the appropriate kind.

The facts concerning adverbial-ambiguities, however, are not as idiosyncratic as a Visibility Parameter would predict. If a lexical parameter of this sort were truly at work, we should expect to find wider variation in the types of adverbs that give rise to ambiguities, and we should expect to find idiosyncrasy within conceptual classes of adverbs; for example, we should expect to find – contrary to fact – that some adverbs of frequency in English (and not others) give rise to ambiguities. Instead, it appears that there are only a small number of adverbs that yield readings consistent with a decomposition-internal position; while full cross-linguistic data is lacking, Beck (2005, §2.1.3) points out that so far the only recognized 'decomposition adverbs' are those with meanings similar to *again* and *almost* (one could add temporal *for*-PPs to this list, at least as far as English is concerned). These considerations do not bode well for a BC-SC analysis of inchoative verbs; the account makes generally available decompositional structures which have sufficient structure for the internal attachment of adverbs, and then requires an ad-hoc lexical parameter limiting the availability of this attachment site in order to reign in the overgeneration of ambiguities. A more parsimonious account might forgo general syntactic decomposition, and instead investigate the lexical properties of verbs and adverbs that are responsible for the generation of ambiguities.

4.3.3 Incorrect readings

A perhaps even greater problem for the BC-SC analysis of inchoative verbs is that it does not generally produce the correct results even for those adverbs which are claimed to have a decomposition-internal attachment site; while the analysis does not fair too poorly with

[10]Thus, the sentences with claimed to be ambiguous may not seem so for all readers.

temporarily and *again*, it makes the wrong predictions for *almost*, temporal *for*-PPs and adverbs like *halfway*.[11] Consider the following three sentences.

(68) a. Godzilla almost dried.
b. The table dried for ten minutes.
c. The door opened halfway.

For the sentences in (68), decomposition-internal attachment sites for the adverbs in question would yield LFs with truth-conditions that are (for present purposes) equivalent to those of the following sentences with *become*.

(69) a. Godzilla became almost dry.
b. The table became dry for ten minutes.
c. The door became open halfway.

The problem is that the sentences in (69) are too weak to be paraphrases of possible readings of the sentences in (68). Consider first the sentence in (68a); the following context allows (69a) as a continuation, but not (68a).

(70) Godzilla was completely dry. Mothra dropped a single drop of water on his head. As a result of this, ...
a. ... Godzilla became (only) almost dry.
b. ... #Godzilla (only) almost dried.

Similarly, whereas (69b) is a possible (though marked) continuation for the following context, (68b) is impossible.

(71) I built a brand new wooden picnic table from dry pieces of wood. I finished building it at 4:00. I was curious to see how long it would remain dry. At 4:09 the table had been dry for nine minutes. When the hand on the clock went around another time,
a. ... The table became dry for ten minutes.
b. #... The table dried for ten minutes.

Finally, (69c) is a possible continuation for the following context, but (68c) is not.

[11] See Morgan (1969); McCawley (1973b); Rapp and von Stechow (1999) for the claim that *almost* has an attachment site below `(become)`; see Morgan (1969); von Stechow (1995) for similar claims about *for*-PPs.

(72) The door was completely open. Someone bumped it, causing it to start closing, and as a result ...

a. ... the door became open (only) halfway.
b. #... the door opened (only) halfway.

The problem in all three cases has to do with the meaning of the adverb affecting not only the result-state component of the truth-conditions, but the pre-state component as well; this is unavoidable given the fact that (as per the meaning of BECOME) the pre-state is just the negation of the result-state. That is, the truth-conditions generated for the relevant readings of the sentences in (68) will be something like the following.

(73) $\exists i : i \prec i^u \ \& \ \exists j, \exists k : \textsc{ibi}_{j,i} \ \& \ \textsc{fbi}_{k,i} \ \&$
$[\![\textsc{almost}(\textsc{dry})(\textsc{g})]\!](j) = \text{F} \ \& \ [\![\textsc{almost}(\textsc{dry})(\textsc{g})]\!](k) = \text{T}$

(74) $\exists i : i \prec i^u \ \& \ \exists j, \exists k : \textsc{ibi}_{j,i} \ \& \ \textsc{fbi}_{k,i} \ \&$
$[\![\textsc{for.ten.min}(\textsc{dry}(\textsc{t}))]\!](j) = \text{F} \ \& \ [\![\textsc{for.ten.min}(\textsc{dry}(\textsc{t}))]\!](k) = \text{T}$

(75) $\exists i : i \prec i^u \ \& \ \exists j, \exists k : \textsc{ibi}_{j,i} \ \& \ \textsc{fbi}_{k,i} \ \&$
$[\![\textsc{halfway}(\textsc{open})(\textsc{d})]\!](j) = \text{F} \ \& \ [\![\textsc{halfway}(\textsc{open})(\textsc{d})]\!](k) = \text{T}$

The pre-state components of these truth-conditions are too weak for truth-conditions of the relevant readings; it is for this reason that the sentences in (68) are incorrectly predicted to be compatible with the above contexts. The relevant readings for the sentences in (68) are more accurately paraphrased as follows.

(76) a. Godzilla became almost dry, and was not completely dry before that.
b. The table was not dry, then became dry for ten minutes.
c. The door was not open, and then became open halfway.

Note that these paraphrases, unlike those in (69), are not possible continuations for the above three contexts. Accepting the sentences in (76) as accurate paraphrases for the relevant readings of the sentences in (68), the truth-conditions for these readings should look more like follows.

(77) $\exists i : i \prec i^u \ \& \ \exists j, \exists k : \textsc{ibi}_{j,i} \ \& \ \textsc{fbi}_{k,i} \ \&$
$[\![\textsc{dry}(\textsc{g})]\!](j) = \text{F} \ \& \ [\![\textsc{almost}(\textsc{dry})(\textsc{g})]\!](j) = \text{F} \ \& \ [\![\textsc{almost}(\textsc{dry})(\textsc{g})]\!](k) = \text{T}$

(78) $\exists i : i \prec i^u \ \& \ \exists j, \exists k : \textsc{ibi}_{j,i} \ \& \ \textsc{fbi}_{k,i} \ \&$
$[\![\textsc{dry}(\textsc{t})]\!](j) = \text{F} \ \& \ [\![\textsc{for.ten.min}(\textsc{dry}(\textsc{t}))]\!](j) = \text{F} \ \&$
$[\![\textsc{for.ten.min}(\textsc{dry}(\textsc{t}))]\!](k) = \text{T}$

(79) $\exists i : i \prec i^u \;\&\; \exists j, \exists k : \textsc{ibi}_{j,i} \;\&\; \textsc{fbi}_{k,i} \;\&$
$[\![\textsc{open}(\textsc{d})]\!] = \text{F} \;\&\; [\![\textsc{halfway}(\textsc{open})(\textsc{d})]\!](j) = \text{F} \;\&\; [\![\textsc{halfway}(\textsc{open})(\textsc{d})]\!](k) = \text{T}$

However, these truth-conditions cannot be straightforwardly obtained in a compositional fashion using a BC-SC decomposition. This is because the adverb and small-clause as a unit constitute the complement to `(become)` in the LF; the meaning of the small-clause without the adverb, needed for the pre-state component of the truth-conditions, is no longer accessible to the meaning of `(become)`. Thus, even for adverbials which intuitively seem able to target result-states, the BC-SC analysis comes up short.[12]

4.3.4 The gradable nature of change

Another problem for a BC-SC approach to inchoative verbs is that it cannot easily account for adverbials, like differential measure-phrases, which quantify the amount of change that an object has undergone, as well as directional measure-phrases, which describe where on a scale an object started and finished its transition. Such adverbials indicate that the transitions encoded by inchoative verbs are gradable, and this sort of gradability is not easily expressed in the BC-SC approach.

Examples of differential measure-phrases are shown in (80), and examples of directional measure-phrases are shown in (81).

(80) a. The river widened (by) ten metres
b. The shirt dried a little bit.
c. The temperature fell substantially.

(81) a. The river widened from twenty to thirty metres.
b. The branch grew from ten to sixteen inches.
c. The temperature fell from twenty degrees (down) to five degrees.

There is no direct way to incorporate such modifiers in the standard BC-SC decompositional analysis. This is because the notion of change in such an analysis is introduced by the `BECOME` operator; `BECOME` denotes a propositional operator, which is true of a proposition (i.e. a function from intervals to truth-values) and an interval only if the proposition transitioned from true to false over the course of the interval.

[12] It should be noted the problem of generating incorrect truth-conditions for LFs with decomposition-internal *for*-PPs was previously noticed by von Stechow (1995, p.108). Von Stechow suggests that the correct way to handle *for*-PPs might be to treat them as appositives that "deliver "subordinate" information and are neglected for the "ordinary" composition" (his quotes). While this option might be pursued for *for*-PPs, it does not seem plausible for *almost* or *halfway*.

The only forseeable way to incorporate differential measure-phrases into a BC-SC approach is to analyze sentences like (80) as containing comparative decompositions; e.g. (80a) would be analyzed analogously to *The river became ten metres wider than before.* A comparative-decomposition solution is not completely implausible for (80a), given that *widen* typically has a result-state characterized with *wider*; it is less motivated for a sentence like (80b), given that the result-state of *dry* is typically characterized with the bare-form of the adjective *dry*. Comparative decompositions also pose issues for PF which are discussed in the following section.

Directional measure-phrases pose more of a problem, as they indicate that pre-state and result-state measurements of an object must be independently isolatable; this apparently cannot be accomplished in the standard BC-SC approach, where the pre-state and target-state of a predicate are represented in terms of the truth and falsity of a single stative proposition in the scope of `BECOME`. Note that a comparative decomposition will not help with directional measure-phrases, since such measure-phrases are in general not compatible with comparatives.

(82) Godzilla is taller than King Kong [*from twenty metres] [*to thirty metres].

Directional measure-phrases thus provide some of the strongest evidence for moving beyond a `BECOME`/small-clause analysis and pursuing a scalar approach to inchoative verbs, where such phrases can be handled in a comparatively straightforward manner (see Chapter 6, §6.3.2.5).

4.3.5 PF issues

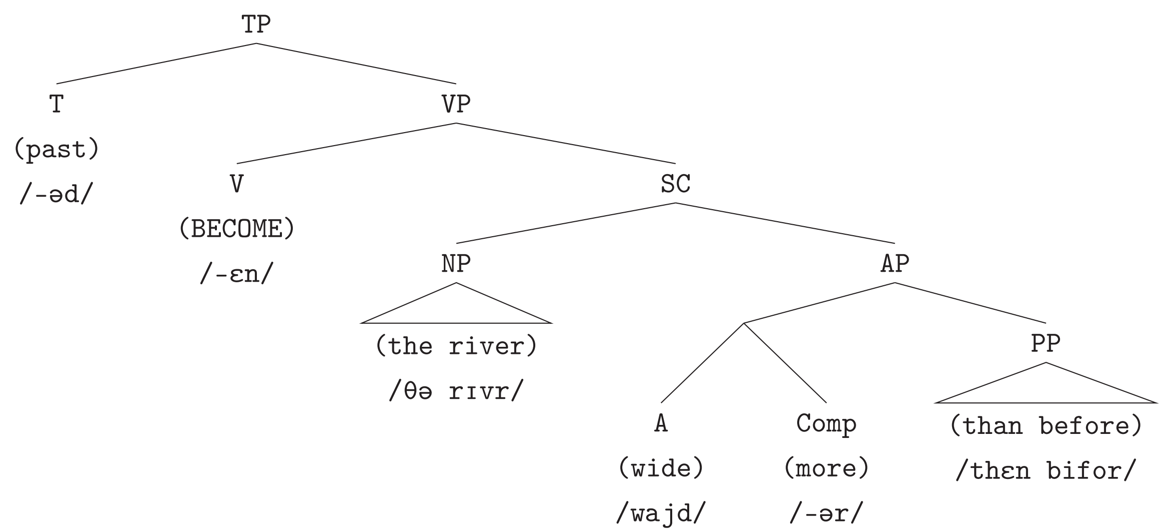
It was remarked in §4.1 that not all have inchoative verbs have result-states that are best paraphrased with bare forms of the corresponding simple adjective; many (e.g. *widen*) have result-states that are better paraphrased using a comparative form of the adjective.

(83) The river has widened.

a. $\not\Rightarrow$ The river is wide.
b. $\Rightarrow$ The river is wider than before.

The difference in result-state inferences between a verb like *widen* and e.g. *dry* or *open* has been taken as indication that they have different decompositions; it has been proposed that the former has a decomposition containing a comparative, whereas the latter have decompositions containing a bare adjectival form (von Stechow 1996; Beck 2005).[13] If one follows this line of reasoning, then *The river widened* might have a pre-Spellout structure like the following.

(84)



While SpellingOut this structure might derive a more accurate LF for the sentence than a structure with a bare adjective, it clearly presents new issues for the PF side of the derivation. The standard operations of head-movement and subject-raising will no longer suffice to generate a PF with the correct phonological output. One might assume that the comparative morpheme, as an affix, is head-raised along with adjectival head, and that its phonology is neutralized by the `/-ɛn/` suffix (c.f. Bobaljik 2012); however, this would still leave behind the *than*-phrase, which cannot be overtly realized (**The river widened than before*).[14] One option would be to assume that the *than*-phrase in this case is phonologically-null. This is not a completely ad-hoc solution, as comparative adjectives can appear unaccompanied by *than*-phrases, as in (85).

(85) The river is wider.

[13] von Stechow (1996) and Beck (2005) provide metalanguage translations for sentences with verbs like *widen* that resemble those of comparative sentences, but they do not actually provide an object-language decomposition.

[14] While a comparative *more* and a *than*-phrase can appear overtly with *widen*, they alter the meaning; for example, (i) is not paraphrasable with (ia), but with (ib).

(i) The river widened more than before.

a. $\not\Leftrightarrow$ The river widened.

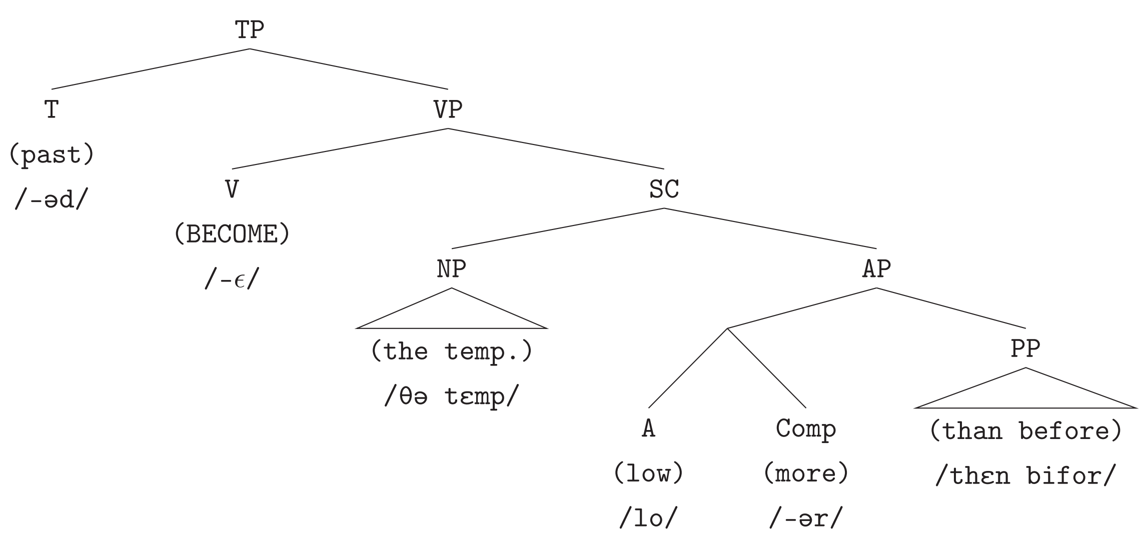
b. $\Leftrightarrow$ The river widened more than it widened before/last time.

While (85) is felicitous when uttered by someone observing that a recently-observed river has increased in width, it is not limited to such situations; it can also be used when comparing the width of the river to another contextually-salient object (c.f. *The creek is wide, but the river is wider*). This latter use is not possible for the verb *widen* (*The creek is wide, but the river widens*), indicating that the silent *than*-phrase in the decomposition of the verb must contain a silent element with a meaning like (BEFORE), which is interpreted relative to the time(s) picked out by the tense. An independently-motivated PF story for 'comparative' inchoative verbs like *widen* thus might be possible, though it will not be as simple as that for verbs whose decompositions are assumed to contain bare adjectives. In any case, multiple decompositions are not the only way to approach the different result-states of *dry* and *wide* in a BC-SC analysis; an alternative approach is discussed in §4.3.7.

More problematic for the PF-side of the BC-SC analysis are cases of verbs that do not have morphologically-related simple adjectives at all. So far, the inchoative verbs considered with respect to the BC-SC analysis have all been ones that have morphologically-related simple adjectives (e.g. *dry/dry*, *open/open*, *widen/wide*); however, many inchoative verbs do not have corresponding simple adjectives (e.g. *rise*, *fall*, *grow*, *shrink*, etc.). Von Stechow (1996, §9) suggests that a sentence containing a verb like *fall*, which is a 'comparative' inchoative verb, still has a BC-SC decomposition; the decomposition he hints at for a sentence would look like (87)

(86) The temperature fell.

(87)



The problem with this decomposition, at least for the PF side, is that the phonological feature of the adjective in the small clause (/lo/) is not part of the phonological form of the verb (`/fal/`); thus head-movement will not aid in achieving the correct phonological form. One might assume that the adjective in the small-clause instead has the phonological feature `/fal/` and the semantic feature `(low)`, but then one would also have to assume that this adjective is limited to appearing internally to a decomposition. It is not clear how such a requirement is to be represented in the grammar, since the small-clause in the decomposition is assumed to be no different than a small-clause in e.g. an overtly resultative VP.

A similar problem is posed by verbs whose corresponding simple verbs are, at least on the surface, deverbal adjectives. For example, the simple adjective associated with the verb *close* is *closed*, which morphologically looks like a deverbal adjective; however, the verb *close* behaves like an inchoative verb in giving rise to both pre-state and result-state inferences, participating in adverbial-ambiguities, etc., and thus would be syntactically decomposed in a BC-SC analysis. From the PF-side of things, it would not make sense for the adjective in the decomposition small-clause to have the phonological feature `/closed/`, as this phonology is not always part of the verb (e.g. when the verb is in the present tense). Thus, it seems one must suppose there to be a more abstract adjective with the meaning `(closed)` and the phonology `/close/`, which only appears in the decomposition structure. The adjective *closed* (which behaves like a simple adjective – see footnote 3) would then be formed by deverbalizing the verb $[_{\texttt{V}}$ `close-BECOME ]`, which in turn contains the abstract adjective $[_{\texttt{adj}}$ `close ]`. From a PF/morphology point-of-view, a more appealing story might be one where the abstract decomposition adjective is not needed, and one can move more easily morphologically from verb to adjective and vice-versa.[15]

A final PF-related issue relating to the BC-SC analysis that might be pointed out concerns adverbs that (at PF) appear pre-verbally, and which at the same time are for semantic reasons taken to attach internal to a decomposition; the main examples are *temporarily* and *almost*.

(88) a. Godzilla temporarily dried.
b. Mothra almost died.

If the correct PF for sentences with inchoative verbs is obtained through head-movement and subject-raising, then a pre-verbal position for an adjective which is attached internal to the decomposition is not expected; this is because the adjective in the small clause (which, in the case of the verb *dry*, contributes the phonology) raises out of the small-clause, and thus above any decomposition-internal adverbs. Hence, `(temporarily)` in the representation of

[15]The Distributed Morphology framework, which features 'categoriless roots', might allow for a different approach to this problem that does not require positing an abstract adjective; however, it would first have to be decided how categoriless roots are to be embedded in a BC-SC analysis. This will not be pursued here, but it should be noted that a more refined morphological analysis may diminish the strength of the above argument.

(88a) should not be able to have a decomposition-internal attachment site, and the sentence should thus not be paraphrasable as *Godzilla dried and remained that way temporarily*; this is, however, an accurate paraphrase for a salient reading of the sentence.

4.3.6 Multiple decompositions and a missed generalization

So far, a distinction has been drawn between inchoative verbs like *dry* and *open*, whose result-states are characterizable with a bare adjective, and verbs like *widen* and *rise* whose result-states are better characterized with the comparative form of an adjective. Under the BC-SC analysis, the distinction between the two types of verbs must be determined by the material in the decompositional small-clause; in one possible analysis, it is determined by whether the small-clause contains a bare adjective or a comparative one. Note that, in this analysis, the lexical semantics of the adjective do not play any role in determining whether the resulting inchoative verb has a comparative result-state or a bare adjective result-state; it is determined entirely by the kind of decomposition structure the adjective is contained in.

There is a strong argument to be made that a multiple-decomposition analysis of this kind misses an important generalization, namely that the result-state of a deadjectival verb is predictable from the lexical semantics of the corresponding gradable adjective (Hay et al. 1999; Winter 2006; Kennedy and Levin 2008). Gradable adjectives are often recognized to fall into two general descriptive classes: RELATIVE ADJECTIVES, whose positive forms require reference to a contextually-provided standard or comparison-class, and ABSOLUTE ADJECTIVES, whose positive forms are generally not context-sensitive in the same way (e.g. Unger 1978; Yoon 1996; Rotstein and Winter 2004; Kennedy and McNally 2005; Kennedy 2007; Burnett 2012). Into the former category fall adjectives like *wide*, *tall*, *expensive*, *strong* and many others; what counts as wide, tall or expensive can vary widely from context-to-context. Absolute adjectives, on the other hand, do not display the same level of context-sensitivity; the requirements for satisfying their positive forms does not vary (or varies to a much less degree) from context-to-context.[16]

These lexical distinctions amongst adjectives carry over to the verbal domain (e.g. Hay et al. 1999; Winter 2006; Kennedy and Levin 2008). In particular, the lexical class of an adjective (relative or absolute) can be used to predict whether or not an inchoative verb based on that adjective will have a bare adjective result-state or a comparative result-state. For example, *dry*, *blur*, *open* and *empty* are all verbs based on absolute adjectives, and all have result-states characterizable with a bare adjective.

[16]The distinction between the two types of adjectives is discussed further in §6.1.2.

(89)
a. The shirt has dried. ⇒ The shirt is dry.
b. The image has blurred. ⇒ The image is blurry.
c. The door has opened. ⇒ The door is open.
d. The sink has emptied. ⇒ The sink is empty.

On the other hand, *widen*, *narrow*, *shorten*, and *expand* are all morphologically-related to relative adjectives (*wide*, *narrow*, *short*, *expansive*), and do not have result-states characterized with bare adjectives, but with comparative forms.

(90)
a. The river has widened. ⇏ The river is wide.
⇒ The river is wider than before.
b. The path has narrowed. ?⇒ The path is narrow.
⇒ The path is narrower than before.
c. The gap has shortened. ⇏ The gap is short.
⇒ The gap is shorter than before.
d. The universe has expanded. ⇏ The universe is expansive.
⇒ The universe is more expansive than before.

Such examples provide evidence for the following generalization: inchoative verbs that are derived from absolute adjectives have bare-form result-states, whereas inchoative verbs that are derived from relative adjectives have only weaker comparative result-states. This correlation between the lexical meaning of an adjective and the meaning of the corresponding inchoative verb is not predicted in a decompositional analysis that captures differences in verb meaning via differences in decompositional structure. Capturing the generalization just described would require some way of ensuring that relative adjectives appear only in comparative decompositions, and that absolute adjectives appear only in bare-form decompositions. It is not apparent how this could be accomplished in a non-stipulative way.

4.3.7 A delineation approach to BECOME

A multiple-decomposition analysis is not the only possible response to the problem posed by bare-form vs. comparative result-states; another possibility is to invoke a 'delineation' analysis of adjectives like that proposed by Kamp (1976) and Klein (1980), in which adjectives are treated as denoting context-dependent functions. The idea is that the property $[\![\textsc{wide}]\!]$ holds of different objects in different contexts, with restrictions on how its extension can vary across contexts. One restriction is that if e.g. $[\![\textsc{wide}]\!]$ holds of x but not of y in context c, then there can be no context c' where $[\![\textsc{wide}]\!]$ holds of y but not x (see Klein 1980, 1982 for further discussion). A comparative like (91a) in a delineation approach receives truth-conditions like (91b).

(91) a. Godzilla is wider than King Kong.
b. $\exists c' : [\![\textsc{wide}(\textsc{g})]\!](i)(c') = \text{T} \;\&\; [\![\textsc{wide}(\textsc{k})]\!](i)(c') = \text{F}$

Unlike a relative adjective such as *wide*, an absolute adjective like *dry* can be assumed to denote a function whose extension does not vary across contexts (van Rooij 2011); under this assumption, if $[\![\textsc{dry}(\textsc{roof})]\!]$ is true (false) of an interval in one context, then it is true (false) of that interval in all contexts.[17]

It was proposed by Dowty (1979, p.90) that an analysis of BECOME might take advantage of the fact that certain adjectives have extensions that vary across contexts, as a way to account for verbs with (only) comparative result-states (see also Abusch 1986).[18] Dowty suggests that BECOME might have a denotation like the following; note that a proposition $\mathcal{P}$ is to now be considered to be a function that takes an interval and a context and returns a truth-value.

(92) $[\![\textsc{become}]\!](\mathcal{P})(i)(c) = \text{T iff } \exists c' \exists j, k : \textsc{ibi}_{j,i} \;\&\; \textsc{fbi}_{k,i} \;\&\; \mathcal{P}(j)(c') = \text{F} \;\&\; P(k)(c') = \text{T}$

This meaning requires there to be some context relative to which, at the beginning of the topic interval, the input proposition is false, and at the end of the topic interval, the proposition is true. If one assumes that e.g. $[\![\textsc{wide}(\textsc{river})]\!](i)$ varies across contexts, whereas e.g. $[\![\textsc{dry}(\textsc{roof})]\!](i)$ does not so vary, then a distinction between verbs with bare-form result-states and those with only comparative result-states can be attained, without positing two different decompositions. Note that, under these assumptions, (93) will entail both (93a) and (93b), whereas (94) will entail (94a) but not (94b). Note that (93b) is assumed to be the truth-conditions of *The roof is dry*, and (94b) is assumed to be the truth-conditions of *The river is wide.*

(93) $[\![\textsc{become}(\textsc{dry}(\textsc{r}))]\!](i)(c)$
a. $\models \exists c' \exists i' : [\![\textsc{dry}(\textsc{r})]\!](i')(c') = \text{T} \;\&\; [\![\textsc{dry}(\textsc{r})]\!](i')(c') = \text{F}$
b. $\models \exists i' : [\![\textsc{dry}(\textsc{r})]\!](i')(c)$

(94) $[\![\textsc{become}(\textsc{wide}(\textsc{r}))]\!](i)(c)$
a. $\models \exists c' \exists i' : [\![\textsc{wide}(\textsc{r})]\!](i')(c') = \text{T} \;\&\; [\![\textsc{wide}(\textsc{r})]\!](i')(c') = \text{F}$
b. $\not\models \exists i' : [\![\textsc{wide}(\textsc{r})]\!](i')(c)$

[17]See Burnett (2014) for further discussion and criticism.

Assuming that the verbs *dry* and *widen* are given BC-SC analyses that respectively yield (93) and (94) as truth-conditions, an inference will be predicted from *The roof has dried* to both *The roof is drier than before* and to *The roof is dry*; however, while an inference will be predicted from *The river has widened* to *The river is wider than before*, an inference will not be predicted from *The river has widened* to *The river is wide*.

The correct results for result-state inferences can thus be obtained with a 'delineation' approach to the meaning of BECOME. This approach does not suffer the drawbacks of a multiple decomposition approach to result-state inferences. Since the delineation approach does not require comparative decompositions, there should be no more problem with generating the correct PF for a sentence like *The river widened* than there is for *The roof dried*. Furthermore, the analysis does capture the link between adjective class and verb class; only absolute adjectives, whose extensions do not vary across contexts, give rise to bare-form result-state inferences. The delineation analysis of BECOME does not, however, help with the problems pertaining to adverbial modification that were discussed in §4.3.1–§4.3.3, as it still involves decomposition into multiple propositional levels. Nor does it help with the problems discussed in §4.3.4 pertaining to the gradable nature of verbal change, as it still makes use of a BECOME operator. Thus, while the delineation approach to the BC-SC analysis offers an improvement over a multiple decomposition approach, it is still faced with seemingly insurmountable problems.[19]

4.3.8 Closing remarks about the BECOME/small-clause analysis

While the BC-SC analysis of inchoative verbs seems initially to be a promising way of capturing pre- and result- state inferences, as well as the behaviour of adverbs that target result-states, on a closer look it was seen to face seemingly insurmountable difficulties. First of all, in the absence of further stipulations or assumptions, the BC-SC overgenerates adverbial-attachment ambiguities. Second, it has the unwanted consequence that adverbs which do seem to target result-states (like *for*-PPs and *halfway*) enter into both the pre- and

[18] Abusch (1986) proposes that BECOME can either quantify over contexts as in (92), or that it can simply use the context-of-utterance, as in (ii).

(ii) $[\![\text{BECOME}]\!](\mathcal{P})(i)(c) = \text{T}$ iff $\exists j,k : \text{IBI}_{j,i}$ & $\text{FBI}_{k,i}$ & $\mathcal{P}(j)(c) = \text{F}$ & $P(k)(c) = \text{T}$

Abusch proposes this optionality in order to explain the 'variable telicity' that many inchoative verbs are said to exhibit. Variable telicity, generalizations about which are still poorly understood, is discussed briefly in §6.2.3; see Dowty (1979, §2.3.5), Winter (2006), Kearns (2007) and Kennedy and Levin (2008) for further discussion on the phenomenon.

[19] The general idea of a delineation-based approach to inchoative verb meaning is, however, definitely worth pursuing (though this will not be attempted here). The idea would be to develop a more refined delineation analysis which does not involve a BECOME-operator; such an analysis could form a competitor to the scale-based analysis developed in Chapter 6.

result- state components of truth-conditions. Third, it has no apparent way of accounting for the gradable nature of the transitions that inchoative verbs encode. The analysis also faces certain PF issues (which are perhaps not as insurmountable as the other issues). Finally, the multiple-decomposition version of the analysis misses an important generalization between the lexical meaning of an adjective and the meaning of the corresponding inchoative verb. A more satisfactory analysis of inchoative verbs would be one which posits a closer link between adjective and verb meaning, and which does not involve positing general syntactic structure whose predicted effects must then be reigned in with additional stipulations and assumptions. There is, however, one point in favour of the BC-SC analysis of inchoative verbs that is not shared by all analyses: it does seem to capture the asymmetry between pre- and result- states in terms of deictic salience.

4.4 Dowty's (1979) Metalinguistic Expansion (ME) analysis

As discussed in Chapter 2, Dowty (1979) proposes an alternative to the syntactic decomposition of predicates which aims to capture the same range of data; rather than syntactically decomposing an inchoative verb, an undecomposed verb receives a logical translation in the logical language that contains expressions like CAUSE and BECOME. For example, the terminal node `[V (dry) ]` might receive a translation like the following ('p' is used as an abbreviation for the type $\langle i, t\rangle$).

(95) $[\![\texttt{[}_{\texttt{V}}\ \texttt{(dry)]}]\!] = \lambda x.\text{BECOME}(\text{DRY}(x))$ (expression of type $\langle e, p\rangle$)

By forgoing syntactic decomposition, the ME analysis avoids the issues that surround derivationally pairing a decomposed LF with the correct PF.

Dowty argues that one of the most compelling reasons for syntactically decomposing verbs is the existence of adverbial ambiguities like those found with *again* and *for*-PPs; since verbs are not syntactically decomposed in his account, syntactic scope cannot be relied on to explain such ambiguities. Dowty proposes two alternative ways of getting an adverb to have semantic scope below BECOME in the translation language; both involve lexical ambiguity. In the first proposal, inchoative verbs like *dry* are systematically ambiguous between a meaning like that in (95) and one in (96).[20]

(96) $[\![\texttt{[}_{\texttt{V}}\ \texttt{(dry}_2\texttt{)]}]\!] = \lambda x.\lambda f.\text{BECOME}(f(\text{DRY}(x)))$
(expression of type $\langle e, \langle\langle\langle e, p\rangle, \langle e, p\rangle\rangle, p\rangle\rangle$)

[20]Dowty's proposals, presented originally in Montague's PTQ, are adapted to the current formalism.

In this second meaning, the verb denotes a function that first takes an entity as an argument, then an adverb. In this proposal, the sentence *Godzilla dried again* would be associated with two LFs like the following.

(97) $[_{TP}$ $[_{T}$ `(past)` $]$ $[_{VP}$ $[_{Adv}$ `(again)` $[_{V'}$ $[_{V}$ `(dry)` $]$ $[_{N}$ `(godzilla)` $]$ $]$ $]$ $]$ $]$

(98) $[_{TP}$ $[_{T}$ `(past)` $]$ $[_{VP}$ $[_{Adv}$ `(again)` $[_{V'}$ $[_{V}$ $\texttt{(dry}_2\texttt{)}$ $]$ $[_{N}$ `(godzilla)` $]$ $]$ $]$ $]$ $]$

Ignoring tense, the VPs of these two LFs would be translated as follows.

(99) $[\![\text{VP of (97)}]\!] = \textsc{again}(\textsc{become}(\textsc{dry}(\textsc{g})))$

(100) $[\![\text{VP of (98)}]\!] = \textsc{become}(\textsc{again}(\textsc{dry}(\textsc{g})))$

While this solution does yield the desired ambiguity for sentences where *again* modifies an inchoative verb, it would seem to suffer from the same overgeneration problem as the BC-SC analysis; that is, since it makes available a general mechanism for having an adverb semantically scope below BECOME, some additional syntactic mechanism would be needed to prevent adverbs like *always*, *never*, *often* and so forth from appearing in VPs with a V like $\texttt{(dry}_2\texttt{)}$. Furthermore, given that the analysis (like the BC-SC analysis) relies on the meaning of BECOME, it will yield the incorrect truth-conditions for sentences containing $\texttt{(dry}_2\texttt{)}$ and modifiers like *for ten minutes* and *almost*, i.e. sentences whose translations have FOR.TEN.MINUTES and ALMOST scoping below BECOME.

The second proposal Dowty offers for getting an adverb to have semantic scope below BECOME is to treat the adverb as ambiguous. Thus, in addition to `(again)`, the language will contain $\texttt{(again}_2\texttt{)}$ which is translated as a different expression in the logical language.

(101) $[\![\texttt{(again}_2\texttt{)}]\!] = \textsc{again}_2$ (expression of type $\langle\langle e,p\rangle,\langle e,p\rangle\rangle$)

Dowty then proposes a complex meaning postulate like the following for linking the meanings of `(again)` and $\texttt{(again}_2\texttt{)}$; Dowty suggests that similar meaning postulates can be used to explain the 'result-state' readings found with other adverbial modifiers, like *almost*, *for*-PPs and *temporarily*.

(102) $\forall f, \forall x[\textsc{again}_2(\textsc{become}(f(x))) \leftrightarrow \textsc{become}(\textsc{again}(f(x)))]$

von Stechow (1995, p.85–87, 111–112) takes issue with this sort of meaning postulate, arguing that it is in an intuitive sense non-compositional, and seems to rely on the translation language as doing more than providing a homomorphic mapping from the object-language to semantic values. In von Stechow's (1995, p.111) words:

> How do we have to interpret the postulate [(102)]? There is a trivial interpretation, namely that the left side is simply a metalinguistic abbreviation for the right side. Such an interpretation would hardly be in the spirit of Montague's general methodology which says that the intensional logic can always be eliminated because there is a homomorphic mapping from the syntactic language into semantics via the intensional language. From this it follows that AGAIN_2 should be a propositional functor which it is not under the trivial interpretation. So the intended interpretation of the postulate is presumably that it should restrict the class of admissible models. But then one would have to show that there is a unique function from propositions into propositions that can serve as a value for AGAIN_2.

Von Stechow then demonstrates that to show there exists such a function would not be a trivial matter. The problem is that, judging from (102), the meaning for AGAIN_2 would in some sense have to 'undo' the effect of BECOME in order to apply to the stative proposition in the scope of BECOME. It is in this sense that von Stechow considers the required meaning for AGAIN_2 to be non-compositional. Even supposing that a postulate like (102) can be made coherent, the analysis will still not derive the correct results for cases where FOR.TEN.MINUTES and ALMOST scope below BECOME.

Putting aside issues with adverbial modification, Dowty's ME analysis of inchoative verbs, like the BC-SC analysis, sheds no light on the relationship between adjective (in particular, the relative-absolute distinction) and verb meaning. One could assume that the verbalizing suffix (phonetically realized either as `[-en]` or as `[-`ϵ`]`) has a meaning like the following.

(103) $[\![\, \texttt{[}_{\texttt{V}}\ \texttt{(-v)]} \,]\!] = \lambda f.\lambda x.\text{BECOME}(f(x))$

The verb *dry* could then be analysed at LF as `[`$_{\texttt{V}}$ `[`$_{\texttt{A}}$ `(dry) ][`$_{\texttt{V}}$ `(-v) ] ]`, which would also be given the translation $\lambda x.\text{BECOME}(\text{DRY}(x))$. While this will yield the correct translation for a verb that is morphologically derived from an absolute adjective, it will yield the incorrect results for an inchoative verb (like *widen*) that is morphologically derived from a relative adjective; for example, if *widen* is analyzed as `[`$_{\texttt{V}}$ `[`$_{\texttt{A}}$ `(wide) ][`$_{\texttt{V}}$ `(-v) ] ]`, then its translation would be $\lambda x.\text{BECOME}(\text{WIDE}(x))$ rather than something like $\lambda x.\text{BECOME}(\text{MORE}(\text{WIDE})(x))$. One might assume a second verbalizing suffix with the following translation (ignoring the details of the comparative):

(104) $[\![\, \texttt{[}_{\texttt{V}}\ \texttt{(-v}_2\texttt{)]} \,]\!] = \lambda f.\lambda x.\text{BECOME}(\text{MORE}(f)(x))$

However, one would then need to stipulate that absolute adjectives appear with `(-v)`, and that relative adjectives appear with `(-v`$_2$`)`; as in the BC-SC analysis, the relevant property of an inchoative verb (whether it has comparative or bare-adjective result-state) cannot be derived directly from the lexical meaning of the corresponding adjective, and an important generalization is thus missed.

Overall, Dowty's (1979) ME analysis of inchoative verbs cannot be said to fare any better than the syntactic BC-SC analysis, and may in fact (if one agrees with von Stechow's misgivings) make the adverbial modification of result-states less straightforward than in an analysis that involves syntactic decomposition.

4.5 Summary

In this chapter, two of the most prominent approaches to the syntax and semantics of inchoative verbs and result-state modification were considered: the `BECOME`/small-clause approach, which dates to the time of the Generative Semanticists, and Dowty's (1979) related Metalinguistic Expansion approach. It was seen that both approaches fall short of the goal in many respects.

In Chapter 6, a more recent approach to the semantics of inchoative verbs will be considered. This approach starts from the assumption that adjectives like *dry* and *widen* are semantically associated with SCALES, and that certain properties of an adjective's scale determine certain properties of an inchoative verb derived from that adjective; scalar analyses of this sort are thus designed to capture the link between the lexical meaning of an adjective and the meaning of the corresponding inchoative verb.

Chapter 5

Foundations of gradability

In this chapter, a formal foundation for an analysis of natural language gradability is provided, using the notion of an INFINITE DIFFERENCE SYSTEM (IDS) as it is defined in the measurement-theoretic work of Suppes and Zinnes (1963). It is shown how the axioms for an IDS describe structures similar to those assumed in 'extent'-based approaches to gradability (Seuren 1984; von Stechow 1984a; Kennedy 2001). An extent-based approach to gradability has been argued to be preferable to a degree-based approach in the analysis of certain phenomena (such as 'cross-polar anomaly', c.f. Kennedy 2001). This chapter demonstrates that the distinction between extents and degrees can be seen as more apparent than real; measurements defined using IDSs can be viewed alternatively as extents or as degrees, with the benefits of both. As empirical support for using IDSs in an analysis of gradability, it is shown how a range of gradability phenomena can be captured quite naturally using such structures; these phenomena include differential modifiers, antonymy, and the distinction between relative and absolute adjectives.

Before proceeding, it will be useful to say a few general words about measurement theory and its possible applications to natural language semantics. In the words of Suppes and Zinnes (1963, p.3), the purpose of measurement theory "is to build a consistent conceptual framework within which it is possible to discuss many (hopefully most) of the theoretical questions of measurement". In measurement theory, one typically takes an established measurement system that is used in the natural or social sciences and investigates its mathematical properties, e.g. by axiomatically defining (non-numerical) structures that are isomorphic to the system. The situation is reversed in the study of the semantics of gradability, since a measurement system is not antecedently given; rather, one is trying to discover through empirical means (e.g. judgments about sentences) what kind of algebraic structure(s) is/are implicit in the meanings of words and phrases of natural language that relate to gradability phenomena. However, since many measurement systems used in the natural and social sciences were developed by language-speaking humans in order to explain 'gradable' features of the natural world, it should not be surprising if the algebraic structures underlying such measurement systems bear some resemblance to those that are implicit in the meanings of words and phrases.[1] In this chapter, it is argued that the algebraic structures which are implied by gradability phenomena in natural language can be characterized using the axioms of an IDS, i.e. axioms which have been identified by Suppes and Zinnes (1963) as underlying 'interval' measurement systems like the Celsius or Fahrenheit temperature scales.

The material in this chapter is quite technical, but it is self-contained and is not presupposed in later chapters; in subsequent chapters, a more traditional presentation of scales and degrees is adopted. It should be understood, however, that underlying this more traditional presentation is a formal structure like the one presented in this chapter.

5.1 Gradability

Following Bierwisch (1989, p.71), GRADABILITY can be understood as the potential for "quantitative evaluations regarding dimensions or features". With respect to linguistic meaning, gradability is most evident in the adjectival domain: for example, adjectives can be modified with expressions like *very* and *slightly*, which indicate that the adjectival property in question can be seen as holding of an object in varying degrees; many adjectives even allow for a specific quantity or degree of an adjectival property to be predicated of an object, via modification with measure phrases like *two metres*, or *fifty percent*.

(1) a. The door is slightly open.
    b. The sink is very full.

(2) a. The water is two metres deep.
    b. The shirt is fifty percent dry.

Questions like (3) indicate that one can inquire about the amount to which an adjectival property is held by an object:

(3) Just how dry is the roof?

Finally, the following sentences demonstrate that objects can be compared and ordered with respect to their exhibited amount of an adjectival property.

[1] For a different, non-algebraic approach to applying notions from measurement theory to the study of gradable adjectives, see Sassoon (2010); Sasson's proposal is discussed in an appendix to this chapter.

(4) a. The river is wider than the lake.
b. The roof is as dry as the sidewalk.
c. The lake is less deep than the river.

While comparative constructions provide evidence of adjectival gradability, they themselves also show signs of gradability. This is perhaps not unexpected; if two objects can vary in the degree to which they exhibit some adjectival property, then the difference between two degrees of the property must also be able to vary. Comparative constructions can be used to specify, qualify or inquire into the magnitude of this difference:

(5) a. The river is two metres wider than the lake.
b. The roof is slightly drier than the sidewalk.
c. How much deeper is the river than the lake?

Signs of gradability such as those just described are not limited to the adjectival domain. Many verbs also permit modification with degree and measure phrases; when they modify verbs, such phrases qualify or specify how much an object has increased in terms of a gradable property.

(6) a. The roof has dried slightly.
b. The lake deepened by two metres.

As with adjectives, interrogative constructions can be used to inquire as to the amount of increase, and comparative constructions can be used compare two objects in terms of how much increase they have undergone.

(7) a. How much did the door open?
b. The river widened more than the lake.

5.1.1 Preorders

Accounts of the semantics of gradability typically begin with the uncontroversial assumption that language speakers possess the cognitive capacity to compare and order a collection of objects relative to some chosen dimension (e.g. width, length, beauty, etc.); allowing for the possibility that a pair of objects might be judged by the speaker to be indiscernable as far as the given dimension is concerned, the kinds of orderings that result from this capacity have the properties of a total preorder (or quasi-order), i.e. of a transitive, reflexive, connected relation. An example of a total preorder is the 'at least as tall as' relation depicted in Fig. 5.1, whose domain contains six entities (transitive arrows are ommitted in this diagram).

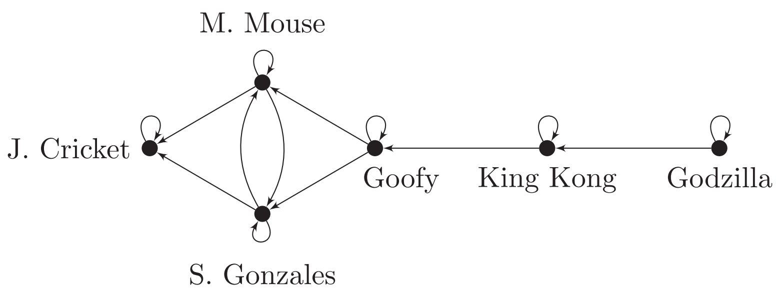


Figure 5.1: The 'at least as tall as' relation

Like any binary relation, a total preorder formally consists of a domain and a relation on that domain. The domain and graph of the total preorder depicted in Fig. 5.1 is given in (8).

(8) a. $D_\tau = \{j, m, s, o, k, g\}$

b. $\succcurlyeq_\tau = \{\langle j, j\rangle, \langle m, m\rangle, \langle s, s\rangle, \langle o, o\rangle, \langle k, k\rangle, \langle g, g\rangle,$
$\langle m, j\rangle, \langle s, j\rangle, \langle o, j\rangle, \langle k, j\rangle, \langle g, j\rangle, \langle s, m\rangle, \langle o, m\rangle\langle k, m\rangle, \langle g, m\rangle,$
$\langle m, s\rangle, \langle o, s\rangle, \langle k, s\rangle, \langle g, s\rangle, \langle k, o\rangle, \langle g, o\rangle, \langle g, k\rangle\}$

The strict order and equivalence relation contained in $\succcurlyeq_\tau$ can be referred to using the symbols $\succ_\tau$ and $\sim_\tau$ respectively.

(9) $x \sim_\tau y \;\leftrightarrow\; x \succcurlyeq_\tau y \;\&\; y \succcurlyeq_\tau x$

(10) $x \succ_\tau y \;\leftrightarrow\; x \succcurlyeq_\tau y \;\&\; \neg y \succcurlyeq_\tau x$

Total preorders are a natural starting point for an analysis of semantic gradability. In fact, substantial ground can be gained with the assumption that an adjective like *tall* semantically specifies a simple preorder like τ. For example, the truth-conditions of simple comparatives and equatives like those below can be stated in terms of simple preorders, at least to a first approximation.

(11) a. Godzilla is at least as tall as King Kong.
b. $g \succcurlyeq_\tau k$

(12) a. Godzilla is taller than Mickey Mouse.
b. $g \succ_\tau m$

(13) a. Mickey Mouse is exactly as tall as Speedy Gonzales.
b. $s \sim_\tau m$

More complex notions pertaining to gradability can also be captured with preorders. For example, the statement in (14b) arguably represents the truth-conditions of a superlative like (14a).

(14) a. Godzilla is the tallest.
b. $\neg\exists x[x \in D_\tau : x \succcurlyeq\!\!\!\!/_\tau\, g]$

Also, the truth-conditions of (15a) can arguably be represented by (15b).

(15) a. King Kong is uniquely tall.
b. $\{x \in D_\tau : x \sim_\tau k\} = \{k\}$

Note, however, that (15) does seem to express something more than just the proposition that King Kong does not have the same height as any other entity (though it does entail this proposition).

The truth-conditions of other sentences with gradable adjectives, like the following three, can arguably be represented in terms of cardinality of sets:

(16) a. King Kong is taller than most.
b. $|\{x : x \in D_\tau \;\&\; k \succ_\tau x\}| > \frac{1}{2}|D_\tau|$

(17) a. Mickey is the middle in terms of tallness/height.
b. $|\{x : x \in D_\tau \;\&\; m \succ_\tau x\}| = |\{x : x \in D_\tau \;\&\; x \succ_\tau m\}|$

(18) a. King Kong is four characters taller than Jiminy Cricket.
b. $|\{x : x \in D_\tau \;\&\; k \succ_\tau x \succ_\tau j\}| = 3$

The statement in (17b) is true iff Mickey is the median in terms of height. Note that the intended meaning of (18a) is not one which claims that the difference in height between King Kong and Jiminy is equal to the height of some particular character multiplied four times; this meaning is not representable with a total preorder. Instead, the intended meaning of (18a) is one which expresses that, were all the characters to be lined up in terms of increasing height, three characters would lie between Jiminy and King Kong in the lineup (c.f. *King Kong is four characters ahead of Jiminy Cricket in terms of height*). In the case of the preorder τ shown in Fig. 5.1, this interpretation of (18a) is true, as Mickey, Speedy and Goofy appear between Jiminy and King Kong.

5.1.2 The move to abstract scales and degrees

As discussed by Suppes and Zinnes (1963) and many others, preorders are a kind of ORDINAL measuring system; they can be used to represent the relative ordering of objects in terms of their bearing of some gradable property (1^{st}, 2^{nd}, 3^{rd}, etc., with ties), but they do not have enough structure on their own to represent the magnitude of the difference between objects. This can be seen by analogy: if one learns that the ordinal ranking of a, b, c in a race is 1^{st}, 2^{nd}, 3^{rd} respectively, then one learns that a was faster than b, but one does not learn anything about how much faster a was than b.

Evidence that a semantic account of natural language gradability requires a means for measuring how much entities differ in a gradable dimension comes from sentences like those in (19):

(19) a. King Kong is six metres taller than Mickey Mouse.
b. King Kong is four times taller than Mickey Mouse.
c. King Kong is much taller than Mickey Mouse.
d. Godzilla is slightly taller than King Kong.
e. King Kong is almost as tall as Godzilla.

Sentences like the above cannot be captured on an account of gradability that only makes use of a preorder ordering of entities; instead, one needs an algebraic structure that is able to represent how much two entities differ in terms of a gradable property. For this, the notions of *scales* and *degrees* become useful; an entity can be assigned a degree on a scale that is semantically associated with an adjective, and an algebraic structure of the required sort can be assumed to underly this scale. In the next section, one particular algebraic structure that can provide a foundation for a scalar semantics is presented.[2]

5.2 Infinite difference systems

As Suppes and Zinnes (1963) show, an INFINITE DIFFERENCE SYSTEM (IDS) is the type of axiomatically-defined structure that is implicit in an 'interval scale', such as the Celsius or Farenheit temperature scales.[3] In the context of semantic gradability, an IDS can be thought of as a type of abstract 'measuring tape'; an entity's measurement in terms of a gradable property can be represented by its extent on this measuring tape, i.e. by a pair of points on the tape. Formally, an IDS is a relational system $\langle P, \trianglelefteq \rangle$, where P is an infinite set of elements and $\trianglelefteq$ is a binary relation on $P \times P$ (or equivalently a quaternary relation on P)

[2]For other possible structures that yield similar results, see Bierwisch (1989, §5) and Winter (2005).

that satisfies the axioms to be given shortly. The statement $xy \trianglelefteq wz$ can be thought of as expressing that "the algebraic difference between x and y is less than or equal to that between w and z". Note, importantly, that an IDS does not include a difference operation on elements of P; it only includes an ordering that orders pairs of elements in M. To get a better grasp of what is intended by this algebraic relation, it might be helpful to consider the following numerical relation on $\mathbb{R} \times \mathbb{R}$ ($\mathbb{R}$ is the set of real numbers):

(20) $xy\Delta zw \leftrightarrow y - x \leq w - z$

One can easily determine that the following statements are true (the number line in Fig. 5.2 is provided for reference).

Figure 5.2

(21) a. $(0,3)\Delta(0,3)$
b. $(0,3)\Delta(0,4)$ & $\neg(0,4)\Delta(0,3)$
c. $(2,2)\Delta(1,3)$ & $(3,1)\Delta(2,2)$
d. $(1,-3)\Delta(-1,-2)$ & $\neg(-1,-2)\Delta(1,-3)$
e. $(1,4)\Delta(-2,1)$ & $(-2,1)\Delta(1,4)$
f. $\forall n, m : (n,n)\Delta(m,m)$

Note also that the following equivalence holds regarding the strict ordering on $\mathbb{R}$ and the Δ relation:

(22) $n < m \leftrightarrow \neg nm\Delta nn$

The Δ relation is an ordering on ordered pairs of numbers whose definition is given in terms of the subtraction operation on $\mathbb{R}$. However, Δ can also be viewed as a stand-alone relation on $\mathbb{R}\times\mathbb{R}$ that meets certain algebraic axioms; that is, one can explore the algebraic properties of the system $\langle\mathbb{R}, \Delta\rangle$, which itself does not contain a subtraction operation. Such a system has the algebraic properties of an IDS. The symbol '$\trianglelefteq$' (rather than Δ, which has a specific

[3]Note that, according to measurement theory, an interval scale is formally weaker than the ratio measuring systems often used in science to assign an object a number representing the ratio of its measurement to some unit measurement. That the Celsius and Fahrenheit scales do not have a unit measurement can be seen from the fact that 0°C is not the same temperature as 0°F (while 0 metres is the same distance as 0 feet).

meaning) will be used as a general symbol for the algebraic relation in an IDS; generally speaking, the domain of an IDS need not be a set of numbers.

The following non-numerical example demonstrates how the IDS structure might serve as the basis for an analysis of semantic gradability. Imagine that one has a non-numeric measuring tape, and suppose that *a–j* in Fig. 5.3 represent equally spaced points on the tape; suppose in addition that the measuring tape is infinitely dense, i.e. that it contains an infinite number of points between each point depicted in Fig. 5.3. One can arbitrarily pick a direction as the direction that leads 'up' the tape – in Fig. 5.3, one goes up the tape by moving to the right.

Figure 5.3

This measuring-tape situation can be viewed as an IDS. Suppose that the points on the tape constitute the set P in an IDS $\langle P, \trianglelefteq \rangle$. The statement $xy \trianglelefteq wz$ can then be thought of as expressing that "moving from x to y involves moving equally far up the tape, less far up the tape, or further down the tape than moving from w to z". The ordering of points on the tape is then given by the following equivalence:[4]

(23) $x \prec y \;\leftrightarrow\; \neg xy \trianglelefteq xx$

Note that in the measuring tape analogy, moving from a point x to the same point x can be considered the same as not moving at all. Thus, (23) can be rendered in words as "y is farther up the tape than x if and only if moving from x to y involves neither moving down the tape nor not moving at all." If one takes $\trianglelefteq$ to have this meaning, then the following statements about the points in Fig. 5.3 will be true.

(24)
a. $eh \trianglelefteq eh$
b. $eh \trianglelefteq ei \;\&\; \neg ei \trianglelefteq eh$
c. $\neg fh \trianglelefteq ff \;\&\; \neg hh \trianglelefteq hf$
d. $fb \trianglelefteq dc \;\&\; \neg dc \trianglelefteq fb$
e. $fi \trianglelefteq cf \;\&\; cf \trianglelefteq fi$
f. $\forall x \forall y [xx \trianglelefteq yy]$

[4] The symbol used here is that of a strict ordering; as Suppes and Zinnes (1963, 34) point out, one needs the axioms of the IDS (given below) to prove that this ordering relation is transitive and asymmetric.

In order to make algebraic statements easier to parse, the following definitions will be adopted:

(25) a. $wx \lhd yz \;\leftrightarrow\; wx \unlhd yz \;\&\; \neg yz \unlhd wx$
b. $wx \equiv yz \;\leftrightarrow\; wx \unlhd yz \;\&\; yz \unlhd wx$

Using the definitions in (23) and (25), the statements in (24) can be expressed equivalently as follows:

(26) a. $eh \equiv eh$
b. $eh \lhd ei$
c. $f \prec h$
d. $fb \lhd dc$
e. $fi \equiv cf$
f. $\forall x \forall y[xx \equiv yy]$

Before providing the axioms for an IDS, one more additional relation needs to be defined. The following recursively-defined relation allows for differences that are n-times the size of a particular difference to be indicated. The base case implies that the difference between wx is the same as the difference between yz, and that $x = y$; higher powers are defined recursively.

(27) i. $wx \oplus^1 yz \;\leftrightarrow\; wx \equiv yz \;\&\; x = y$
ii. $wx \oplus^{n+1} yz \;\leftrightarrow\; \exists u \exists v[wx \oplus^n uv \;\&\; uv \oplus^1 yz]$

Considering again a–j in Fig. 5.3 as equally spaced points on a measuring tape, the following statements will be true (see also Suppes and Zinnes 1963, p. 35).

(28) a. $ab \oplus^1 bc$
b. $ab \oplus^2 cd$
c. $ab \oplus^3 de$
d. $ab \oplus^4 ef$

Note that the above statements imply that the distance ac is twice the distance of ab, the distance ad is three times that of ab, ae is four times ab, af is five times ab, and so forth.

The set of axioms for an IDS are now shown below; these axioms are essentially identical to those provided by Suppes and Zinnes (1963, p.35).[5]

[5] The only difference is that (29e) has been added as an axiom. Instead of an exiom of equality, Suppes and Zinnes define an equivalence relation ($aIb \;\leftrightarrow\; ab \unlhd ba \;\&\; ba \unlhd ab$) over elements of P, allowing for distinct elements of P to be treated equivalently by $\unlhd$.

(29) A relation $\langle P, \trianglelefteq \rangle$ is an IDS iff $\forall a, b, c, d, e, f \in P$:

a. $[ab \trianglelefteq cd \;\&\; cd \trianglelefteq ef] \rightarrow ab \trianglelefteq ef$ [transitivity]
b. $ab \trianglelefteq cd \vee cd \trianglelefteq ab$ [totality]
c. $ab \trianglelefteq cd \rightarrow ac \trianglelefteq bd$
d. $ab \trianglelefteq cd \rightarrow dc \trianglelefteq ba$
e. $ab \trianglelefteq ba \;\&\; ba \trianglelefteq ab \;\leftrightarrow\; a = b$
f. $\exists x[ax \trianglelefteq xb \;\&\; xb \trianglelefteq ax]$ [midpoint]
g. $[a \prec b \;\&\; cd \triangleleft ab] \rightarrow \exists x[a \prec x \;\&\; x \prec b \;\&\; cd \trianglelefteq ax]$ [continuity]
h. $[a \prec b \;\&\; ab \trianglelefteq cd] \rightarrow \exists x \exists y \exists n[cx \oplus^n yd \;\&\; cx \trianglelefteq ab]$ [Archimedean]

Taken together, the first two axioms imply that $\trianglelefteq$ is a total preorder over pairs of elements from P; this means that any two pairs of elements will be ordered with respect to each other by $\trianglelefteq$.[6] The axiom in (29f) implies that between any two elements a, c of P there is a third element b in P which is a midpoint; this implies that the set P is infinite (assuming the IDS is non-trivial). The axiom in (29h) is the Archimedean axiom; this axiom is a formulation of the Archimedean principle, which Suppes and Zinnes (1963, p.36) describe as follows:

> Let L_1 be a distance no matter how large, and let L_2 be a distance no matter how small. Then [the Archimedean principle ensures that] there is a positive integer n such that an n^{th} part of L_1 is smaller than L_2. On the other hand, [it also ensures that] there is a positive integer m such that if we lay off L_2 m times on a line, the resulting distance will be greater than L_1.

A full grasp of the axioms in (29) will not be necessary for what follows; however, a couple points that will be relevant to semantic gradability might be noted. In the following, a MEASURE FUNCTION will be taken to be a function that maps an object to its abstract measurement on a scale; a measurement will be taken to be an ordered pair of elements from the domain of an IDS. The axioms in (29) ensure, first of all, that any two measurements will be comparable. Second, the axioms ensure that if we can use $\trianglelefteq$ to order two measurements *ab* and *ac* relative to each other and to other measurements, then we can also use $\trianglelefteq$ to order the pair of points *bc* relative to other measurements; this will be seen below to be the key to analyzing differential modifiers in terms of an IDS.

[6] Note that the preorders discussed in §5.1.1 were determined to be insufficient for handling sentences with 'differential' modifiers. However, the preorders considered there were orderings of individuals (like Mickey Mouse and Godzilla), not their abstract measurements. The claim in §5.1.1 was that a preorder (a transitive, total relation) on its own is insufficient for handling the complete range of gradability; the additional axioms of an IDS will allow for a wider range of phenomena (including differential modifiers) to be captured.

5.2.1 IDSs and gradability

As discussed above, directly ordering objects like people, buildings, trees, etc. in the way described in §5.1.1 provides a structure (a total preorder) that is sufficient for representing the meanings of basic comparative sentences, but not one that is sufficient for handling the full range of gradability phenomena found in natural language; being ordinal measuring systems, total preorders alone are insufficient for representing the degree to which objects differ relative to some gradable property (e.g. height). Adopting an IDS (or something functionally equivalent – c.f. Bierwisch 1989, §5 and Winter 2005) as the foundation for an analysis of gradability provides the structure necessary for representing and comparing measurements and differences between measurements. However, making use of a structure like an IDS necessarily involves more abstraction than making use of a simple ordering of objects; in particular, an additional function is required that maps an object to an abstract measurement.

Various components of the meanings of gradable adjectives have been identified in previous work. First of all, gradable adjectives must specify the dimension with respect to which objects are assigned measurements (see e.g. von Stechow 1984a; Bierwisch 1989; Kennedy 1999); examples of dimensions include height, width, length, volume, dryness, as well as less tangible dimensions like cleverness and prettiness. In addition, gradable adjectives are often taken to specify both a scale and a measure function as part of their meaning (e.g. Bartsch and Vennemann 1973; Cresswell 1976; von Stechow 1984a; Klein 1991; Kennedy 1999; Bale 2011). In the present analysis, the DIMENSION of a gradable adjective will be identified with an IDS; the IDSs of different gradable adjectives will be notationally differentiated with a subscript. Where $\langle P_\alpha, \trianglelefteq_\alpha \rangle$ is the dimension of an adjective A, a pair of points in $P_\alpha \times P_\alpha$ will be referred to as a MEASUREMENT of dimension $\langle P_\alpha, \trianglelefteq_\alpha \rangle$. The SCALE of a gradable adjective with dimension $\langle P_\alpha, \trianglelefteq_\alpha \rangle$ will be taken to be a set of measurements meeting certain conditions (i.e. a proper subset of the set of all measurements of dimension $\langle P_\alpha, \trianglelefteq_\alpha \rangle$).[7] A MEASURE FUNCTION will be taken to be a function from individuals into a scale. A gradable adjective will thus be assumed to semantically specify at least the following components:

[7] C.f. Bierwisch (1989, §5.2) for this conception of a scale.

(30) A gradable adjective A specifies a tuple $\langle\langle P_\alpha, \trianglelefteq_\alpha\rangle, S_\alpha, f_\alpha\rangle$, such that:

i. $\langle P_\alpha, \trianglelefteq_\alpha\rangle$ is an IDS ($\langle P_\alpha, \trianglelefteq_\alpha\rangle$ is the DIMENSION of A)

ii. $S_\alpha \subset P_\alpha \times P_\alpha$ (S_α is the SCALE of A)

iii. $\exists x[S_\alpha \subseteq \{xy : xx \trianglelefteq_\alpha xy\} \vee$ (x is the ORIGIN of S_α)
$S_\alpha \subseteq \{xy : xy \trianglelefteq_\alpha xx\}]$

iv. f_α is a function from objects to S_α (f is the MEASURE FUNCTION of A)

Regarding (iii), Bierwisch (1989, p. 112) identifies two properties that the scales of gradable adjectives must have in order for comparison of measurements to be possible: all measurements on a scale must overlap, and all measurements on a scale must have a common starting point; together, these two properties imply that all measurements on a scale run in the same direction. The degree that serves as the common starting point for measurements on a scale will be called the ORIGIN of the scale; any arbitrary degree in P_α can serve as the origin. The two properties identified by Bierwisch can be captured in the present formalism by assuming that all scales meet the condition in (iii). This condition ensures that the non-zero measurements on a scale are either all POSITIVE or all NEGATIVE measurements; measurement polarity is defined as follows.

(31) a. ab is a POSITIVE MEASUREMENT according to $\trianglelefteq_\alpha$ iff $aa \triangleleft_\alpha ab$

b. ab is a NEGATIVE MEASUREMENT according to $\trianglelefteq_\alpha$ iff $ab \triangleleft_\alpha aa$

Measurement polarity will be seen in §5.2.3 to play a defining role in an analysis of antonymy.

An example should serve to clarify what is intended by the above notions. The adjective *tall* can be assumed to have a semantic specification like the following.

(32) The adjective *tall* specifies a tuple $\langle\langle P_\tau, \trianglelefteq_\tau\rangle, S_\tau, f_\tau\rangle$

In order to reduce the number of parentheses in formal statements, $f_\tau(x)$ will be written $f_\tau x$. Fig. 5.4 depicts a possible example of the measure function f_τ, which maps Godzilla, King Kong, Goofy, Mickey Mouse, Speedy Gonzales and Jiminy Cricket into the scale S_τ. In this diagram, the origin of S_τ is depicted as p_0; the other points shown in the figure are depicted with subscripts relative to the origin for convenience. (It should be kept in mind that $\langle P_\tau, \trianglelefteq_\tau\rangle$ is an *Infinite* Difference System, and that there are thus an infinite number of points (not shown in the diagram) located between each pair of depicted points.) One should also assume the points depicted in Fig. 5.4 to be equally spaced, i.e. that $p_0p_1 \equiv_\tau p_1p_2$, $p_1p_2 \equiv_\tau p_2p_3$ and so forth. Regarding the depicted measurements, the dot at the stem of an arrow indicates the initial point of a measurement (in each case, the origin), and the dot at the tip of an arrow indicates the final point; thus, for example, Fig. 5.4 depicts that $f_\tau k = p_0 p_8$, that $f_\tau m = p_0 p_4$, and so forth.

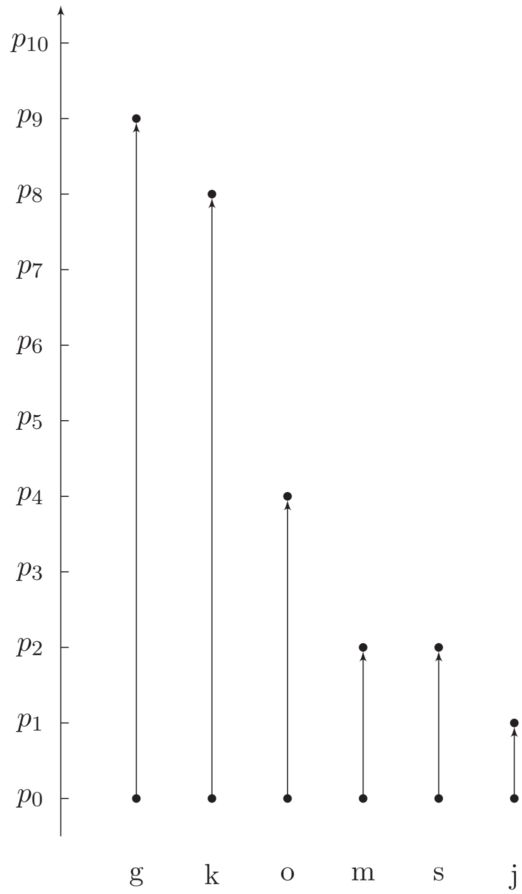


Figure 5.4: The measure function f_τ

The truth-conditions for a basic comparative sentence can be stated quite straightforwardly in the present formalism; a comparative sentence can be taken as asserting that the value which the measure function assigns to the subject of the sentence is ranked higher (by $\trianglelefteq_\alpha$) than the value assigned to the NP in the *than*-clause. An example is shown below.

(33) a. King Kong is taller than Mickey.

b. $f_\tau m \lhd_\tau f_\tau k$

If f_τ is as depicted in Fig. 5.4, then (33) is true; note that $f_\tau k = p_0 p_8$, $f_\tau m = p_0 p_4$, and $p_0 p_4 \lhd_\tau p_0 p_8$.

It was remarked above that it is not possible to capture the truth-conditions of sentences containing 'differential' comparative modifiers (like *much* and *slightly*) using total preorders. An IDS-based formalization of gradability, on the other hand, will be seen to allow for the truth-conditions of such sentences to be stated. To set the stage for the coming discussion on differential modifiers, consider how the truth-conditions of a basic comparative sentence like (33) can be stated in a slightly different way. First of all, note that the following holds in general for an IDS.[8]

(34) $ab \lhd_\alpha cd \rightarrow ac \lhd_\alpha bd$

Now let the function FF ('final-final') be defined as follows; this function will be used to refer to the measurement built from the final points of two other measurements.

(35) $\textsc{ff}(wx)(yz) = xz$

When applied to two measurements in a scale, the FF function can be thought of as picking out a measurement that represents the size of the difference between two measurements on a scale; this difference may be positive, negative, or zero (where 'zero' means 'equivalent to xx, for any x'). Note that the output of the FF function will not in general be a measurement in the scale; this will only be the case if the first input measurement to FF is p_0p_0. The output measurement of FF will, however, be related to other measurements by the adjective's dimensional relation, and can thus be compared to other measurements using this relation.[9] Since (34) holds in an IDS, the truth conditions in (33b) can be re-written as (36).

(36) $p_0p_0 \lhd_\tau \textsc{ff}(f_\tau m)(f_\tau k)$

In prose, these truth conditions assert that the measurement that runs from the top of Mickey's measurement to the top of King Kong's measurement is positive. To see that this is indeed a correct characterization, consider once again Fig. 5.4. In this diagram, $\textsc{ff}(f_\tau m)(f_\tau k) = p_2p_8$, and p_2p_8 is a positive measurement. Note, however, that *Mickey is taller than King Kong* is not true according to Fig. 5.4; $\textsc{ff}(f_\tau k)(f_\tau m) = p_8p_2$, which is a negative measurement.

5.2.2 Differential modifiers

Recall the types of differential modifiers that were argued to be beyond the grasp of a simple preorder approach to gradability; sentences containing such modifiers were provided in (19), repeated below.

(19) a. King Kong is six metres taller than Mickey Mouse.
b. King Kong is four times taller than Mickey Mouse.

[8]Suppose $ab \lhd_\alpha cd$. By definition, $ab \unlhd_\alpha cd$ & $\neg cd \unlhd_\alpha ab$. The axiom (29c) and the first conjunct imply $ac \unlhd_\alpha bd$; (29c) and the second conjunct imply $\neg ca \unlhd_\alpha db$. The latter along with (29d) imply $\neg bd \unlhd_\alpha ac$. Thus, $ac \unlhd_\alpha bd$ & $\neg bd \unlhd_\alpha ac$, which by definition means $ac \lhd_\alpha bd$. □

[9]This is guaranteed by the totality axiom (29b).

c. King Kong is much taller than Mickey Mouse.
d. Godzilla is slightly taller than King Kong.
e. King Kong is almost as tall as Godzilla.

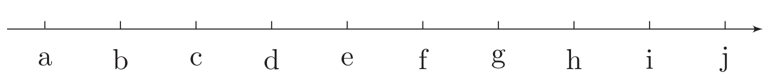
In an IDS-based formalization of gradability, the ability to refer (using FF) to a measurement that represents the difference between two scalar measurements is the key to capturing the semantic effect of these differential modifiers. While the analysis of differential measure phrases provided here is only an outline, it will serve to demonstrate how an IDS structure allows one to capture certain phenomena that cannot be captured using simple preorders.

5.2.2.1 Measure and ratio phrases

Though much has been said about the semantics of measure phrases (see e.g. Cresswell 1976; Klein 1980, 1982; von Stechow 1984b; Seuren 1984; Bierwisch 1989; Faller 1999; Schwarzschild 2005; Winter 2005; Bale 2008; Sassoon 2010), much is still mysterious; only the outline of a possible account in IDS terms will be provided here. In order to describe the semantic effect of measure and ratio phrases, it will be useful to first define a relation that relates a measurement to a measurement n-times its size with the same initial point, for a rational number n; this relation is defined with four cases, using the relation $\oplus^n$ defined above in (27).

(37) a. $ab \otimes^1 cd \leftrightarrow cd = ab$
b. $ab \otimes^n cd \leftrightarrow a = c \;\&\; \exists x[ab \oplus^{n-1} xd]$ (for natural numbers $n : 1 < n$)
c. $ab \otimes^n cd \leftrightarrow a = c \;\&\; \exists x[ad \oplus^{\frac{1}{n}-1} xb]$ (for rational numbers $n : 0 < n < 1$)
d. $ab \otimes^n cd \leftrightarrow a = c \;\&$ (for rational numbers $n : 1 < n$)
$\exists x[ab \otimes^q ax \;\&\; ab \otimes^r xd]$
where $n = 1q + r$, for $r : 0 < r < 1$

To get a better grasp of what is intended by this relation, consider again Fig. 5.3, repeated below.



Assuming as before that all of the points depicted in this figure are equally spaced, the following statements will all be true.

(38)
a. $ab \otimes^1 ab$
b. $ab \otimes^2 ac$
c. $ab \otimes^3 ad$
d. $bd \otimes^2 bf$
e. $bf \otimes^{\frac{1}{2}} bd$
f. $bh \otimes^{\frac{1}{3}} bd$
g. $gf \otimes^2 ge$
h. $hb \otimes^{\frac{1}{3}} hf$
i. $ac \otimes^{2\frac{1}{2}} af$
j. $ac \otimes^{1\frac{1}{2}} ad$

Note that the operation $\otimes^n$ is similar to scalar multiplication in a vector space.

Now consider the sentence in (19a), which contains the measure phrase *six metres*. Let it be assumed that measure words like *metre*, *kilogram*, *litre* and so forth denote functions that pair an adjectival dimension with a positive measurement in that dimension. It can be assumed that such functions are not defined for all adjectival dimensions; thus, for example, the function METRE will be defined for dimensions associated with *tall*, *wide*, *deep*, *long* and so forth, but not the dimensions associated with *heavy*, *clever* or *dry*. For convenience, the measurement specified by e.g. $\textsc{metre}(\langle P_\alpha, \trianglelefteq_\alpha \rangle)$ will be written as $\textsc{metre}_\alpha$. Suppose that the measure phrase *at least three and a half metres* picks out the set of measurements (in the dimension of the modified adjective) that are of length equivalent to or greater than a measurement three-and-a-half times the measurement of a metre (c.f. Schwarzschild 2005). A sentence like (39a) can then be seen as expressing that the difference between Mickey Mouse's and Godzilla's heights is in this set.

(39)
a. Godzilla is (at least) three and a half metres taller than Mickey Mouse.
b. $\textsc{ff}(f_\tau m)(f_\tau g) \in \{xy : \exists wz[\textsc{metre}_\tau \otimes^{3\frac{1}{2}} wz \;\&\; wz \trianglelefteq_\tau xy]\}$

Considering again Fig. 5.4, if $\textsc{metre}_\tau = p_0p_2$, then the above sentence will be true; note that $\textsc{metre}_\tau \otimes^{3\frac{1}{2}} p_0p_7$, that $\textsc{ff}(f_\tau m)(f_\tau g) = p_2p_9$, and that $p_0p_7 \trianglelefteq_\tau p_2p_9$.

A ratio modifier like *four times* in (40a) can also be handled in a similar fashion, by measuring the difference between two measurements; the truth conditions for (40a) express that the difference between King Kong's and Mickey Mouse's measurement is at least three times the measurement of Mickey Mouse.[10]

(40)
a. King Kong is (at least) four times taller than Mickey Mouse.
b. $\textsc{ff}(f_\tau m)(f_\tau k) \in \{xy : \exists wz[f_\tau m \otimes^3 wz \;\&\; wz \trianglelefteq_\tau xy]\}$

Referring again to Fig. 5.4, note that $f_\tau m = p_0p_2$, that $p_0p_2 \otimes^3 p_0p_6$, that $\textsc{ff}(f_\tau m)(f_\tau k) = p_2p_8$ and that $p_0p_6 \trianglelefteq_\tau p_2p_8$.

[10]This will imply that King Kong's measurement is four times that of Mickey Mouse's measurement. Note that (40a) does not express that the difference between King Kong's and Mickey Mouse's measurement is four times the measurement of Mickey Mouse.

5.2.2.2 *Much*, *slightly* and *almost*

The effect of the modifiers *much*, *slightly* and *almost* in (19c-e) can be assumed to be similar to that of a measure phrase like *six metres*, i.e. they can be assumed to pick out a set of measurements in the dimension of a modified adjective. Representing the relevant measurements as $\textsc{much}_\alpha$, $\textsc{slight}_\alpha$ and $\textsc{almost}_\alpha$, one might have the following truth-conditions for the sentences in (19c-e).

(41) a. King Kong is much taller than Mickey Mouse.
b. $\textsc{ff}(f_\tau m)(f_\tau k) \in \textsc{much}_\tau$

(42) a. Godzilla is slightly taller than King Kong.
b. $\textsc{ff}(f_\tau k)(f_\tau g) \in \textsc{slight}_\tau$

(43) a. King Kong is almost as tall as Godzilla.
b. $\textsc{ff}(f_\tau k)(f_\tau g) \in \textsc{almost}_\tau$

Unlike the meanings of measure and ratio phrases, which can be thought of as specifying a precise set of measurements that does not vary from context-to-context, the sets specified by *much*, *slightly* and *almost* are vague and context-sensitive. These additional properties will not be explored here.[11]

5.2.3 Antonymy

Another property of gradable adjectives which has been much-discussed is that they often come in ANTONYMOUS pairs. Many antonymous pairs make the following inference valid (Cruse 1976; Bierwisch 1989; Kennedy 2001).

(44) x is A-er than y. $\Leftrightarrow$ y is B-er than x.

According to this criteria, the adjectives *tall* and *short* are antonyms; other antonymous pairs include *wide/narrow*, *big/small*, *dry/wet*, *blurry/crisp*, *easy/difficult*, *safe/dangerous*, *straight/curved*, *open/closed* and *empty/full*. There are various approaches to explaining the properties of antonymous adjectives, which vary depending on underlying assumptions about the formalization of gradability; these range from explaining antonymy via the inversion of measurement scales (e.g. Rotstein and Winter 2004; Kennedy and McNally 2005), to

[11] See e.g. Bierwisch (1989, §8.1), Rotstein and Winter (2004) and Solt (2012) for more discussion on differential modifiers like those briefly discussed in this section. Also, as Louise McNally (p.c.) points out, *almost* can appear with equatives while *much* and *slightly cannot*; these differences would neet to be explained in a fuller account.

introducing the notion of positive and negative extents (e.g. Seuren 1984; Kennedy 2001). In this section, two possible IDS-based approaches to antonymy are discussed.

5.2.3.1 Dimension-inversion

Since the dimensions of adjectives are in the present formalization treated as IDSs, one might consider antonymous adjectives to have dimensions that are inverse IDS relations. The inverse relation $\trianglelefteq_\alpha^{-1}$ of a relation $\trianglelefteq_\alpha$ is defined as follows.[12]

(45) $wx \trianglelefteq_\alpha^{-1} yz \;\leftrightarrow\; yz \trianglelefteq_\alpha wx$

Antonymy might now be defined as follows; antonymous pairs of adjectives have the same scales and measure functions, but have inverse dimensions.

(46) ANTONYMY (first definition):
Two adjective meanings $\mathcal{A}$ and $\mathcal{B}$ are ANTONYMOUS iff
i. $\mathcal{A} = \langle\langle P_\alpha, \trianglelefteq_\alpha\rangle, S_\alpha, f\rangle$
ii. $\mathcal{B} = \langle\langle P_\alpha, \trianglelefteq_\alpha^{-1}\rangle, S_\alpha, f\rangle$

Note that ${\trianglelefteq_\alpha^{-1}}^{-1} = \trianglelefteq_\alpha$. Note also that inversion reverses polarity; measurements which have positive (negative) polarity in an IDS relation have negative (positive) polarity in the inverse relation.

(47) a. $p_0p_0 \trianglelefteq_\alpha xy \;\leftrightarrow\; xy \trianglelefteq_\alpha^{-1} p_0p_0$
b. $xy \trianglelefteq_\alpha p_0p_0 \;\leftrightarrow\; p_0p_0 \trianglelefteq_\alpha^{-1} xy$

The definition of antonymy in (46) will predict inferences like (44) to hold for antonymous pairs of adjectives; this follows directly from the definition of inversion in (45). As a demonstration, consider the meaning of the adjective *short* (the antonym to *tall*) under this proposal; it would be as follows.

(48) Where *tall* specifies the tuple $\langle\langle P_\tau, \trianglelefteq_\tau\rangle, S_\tau, f_\tau\rangle$,
short specifies the tuple $\langle\langle P_\tau, \trianglelefteq_\tau^{-1}\rangle, S_\tau, f_\tau\rangle$

The function f_τ with respect to the dimension of *short* is depicted in Fig. 5.5; note that, although the function is the same as that in Fig. 5.4, the polarity of the measurements is reversed, i.e. they are all negative measurements.

Now consider the truth-conditions for the following sentence.

[12] In a proper treatment, it would have to be shown that, given an IDS $\langle P_\alpha, \trianglelefteq_\alpha\rangle$, that $\langle P_\alpha, \trianglelefteq_\alpha^{-1}\rangle$ is also an IDS, i.e. that it satisfies the axioms in (29).

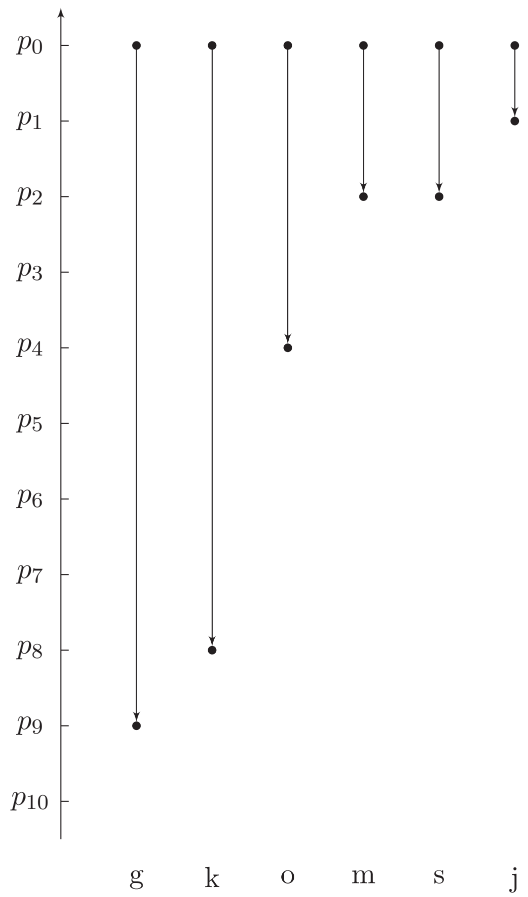


Figure 5.5: f_τ with respect to $\langle P_\tau, \trianglelefteq_\tau^{-1}\rangle$

(49) a. Mickey Mouse is shorter than Godzilla.
b. $p_0p_0 \triangleleft_\tau^{-1} \textsc{ff}(f_\tau g)(f_\tau m)$

This sentence will be true with respect to Fig. 5.5; note that $\textsc{ff}(f_\tau g)(f_\tau m) = p_9p_2$, and that $p_0p_0 \triangleleft_\tau^{-1} p_9p_2$. It can easily be seen by comparing Fig. 5.4 and Fig. 5.5 that inferences like the following are predicted.

(50) Godzilla is taller than Mickey Mouse $\Leftrightarrow$ Mickey Mouse is shorter than Godzilla

The dimension-inversion analysis of antonomy thus captures one of the key properties of antonomy.

Another pattern which has been noticed with regards to antonymous pairs is that if one member of the pair allows measure phrases in the comparative, then so does the other member; however, if one member allows a measure phrase in the bare form, then the other member does not.[13] This pattern is exemplified by the pair *tall/short* (note also that one can infer (51b) from (51a) and vice-versa).

(51) a. King Kong is three metres taller than Mickey Mouse.
b. Mickey Mouse is three metres shorter than King Kong.

(52) a. King Kong is four metres tall.
b. #Mickey Mouse is one metre short.

With regards to the present formalism, recall from §5.2.2.1 that METRE is assumed to be a function from dimensions to a measurement in that dimension. With regard to the dimensions of antonymous pairs *tall* and *short*, there are two possibilities: either $\textsc{metre}(\langle P_\tau, \trianglelefteq_\tau \rangle) = \textsc{metre}(\langle P_\tau, \trianglelefteq_\tau^{-1} \rangle)$ or $\textsc{metre}(\langle P_\tau, \trianglelefteq_\tau \rangle) \neq \textsc{metre}(\langle P_\tau, \trianglelefteq_\tau^{-1} \rangle)$. The first possibility will produce incorrect results. Suppose first that (53a) has the following truth-conditions.

(53) a. Mickey Mouse is one metre tall.
b. $f_\tau m = \textsc{metre}(\langle P_\tau, \trianglelefteq_\tau \rangle)$

Now suppose that $\textsc{metre}(\langle P_\tau, \trianglelefteq_\tau \rangle) = \textsc{metre}(\langle P_\tau, \trianglelefteq_\tau^{-1} \rangle) = p_0 p_2$. There is no semantic reason for ruling out (54a); it should be equivalent to (53a).

(54) a. Mickey Mouse is one metre short.
b. $f_\tau m = \textsc{metre}(\langle P_\tau, \trianglelefteq_\tau^{-1} \rangle)$

More problematic is that, if $\textsc{metre}(\langle P_\tau, \trianglelefteq_\tau \rangle) = \textsc{metre}(\langle P_\tau, \trianglelefteq_\tau^{-1} \rangle)$, then the following inference is incorrectly predicted.

(55) Mickey Mouse is three metres shorter than King Kong $\Leftrightarrow$
Mickey Mouse is three metres taller than King Kong.

To see that this is the case, let $\textsc{metre}(\langle P_\tau, \trianglelefteq_\tau \rangle) = \textsc{metre}(\langle P_\tau, \trianglelefteq_\tau^{-1} \rangle) = p_0 p_2$. Note that $p_0 p_2 \otimes^3 p_0 p_6$. It can be verified by referring to Fig. 5.4 and Fig. 5.5 that the following both hold.

(56) a. $p_0 p_6 \trianglelefteq_\tau \textsc{ff}(f_\tau m)(f_\tau g)$
b. $p_0 p_6 \trianglelefteq_\tau^{-1} \textsc{ff}(f_\tau m)(f_\tau g)$

One would thus have to conclude that, in a dimension-inversion analysis of antonymy, $\textsc{metre}(\langle P_\tau, \trianglelefteq_\tau \rangle) \neq \textsc{metre}(\langle P_\tau, \trianglelefteq_\tau^{-1} \rangle)$. The right results are obtained if one takes

[13] An exception to this pattern is the pair *early/late*, which both allow measure phrase modification of both comparative and bare forms. See Winter (2005) for a discussion of these adjectives.

$\text{METRE}(\langle P_\tau, \trianglelefteq_\tau^{-1}\rangle)$ to be the 'mirror' measurement of $\text{METRE}(\langle P_\tau, \trianglelefteq_\tau\rangle)$; for example, if $\text{METRE}(\langle P_\tau, \trianglelefteq_\tau\rangle) = p_0p_2$, then $\text{METRE}(\langle P_\tau, \trianglelefteq_\tau^{-1}\rangle) = p_2p_0$. This being the case, the inference in (57), rather than the incorrect one in (55), will be predicted.

(57) Mickey Mouse is three metres shorter than King Kong $\Leftrightarrow$
King King is three metres taller than Mickey Mouse.

One also has a possible explanation for the anomaly of (52b); note that p_2p_0 is not in the scale associated with *short* under the dimension-inversion analysis, since it is not in the scale associated with *tall*.

5.2.3.2 Mirror measurements

An alternative account of antonymy would make use of the notion of a 'mirror' measurement, rather than dimension-inversion; this will result in an analysis of antonymy that is essentially the same as that of Winter (2005), who makes use of a full vector space semantics for gradable adjectives.

Two measurements are taken to be mirror measurements iff they have the same origin and size, but opposite polarity (i.e. one is a positive measurement and the other is a negative measurement). First of all, let it be assumed that an antonymous pairs of adjectives have the same IDS dimension, and that this IDS dimension has the following property.[14]

(58) $\forall x \forall y \exists z [xy \equiv_\alpha zx]$

For IDSs in which the above equation holds, there will be a unique z for each x, y such that $xy \equiv_\alpha zx$. This follows from the fact that the axioms in (29) imply $[ba \equiv ca] \rightarrow [b = c]$, so there cannot be distinct w, z such that $xy \equiv_\alpha wx \equiv_\alpha zx$.[15] This means that when the above property holds, a function like the following can be defined.

(59) $\text{MIR}_\alpha(ab) = ax : ab \equiv_\alpha xa$

Note that $ab = \text{MIR}_\alpha(\text{MIR}_\alpha(ab))$. Note also that a measurement will have the opposite polarity of its mirror measurement. The mirror function is extended to scales (i.e. sets of measurements) and measure functions in the following way:

(60) Where S_α is a set of measurements of dimension $\langle P_\alpha, \trianglelefteq_\alpha\rangle$,
$\text{MIR}_\alpha(S_\alpha) = \{xy : \exists z[xz \in S_\alpha \;\&\; xz = \text{MIR}_\alpha(xy)]\}$

[14] That this property is consistent with the axioms in (29) can be seen from the fact that it holds in any IDS isomorphic to $\langle \mathbb{R}, \Delta\rangle$. This can be seen by noting that $\forall x, y \in \mathbb{R} \exists z \in \mathbb{R}[y - x = x - z]$.

[15] Suppose $ba \equiv ca$. Then by definition $ba \trianglelefteq ca$ and $ca \trianglelefteq ba$. By (29c), $bc \trianglelefteq aa$ and $cb \trianglelefteq aa$. By (29d), $aa \trianglelefteq cb$ and $aa \trianglelefteq bc$. By (29a) and the last two steps, $bc \trianglelefteq cb$ and $cb \trianglelefteq bc$. By (29e), $b = c$. □

(61) Where f is a function into measurements of dimension $\langle P_\alpha, \trianglelefteq_\alpha \rangle$,
$\textsc{mir}_\alpha(f) = g : g(x) = \textsc{mir}(f(x))$

Antonymy can now be defined as follows; the idea is that antonymous pairs of adjectives share a single dimension, but have scales and measure functions that are mirrors of each other.

(62) ANTONYMY (second definition):
Two adjective meanings $\mathcal{A}$ and $\mathcal{B}$ are ANTONYMOUS iff

i. $\mathcal{A} = \langle\langle P_\alpha, \trianglelefteq_\alpha \rangle, S_\alpha, f\rangle$
ii. $\mathcal{B} = \langle\langle P_\alpha, \trianglelefteq_\alpha \rangle, \textsc{mir}(S_\alpha), \textsc{mir}(f_\alpha)\rangle$

To take an example, consider the antonymous pair *tall/short* under this analysis.

(63) Where *tall* specifies $\langle\langle P_\tau, \trianglelefteq_\tau \rangle, S_\tau, f_\tau\rangle$, *short* specifies $\langle\langle P_\tau, \trianglelefteq_\tau \rangle, \textsc{mir}(S_\tau), \textsc{mir}(f_\tau)\rangle$

A depiction of the measure function $\textsc{mir}(f_\tau)$ which corresponds to the depiction of f_τ in Fig. 5.4 is given in Fig. 5.6; in this depiction, mirror measurements are indicated with negative numbers for convenience, e.g. $\textsc{mir}(p_0p_2)$ is depicted as p_0p_{-2}.

In the mirror-measurement analysis of antonymy, inferences like (44) are predicted, just as they are in the dimension-inversion analysis; note that the following equivalence holds.

(64) $p_0p_0 \lhd_\alpha \textsc{ff}(f_\tau x)(f_\tau y) \;\leftrightarrow\; p_0p_0 \lhd_\alpha \textsc{ff}(\textsc{mir}(f_\tau y))(\textsc{mir}(f_\tau x))$.

Note also that the correct results for measure phrases are obtained; for example, the inference in (57) is predicted. To see that this is the case, suppose $\textsc{metre}(\langle P_\tau, \trianglelefteq_\tau\rangle) \otimes^3 p_0p_6$; the following equivalence also holds.

(65) $p_0p_6 \lhd_\alpha \textsc{ff}(f_\tau x)(f_\tau y) \;\leftrightarrow\; p_0p_6 \lhd_\alpha \textsc{ff}(\textsc{mir}(f_\tau y))(\textsc{mir}(f_\tau x))$.

Note also that $\textsc{metre}(\langle P_\tau, \trianglelefteq_\tau\rangle)$ will not be a member of both S_τ and $\textsc{mir}(S_\tau)$, which may help to explain the anomaly of (52b).

The mirror-measurement analysis of antonymy might have an advantage over the dimension-inversion analysis when it comes to the phenomenon of 'cross-polar anomaly'; this refers to the anomaly of sentences like the following.

(66) a. #Godzilla is taller than Mickey Mouse is short
b. #Mickey Mouse is shorter than Godzilla is tall.

Note that in the mirror-measurement account, the scale associated with *tall* will contain different measurements than the scale associated with *short* (the former will be S_τ and the

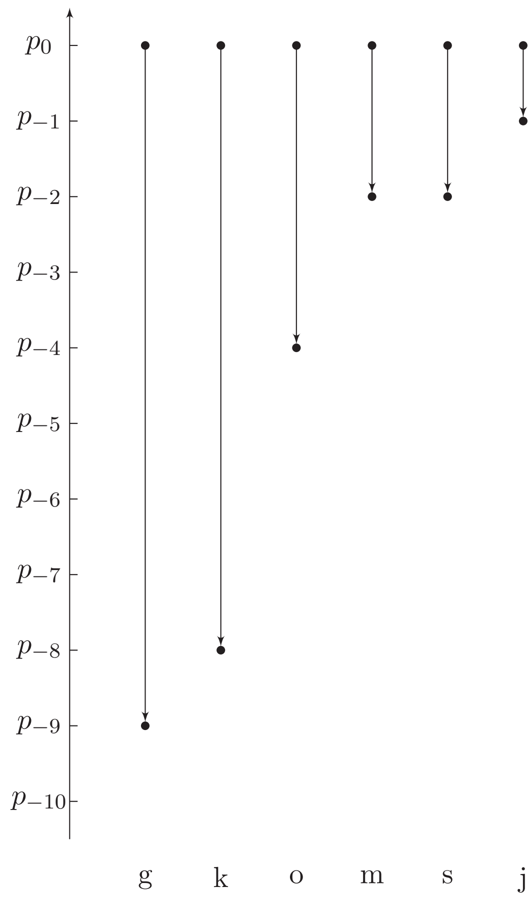


Figure 5.6: The measure function MIR(f_τ)

latter will be MIR(S_τ)); this could potentially provide a 'sortal' explanation for cross-polar anomaly similar to that of Kennedy (2001).[16] For more discussion on issues related to cross-polar anomaly, see e.g. Kennedy (2001), Büring (2007), and Bale (2008).[17]

5.2.4 Closed and open scales

The final scalar notion that will be discussed with respect to the IDS formalism is the distinction between open and closed scales. It is argued that the observed distinction between RELATIVE and ABSOLUTE adjectives can be explained in terms of a formal distinction between open and closed scales (e.g. Rotstein and Winter 2004; Kennedy and McNally 2005).

[16] Assuming that f_τ maps all entities to a positive measurement, *x is taller than y is short* will always be true, and *x is shorter than y is tall* will always be false. This is because, under the assumption that $f_\tau x$ is positive for all entities x, the following will both hold: $\forall x, y[p_0 p_0 \lhd_\tau \text{FF}(\text{MIR}(f_\tau x))(f_\tau y)]$ and $\neg\exists x, y[p_0 p_0 \lhd_\tau \text{FF}(f_\tau x)(\text{MIR}(f_\tau y))]$.

[17] Kennedy (2001) explains cross-polar anomaly in terms of 'positive' and 'negative' degrees, where degrees are in this case taken to be intervals on a linearly ordered set of points (i.e. on a scale). An adjective like *tall* maps objects to positive degrees on the scale of height, and *short* to negative degrees. Cross-polar anomaly arises because positive and negative degrees are not comparable.

The relative-absolute distinction is discussed in greater detail in the following chapter; for now, it can be noted that the main characteristic of relative adjectives is that their bare forms have 'standards' that are highly context-dependent, whereas the bare-form standards for absolute adjectives are much less so. The adjectives *tall*, *wide* and *expensive* are examples of relative adjectives; what counts as *tall*, *wide* or *expensive* can vary widely from context-to-context. The adjectives *dry*, *empty*, *open* and *bent* are examples of absolute adjectives; the criteria for satisfying their bare forms does not vary drastically between contexts. Within the class of absolute adjectives, a further distinction is often drawn between what might be called MAXIMAL and NON-MINIMAL adjectives (this is also referred to as the 'partial/total' distinction (Yoon 1996)). The adjectives *dry* and *empty* are considered to be maximal adjectives; intuitively, their bare forms typically require their subjects to exhibit a maximal or near-maximal degree of the property in question (where e.g. the maximal degree of dryness represents being completely dry). The adjectives *open* and *bent* are considered to be non-minimal adjectives; they intuitively require their subjects to have a non-zero amount of the property in question. The relative/absolute distinction is argued to be best explained in terms of the distinction between closed and open scales; the idea is that a closed scale provides a inherent standard for the bare form, so there is no need to resort to context to obtain one (c.f. Kennedy 2007). The maximal/non-minimal distinction is then argued to be explained in terms of the distinction between top-closed and bottom-closed scales (c.f. Rotstein and Winter 2004; Kennedy and McNally 2005).

In terms of an IDS-based view of gradability, a top-closed scale will be one which has a maximal measurement, and a bottom-closed scale will be one which has a minimal measurement. A closed scale will have either a maximal or minimal measurement (or both), and an open scale will have neither. The definitions for maximal and minimal measurements are given below.

(67) a. ab is a MAXIMAL MEASUREMENT of a scale S_α iff
$ab \in S_\alpha \; \& \; \forall xy[xy \in S_\alpha \rightarrow xy \trianglelefteq_\alpha ab]$

b. ab is a MINIMAL MEASUREMENT of a scale S_α iff
$ab \in S_\alpha \; \& \; \forall xy[xy \in S_\alpha \rightarrow ab \trianglelefteq_\alpha xy]$

It has been observed that the antonym of a maximal adjective is typically a non-minimal adjective, and vice-versa; for example, *dry* is considered to be a maximal adjective, while *wet* is considered to be a non-minimal adjective, and similarly for *closed* and *open*.[18] This generalization falls out from an account of antonymy which ensures antonymous adjectives have scales that are mirror-images of each other (i.e. that an adjective with a top-closed scale has an antonym with a bottom-closed scale). This includes the mirror-measurement analysis of ambiguity described in the previous section; note that the following is true in this analysis.

(68) ab is a maximal measurement of S_α iff ab is a minimal measurement of $\textsc{mir}(S_\alpha)$.

The following chapter discusses in detail how formal distinctions between different types of scales (open/closed, top-closed/bottom-closed) can be used to explain a number of generalizations in the adjectival and verbal domains; as shown here, the necessary formal distinctions are expressible in an IDS-based approach to gradability.

5.3 IDS measurements as 'degrees'

The IDS formalism that has been developed in this chapter can be seen as serving as a formal foundation for the semantic analysis of natural language gradability; in this respect, it is similar to the vector-based formalism of Winter (2005) and the interval-based formalism of Bierwisch (1989). An IDS structure can be viewed as underlying a more standard degree-based presentation, including the one adopted in the following chapter. In the standard presentation, the term 'scale' refers to a total ordering on a domain of 'degrees'; a gradable adjective is then taken to specify a measure function f that maps an entity to a degree on the appropriate scale. This will yield a conception of the scale and measure-function for *tall* like that depicted in Fig. 5.7 (transitive and reflexive arrows are omitted in the diagram).

In §5.1.1, it was discussed how an approach to gradability built upon total preorders is too weak to serve as a basis for an analysis of natural language gradability; as ordinal measurement systems, preorders can represent the relative ordering of objects, but not the magnitudes of difference between them. In the standard presentation of scales, degrees are ordered by a total ordering, i.e. by an antisymmetric total preorder; this means that the magnitude of difference between two degrees is not captured in the standard presentation. Thus, a standard degree-based presentation like that depicted in Fig. 5.7 conveys no more information about the magnitude of height difference between two entities than a preorder approach like the one depicted in Fig. 5.1, in which the entities themselves form the domain of the ordering. The standard degree-based conception can, however, simply be seen as shorthand for an IDS-based analysis of gradability; the 'degrees' on the scale in Fig. 5.7 can be understood as IDS-based measurements, with the ordering of these 'degrees' provided by the IDS-relation in the dimension of the adjective. Thus, Fig. 5.7 can be viewed simply as

[18] There are exceptions to this generalization, namely *empty* and *full*, which are both considered maximal adjectives.

shorthand for Fig. 5.8; note the correspondence of the latter figure with Fig. 5.4 presented earlier.

This means that one can make use of the convenience of the standard degree-based presentation, while understanding that underlying this standard presentation is an algebraic structure with the properties necessary for a more complete account of gradability-related phenomena. In the remaining chapters, the more standard degree-based presentation will be adopted for explanatory purposes, but this presentation should be understood as being shorthand for an analysis rooted in a structure like the one proposed in this chapter.

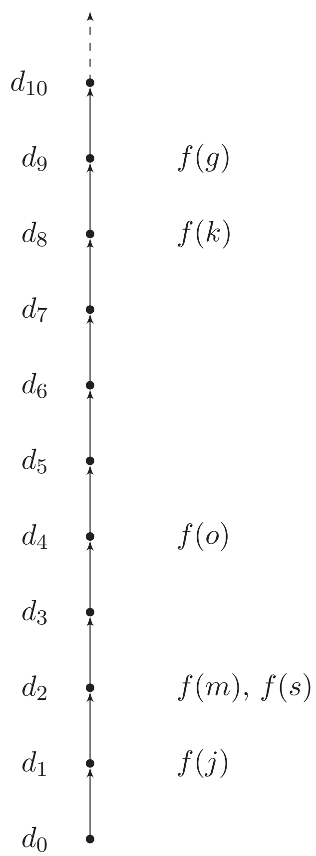


Figure 5.7: The standard picture of scales and measure-functions

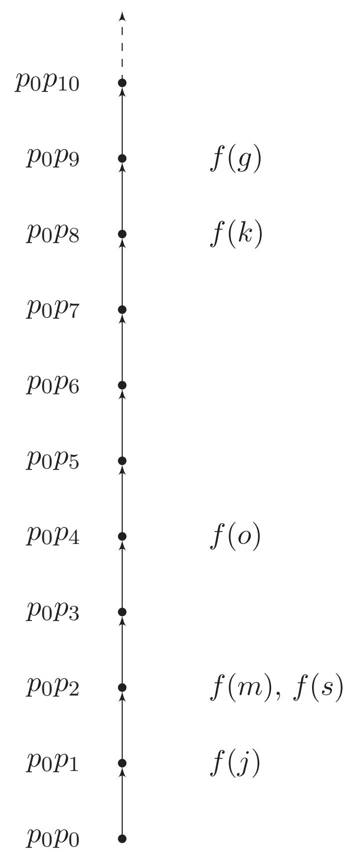


Figure 5.8: The standard picture, with degrees as IDS-based measurements

5.A Sassoon's (2010) measurement-theoretic analysis

Sassoon (2010) presents an alternative method for incorporating measurement-theoretic notions into an analysis of gradability. According to Sassoon, a gradable adjective denotes a context-sensitive function that maps an entity and context to a real number.

(69) An adjective denotes a function f from the domain E of entities to functions from the domain C of contexts to $\mathbb{R}$.

Sassoon proposes that different adjectives have different constraints on how the numbers they assign to objects can vary across contexts; the different constraints that are proposed correspond to the transformations used in measurement theory to classify different types of scales (c.f. Suppes and Zinnes 1963).

As an example of the latter, consider the relation between the metric and imperial systems for measuring distance. Note that one can 'transform' any numerical measurement given in metres to an equivalent one in feet by multiplying it by 3.28. The transformation from metres to feet preserves ratios between measurements; if x measures n metres and y measures $2 \cdot n$ metres, then x will measure $n \cdot 3.28$ feet and y will measure $2 \cdot n \cdot 3.28$ feet. The meaningfulness of ratios between measurements is what characterizes RATIO SCALES like those used to measure distance; given two measurement systems that can be used for measuring distance, one will be able translate measurements from one to the other by multiplying by some real number n.

Ratios between measurements are not meaningful in all scales used in the sciences; in INTERVAL SCALES, ratios between measurements are not meaningful, but ratios between differences of pairs of measurements are. Consider the Celsius and Fahrenheit temperature scales. One can transform a Celsius measurement to an equivalent one in Fahrenheit by multiplying the measurement by $\frac{9}{5}$ then adding 32. This transformation does not preserve ratios between measurements; 1° Celsius = 33.8° Fahrenheit, 2° Celsius = 35.6° Fahrenheit, but $35.6 \neq 2 \cdot 33.8$. Ratios between differences of pairs of measurements are preserved in the transformation from Celsius to Fahrenheit, however. That is, if a, b are measurements in Celsius, and f is the function that transforms Celsius measurements to Fahrenheit measurements, then for all n, $a - b = n \cdot (c - d)$ iff $f(a) - f(b) = n \cdot (f(c) - f(d))$. For example, note that $f(1) = 33.8$, $f(2) = 35.6$ and $f(4) = 39.2$, and that $4 - 2 = 2 \cdot (2 - 1)$, and that $39.2 - 35.6 = 2 \cdot (35.6 - 33.8)$.[19] The meaningfulness of ratios between differences characterizes an interval scale; when mapping between any two interval scales (like the Celsius and Fahrenheit scales) ratios between differences will be preserved, but ratios between measurements may not be.

Sassoon proposes that the numerical relations that define admissible mappings between scale types in measurement theory have semantic import; they also define the constraints on how adjectives can vary across contexts in their assignment of numbers to entities. For example, an adjective like *tall*, which measures distance, will have a constraint on its context-variance like the following.

(70) $\forall n \in \mathbb{R}, \forall x, y \in E,$
$[\exists c : f(x)(c) = n \cdot f(y)(c)] \rightarrow [\forall c : f(x)(c) = n \cdot f(y)(c)]$

In other words, ratios between the numbers assigned to entities will be preserved across contexts. Note that (70) implies (71).

(71) $[\exists c : f(x)(c) = 0] \rightarrow [\forall c : f(x)(c) = 0]$

In other words, any entity that is assigned the number 0 in one context will be assigned 0 in all contexts; a measurement of 0 assigned by adjectives that meet the constraint in (70) is thus taken to represent an absence of the gradable property. Sassoon proposes that a necessary condition for an adjective to be compatible with a measure-phrase (like *two metres* in *two metres tall*) or a ratio phrase (like *twice* in *twice as tall*) is that it meet the condition in (70).

Sassoon proposes that while not all gradable adjectives meet the condition in (70), they all meet the condition in (72)

(72) $\forall n \in \mathbb{R}, \forall w, x, y, z \in E,$
$[\exists c : f(x)(c) - f(y)(c) = n \cdot (f(w)(c) - f(z)(c))] \rightarrow$
$[\forall c : f(x)(c) - f(y)(c) = n \cdot (f(w)(c) - f(z)(c))]$

In other words, ratios between differences in the numbers assigned to entities are preserved across contexts. According to Sassoon, this is a necessary condition for permitting measure-phrases in comparatives, which have been observed to have a wider distribution than measure-phrases with bare adjectives (e.g. **three kilometres fast* vs. *three kilometres faster*).

Finally, Sassoon proposes that the relation that links a 'positive' adjective (e.g. *tall*) and its 'negative' antonym (e.g. *short*) is given by the following, where f is the denotation of a positive adjective and g is the denotation of its negative counterpart.

[19] If a, b are measurements in Celsius, and f is the function that transforms Celsius measurements to Fahrenheit measurements, then $a - b = \frac{9}{5} \cdot (f(a) - f(b))$.

(73) $\forall c \exists n : g(x)(c) = n - f(x)(c)$ &
$\neg \exists n \forall c : g(x)(c) = n - f(x)(c)$

This second conjunct of this condition ensures that negative adjectives do not meet the condition in (71), and thus that they do not meet the condition in (70) either. Thus, it will be correctly predicted that negative adjectives cannot appear with measure-phrases, even when their positive counterparts can (e.g. **two metres short* vs. *two metres tall*). Negative adjectives will still meet the condition in (72) if their positive counterparts do, and thus will be correctly predicted to permit measure-phrases in comparatives (e.g. *two metres shorter*).

Sassoon's account thus derives the distribution of measure and ratio phrases by directly applying numerical constraints on the admissible transformations for measurement systems to the definitions of constraints on the context-variance of adjective denotations. While the account appears to technically derive the correct distributions of various expressions, there are questions about whether it can be considered convincing as an account of a speaker's semantic knowledge. Sassoon clearly intends this to be the case, as the account is intended to explain speaker judgments regarding the compatibility of measure-phrases with various adjectives in various constructions. Taken as a psychological theory, the account implies that a speaker must know (at least implicitly) that e.g. the context-invariance condition in (70) holds of *tall*. Thus, this position seems to commit Sassoon to the assumption that (implicit) mathematical knowledge about e.g. ratio-invariant numerical transformations is a prerequisite for knowing whether or not an adjective can be modified with a measure-phrase. More generally, the account implies that a mental representation of the real numbers with a multiplication and subtraction operation is needed for an understanding of gradable adjective meaning, since these are invoked in the context-invariance conditions that form the heart of the analysis.

The algebraic approach to gradability that was developed in this chapter attempts to explain similar phenomena, but without requiring assumptions about implicit knowledge of real numbers and numerical operations. The proposed analysis makes use of an algebraic structure called an 'infinite difference system' (IDS). As shown by Suppes and Zinnes (1963), any two numerical systems that are isomorphic to an IDS will be related by a linear transformation, i.e. by a transformation that preserves ratios between the differences of pairs of numbers. Such transformations are used to translate between 'interval-scale' measurement systems like the Celsius and Fahrenheit scales.

The difference between an algebraic approach the gradability and the context-invariance approach of Sassoon (2010) can now be described as follows. Sassoon's approach involves assigning an adjective a value that, in a certain context, has the properties of a particular numerical system; this value is then allowed to vary across contexts only in ways that preserve the structure of that numerical system. In other words, the possible contextual values for an adjective are just those with properties of numerical systems that are isomorphic in certain ways. In the algebraic approach, there is no need to introduce isomorphic numerical systems using context-variance; the algebraic structure provides, in a single abstract object, the structure that is common to all of the relevant isomorphic numerical systems. An adjective can thus be assigned a (non-context-dependent) denotation that includes an algebraic structure of the appropriate kind (e.g. an IDS). An added benefit of the algebraic approach is that it does not rely on assumptions about implicit knowledge of real numbers and numerical operations; the IDS structure in an adjective's denotation can, if one so desires, be taken to be an algebraic representation of the 'conceptual space' associated with that adjective.[20]

[20]See Gärdenfors (2000) for an introduction to the mathematical approach to conceptual spaces.

Chapter 6

A scalar analysis of inchoative verbs

In this chapter, a scalar analysis of inchoative verbs will be presented, which builds on previous analyses of a similar kind by Hay et al. (1999), Winter (2006) and Kennedy and Levin (2008). Previous scalar approaches to verb meaning have typically taken as a starting point analyses of the bare (positive) forms of gradable adjectives, with particular attention paid to the distinction between 'relative' and 'absolute' adjectives; the discussion in this chapter will thus begin with a more general look at distinctions made in the adjectival domain. Following this, a scalar analysis of inchoative verbs that makes use of DEGREE-PAIRS will be presented; this analysis differs from previous analyses that make use of difference degrees. The scalar analysis of inchoative verbs presented here will then be compared with the `BECOME`/small-clause analysis described in Chapter 4, with particular focus given to how the two analyses fare with respect to adverbial modification.[1]

6.1 Gradable Adjectives

In this section, various distinctions that have been made in the adjectival domain will be pointed out, and a simple analysis of adjectival bare-forms will be presented; this will provide the necessary foundation for the scalar analysis of inchoative verbs that follows.

6.1.1 Gradable and non-gradable adjectives

The first adjectival distinction to be drawn is that made between GRADABLE and NON-GRADABLE adjectives. As mentioned in Chapter 5, gradability can be understood as the semantic property that permits "quantitative evaluations regarding dimensions or features" (Bierwisch 1989, p.71); evidence that an adjective is gradable comes from compatibility with

[1]Some of the material in this chapter appears in modified form in *The Journal of Semantics*, in Pedersen (2014).

intensifiers like *very*, *quite* and *fairly*, and the ability to appear in 'degree constructions' such as comparatives and 'degree' questions (c.f. Kennedy 1999, xii–xv).

(1) a. The sink is very full.
    b. The image is quite blurry.

(2) a. The river is wider than the lake.
    b. The door is more open than it was before.

(3) Just how dry is the roof?

Although many adjectives can be classified as gradable adjectives using such criteria, there are many other adjectives which are naturally taken to be non-gradable; examples of such adjectives include *dead*, *octagonal*, *former*, *metal*, *wooden*, *false*, *true*, *atomic*, *binary*, *fake*, *foreign*, *married*, and *pregnant*. These adjectives do not so easily appear with intensifiers, and result in comparatives and degree questions which, though not entirely uninterpretable, have interpretations that are somewhat marked and require some extra work to make sense of.

(4) a. #The chair is very wooden.
    b. #The number system is quite binary.

(5) a. #John is more married than Bill.
    b. #Mothra is more dead than Godzilla.

(6) #Just how metal is the table?

Formally, the distinction between gradable and non-gradable adjectives is often captured by invoking SCALES and DEGREES; gradable adjectives are taken to denote functions from entities to degrees on a multi-valued scale, whereas non-gradable adjectives are either taken to denote a simple property (i.e. a function from entities to truth-values), or (equivalently) are taken to be 'gradable' adjectives that have a scale with just two values.[2]

6.1.2 Relative and absolute adjectives

The next set of distinctions to be discussed are made with reference to the bare (or 'positive') form of gradable adjectives; the distinctions to be discussed are those drawn between 'relative' and 'absolute' adjectives, and between 'maximal' and 'non-minimal' adjectives.

[2]See Klein (1980, 1982) for an alternative 'delineation' approach to gradable adjectives, in which both gradable and non-gradable adjectives are taken to denote simple properties.

The bare form of an adjective is the unmodified form which is found in sentences like the following:

(7) a. Goofy is tall.
    b. The Grand Canyon is wide.

Bare forms of gradable adjectives have received a large amount of attention, in large part because the bare forms of many (but not all) adjectives are highly context-sensitive, and are prototypical examples of vague predicates. This is the case for *tall* and *wide*; (7a) might be considered true in a context where Disney characters are under discussion, but not in a discussion that also includes King Kong and Godzilla. Similarly, (7b) will likely be considered true in a context where geological formations on Earth are under discussion, but not in a context which includes geological formations on other planets (Valles Marineris on Mars is much wider). In addition to being context-sensitive, adjectives like *tall* and *wide* exhibit properties of vague predicates. For example, they are susceptible to the sorites paradox, as the following argument demonstrates:

(8) Godzilla, who is 30m tall, is tall.
    Any entity that is 1mm shorter than a tall entity is still tall.

    Jiminy Cricket is tall.

The premises of this seemingly valid argument are not obviously false, yet one is hesitant to accept the conclusion. Investigating the source of the context-sensitivity and vagueness of adjectives like *tall* and *wide* will not be the focus here, but a few points might be made. First of all, it generally agreed that the notion of a COMPARISON CLASS is necessary for deriving the truth-conditions of sentences like (7a) and (7b); a comparison class is taken to be the set of entities with respect to which the STANDARD for counting as tall or wide is determined. One argument that comparison classes are involved comes from the observation that they can apparently be made explicit with a *for*-phrase:

(9) a. Goofy is tall for a Disney Character.
    b. The Grand Canyon is wide for a canyon on Earth.

The context-sensitivity of these adjectives can then be taken to result from the fact that comparison classes may differ from context-to-context, though the exact mechanisms differ from account to account (c.f. Bale 2011).

There are also numerous approaches to the vagueness of gradable adjectives. These include explaining vagueness using partial functions (e.g. Kamp 1976), using partial functions and comparison classes (e.g. Klein 1980), using an 'indifference relation' (e.g. van Rooij 2011), or deriving vagueness from a 'standard' function in the meaning of the positive-form operator (e.g. Kennedy 2007).[3]

While much about the context-sensitivity and vagueness of gradable adjectives remains under debate, what is important for present purposes is that not all gradable adjectives are context-sensitive and vague, at least not in the same way or to the same degree as the adjectives in (7). Examples of gradable adjectives that do not exhibit the same sort of context-sensitivity as *tall* and *wide* are shown in (10); the gradability of these adjectives is evidenced by, for example, the fact that they are felicitous in comparative constructions like those in (11).

(10) a. The shirt is dry.
b. The bucket is empty.
c. The window is open.
d. The pole is bent.

(11) a. This bucket is emptier than that one.
b. The window is more open than it was before.

The intuitive truth-conditions of the sentences in (10) demonstrate their absolute nature. For example, it is hard to imagine (10a) being considered true in any discourse context if the shirt has a substantial amount of water on it; similarly, it is hard to imagine (10b) being considered true in any context if the bucket has a substantial amount of water in it. The adjectives *empty* and *dry* are considered to be examples of MAXIMAL adjectives – they typically require their subjects to have a maximal or near-maximal degree of the property in question (where e.g. the maximal degree of emptiness represents being completely empty). The adjectives *open* and *bent*, on the other hand, are considered to be examples of NON-MINIMAL adjectives; they require their subjects to have a non-zero amount of the property in question. For example, (10c) can be uttered truthfully in any situation so long as the window is not closed; (10d) can be uttered truthfully so long as the pole is not straight (or in its original shape, whatever that may be). Together, the maximal and non-minimal adjectives comprise the class of ABSOLUTE adjectives, which contrast with RELATIVE adjectives like *tall* and *wide*. Further examples from all three classes are shown in (12).

(12) a. Maximal adjectives: *dry*, *closed*, *invisible*, *pure*, *clean*, *straight*, *flat*, *empty*, *full*...
b. Non-minimal adjectives: *wet*, *open*, *visible*, *impure*, *dirty*, *curved*, *bent*, *bumpy*...
c. Relative adjectives: *tall*, *wide*, *narrow*, *long*, *big*, *strong*, *expensive*, *old*, *high*, *cold*, *hot*...

[3]See also Barker (2002b) for a discussion of adjectival vagueness from the perspective of dynamic semantics.

Absolute adjectives also do not display the same signs of vagueness that relative adjectives do. Kennedy (2007) points out that neither maximal nor non-minimal adjectives are susceptible to the sorites paradox in the way that relative adjectives are; for example, Kennedy (2007, §3.2.4) points out that the second premise in the following argument is judged false, unlike the corresponding premise in (8).

(13) A rod that has 10 degrees of bend is bent.
A rod that is 1 degree less bent than a bent rod is bent.
A rod that has 0 degrees of bend is bent.

Absolute adjectives have also been observed to differ from relative adjectives in the sorts of inferences they take part in, namely with respect to inferences involving antonymous pairs of adjectives (Cruse 1986; Rotstein and Winter 2004; Kennedy 2007). Antonymy was discussed in §5.2.3; here, it suffices to point out that many antonymous pairs of adjectives give rise to inferences like the following:

(14) King Kong is taller than Mickey Mouse. $\Leftrightarrow$ Mickey Mouse is shorter than King Kong.

Cruse (1986) and Rotstein and Winter (2004) observe that, while the antonym of a relative adjective is also a relative adjective, the antonym of a non-minimal adjective is typically a maximal adjective (and vice-versa); this is the case, for example, for the pairs *wet/dry*, *blurry/crisp*, *impure/pure*, *safe/unsafe*, *straight/curved* and *open/closed* (an exception is the pair *empty/full*, both of which are maximal adjectives). For such pairs, there is an inference from the negation of the non-minimal adjective to the bare form of the maximal adjective (Cruse 1986).

(15) a. The shirt is not wet. $\Rightarrow$ The shirt is dry.
b. The window is not open. $\Rightarrow$ The window is closed.

Similar inferences do not hold for antonymous relative adjectives:

(16) a. Goofy is not tall. $\not\Rightarrow$ Goofy is short.
b. The river is not wide. $\not\Rightarrow$ The river is narrow.

Kennedy (2007) also observes that comparatives with non-minimal adjectives generate inferences to the bare form of the adjective, whereas comparatives with maximal adjectives generate inferences to the negation of the bare form.

(17) a. The shirt is wetter than the tie. ⇒ The shirt is wet
b. The window is more open than before. ⇒ The window is open.

(18) a. The tie is drier than the shirt ⇒ The shirt is not dry.
b. That window is more closed than before. ⇒ The window was not closed before.

Similar inferences do not hold for relative adjectives:

(19) a. Goofy is taller than Mickey. ⇏ Goofy is tall.
b. Mickey is shorter than Goofy ⇏ Goofy is not short.

A further difference between absolute and relative adjectives is observed by Syrett (2007). Syrett observes experimentally that a request like the following, which contains the relative adjective *long*, can be understood as a request for the longer of two sticks; speakers feel able to respond to the request so long as the the two sticks involved have noticeably different lengths. Thus, (20a) can be understood as making the same request as (20b).

(20) a. Please give me the long stick.
b. Please give me the longer stick.

However, similar requests involving absolute adjectives cannot be taken simply as requests for identifying the object that has a higher degree of the relevant gradable property. For example, (21a) is judged as an infelicitous request if neither jar appears full; it cannot be used as a request for a half-full jar as opposed to a quarter-full jar (note that *full* is a maximal adjective). Thus, (21a) cannot be understood as making the same request as (21b).

(21) a. Please give me the full jar.
b. Please give the jar that is more full.

Similarly, (22a) is rejected as infelicitous if both boards involved are noticeably bumpy, even if one board contains noticeably more bumps than the other (note that *bumpy* is a non-minimal adjective). Thus, (22a) cannot be understood as making the same request as (22b).

(22) a. Please give me the bumpy board.
b. Please give me the bumpier board.

According to Syrett, (21a) is infelicitous in the situation described because the existence presupposition introduced by the definite article is not met (neither jar is considered a full jar); (22a) is infelicitous in the situation described because the uniqueness presupposition is not met (both boards are considered bumpy boards). This is taken as further indication that, unlike relative adjectives, bare forms of absolute adjectives have do not have context-sensitive standards; the reason why (20a) can be understood as (20b) (and why the existence and uniqueness presupposition in (20a) can be met) is because the standard for *long* can be set relative to just those sticks involved in the context of the request (c.f. Kennedy 2007, §3.2.3 for further discussion).

A final difference that might be noted between relative and absolute adjectives is the naturalness with which they appear with certain modifiers, including *not quite* and *barely*.[4] These modifiers require that their modifiees have a precise standard; relative adjectives, whose standards are vague, result in sentences that are marked (though not uninterpretable) and require extra work to make sense of.

(23) a. #Godzilla is not quite tall.
b. #Godzilla is barely tall.

The modifier *not quite* is naturally compatible with maximal adjectives, but not non-minimal (or relative) adjectives; this modifier can be thought of as signifying that an object is just under the standard associated with the adjective.

(24) a. The theatre is not quite empty.
b. The pole is not quite straight.
c. ?The window is not quite open.
d. ?The pole is not quite bent.

When combined with a non-minimal adjective as in (24c) and (24d), *not quite* seems to imply that someone is actively attempting to open/bend the relevant object. Such an implication is not necessary (though it is possible) when *not quite* combines with maximal adjectives as in the first two sentences; (24a) and (24b) can be used to simply describe the current state of the theatre/pole, regardless of whether a change to the object is underway or being attempted.

The modifier *barely*, on the other hand, is naturally compatible with non-minimal adjectives, but not with maximal (or relative) adjectives; this modifier can be thought of as signifying that an object is just above the standard associated with the adjective.

(25) a. The window is barely open.
b. The pole is barely bent.
c. ?The theatre is barely empty.
d. ?The pole is barely straight.

[4]See Burnett (2012) for a discussion of how other modifiers combine with relative and absolute adjectives.

While *barely* does not easily combine with maximal adjectives in the present tense (as (25c) and (25d) demonstrate), the situation is improved when the tense of these sentences is changed to past tense and the sentences appear with a subordinate *when*-clause (e.g. *The theatre was barely empty when I arrived*). This improvement can once again be traced to the fact that the improved sentences imply that the object has undergone a recent change in the relevant property; in such cases, *barely* can be seen as modifying the temporal aspect of the sentence, rather than the degree of the gradable property.

Note that compatibility with *not quite* and/or *barely* can be taken as indication that an expression is associated with a precise standard; thus, although relative adjectives like *tall* and *wide* are not naturally compatible with these modifiers in their bare forms, when modified with measurement phrases they become compatible:

(26) a. Godzilla is not quite fifty metres tall.
b. Godzilla is barely fifty metres wide.

Measurement phrases can thus be seen as providing a relative adjective with a precise standard like that which is inherently associated with an absolute adjective (c.f. Kennedy 2007).

Although absolute adjectives have been characterized as having inherently non-context-sensitive standards, there are uses of certain absolute adjectives that seem to indicate that the standard can be shifted a to non-absolute degree of the property. For example, (27) can be used to describe a large theatre which, contrary to expectations, is observed to have very few people in it.

(27) The theatre is empty tonight.

Kennedy (2007) warns against taking such examples as indication that the standard for *empty* is not absolute; rather, Kennedy argues that in a sentence like (27) the adjective *empty* is being used 'imprecisely' by the speaker. That is, (27) is false in such a situation, but Gricean reasoning leads one to understand the sentence as conveying that the theatre has few people in it. Evidence for this sort of explanation comes from the fact that the paraphrase of (27) given in (28), which does not contain a gradable adjective, can also be used imprecisely in the same situation to convey the same message.[5]

(28) There is no one in the theatre tonight

[5]Thanks to Bernhard Schwarz (p.c.) for pointing out this example.

6.1.3 Explaining the relative-absolute distinction

The specific factors that go into determining whether a particular adjective exhibits relative or absolute features are still not very well understood, and further investigation into this issue will not be the main focus in what follows. However, a number of recent proposals will be reviewed in this section, in order to provide a basic overview of the nature of the problem.

Kennedy and McNally (2005) and Kennedy (2007) argue that the difference between relative, maximal and non-minimal adjectives results directly from differences in the structure of the scales associated with adjectives in each descriptive class; maximal adjectives have scales with a maximal degree, non-minimal adjectives have scales with a minimal degree, and relative adjectives have scales with neither a maximal nor a minimal degree (see also Rotstein and Winter 2004; Cruse 1986). Kennedy (2007) then appeals to a hypothesized principle of Interpretive Economy to explain why absolute adjectives do not have standards that are fixed by context. Interpretive economy is essentially a 'context-as-last-resort' principle:

> Interpretive Economy...requires truth-conditions to be computed on the basis of the conventional meanings of the expressions of a sentence (or logical form) to the extent possible, allowing for context-dependent truth-conditions only when conventional meaning is insufficient. (Kennedy 2007, p.36)

Because scale-structure, in particular the presence of maximal and minimal degrees, is a component of the conventional meaning of a gradable adjective, Interpretive Economy will ensure that maximal and minimal degrees will play a role in determining the extension of positive-form properties like *be straight* and *be open*; since adjectives like *tall* and *wide* lack structural degrees on which to anchor a standard, context will be needed to obtain the standard necessary for building properties like *be tall* or *be wide*.

While a pure scale-structure explanation of the relative/absolute distinction like that of Kennedy (2007) has the advantage of conceptual simplicity, it is not without its problems. Kennedy (2007, §4.2) himself recognizes that an account based purely on scale-structure will require sometimes disregarding our naïve intuitions about what sorts of scales are associated with particular adjectives. For example, the adjective *expensive* exhibits characteristics of a relative adjective, and thus for Kennedy must have neither a maximal nor a minimal degree; in other words, it must have an infinite number of degrees, with no least degree. However, as Kennedy points out, one might naïvely expect the scale associated with *expensive* to have a minimal degree – a degree representing no cost at all – just as the scale for e.g. *curved* has a degree representing no amount of curve. Similar considerations apply to adjectives like *tall*, *wide*, *deep*, *fast*, and *long*, which are associated with measurement systems; the measurement systems for measuring e.g. speed includes a zero value (no speed), but under

Kennedy's proposal the scale associated with *fast* cannot include such a value, since *fast* behaves like a relative adjective.

McNally (2011) and Sassoon and Toledo (2011) argue that more than just scale-structure is relevant to the relative-absolute distinction. McNally considers sentences like (29), pointing out that a wine glass does not typically need to be filled to the brim to be considered full, but is usually considered full if it is filled to half its capacity with wine.

(29) The wine glass is full.

Based on such examples, McNally argues that the fundamental difference between relative and absolute adjectives is that the former involve 'similarity-based' ascription, whereas the latter involve 'rule-based' ascription. Absolute adjectives are ascribed to entities based on whether an entity conforms to some general 'rule'; in the case of *full*, the relevant rule is typically that the container's volume be completely occupied (i.e. that the container have the maximal degree of fullness), but more specific rules applying to specific types of containers (e.g. wine glasses) may not require a maximal degree of fullness, but a degree representing a certain percentage of fullness. Relative adjectives, on the other hand, are ascribed not by a general rule, but based on an entity's similarity to some 'prototype'; for example, *tall* might be ascribed to King Kong by comparing him to a protypically tall object in the relevant comparison class. According to McNally, the reason why adjectives with maximal and minimal degrees (as determined by e.g. compatibility with *slightly* and *completely*) are typically ascribed based on rule is because rules are easily formulated using structurally-identifiable degrees; adjectives that lack degrees that stand out structurally will not have general rules that are easily formulated, and will thus typically be ascribed based on similarity to a prototype. McNally assumes (as does Kennedy) that adjectives like *tall* and *fast* have scales without a minimal degree; however, McNally's account allows for the possibility that non-maximal and minimal degrees may in certain situations be used to define a general rule for the ascription of an adjective.

Sassoon and Toledo offer an explanation of the relative-absolute distinction that is somewhat similar to McNally's, arguing that the important difference between relative and absolute adjectives is that the former involve 'cross-individual comparison', whereas the latter involve 'within-individual comparison'. That is, the comparison classes of adjectives like *tall* and *wide* are composed of different individuals, whereas the comparison classes of adjectives like *full*, *open* and *straight* are composed of different temporal or modal 'counterparts' of a single individual. For example, the comparison class involved in determining the truth of a sentence like *The tea cup is full* will include counterparts of the tea cup filled to different levels, including a counterpart that is completely full. Sassoon and Toledo then rely on a principle like Kennedy's Interpretive Economy to insure that the counterpart that is ranked highest on the fullness scale is taken as the standard for judging whether the adjective can be ascribed to the tea cup in the actual world. Relative adjectives, on the other hand, have comparison classes that are composed of different individuals, with the result that the truth of a sentence like *King Kong is tall* is determined in the standard way, in terms of how King Kong measures up against other individuals in a contextually-determined comparison class. As evidence for this proposal, Sassoon and Toledo point out that, when they are acceptable at all, overt comparison classes that modify absolute adjectives typically refer (indirectly) to counterparts of a single entity:

(30) a. This theatre is empty for a Friday night.
b. The tree is straight for this time of year.

Overt comparison classes with relative adjectives, on the other hand, typically refer to a set of distinct individuals (see (9)).

As an additional argument that the relative-absolute distinction might amount to the difference between cross-individual and within-individual comparison, Sassoon and Toledo argue that relative adjectives typically describe relatively stable properties (and hence are more likely to induce comparison between individuals) whereas absolute adjectives typically describe transient properties (hence making comparison of different states of a single individual more salient). The authors argue that height, width and weight are arguably relatively stable properties for many objects that are commonly encountered (e.g. people, animals, vehicles); properties like cleanliness, dryness, fullness, and openness are typically less stable. Sassoon and Toledo cite numerous constructions that are most compatible with expressions that describe transient properties; these include embedding under temporal quantifiers like *every time*, modification with adverbials like *once*, and appearance as secondary predicates (see Sassoon and Toledo 2011 for further examples). They point out that absolute adjectives are more at home in these constructions than relative adjectives.

(31) a. Every time the kettle is full, you...
b. #Every time your son is tall, you...

(32) a. Once full, the box can be sent away.
b. #Once wide, the path can serve as a road.

(33) a. The box arrived empty.
b. #The man arrived tall.

Note also that while the current speed of an object can be regarded as a transient property, its maximum speed can be regarded as an enduring property; the relative adjectives *fast* and *slow* typically describe the latter property, e.g. a parked race car can be truthfully described as a *fast car*.

An advantage of Sassoon and Toledo's approach to the relative-absolute distinction is that it does not require assuming that relative adjectives have infinite scales that lack zero degrees; the context-sensitivity of relative adjectives arises not because of their lack of structurally-defined degrees, but because they involve cross-individual comparison. That is, the scales associated with relative adjectives like *tall* and *wide* can have a zero degree, though this zero degree will rarely if ever play a role in determining the standard for bare forms because it is unlikely that any entities in a comparison class will have zero length or width. Put differently, a minimal standard would not be very useful for an adjective (like *tall* or *wide*) that describes a relatively enduring property, for which objects possessing a zero degree of the property are rarely, if ever, encountered. The disadvantage of Sassoon and Toledo's account is that it is not clear why within-individual comparison generally produces non-vague and non-context-sensitive bare forms; apparently, it must be stipulated that counterpart-based comparison classes always include counterparts that exhibit the maximal/minimal amount of the property in question. This calls into question just how different Sassoon and Toledo's account ultimately is from McNally's (2011) rule vs. similarity account.

Many questions remain as to what factor or factors underlie the relative-absolute distinction, and even whether a general account of what underlies the distinction is properly in the domain of semantic theory. While the underlying source of the relative-absolute distinction will receive no more attention here, the distinction itself will play an important role in what follows.

6.1.4 A semantics for adjectival bare forms

The formal account of adjectival bare forms presented here is a relatively standard one. It is assumed that the meaning of a gradable adjective contains two components: a SCALE and a MEASURE FUNCTION.

(34) An adjective A denotes a pair $\langle\langle D, <\rangle, f\rangle$, where:

i. $\langle D, <\rangle$ is a strict ordering on D
($\langle D, <\rangle$ is the scale of A)

ii. f is a function from object-moment pairs into D
(f is the measure function of A)

In order to notationally distinguish the metalinguistic representations of different adjective denotations, subscripts will be used. For example, the adjective *wide* will have the following denotation.

(35) The adjective *wide* denotes a pair $\langle\langle D_{\text{WIDE}}, <_{\text{WIDE}}\rangle, f_{\text{WIDE}}\rangle$

In what follows, a metalanguage expression like $f_{\text{WIDE}}(x)(m)$ will often be abbreviated as WIDE_x^m.

The first component of an adjective's meaning is its scale. For present purposes, a scale can be thought of simply as follows.

(36) A scale is a pairing $\langle D, <\rangle$ where D is a set of degrees and $\langle D, <\rangle$ is a strict ordering on D.

In Chapter 5, it was shown how the formal structure underlying scales and degrees can be taken to be an infinite difference system, as it is defined in the measurement-theoretic work of Suppes and Zinnes (1963); in this section, a more traditional presentation of scales will be adopted, with the understanding that underlying this simple presentation is a formal structure of the appropriate kind.

Adjective scales can differ as to whether they have a maximal degree, a minimal degree, both, or neither. Maximal and minimal degrees are defined as in (37).

(37) a. A degree $d \in D$ is a maximal degree of $\langle D, <\rangle$ iff $\forall d' \in D : d \neq d' \rightarrow d' < d$

b. A degree $d \in D$ is a minimal degree of $\langle D, <\rangle$ iff $\forall d' \in D : d \neq d' \rightarrow d < d'$

The maximal and minimal degree of an adjective scale $\langle D_\alpha, <_\alpha\rangle$ will be written MAX_α and MIN_α respectively; a scale with a maximal degree will be called TOP-CLOSED, and a scale with a minimal degree will be called BOTTOM-CLOSED. A scale with neither a maximal nor a minimal degree is an OPEN scale.

The second component of an adjective's meaning is a MEASURE FUNCTION.[6] A measure function is a function which maps an object to a degree on the associated adjectival scale (Bartsch and Vennemann 1973; Cresswell 1976; von Stechow 1984a; Klein 1991; Kennedy 1999; Bale 2011); here, measure functions will be relativized to points of time (c.f. Hay et al. 1999; Winter 2006). For example, the adjective *wide* will specify a measure function which maps an object and a moment to a degree on the scale of width, which represents the object's measurement at that moment.

[6] This line of research contrasts with a DELINEATION approach, where gradable adjectives denote properties whose denotations vary in restricted ways according to context (c.f. Kamp 1976; Klein 1980, 1982; Doetjes et al. 2011; Burnett 2012)).

While an adjective like *wide* is assumed to have a complex meaning with two components (one of which is a measure function), a verb phrase like *be wide* should denote a property of individuals. This means that some additional semantic operation is required to derive a property from an adjectival denotation. This operation will, following common assumptions, be introduced by a silent morpheme `POS`; this morpheme is assumed to occupy the same position that an overt measure phrase or comparative morpheme would, and to derive a property from an adjectival denotation (c.f. Bartsch and Vennemann 1973; Cresswell 1976; von Stechow 1984a; Kennedy 1999, 2007).[7] Following the 'Interpretive Economy' view of Kennedy (2007), it will be assumed that the `POS` morpheme is sensitive to the scale-structure of the adjective it operates on. That is, it will be assumed (following Kennedy) that if an adjective's scale has either a maximal or minimal degree, then this degree determines the nature of the resulting momentary property; if an adjective's scale lacks such a structurally distinguished degree, then context must be relied upon to provide a degree, thereby avoiding the generation of a trivial meaning for the resulting property (i.e. one where every object-moment pair is mapped to true).[8]

(38) $[\![\texttt{POS}]\!](\langle\langle D_\alpha, <_\alpha\rangle, f_\alpha\rangle)(x)(m) = \text{T}$ iff:

i. $f_\alpha(x)(m) = \text{MAX}_\alpha$ (if $\langle D_\alpha, <_\alpha\rangle$ is top-closed)

ii. $\text{MIN}_\alpha <_\alpha f_\alpha(x)(m)$ (if $\langle D_\alpha, <_\alpha\rangle$ is bottom-closed)

iii. $c <_\alpha f_\alpha(x)(m)$, (if $\langle D_\alpha, <_\alpha\rangle$ is open)
where c is a contextually-given degree in D_α

As discussed by Kennedy, the possibility that some adjectives have fully-closed scales (scales with both a maximal and a minimal degree) complicates this simple picture somewhat. There is reason to think that adjectives like *empty*, *exposed* and *open* have fully-closed scales (based on their compatibility with modifiers like *half*); if this is the case, then scale structure cannot be the sole factor at work in determining the property that results from applying `POS` to such adjectives. This is because these adjectives, despite having structurally similar scales, do not have uniform default interpretations; *empty* behaves like a maximal adjective, while *exposed* behaves like a non-minimal adjective. Kennedy and McNally (2005) and Kennedy (2007) take this as indication that something other than scale structure causes either the maximal or minimal degree to 'stand out' in such cases; in particular, these authors note that adjectives with fully-closed scales are typically deverbal, and hypothesize that in such cases

[7] Accounts differ as to whether the property-forming operation is handled by an abstract morpheme or by some sort of type-shifting operation (c.f. Kennedy 2007, §2 for discussion and references); this distinction is not crucial here, and the former option will be adopted in what follows.

[8] That is, it is assumed that bare forms should have the ability to be true of some arguments, and false of others. See Kennedy (2007) for discussion on this point.

the adjectival standard is derived from the verbal one. At any rate, the details of fully-closed adjectives (of which there seem to be comparatively few) remain currently mysterious, and will not play much of a role in what follows.

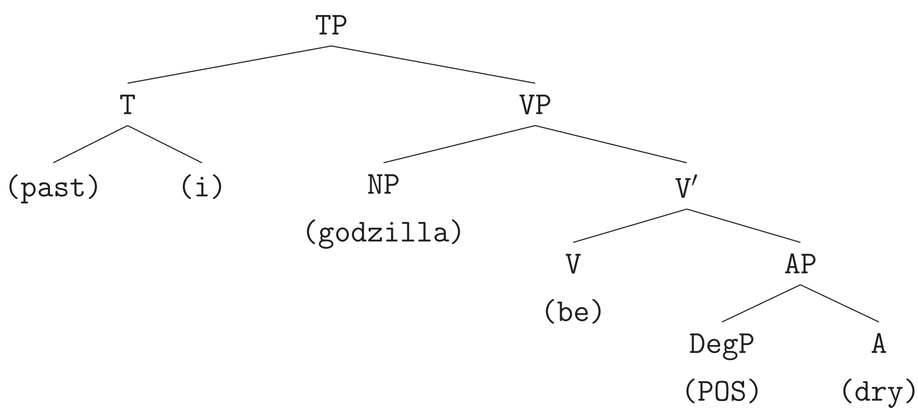
The property generated by applying $[\![\texttt{POS}]\!]$ to an adjective denotation is a 'momentary property'; it returns a truth value when given an object and a moment. However, copular VPs with bare form adjectives (like *be dry*) are typically taken to be 'stative properties' in the sense of Dowty (1979); they take an object and time interval as arguments, and they have the subinterval property (i.e. they are true of an interval only if they are true of every subinterval of that interval). A stative property can be derived from a momentary property like the one in (38) by universally quantifying over the moments in an interval; it might be assumed that this universal quantification is introduced by the copula. Where $\mathcal{R}$ is a momentary property,

(39) $[\![be]\!](\mathcal{R})(x)(i) = \mathrm{T}$ iff $\forall m \in i : \mathcal{R}(x)(m) = \mathrm{T}$

The resulting property will be a stative one which exhibits the subinterval property.

As a concrete example of the analysis of adjectival bare forms described in this section, suppose that the LF for the sentence *Godzilla was dry* is the structure in (40) (this LF presumes a pronominal analysis of tense, described in Chapter 4).

(40)



The interpretation of this LF will be as follows (omitting the variable assignment for simplicity, and abbreviating $f_{\text{DRY}}(g)(m)$ as DRY_g^m).

(41) $[\![\texttt{be}]\!]([\![\texttt{POS}]\!]([\![\texttt{dry}]\!]))(g)([\![\texttt{past}]\!](i))$

a. is defined only if $i \prec i_u$ (where i_u is the utterance interval)

b. if defined, equals T only if $\forall m \in i : \text{DRY}_g^m = \text{MAX}_{\text{DRY}}$

In prose, the truth-conditions for this LF require there to be an interval preceding the utterance interval, every moment of which Godzilla has the maximal degree of dryness. Note that these truth-conditions are generated under the assumption that *dry* is a maximal adjective and has a top-closed scale. The truth-conditions for analogous sentences containing other adjectives will vary in nature in accordance with the scale-structure of the adjective involved. For example, the truth-conditions for *The television was blurry* (containing a non-minimal adjective) might be as in (42), and the truth-conditions for *The river was wide* (containing a relative adjective) might be as in (43).

(42) $[\![\texttt{be}]\!]([\![\texttt{POS}]\!]([\![\texttt{blurry}]\!]))(t)([\![\texttt{past}]\!](i))$

a. is defined only if $i \prec i_u$

b. if defined, equals T only if $\forall m \in i : \textsc{min}_{\textsc{blur}} <_{\textsc{blur}} \textsc{blur}_t^m$

(43) $[\![\texttt{be}]\!]([\![\texttt{POS}]\!]([\![\texttt{wide}]\!]))(r)([\![\texttt{past}]\!](i))$

a. is defined only if $i \prec i_u$

b. if defined, equals T only if $\forall m \in i : c <_{\textsc{wide}} \textsc{wide}_r^m$
(Where c is a contextually provided degree in $D_{\textsc{wide}}$)

In prose, (42) requires there to be an interval preceding the utterance interval, every moment of which the TV has a non-minimal (i.e. non-zero) degree of blurriness; (43) requires there to be an interval preceding the utterance interval, every moment of which the river has a degree of width greater than a contextually-provided degree. The analysis thus generates different types of truth-conditions for maximal, non-minimal and relative adjectives, in accordance with the different types of scales these classes of adjectives are associated with.

6.2 A scalar analysis of verb meaning

In this section, a scalar analysis of inchoative verbs will be presented. The analysis presented here builds on the work of Hay et al. (1999), Winter (2006) and Kennedy and Levin (2008), and incorporates many of their insights; however, the analysis here differs from previous approaches in that it makes use of DEGREE-PAIRS, which offer numerous advantages over approaches involving difference degrees.

6.2.1 Scales and inchoative verbs

As opposed to adjectival measure functions which simply take an object's measurement on a scale at a single moment, inchoative verbs can be viewed as encoding functions that measure the amount of scalar change that an object undergoes over time (Hay et al. 1999; Kennedy and Levin 2008). Consider the following sentences:

(44) a. The roof dried.
b. The image blurred.
c. The river widened.

The meanings of these sentences can be characterized in scalar terms as follows. (44a) expresses that the roof went from a non-maximal state of dryness to a maximal state of dryness (c.f. Kearns 2007). (44b) expresses that the image went from a minimal (zero) degree of blurriness to a non-minimal degree. (44c) expresses simply that river's width increased; one cannot infer from (44c) anything about the specific degree of width attained, other than that it is greater than the degree of width at the start of the interval. The verbs *dry*, *blur* and *widen* can be taken as examples of maximal, non-minimal and relative verbs, respectively; other examples are shown below.

(45) a. Maximal verbs: *dry*, *close*, *purify*, *clean*, *straighten*, *flatten*, *empty*, *fill*, *hide*...
b. Non-minimal verbs: *blur*, *open*, *wet*, *expose*, *curve*, *bend*, *dirty*...
c. Relative verbs: *widen*, *narrow*, *shorten*, *broaden*, *strengthen*, *grow*, *age*, *rise*, *fall*, *cool*...

Note that the term 'relative' is not as apt for verbs as it is for adjectives, but it shall be retained for the sake of terminological uniformity.

There are various ways of encoding the notion of scalar change required for a scalar analysis of verb meaning; the method adopted here will be one which treats verbs as functions that return a DEGREE-PAIR – an ordered pair of degrees from a single scale.

(46) $\langle d, e\rangle$ is a degree-pair of scale $\langle D, <\rangle$ iff $\langle d, e\rangle \in D \times D$

Whereas adjectives are taken to include a measure function in their denotation, inchoative verbs will be taken to include a MEASURE-OF-CHANGE (MOC) function, adopting the terminology of Kennedy and Levin (2008). A MOC-function is to be understood here as a function which maps an object-interval pair to a pair of degrees.

(47) A MOC-function is a function g from object-interval pairs to $D \times D$
(where D is the domain of a scale $\langle D, <\rangle$).

An inchoative verb will be assumed to have the following type of denotation.

(48) An inchoative verb V denotes a pair $\langle\langle D, <\rangle, g\rangle$, where:

i. $\langle D, <\rangle$ is a strict ordering on D
($\langle D, <\rangle$ is the scale of V)

ii. g is a function from object-interval pairs into $D \times D$
(g is the MOC function of V)

A degree-pair approach to verb meaning differs from that proposed by Kennedy and Levin (2008), who argue that inchoative verbs encode difference functions – functions which return a degree representing the difference between an interval-initial measurement and an interval-final measurement. Note that a degree-pair approach is richer than a difference degree approach, since the difference can always be taken between the two degrees that form a pair. Some general arguments motivating a degree-pair approach are provided in §6.2.4.

As in previous scalar approaches, the meaning of an inchoative verb can be derived from the meaning of an adjective (c.f. Hay et al. 1999; Winter 2006; Kennedy and Levin 2008). A function Δ derives a MOC-function from a momentary measure function; in the present analysis, the derived MOC-function will map an object-interval pair to the degree-pair obtained by taking the object's interval-initial and interval-final measurements.

(49) Where f is a momentary measure function,
$\Delta(f)(x)(i) = \langle f_x^{\text{INF}_i}, f_x^{\text{SUP}_i}\rangle$

The mapping from an adjective meaning to an inchoative verb meaning will involve applying the Δ to the measure function of the adjective, leaving the scale untouched; both the adjective and the derived verb will then have denotations with the same scale component. This mapping can be assumed to be accomplished by the suffix *-en* (which also has a phonologically-null variant).

(50) $[\![-\texttt{en}]\!](\langle\langle D_\alpha, <_\alpha\rangle, f_\alpha\rangle) = \langle\langle D_\alpha, <_\alpha\rangle, \Delta(f_\alpha)\rangle$

For example, $[\![-\texttt{en}]\!]([\![\texttt{wide}]\!])$ – the denotation of *widen* – will equal the pair $\langle\langle D_{\text{WIDE}}, <_{\text{WIDE}}\rangle, \Delta(\text{WIDE})\rangle$; the MOC-function in this denotation will, when given an object and interval as input, return the degree-pair comprised of the object's interval-initial and interval-final widths.

(51) $\Delta(\text{WIDE})(x)(i) = \langle \text{WIDE}^x_{\text{INF}_i}, \text{WIDE}^x_{\text{SUP}_i}\rangle$

Note that the verbs *dry* and *blur* will have the same type of denotation as *widen*. That is, total, partial and relative verbs will not differ in the type of semantic value they receive.[9]

Since inchoative verbs in the present analysis do not denote properties, an additional property-forming operation is required, as was the case with adjectival bare forms. Following previous proposals (c.f. Dowty 1979; Abusch 1986; Kearns 2007; Winter 2006; Kennedy and Levin 2008), the idea will be to assimilate the semantics of verbal bare forms to that of adjectival bare forms. Recall that the semantics for adjectival bare-forms made use of a `POS` morpheme; following Kennedy and Levin (2008), the analysis of inchoative verbs will make similar use of such a morpheme. The reasoning behind this is as follows. Just as not every measurement of e.g. dryness is enough to satisfy the bare form of the adjective *dry*, so not every change in dryness (nor even every increase) is enough to satisfy the bare form of the verb *to dry*. For example, a soaking wet shirt could sit in the sun for a couple minutes and afterwards feel slightly less wet, yet it would still be infelicitous to use the bare form of *dry*, i.e. to say *the shirt dried*; rather, one would use a modified version of the verb such as *the shirt dried a bit*. Hence, even though there is an increase in dryness, it does not meet the requirements demanded by the bare form of the verb *dry*. As with adjectives, the nature of the property that `POS` returns when given a verb denotation will depend on the type of scale that is associated with the verb (c.f. Kennedy and Levin 2008).

(52) $[\![\texttt{POS}]\!](\langle\langle D_\alpha, <_\alpha\rangle, g_\alpha\rangle)(x)(i) = \text{T iff:}$

i. $g_\alpha(x)(i) = \langle d, \text{MAX}_\alpha\rangle$, for some $d <_\alpha \text{MAX}_\alpha$ (if $\langle D_\alpha, <_\alpha\rangle$ is top-closed)

ii. $g_\alpha(x)(i) = \langle \text{MIN}_\alpha, d\rangle$, for some $d >_\alpha \text{MIN}_\alpha$ (if $\langle D_\alpha, <_\alpha\rangle$ is bottom-closed)

iii. $g_\alpha(x)(i) = \langle d, e\rangle$, for some $d, e \in D_\alpha : d <_\alpha e$ (if $\langle D_\alpha, <_\alpha\rangle$ is open)

Given the truth-conditions of sentences like (44c), it is important that the property associated with the bare form of a relative verb is one for which any scalar increase suffices, and not one that requires the attainment of a contextually-specified standard; *The river widened* does not mean that the river became contextually wide, but simply that its width increased. Kennedy and Levin (2008) demonstrate that, in a difference-degree approach, this result follows naturally if one assumes that a principle like Interpretive Economy is in effect (see §6.2.4 for details). As it turns out, if one adopts a degree-pair approach, Interpretive Economy can also derive this result.

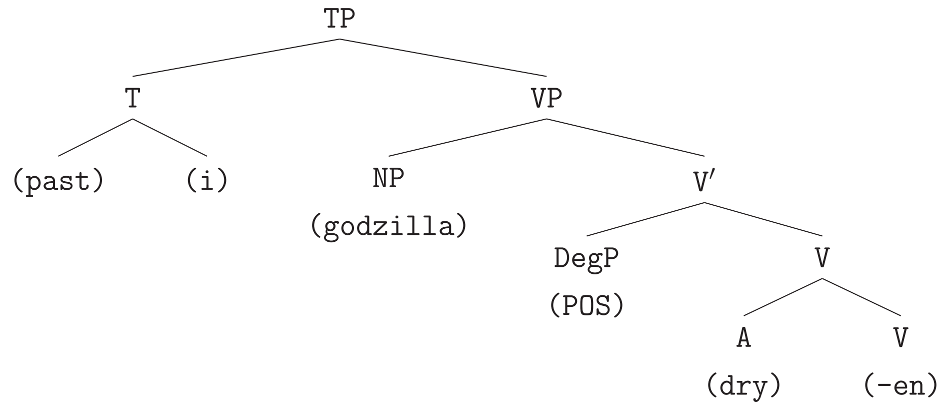
To see that this is the case, consider what it might mean to derive a property from a verb denotation following the principle of Interpretive Economy (which implies 'context-as-

[9] If one takes morphology at face-value, then a verb like *blur* is not deadjectival; rather, the adjective *blurry* is denominal, based on the noun *blur*. However, it can still be safely assumed that the meanings of *blur* (the verb) and *blurry* make use of the same measure function (though how the adjective gets this meaning from the noun requires some explanation), and therefore that the meaning of the verb *blur* is $[\![-\texttt{en}]\!]([\![\texttt{blur}]\!])$.

last-resort'). As with adjectives, Interpretive Economy will require that the property derived from a verb denotation be determined by scalar properties as much as possible, with context resorted to only if such properties fail. However, unlike an adjectival measure function which returns a single degree, a verbal MOC-function returns a pair of degrees. Where adjectives are concerned, the only scale-structure feature that is assumed to be relevant to $[\![\texttt{POS}]\!]$ when constructing a property from an adjectival denotation is the presence or absence of a maximal or minimal element on the adjectival scale. However, where verbs are concerned, the additional structure of a degree-pair allows another scalar property to come into play when constructing a property using $[\![\texttt{POS}]\!]$: the ordering relation itself. Note that the ordering relation of a scale (like any ordering relation) is given by a set of ordered pairs that define the graph of the relation; in the case of a scale $\langle D_\alpha, <_\alpha \rangle$, the relation $<_\alpha$ formally consists of a set of degree-pairs. In other words, $<_\alpha \subset D_\alpha \times D_\alpha$; this means that $[\![\texttt{POS}]\!]$ can construct a property from a verb denotation on the basis of scale-structure alone, even if the scale lacks any structurally distinguished degrees. In the simplest case – where the scale lacks a maximal or minimal degree – the property obtained through Interpretive Economy can be assumed to be true of any object-interval pair such that the degree-pair assigned to that object and interval by the MOC-function is in the ordering relation of the scale. Because the ordering relation of a scale is taken to be a strict order, this property will be true of any object-interval pair such that the object underwent increase on the scale during the interval – i.e. it will be a property of the kind in (52-iii). Regarding verbs whose scales possess a maximal or minimal degree, Interpretive Economy requires maximizing the use of the conventional elements of meaning, including structurally distinguished degrees; for such verbs, the property derived through Interpretive Economy will be true of an object-interval pair so long as the pair consisting of the object's initial and final measurements is in the ordering relation of the scale restricted to just those pairs which contain the maximal or minimal degree – i.e. it will be of the form of (52-i) or (52-ii). Importantly, though, even for verbs whose scales lack a maximal or minimal degree, there is no need for $[\![\texttt{POS}]\!]$ to resort to context when constructing a property, so long as Interpretive Economy is in effect.

As a concrete example of the analysis of inchoative verbs proposed here, suppose that the sentence *Godzilla dried* has an LF like the following.

(53)



The interpretation of this LF will be as follows (omitting the variable assignment for simplicity, and where i_u is the utterance interval).

(54) $[\![\texttt{POS}]\!]([\![\texttt{-en}]\!]([\![\texttt{dry}]\!]))(g)([\![\texttt{past}]\!](i))$

a. is defined only if $i \prec i_u$

b. if defined, equals T only if $\Delta(\textsc{dry})(g)(i) = \langle d, \textsc{max}_{\textsc{dry}} \rangle$, for some $d \in D_{\textsc{dry}} : d <_{\textsc{dry}} \textsc{max}_{\textsc{dry}}$

In prose, the truth-conditions for this LF require there to be an interval preceding the utterance interval, during which Godzilla's dryness level increased from a non-maximal degree to a maximal degree; these truth-conditions are generated under the assumption that *dry* is a maximal adjective and has a top-closed scale. The truth-conditions for analogous sentences containing other inchoative verbs will vary in accordance with the scale-structure of the verb involved. For example, the truth-conditions for *The television blurred* might be as in (55b), and the truth-conditions for *The river widened* might be as in (56b).

(55) $[\![\texttt{POS}]\!]([\![\texttt{-en}]\!]([\![\texttt{blur}]\!]))(t)([\![\texttt{past}]\!](i))$

a. is defined only if $i \prec i_u$

b. if defined, equals T only if $\Delta(\textsc{blur})(t)(i) = \langle \textsc{min}_{\textsc{blur}}, d \rangle$, for some $d \in D_{\textsc{blur}} : \textsc{min}_{\textsc{blur}} <_{\textsc{dry}} d$

(56) $[\![\texttt{POS}]\!]([\![\texttt{-en}]\!]([\![\texttt{wide}]\!]))(r)([\![\texttt{past}]\!](i))$

a. is defined only if $i \prec i_u$

b. if defined, equals T only if $\Delta(\textsc{wide})(r)(i) = \langle d, e \rangle$, for some $d, e \in D_{\textsc{wide}} : d <_{\textsc{wide}} e$

In prose, (55b) requires there to be an interval preceding the utterance interval, during which the TV's blurriness increased from a minimal (i.e. zero) degree of blurriness to a non-zero degree; (56b) requires there to be an interval preceding the utterance interval, during which the river's degree of width increased. The analysis thus generates different types of truth-conditions for maximal, non-minimal and relative verbs, in accordance with the different types of scales these classes of verbs are associated with.

In §6.3, the scalar approach to verb meaning developed here is compared with the BECOME/small-clause approach described in Chapter 4; before providing this comparison, however, a few additional matters pertaining to the scalar approach deserve some attention.

6.2.2 Verbs with fully-closed scales

Inchoative verbs with fully-closed scales (arguably, *open*, *close*, *expose*, *empty*, *fill* and others) seem to pose a problem for the present analysis; evidence that a verb has a fully-closed scale comes from its compatibility with modifiers like *half* (e.g. *the door half opened*) (c.f. Bochnak 2013). Depending on one's assumptions about Interpretive Economy (i.e. whether it looks for the strongest or the weakest meaning that can be constructed using all available components of scale-structure), the property derived from a verb with a fully-closed scale should be either like (57) or (58). Where $\langle D_\alpha, <_\alpha \rangle$ is fully-closed,

(57) $[\![\texttt{POS}]\!](\langle\langle D_\alpha, <_\alpha\rangle, g_\alpha\rangle)(x)(i) = \text{T iff}$
$g_\alpha(x)(i) = \langle \text{MIN}_\alpha, \text{MAX}_\alpha \rangle$

(58) $[\![\texttt{POS}]\!](\langle\langle D_\alpha, <_\alpha\rangle, g_\alpha\rangle)(x)(i) = \text{T iff}$
$g_\alpha(x)(i) = \langle d, \text{MAX}_\alpha \rangle$, for some $d <_\alpha \text{MAX}_\alpha \vee$
$g_\alpha(x)(i) = \langle \text{MIN}_\alpha, d \rangle$, for some $d >_\alpha \text{MIN}_\alpha$

A property like the one in (57) seems too strong for any inchoative verb; for example, such a property would predict *The sink emptied* require the sink to go from completely full to completely empty. Similarly, a property like (58) will be too weak for most cases. For example, it would predict *The sink emptied* to require that the sink either lost all the water that was in it, or that it was completely full and lost some amount of water (perhaps just a single drop); the sentence cannot typically be used in the second type of situation (something like *The sink emptied a bit* would be used instead). Instead, what seems to be the case is that the property derived from a verb with a fully-closed scale is oriented either to a maximal degree (e.g. *empty*) or to a minimal degree (e.g. *expose*), but not to both; this parallels the case with adjectives. However, note that a constructed verb like *transparentize* does seem to behave rather like it has a property of the form in (58); *The* *liquid transparentized* can seemingly be used either if a fully opaque liquid gained some degree of transparency, or if a partially opaque liquid became fully transparent.[10] This might be taken as indication that more than just Interpretive Economy is at work in determining the nature of the property derived from established verbs with fully-closed scales. One possible reason for looking beyond Interpretive Economy in the generation of a property might be the avoidance of homophony; if just Interpretive Economy were involved, then antonymous pairs like *empty*/*full* and *close*/*open* would end up having synonymous bare forms, though their comparative forms would still yield different truth-conditions.[11] At any rate, the open problems posed by verbs and adjectives with fully-closed scales are not unique to the present scalar approach.

6.2.3 Variable telicity

An analysis of the so-called 'variable telicity' that many inchoative verbs exhibit (c.f. Dowty 1979; Abusch 1986; Kearns 2007; Kennedy and Levin 2008) is possible in the current degree-pair approach, and can be explained in exactly the same way as it is explained in the difference-degree approach of Kennedy and Levin (2008). Variable telicity is the phenomenon, first observed by Dowty (1979), whereby certain inchoative verbs appear to be interpretable either telically or atelically;[12] in the present approach, variable telicity can be assumed to result from some indeterminacy or context-sensitivity in how a property is derived from a verb. If the properties in (52) are thought of as default values assigned via Interpretive Economy on the basis of scale-structure, then it can be assumed that with enough contextual or co-textual support these default values can be overridden. By ignoring the structurally distinguished degree on a scale, a maximal (or 'default telic') verb could temporarily be associated with an 'atelic' property like that in (52-iii). With enough contextual support, it may also be possible to use a 'derived' maximal degree for the purpose of forming a standard-set, thus enabling a relative (or 'default atelic') verb to temporarily have a 'telic' standard-set like (52-i) (c.f. Hay et al. 1999). In any event, variable telicity is a complex phenomena on which more research is needed.

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[10]This example was pointed out by an anonymous reviewer with *The Journal of Semantics*.

[11]e.g. *The sink emptied more than the bathtub* ⇒ *The sink did not fill more than the bathtub*

[12]For example, the variable telicity of the verb *cool* is claimed to be evidenced by the fact that it can appear with both *in*-PPs and *for*-PPs (c.f. Dowty 1979, §2.3.5).

(i) a. The soup cooled in ten minutes.
b. The soup cooled for ten minutes.

6.2.4 Degree-pairs vs. difference degrees

In this section, additional motivation will be provided for a scalar analysis of inchoative verbs that involves degree-pairs. The use of degree-pairs is the main difference between the scalar analysis of inchoative verbs offered here and prior scalar analyses, most notably that of Kennedy and Levin (2008) where it is proposed that inchoative verbs involve functions that return differential degrees. A number of general arguments can be provided which motivate a degree-pair approach to the meaning of inchoative verbs over a differential degree approach.

Kennedy and Levin (2008) (henceforth 'KL') propose that the semantics of inchoative verbs should be assimilated to that of adjectival comparatives, which (following proposals in Kennedy and McNally 2005) they describe as involving DIFFERENCE FUNCTIONS. A difference function $m^{\uparrow}_{c}$ is derived from a measure function m and a comparative-standard degree c; the general idea is that $m^{\uparrow}_{c}$ should take an entity/moment pair as input and return a degree that represents the difference between the measurement of that entity at that moment and the comparative standard c. A definition of a difference function which captures the crucial elements of KL's proposal is given in (59).[13]

(59) For any measure function m from objects and times to degrees on a scale D_α, and for any $c \in D_\alpha$, the DIFFERENCE FUNCTION $m^{\uparrow}_{c}$ is the function such that:

i. its associated scale is $\{d \in D_\alpha : \exists d' \in D_\alpha : d' - c = d\} \cup \{0\}$, and

ii. for any x, t in the domain of m, if $m(x,t) \leq c$ then $m^{\uparrow}_{c}(x,t) = 0$

iii. for any x, t in the domain of m, if $c < m(x,t)$ then $m^{\uparrow}_{c}(x,t) = m(x,t) - c$

KL's particular proposal is that the scale-structure of the difference function should in certain respects mirror that of the underlying measuring function – in particular, if the scale of m contains a maximal degree, then the scale of $m^{\uparrow}_{c}$ should as well. This follows straightforwardly given the above definition – if the scale used by a measure function m has a maximal degree, then there will necessarily be a degree representing the maximal amount that an object's measurement can differ from the comparative standard degree c; this maximal difference degree will be $\textsc{max}_S - c$. The definition in (59) also requires that all difference function scales have a minimal (zero) degree; this minimal degree covers cases where the input object's degree measurement is either the same as or less than the comparative standard.[14] Thus,

[13]This definition assumes that degree addition and subtraction are defined. Note that the definition in (59) differs from the definition given by Kennedy and Levin (2008, p. 17); the definition they provide is technically not a difference function, as it does not make use of either degree addition or subtraction.

[14]In (59), a zero degree is added to a difference function scale in order to cover cases where the underlying measure function scale does not have a zero degree (as is the case with the scale used by WIDE.)

given the definition in (59), the scale of $\text{DRY}^{\uparrow}_{c}$ will (for any c) have both a minimal and a maximal degree; the scale of $\text{WIDE}^{\uparrow}_{c}$ will have a minimal but not a maximal degree.

KL apply this notion of a difference function to the semantics of inchoative verbs; in particular, KL propose that such verbs denote a special kind of difference function, one whose comparative standard is an object's measurement at the beginning of an interval. This difference function is then used to measure the difference between this interval-initial measurement and the object's measurement at the end of the interval.

Since difference functions in KL's analysis are assumed to be of the same semantic type as basic measure functions, degree modifiers (like POS) can combine with them in the same way they combine with basic adjectival measure functions. In the case of an unmodified inchoative verb, KL propose that the same covert POS operator that combines with adjectives combines with the inchoative verb. Thus, the sentences in (60) and (61) receive the following interpretations in their analysis.

(60) a. The river widened.
b. $\text{POS}(\text{WIDE}^{\uparrow}_{\text{WIDE}(\text{RIVER},\ \text{LB}_i)})(\text{RIVER}, \text{RB}_i)$

(61) a. The roof dried.
b. $\text{POS}(\text{DRY}^{\uparrow}_{\text{DRY}(\text{ROOF},\ \text{LB}_i)})(\text{ROOF}, \text{RB}_i)$

Assuming Interpretive Economy is at work, KL's analysis will correctly derive a default atelic interpretation for (60) and a default telic interpretation for (61). This is because the scale of a difference function built from DRY will contain a maximal degree as well as a minimal degree (in (61), the maximal degree will be $\text{MAX}_{\text{DRY}} - \text{DRY}^{\text{LB}_i}_{\text{ROOF}}$), whereas the scale of a difference function built from WIDE will contain only a minimal degree. In unmarked situations, the interpretations of (60) and (61) can thus be assumed reduce respectively to (62) and (63); (62) takes into account the minimal degree on the WIDE scale, and (63) takes into account the minimal and maximal degrees on the DRY scale.

(62) $\text{WIDE}^{\text{RB}_i}_{\text{RIVER}} - \text{WIDE}^{\text{LB}_i}_{\text{RIVER}} > 0$

(63) $[\text{DRY}^{\text{RB}_i}_{\text{ROOF}} - \text{DRY}^{\text{LB}_i}_{\text{ROOF}} > 0]\ \&$
$[\text{DRY}^{\text{RB}_i}_{\text{ROOF}} - \text{DRY}^{\text{LB}_i}_{\text{ROOF}} = \text{MAX}_{\text{DRY}} - \text{DRY}^{\text{LB}_i}_{\text{ROOF}}]$

The interpretation in (63) is telic because from it one can deduce that at the end of the interval the roof's degree of dryness was MAX_{DRY}. The interpretation in (62) is atelic because one can only deduce that at the end of the interval the river's wideness is greater than it was at the beginning. According to KL, variable telicity effects result when Interpretive

Economy is overridden; for example, context may provide a degree which can serve as a maximal degree on the WIDE scale, thus allowing a telic interpretation for (60), or it may make an atelic interpretation of (61) more prominent than a telic one. It is a significant advantage of this proposal is that the telicity properties of inchoative verbs can be explained in terms of the same meaning components (POS and scale-structure) that are at play in the adjectival domain. An additional advantage of analyzing the meanings of inchoative verbs in terms of difference functions is that measure phrases that modify such verbs (like *two metres* in *The river widened two metres*) are immediately predicted to qualify the amount of change that an object underwent.

While these advantages are notable, KL's general proposal faces some substantial problems. One of the main motivations for pursuing the difference function approach to inchoative verbs is to assimilate the semantics of verbs to the semantics of comparatives. However, the very mechanisms that allow KL to explain the default telicity values of inchoative verbs – the presence or absence of a maximal degree on the scale of a difference function, and the sensitivity of POS to this degree – actually make incorrect predictions when it comes to comparatives. For example, consider the sentence in (64a), which under KL's analysis receives the interpretation in (64b).

(64) a. The roof is drier than the driveway.
b. $\text{POS}(\text{DRY}^{\uparrow}_{\text{DRY(DRIVEWAY},\ t)})(\text{ROOF}, t)$

Since the standard associated with a top-closed difference function is by default set to the maximal degree, KL's analysis will predict that the bare form of a comparative built from a total adjective should require its input entity argument to bear the maximal degree of the associated property. That is, in unmarked situations, the interpretation in (64b) will reduce to (65), just as (61b) reduces to (63).

(65) $[\text{DRY}^t_{\text{ROOF}} - \text{DRY}^t_{\text{DRIVEWAY}} > 0]\ \&$
$[\text{DRY}^t_{\text{ROOF}} - \text{DRY}^t_{\text{DRIVEWAY}} = \text{MAX}_{\text{DRY}} - \text{DRY}^t_{\text{DRIVEWAY}}]$

However, (65) is equivalent to (66). Thus, (64a) is predicted to have the same truth conditions as (67).

(66) $\text{DRY}^t_{\text{ROOF}} = \text{MAX}_{\text{DRY}}\ \&\ \text{DRY}^t_{\text{DRIVEWAY}} \neq \text{MAX}_{\text{DRY}}$

(67) The roof is dry and the driveway is not dry.

KL's analysis thus predicts that (64a) should, in unmarked situations, carry an implication that the roof is completely dry. Such an inference is not attested.

(68) The roof is drier than the driveway. $\not\Rightarrow$ The roof is dry.

Importantly, this incorrect prediction follows from the very same assumptions that KL use to explain the default telic interpretation of a sentence like *The roof dried.* In order to avoid making this incorrect prediction, one would need to find a way to ensure that maximal degrees on difference scales are ignored by comparatives (but not by inchoative verbs); that is, it must be ensured that the standard for comparatives (but not inchoative verbs) will always be the zero degree on the difference scale, regardless of whether or not the underlying adjective has a scale with a maximal degree.[15]

Another potential problem with KL's analysis relates to verbs derived from adjectives with bottom-closed scales; in the absence of additional assumptions, a sentence like *The image blurred* will receive an interpretation similar to *The river widened* – namely, one which requires only that the difference between the image's interval-initial blurriness and its interval-final blurriness is greater than 0 (assuming for the sake of argument that the BLUR scale does not have a maximal degree). This is because, in default contexts, the standard for any difference scale which lacks a maximal degree will be set to the zero degree on the difference scale.

(69) a. The image blurred.
b. $\text{POS}(\text{BLUR}^{\uparrow}_{\text{BLUR(IMAGE, LB}_i)})(\text{IMAGE}, \text{RB}_i)$
c. $\text{BLUR}^{\text{RB}_i}_{\text{IMAGE}} - \text{BLUR}^{\text{LB}_i}_{\text{IMAGE}} > 0$

However, the default interpretation of a sentence like *The image blurred* is intuitively one in which the image begins sharp (i.e. at the bottom of the blurriness scale) and achieves some minimal degree of blurring; *The image blurred* does not typically mean simply that *The image got blurrier.* That is, the default interpretation of (69a) is not the one given in (69c), but the stronger one in (70).

(70) $\text{BLUR}^{\text{RB}_i}_{\text{IMAGE}} - \text{BLUR}^{\text{LB}_i}_{\text{IMAGE}} > 0 \ \& \ \text{BLUR}^{\text{LB}_i}_{\text{IMAGE}} = \text{MIN}_{\text{BLUR}}$

The second conjunct in the default interpretation does not follow directly in KL's analysis, since when `POS` applies as in (69b) it is sensitive only to the amount of difference between two measurements, not to where those two measurements line up on the scale of the measure function underlying the difference function. Thus, additional assumptions will be needed to

[15] Chris Kennedy (P.C.) suggests that a possible response to this objection might be that a maximal standard interpretation for a comparative like (64a) is ruled out by the meaning of the bare form and something like a conventionalized implicature. If a listener assumes that comparative morphosyntax is chosen by a speaker in order to convey a meaning not conveyable with just the bare form and its negation, then a minimal standard interpretation for *x is drier than y* will be selected.

explain why verbs derived from adjectives with bottom-closed scales typically require their object to begin with the minimal amount of the relevant property. Note that the degree-pair analysis proposed in §6.2.1 straightforwardly derives the default interpretations for inchoative verbs with bottom-closed scales since, unlike a differential degree, a pair by definition contains information not only about the size of the difference between two measurements, but also what those measurements are.[16]

KL's difference-function approach does seem to have an advantage over one based on degree-pairs when it comes to interpreting differential measure phrases (like *ten metres* in *widen ten metres*); in a difference function approach, such measure phrases can be immediately interpreted, whereas in a degree-pair approach an additional operation taking the difference between the degrees in a pair is needed. However, it is perhaps of note that differential measure phrases optionally appear with the preposition *by*, as in *widen by ten metres*. One might view *by* as denoting an operator which, when presented with a pair-returning function like *widen*, mediates between a degree and a degree-pair by taking the size of the pair and comparing it to the degree.[17]

(71) $[\![\texttt{by}]\!](d)(\langle\langle D_\alpha, <_\alpha\rangle, g_\alpha\rangle)(x)(i) = \mathrm{T}$ iff $\exists b, c : g_\alpha(x)(i) = \langle b, c\rangle \ \&\ c - b \geq d$

The phonological absence of *by* in *widen ten metres* might be viewed as the result of a phonological reduction operation, or may be assumed to involve a covert variant of *by*.

When measure phrases other than differential measure phrases are taken into consideration, the data actually seems to support an analysis of inchoative verbs based on something richer than the difference functions proposed by KL for handling comparatives. A verb like *widen* can be modified not only by a measure phrase that measures the difference between an initial and final measurement, but also by 'directional' measure phrases that specify what those initial and final measurements are:

(72) The river widened [(by) ten metres] [from twenty metres] [to thirty metres].

In contrast, comparatives can only be modified by differential measure phrases; there are no modifiers that can be added to a comparative which specify the measurements of the two objects being compared:

[16] Due to similar considerations, inchoative verbs with fully closed scales will be predicted in KL's analysis to behave uniformly like verbs with top-closed scales; this prediction is also incorrect, if one takes a verb like *open* to have a fully closed scale.

[17] If one adopts the proposals in Chapter 5 that degrees represent measurements in an infinite difference system, then the subtraction operation in this definition can be replaced with the FF function described in that chapter; measure phrases could then be handled as in §5.2.2.1.

(73) a. Godzilla is ten metres taller than King Kong.
b. Godzilla is taller than King Kong by ten metres.

(74) Godzilla is taller than King Kong [*from twenty metres] [*to thirty metres].

This data can be taken as evidence that inchoative verbs have access to a richer sort of information than comparatives do; while the latter have access only to a difference degree, the former have access to (at least) the interval-initial and interval-final measurements of an object, from which a difference degree can be obtained if necessary. A degree-pair is one way of representing the richer sort of information that inchoative verbs are able to access.[18]

6.3 Comparison of the scalar and BECOME/small-clause approaches

In this section, the scalar analysis of inchoative verbs just presented will be compared to the BECOME/small-clause (BC-SC) decompositional analysis described in Chapter 4. Particular attention will be paid to how the two analyses handle result-state inferences and adverbial modification.

6.3.1 Result-state inferences

As discussed in §4.3.6, one of the main drawbacks of the traditional BC-SC analysis of inchoative verbs is that it fails to capture generalizations linking certain features of a gradable adjective (e.g. whether it is relative or absolute) with certain features of a morphologically-related verb (e.g. whether it gives rise to bare form or comparative result-state inferences). Scalar analyses of inchoative verbs have been devised with these generalizations in mind, with scales providing the relevant link between adjective and verb meaning.

Recall from Chapter 4 that inchoative verbs derived from absolute adjectives give rise to result-state inferences that are characterized with the bare form of the adjective (as in (75)),

[18] Bobaljik (2012) provides morphological evidence from a large number of languages that supports a universal 'comparative/change-of-state generalization', which states that "if the comparative [form] of an adjective is suppletive, then the corresponding change-of-state verb is also suppletive" (Bobaljik 2012, p.171). As Bobaljik argues, this generalization can be explained if inchoative verbs (at least those whose corresponding adjectives have a synthetic comparative form) are built from comparatives, e.g. if *widen* is represented as `[ [ wide -ER ] -EN ]`. As it stands, KL's semantic analysis of inchoative verbs (in which the semantics of inchoative verbs is based on the semantics of comparatives) is closer to the form required by Bobaljik's proposed structure; future work will have to determine how an account of inchoative verbs that contains the required richness of the degree-pair approach can be made compatible with Bobaljik's proposals about the morphological structure of inchoative verbs.

whereas inchoative verbs derived from relative adjectives give rise to weaker result-state inferences characterized with the comparative form of the adjective (as in (76)).

(75)
a. The shirt has dried. $\Rightarrow$ The shirt is dry.
b. The image has blurred. $\Rightarrow$ The image is blurry.
c. The door has opened. $\Rightarrow$ The door is open.
d. The sink has emptied. $\Rightarrow$ The sink is empty.

(76)
a. The river has widened. $\not\Rightarrow$ The river is wide.
$\Rightarrow$ The river is wider than before.
b. The path has narrowed. ?$\Rightarrow$ The path is narrow.
$\Rightarrow$ The path is narrower than before.
c. The gap has shortened. $\not\Rightarrow$ The gap is short.
$\Rightarrow$ The gap is shorter than before.
d. The universe has expanded. $\not\Rightarrow$ The universe is expansive.
$\Rightarrow$ The universe is more expansive than before.

This data was shown to be problematic for the BC-SC approach to inchoative verbs. Capturing the generalizations just described would require some way of ensuring that relative adjectives appear only in comparative decompositions, and that absolute adjectives appear only in bare-form decompositions. It is not apparent how this could be accomplished in a non-stipulative way.

The result-state generalizations fall out correctly from a scalar analysis of inchoative verbs like the one presented in §6.2 (and in other accounts, c.f. Winter 2006; Kennedy and Levin 2008). Moreover, there is no need to assume different syntactic representations for verbs based on whether they have bare form or comparative result-states; instead, the correct results are obtained in virtue of the fact that both adjectives and their corresponding verbs share the same scale, and that property-forming $[\![\texttt{POS}]\!]$ (which applies to both adjectives and verbs) is sensitive to scale-structure.

To see how the scalar analysis yields the correct result-states for inchoative verbs, consider first how the maximal verb *dry* is predicted to have a bare-form inference. The truth-conditions for *Godzilla dried* (omitting tense) are shown below in (77b); note that these truth-conditions entail (77c).

(77)
a. $[\![\texttt{POS}]\!]([\![-\texttt{en}]\!]([\![\texttt{dry}]\!]))(g)(i) = \mathrm{T}$ iff
b. $\Delta(\textsc{dry})(g)(i) = \langle d, \textsc{max}_{\textsc{dry}}\rangle$, for some $d <_{\textsc{dry}} \textsc{max}_{\textsc{dry}}$ $\models$
c. $\textsc{dry}_g^{\textsc{sup}_i} = \textsc{max}_{\textsc{dry}}$ iff
d. $[\![\texttt{POS}]\!]([\![\texttt{dry}]\!])(g)(\{\textsc{sup}_i\})$

But note that (77c) means that $(g)(\textsc{sup}_i)$ satisfy the bare-form of the adjective *dry*. This means that if *Godzilla dried* is true of an interval i, then *Godzilla is dry* will be true of an interval that contains $\textsc{sup}_i$; in other words, a bare-form result-state inference is predicted for a maximal verb like *dry*.[19]

Analogous reasoning applies to non-minimal verbs/adjectives. The truth-conditions for *The TV blurred* (omitting tense) are shown in (78b); (78b) entails (78c).

(78) a. $[\![\texttt{POS}]\!]([\![-\texttt{en}]\!]([\![\texttt{blur}]\!]))(t)(i) = \text{T}$ iff

b. $\Delta(\text{BLUR})(t)(i) = \langle \text{MIN}_{\text{BLUR}}, d\rangle$, for some $d >_{\text{BLUR}} \text{MIN}_{\text{BLUR}}$ $\models$

c. $\text{MIN}_{\text{BLUR}} <_{\text{BLUR}} \text{BLUR}_t^{\text{SUP}_i}$ iff

d. $[\![\texttt{POS}]\!]([\![\texttt{blur}]\!])(t)(\textsc{sup}_i) = \text{T}$

But (78c) means that $(t)(\textsc{sup}_i)$ satisfy the bare form of the adjective *blurry*. This means that if *The TV blurred* is true of an interval i, then *The TV is blurry* will be true of an interval that contains $\textsc{sup}_i$; thus, a bare-form result-state inference is predicted for a non-minimal verb like *blur* as well.

The situation is different for a relative adjective like *wide*. The truth-conditions for *The river widened* (tense omitted) are shown below in (79b); note that (79b) is equivalent to (79c).

(79) a. $[\![\texttt{POS}]\!]([\![-\texttt{en}]\!]([\![\texttt{wide}]\!]))(t)(i) = \text{T}$ iff

b. $\Delta(\text{WIDE})(r)(i) = \langle d, e\rangle$, for some $d, e : d <_{\text{WIDE}} e$ $\equiv$

c. $\text{WIDE}_r^{\text{INF}_i} <_{\text{WIDE}} \text{WIDE}_r^{\text{SUP}_i}$

Although adjectival comparatives have not been discussed in this chapter, one can easily see that, given (79c), a sentence like *The river is wider than before* will be true of $(r, \textsc{sup}_i)$; hence, a relative verb like *widen* should at least have a comparative result-state inference.

However, supposing that (79c) is true, one cannot infer that *The river is wide* is true of $(r)(\textsc{sup}_i)$ Recall that when $[\![\texttt{POS}]\!]$ is applied to the bare-form of a relative adjective like *wide* (one whose scale lacks a maximal or minimal degree), it results in a property that is true of an object-moment pair only if the object's measurement at that moment is greater than some contextually-provided degree; this is shown in (80).

(80) a. $[\![\texttt{POS}]\!]([\![\texttt{wide}]\!])(t)(\textsc{sup}_i) = \text{T}$ iff

b. $d_c <_{\text{WIDE}} \text{WIDE}_r^{\text{SUP}_i}$

(where d_c is a contextually-specified degree of D_{WIDE})

[19] Note that (77c) entails $\forall m \in \{\textsc{sup}_i\} : \textsc{dry}_g^m = \textsc{max}_{\textsc{dry}}$. This means that $[\![\texttt{be}]\!]([\![\texttt{POS}]\!]([\![\texttt{dry}]\!]))(g)(\{\textsc{sup}_i\})$ will be true.

(79c) does not entail (80b); note that (79c) could be true even when $\text{WIDE}_r^{\text{INF}_i} <_{\text{WIDE}} \text{WIDE}_r^{\text{SUP}_i} <_{\text{WIDE}} d_c$, which contradicts (80b). Hence, a relative verb like *widen* is expected to give rise to a comparative result-state inference, but not a bare-form one.[20]

Unlike the BC-SC account of inchoative verbs, then, a scalar analysis like the one presented here can straightforwardly derive the correct result-states for different inchoative verbs; moreover, this can be accomplished while assuming a uniform syntax and semantics for maximal, non-minimal and relative inchoative verbs.

6.3.2 Adverbial modification

Since the time of the generative semanticists, the BC-SC approach to inchoative verbs was claimed to provide an elegant explanation for how certain adverbials can access result-states: they can appear in the stative small-clause in the decomposition of a predicate. With this assumption, certain ambiguities involving adverbs like *again*, *almost* and *for*-PPs could then be explained in terms of the ability of an adverbial to attach either above or below `BECOME`. In Chapter 4, it was shown that the BC-SC approach is, despite first appearances, highly problematic; it overgenerates ambiguities, and it derives incorrect truth-conditions for many sentences with decomposition-internal adverbials. In this section, it will be shown how a scalar analysis of inchoative verbs offers a new way to look at result-state modification, and does not suffer from the same ambiguity-overgeneration problem. In addition, it is shown that a scalar approach to inchoative verb meaning makes possible the semantic analysis of additional classes of adverbials, which escape the grasp of a BC-SC approach.

6.3.2.1 'Degree' modifiers: *halfway*, *slightly*, *completely*

Modifiers which, in a BC-SC analysis, plausibly have small-clause internal attachment sites include 'degree modifiers' like *halfway*, *slightly*, and *completely*; the (b) sentence in each pair below appears at first glance to be a plausible paraphrase for the (a) sentence.

(81) a. The door opened halfway.
b. The door became halfway open.

(82) a. The door opened slightly.
b. The door became slightly open.

[20] Showing this more concretely would require being more explicit about how context determines the bare-form standard for a relative adjective like *wide*, which would require introducing some form of intensionality into the semantic framework.

(83) a. The door opened completely.
b. The door became completely open.

In fact, such modifiers would arguably only have an attachment site below BECOME, since they do not yield ambiguities in the way that *almost* and *again* do; they only seem able to modify the 'result-state' component of the meaning.

While such examples might seem to support a BC-SC analysis of inchoative verbs, this is in fact not the case. As discussed in §4.3.3, the BC-SC analysis generally produces incorrect truth-conditions sentences with decomposition-internal adverbs. For example, the BC-SC analysis incorrectly predicts (81a) to be true when the door transitions from completely open to halfway open (i.e. when it closes halfway), and incorrectly predicts (82a) to be true when the door transitions from completely open to slightly open (i.e. when it closes most of the way). The problem is that, due to the meaning of BECOME, a small-clause-internal adverb affects not only the result-state component of the truth-conditions, but the pre-state component as well. Thus, considerations internal to the BC-SC analysis provide motivation to look for an alternative explanation of apparent cases of result-state modification, an explanation which does not rely on decompositions involving BECOME.

As it turns out, a scalar analysis of inchoative verbs is naturally designed to handle 'degree-modifiers' like *halfway*, *slightly* and *completely*. For example, *halfway* might have a denotation like that in (84).[21]

(84) $[\![\texttt{halfway}]\!](\langle\langle D_\alpha, <_\alpha\rangle, g_\alpha\rangle)(x)(i)$
a. is defined only if $\langle D_\alpha, <_\alpha\rangle$ has a minimal and maximal degree
b. where defined, equals T only if $g_\alpha(x)(i) = \langle \textsc{min}_\alpha, e\rangle$, where $e - \textsc{min}_\alpha = \textsc{max}_\alpha - e$.

This denotation should be taken as an approximation only.[22] Note, however, that a denotation like (84) will generate truth-conditions for (81a) that are more accurate than those generated by the BC-SC account; in particular, they will require that the door's degree of openness increased to the halfway point. These more accurate truth-conditions are made possible by the fact that a scalar analysis of inchoative verbs (in particular, one that involves degree-pairs) allows adverbials to directly access an object's interval-initial and/or interval-final measurement.

The adverb *slightly* can be viewed as expressing that the amount of scalar change an object underwent is 'small'. Note that this adverb is compatible with maximal, non-minimal and relative verbs.

[21] See Bochnak (2013) for discussion on *half*; the denotation for *halfway* in (84) is similar to Bochnak's denotation.
[22] For an idea on how degree subtraction should be viewied, see footnote 17.

(85) a. Godzilla dried slightly.
b. The image blurred slightly.
c. The river widened slightly.

Note also that when it modifies a maximal verb like *dry*, there is no longer an inference that the maximal degree of dryness was attained. Thus, a possible denotation for *slightly* might be the following.

(86) $[\![\texttt{slightly}]\!](\langle\langle D_\alpha, <_\alpha\rangle, g_\alpha\rangle)(x)(i) = \text{T iff}$
$g_\alpha(x)(i) = \langle d, e\rangle$, where $d <_\alpha e$ & d is 'close' to e on $\langle D_\alpha, <_\alpha\rangle$.

This denotation should also be seen as a first approximation; there are questions as to what it means for two degrees on a scale to be 'close', questions which would need to be worked out in a fuller analysis.[23] In addition, this denotation has substantial overlap with that of `POS` (since it requires positive scalar increase), which might be undesirable in a more complete analysis. However, the denotation does show how a scalar approach to inchoative verbs allows for the semantics of degree modifiers to be explored with ease, something which is not possible in a BC-SC analysis.

While degree adverbs like *halfway*, *slightly* and *completely* all demand closer examination, the brief discussion undertaken here demonstrates that a scalar analysis of inchoative verbs can offer insight into the meanings of certain adverbials, as they can be assigned meanings that operate on the scalar components of a verb denotation. Thus, in an important respect, the scalar components of verb meaning can take the place of the small-clause in the BC-SC analysis, and yield more accurate results.

6.3.2.2 *Almost*

The observation that the adverb *almost* apparently gives rise to ambiguities when it modifies certain verbs was offered as an early argument that such verbs should be decomposed into `BECOME` and a small-clause (e.g. Morgan 1969; McCawley 1973b). The sentence in (87) is an example of the kind of sentence that is claimed to be ambiguous; the claimed ambiguity is between a reading which is paraphrasable as (87a), and another which is paraphrasable as (87b).

(87) Godzilla almost dried.
a. It almost came to be that Godzilla dried.
b. Godzilla became almost dry.

[23] See Solt (2012) for discussion on adjective-modifying usages of *slightly*.

Note that (87a) does not imply that Godzilla underwent any change in his level of dryness, whereas (87b) does; in a BC-SC analysis, the reading paraphrasable as (87b) is the one generated when *almost* appears in the small-clause below `BECOME`.

Although examples like (87) have been presented as support for a BC-SC analysis, it was shown in §4.3.3 that this type of analysis actually produces incorrect truth-conditions for sentences where *almost* appears internal to the decomposition (i.e. below `BECOME`). For example, the BC-SC analysis incorrectly predicts the result-state reading of (87) to be true when Godzilla transitions from being completely dry to slightly less than completely dry (i.e. from being not almost dry to being almost dry). This incorrect prediction arises, once again, because a small-clause-internal adverb affects not only the result-state component of the truth-conditions, but the pre-state component as well.

A scalar analysis of inchoative verbs allows for a number of alternative explanations of the result-state reading of sentences like (87) to be pursued. One might treat *almost* as a degree-modifier, similar to *completely*, *halfway* and *slightly*, as there is precedent for the idea that *almost* is sensitive to scale-structure (c.f. Aranovich 1995; Rotstein and Winter 2004; Winter 2006). Alternatively, one might view *almost* as being a propositional operator with a general counterfactual meaning, along the lines of Nouwen (2006); under such a view, a sentence like (87) would not be ambiguous, but underspecified. Both alternatives are briefly discussed here.

Regarding the first alternative, note that *almost* is not limited to modifying verbs and verb-phrases; it can also modify adjectives, quantifiers and arguably prepositional-phrases as well.[24]

(88) a. Godzilla is almost dry.
b. Almost all my friends are here.
c. I ran almost to the park.

In their analysis of adjective-modifying uses of *almost*, Rotstein and Winter (2004) argue that *almost* is sensitive to the scale-structure of an adjective, appearing most naturally with maximal adjectives. Winter (2006) discusses how the scale-sensitivity of *almost* is also apparent in PP-modifying and verb-modifying usages, where it most naturally appears with maximal verbs and with PPs that denote closed paths. As an example of the type of verb-modifying, scale-sensitive meaning that might be assigned to *almost*, consider (89).

[24]According to Winter (2006), sentences like (88c) are not accepted by all speakers.

(89) $[\![\texttt{almost}]\!](\langle\langle D_\alpha, <_\alpha\rangle, g_\alpha\rangle)(x)(i)$

a. is defined only if $\langle D_\alpha, <_\alpha\rangle$ has a maximal degree

b. where defined, equals T only if $g_\alpha(x)(i) = \langle d, e\rangle$, where $d <_\alpha e <_\alpha \text{MAX}_\alpha$ & e is 'close' to MAX_α on $\langle D_\alpha, <_\alpha\rangle$.

While this denotation should be seen as a first approximation only, note that it will generate truth-conditions for the result-state reading of *Godzilla almost dried* that are more accurate than those generated by the BC-SC account; in particular, they will require that Godzilla's level of dryness increase to a near maximal degree. These more accurate truth-conditions are once again made possible by the fact that a scalar analysis of inchoative verbs allows for the interval-final measurement of an object to be isolated by an adverbial.

Of course, the meaning in (89) will only explain the result-state reading of (87); for the 'counterfactual' reading, a separate meaning for *almost* would be required. However, it is not so clear that sentences like (89) are in fact ambiguous; Dowty (1979, p.243) and others have questioned whether *almost* actually gives rise to ambiguities, or whether apparent cases of ambiguity are in fact cases of underspecification. In this regard, it has been noted that the 'result-state' reading of a sentence like (87) entails the 'counterfactual' reading. Thus, it may be that a verb-modifying, scale-sensitive meaning for *almost* is not required; *almost* might be viewed as simply being a intensional operator with a counterfactual component. For example, suppose the truth-conditions of *Godzilla almost dried* expresses that there is some possible world which differs minimally from the actual world, in which *Godzilla dried* is true; the minimal difference between a possible world and the actual world might be due to Godzilla attaining a slightly different degree of dryness in both worlds, or might be due to other, non-scale-related considerations. Nouwen (2006) sketches a counterfactual analysis of *almost* along exactly these lines, indicating how scalar meanings indirectly interact with *almost* by providing salient ways in which worlds might minimally differ. Thus, regardless of whether *almost* is treated as having a directly scale-sensitive meaning, or whether it is treated as having a purely counterfactual meaning, a scalar analysis of inchoative verbs can offer insight into its workings not afforded by a BC-SC analysis.

6.3.2.3 *Again*

Unlike *almost*, *halfway*, *completely* and *slightly*, there is no precedent for the view that *again* has a scale-sensitive meaning; the most influential view of *again* treats the adverb as denoting a function from propositions to propositions, and uses a BC-SC decomposition to obtain the different readings of ambiguous sentences (c.f. von Stechow 1995, 1996). In the next chapter, it will be argued that *again* is actually polysemous, having a scale-sensitive meaning in addition to the standard meaning it is usually assigned; the proposed polysemy can explain the ambiguities that arise when *again* appears with an inchoative verb, without requiring such verbs to be syntactically decomposed into multiple propositional levels.

6.3.2.4 Ambiguity overgeneration

By foregoing syntactically decomposing inchoative verbs into multiple proposition levels, a scalar analysis of inchoative verbs like the one presented in this chapter avoids the problem of ambiguity overgeneration faced by the BC-SC analysis (see Chapter 4, §4.3.1). The question faced by such an analysis is rather how adverbial-ambiguities can arise at all.

As is argued in detail in the next chapter for *again*, one way in which such ambiguities can arise is through polysemy. Although the scalar analysis forgoes positing the presence of a stative predicate in the syntactic analysis of an inchoative verb, it does make semantically available to modification the scalar components of a verb's meaning. An adverb which is associated both with a meaning that is able to access the scalar components of a verb denotation, as well as with a meaning that operates on properties or propositions, will be expected to give rise to ambiguities if word-order does not distinguish between a verb-modifying and VP-modifying attachment site. As discussed further in the next chapter, a polysemy approach to adverbial ambiguities accords better with attested cross-linguistic and cross-speaker variation in reading availability than does a decompositional approach.

6.3.2.5 Differential and directional measure phrases

As discussed in §4.3.4, adverbials which appear to be problematic for a BC-SC analysis include differential measure phrases, which quantify the amount of change an object has undergone, as well as directional measure phrases, which describe where on a scale an object started and finished its transition. Examples of differential measure phrases are shown in (90), and examples of directional measure phrases are shown in (91).

(90) a. The river widened (by) ten metres
b. The shirt dried a little bit.
c. The temperature fell substantially.

(91) a. The river widened from twenty to thirty metres.
b. The branch grew from ten to sixteen inches.
c. The temperature fell from twenty degrees (down) to five degrees.

It can be seen quite easily that a scalar analysis of inchoative verbs like the one presented here provides the necessary ingredients for an analysis of differential measure phrases and directional measure phrases. In fact, directional measure phrases appear to demand a scalar analysis with at least the structure of a degree-pair.[25] The two degrees in the degree-pair returned by a MOC-function provide the initial and final measurements accessible by directional measure phrases; an operation that takes the distance between these two degrees can provide the measurement accessed by a differential measure phrase. A sketch of an analysis for differential measure phrases is shown in (92), and for directional measure phrases in (93).

(92) $[\![\texttt{by ten metres}]\!]([\![-\texttt{en}]\!]([\![\texttt{wide}]\!]))(r)(i) = \text{T iff}$
$\Delta(\text{WIDE})(r)(i) = \langle d, e\rangle \;\&\; e - d = c \;\&\; [\![\texttt{ten metres}]\!](c)$

(93) $[\![\texttt{from twenty to thirty metres}]\!]([\![-\texttt{en}]\!]([\![\texttt{wide}]\!]))(r)(i) = \text{T iff}$
$\Delta(\text{WIDE})(r)(i) = \langle d, e\rangle \;\&\; [\![\texttt{twenty metres}]\!](d) \;\&\; [\![\texttt{thirty metres}]\!](e)$

There is much complexity to measure phrase and degree-path modification that cannot be discussed here; however, it should be apparent that a scalar approach to verb meaning provides a much more promising avenue for the exploration of such modifiers than a non-scalar approach.

6.3.2.6 Durative modifiers

The most uncontroversial examples of result-state modification are perhaps those which involve durative modifiers like *temporarily* and *for*-PPs. The sentences in (94) have readings which can be paraphrased as in (95).

(94) a. The sponge dried temporarily / for a few minutes.
b. The image blurred temporarily / for a few minutes..
c. The river widened temporarily / for a few minutes.

(95) a. The sponge dried, but only remained dry temporarily / for a few minutes.
b. The image blurred, but only remained blurry temporarily / for a few minutes.
c. The river widened, but only remained at that width temporarily / for a few minutes.

[25] See the discussion in §6.2.4. See also Krifka (1998, §4.6), Zwarts and Winter (2000) and Zwarts (2005) for related discussion. These authors analyze directional prepositions (like *from* and *to*) in terms of path structures. Note that path structures are formally richer than degree-pairs; this additional richness allows for a general analysis of directional prepositions, as many directional prepositions (e.g. *around*) involve movements that are more complex than movement along a one-dimensional measurement scale. Krifka's (1998) semantics for change-of-state verbs makes general use of path structures, one kind of which are degree-paths.

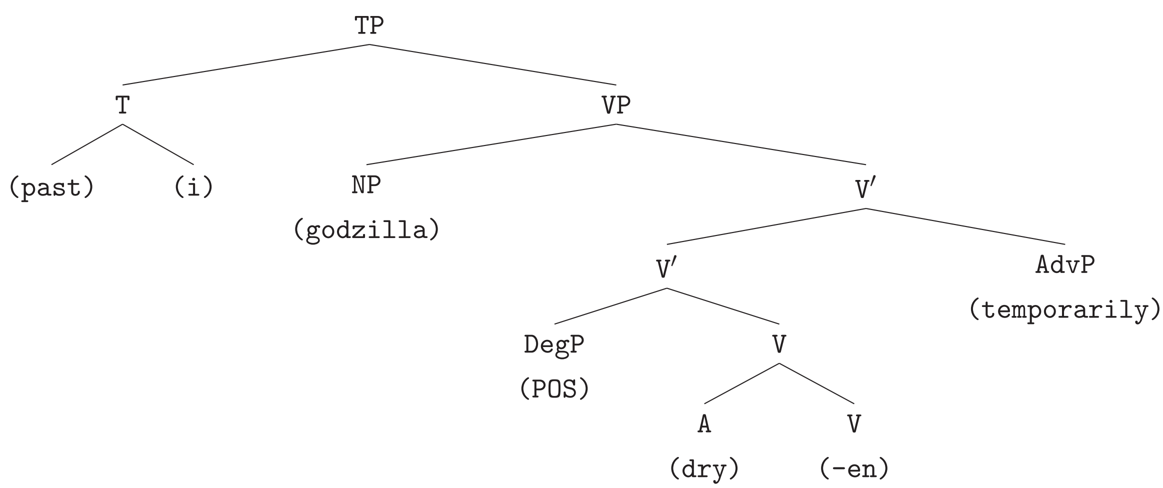
As shown in Chapter 4, the BC-SC analysis can generate adequate truth-conditions for sentences where *temporarily* appears below BECOME; however, it generates incorrect truth-conditions for sentences where *for*-PPs appear below BECOME for the same reason that it falters on *halfway*, *slightly* and *almost*.

Unlike the other adverbs considered above, a scalar analysis of inchoative verbs does not obviously shed new light on how durative adverbs access result-states; there is less reason than in the other cases to think that such adverbials operate on scalar meanings. Note that they appear outside of adverbials that are more convincingly thought of as degree modifiers.

(96) a. The sponge dried a little bit temporarily.
b. The image blurred slightly for a few minutes.
c. The river widened twenty metres temporarily.

Such examples suggest that in a sentence like *Godzilla dried temporarily*, the adverb *temporarily* attaches outside POS, as shown in (97).

(97)



If this is the case, then there must be a way for durative modifiers to access the duration of a result-state that does not rely on accessing the scalar component of verb-meaning, as this component is no longer accessible after ⟦POS⟧ applies. How this is possible will not be pursued here; such adverbs may show that additional structure is called for in the VP, or that verb-meanings should be enriched in some additional way. At any rate, durative adverbials currently present a problem for both the BC-SC and scalar analyses of inchoative verbs.[26]

[26] Von Stechow (1995, §10) suggests that durative adverbials might actually be appositives, i.e. that "they deliver 'subordinate' information, and are neglected for the 'ordinary' composition."

6.3.3 Result-state/pre-state asymmetries

As discussed in §4.1, there is an asymmetry between pre-states and result-states with respect to both modifier accessibility and deictic reference. Regarding the latter, recall that the phrase *that way* can refer deictically to the result-state implied by an inchoative verb; the sentences in (98) can be paraphrased as in (99).

(98) a. The shirt dried, and remained that way until it rained.
b. The image blurred, and remained that way until the TV was fixed.
c. The river widened, and remained that way until the rain stopped.

(99) a. The shirt dried, and remained dry until it rained.
b. The image blurred, and remained blurry until the TV was fixed.
c. The river widened, and remained wider than before until the rain stopped.

While the result-state of an inchoative verb can be picked out deictically, the pre-state cannot. Thus, the sentences in (100) cannot be understood as meaning the same as the sentences in (101) without additional contextual support.

(100) a. The shirt dried. #Before drying, it had been that way for a few days.
b. The image blurred. #Before blurring, it had been that way for a few hours.
c. The river widened. #Before widening, it had been that way for a few months.

(101) a. The shirt dried. Before drying, it had been wet for a few days.
b. The image blurred. Before blurring, it had been crisp for a few hours.
c. The river widened. Before widening, it had been at its previous width for a few months.

Although an inchoative verb implies some kind of pre-state, the implied pre-state cannot be automatically picked out by deictic phrases like *that way.*

As it currently stands, the BC-SC analysis of inchoative verbs may appear to have an advantage over the present scalar analysis with respect to explaining this asymmetry; recall that, for example, the stative property $[_{\mathrm{AP}}\ \mathtt{dry}\ ]$ is syntactically present in the decomposition assigned to *The shirt dried*, and thus could be the target for deictic reference in a sentence like (98a). In the scalar analysis of the same sentence, the adjective *dry* is also present, though not in its bare (positive) form (i.e. not as $[_{\mathrm{AP}}\ [_{\mathrm{DegP}}\ \mathtt{POS}\ ]\ [_{\mathrm{A}}\ \mathtt{dry}\ ]\ ]$); rather, the verb *dry* is analyzed as $[_{\mathrm{V}}\ [_{\mathrm{A}}\ \mathtt{dry}\ ]\ [_{\mathrm{V}}\ \mathtt{-en}\ ]\ ]$. In a scalar analysis, then, the deictic reference to a stative property would be less direct; this may or may not be a drawback to the analysis. In any case, it is not so clear that *that way* must have a syntactic antecedent. An alternative analysis might hold that a phrase like *that way* can pick out a salient degree, the measurement of the object at the end of the topic interval. The question for such an analysis would then be what makes an interval-final measurement more salient than an interval-initial measurement. This is an important question, which is left for future consideration.

Note that a similar asymmetry exists with respect to durative modifiers; they can access result-states, but not pre-states. For example, a sentence like *The door opened for ten minutes* does not have a reading paraphrasable as *The door opened, and prior to that was closed for ten minutes*. In an ideal analysis, this latter asymmetry would be traced to the same source as the asymmetry in deictic reference.

6.4 Summary

In this chapter, a scalar analysis of inchoative verbs was presented and compared with the `BECOME`/small-clause analysis described in Chapter 4. The scalar analysis was shown to compare favorably to the BC-SC analysis; most notably, it captures generalizations linking features of gradable adjectives to features of inchoative verbs, generalizations that are missed by a BC-SC approach. In addition, it does not suffer from an ambiguity-overgeneration problem, is able to handle sentences whose truth-conditions are problematic for the BC-SC approach, and offers insight into the semantics of various kinds of adverbials. Open questions remain regarding how result-state readings of durative modifiers are to be handled, and regarding the source of the asymmetries between pre-states and result-states with respect to deictic reference and adverbial modification.

Chapter 7

A scalar analysis of *again*-ambiguities

In this final chapter, the adverb *again* and the ambiguities it gives rise to will be explored from the perspective of a scalar approach to verb meaning. *Again*-ambiguities have been argued to provide the strongest kind of evidence that inchoative verbs are syntactically decomposed into `BECOME` and a small-clause (e.g. von Stechow 1995, 1996; Rapp and von Stechow 1999; Beck 2005). However, the `BECOME`/small-clause (BC-SC) analysis of inchoative verbs was shown in Chapter 4 to have a number of serious problems; it overgenerates ambiguities, and it provides incorrect truth-conditions for many sentences which would be naturally analyzed as having adverbs in decomposition-internal positions. In Chapter 6, a scalar approach to inchoative verbs was presented, which does not suffer from the drawbacks inherent in the BC-SC analysis. Providing an analysis of *again*-ambiguities that is compatible with such an approach will thus go a long way to demonstrating that decompositional structures can be replaced with suitably formulated scalar meanings.

The observation that *again* gives rise to ambiguities dates back to early work in the Generative Semantics tradition (Morgan 1969; McCawley 1971), where ambiguous sentences like (1) were considered.

(1) The roof dried again.

Sentences like the above are commonly understood as being ambiguous between a 'repetitive' reading which conveys that the entire transition encoded by the verb has occurred before (in the case of (1), the transition of going from wet to dry), and a 'restitutive' or 'result-state' reading which conveys that the state which is the result of this transition (e.g. the state of being dry) previously held of the object, even though the entire transition may not have ever previously taken place.

In Chapter 6, it was shown how different verbs give rise to different types of result-state inferences, with scale-structure playing a role in determining how a verb's result-state is characterized; ABSOLUTE verbs like *dry* give rise to result-inferences characterizable with an adjectival bare-form, whereas RELATIVE verbs like *widen* give rise to result-state inferences best characterized with the comparative form of an adjective.

(2) a. The roof has dried ⇒ The roof is dry
 b. The river widened ⇒ The river is wider than before

While *again*-ambiguities have been most often discussed with regards to absolute verbs like *dry* and *open*, they are also found in conjunction with relative verbs like *widen* and *fall* (Fabricius-Hansen 2001; von Stechow 1996); for example, the sentence in (3) is also ambiguous.

(3) The river widened again.

There are subtle differences between the nature of the readings of (1) and (3). Like (1), the sentence in (3) has a repetitive reading conveying that the object has participated in the transition encoded by the verb (an increase in width) before. However, the transition encoded by *widen*, unlike that of *dry*, does not have a clearly-defined endpoint. As discussed below, this allows a sentence like (3) to be used in contexts where an object experiences successive-increases in terms of the relevant gradable property; for example, (3) can be used felicitously in contexts where the river widened, then subsequently widened some more. Analogous 'successive-increase' contexts are not compatible with sentences like (1), i.e. sentences that contain absolute verbs.

The particular analysis proposed here is one in which *again* is taken to be polysemous; this idea (which has precedents) contrasts with the idea found in decompositional approaches that *again*-ambiguities are solely structural in nature. The polysemy argued for here incorporates a number of ideas from Fabricius-Hansen (2001), who argues that *again* has a 'counterdirectional' meaning as well as a repetitive one; however, the adoption of a scalar account of verb meaning allows for counterdirectional change to be more precisely characterized than in previous polysemy accounts. The novel meaning proposed for *again* is one that allows for combination directly with the scalar denotation associated with an inchoative verb; this meaning allows *again* to introduce a presupposition of prior ANTONYMOUS SCALAR CHANGE. Formal connections are drawn below between the scale-sensitive meaning of *again* and the more standard repetitive meaning, providing justification for lexically linking the two meanings with a single phonological form.

This chapter has the following organization. In §7.1, the basic empirical points relating to *again* and *again*-ambiguities are covered. In §7.2, previous analyses of *again* are summarized, and their benefits and drawbacks are highlighted. In §7.3, a polysemy analysis of *again* and *again*-ambiguities is provided that fits naturally into a scale-based approach to verb meaning;

this analysis is then compared to the decompositional analysis of *again*-ambiguities, over which it is argued to offer a number of advantages.[1]

7.1 *Again*-ambiguities

This section covers the main empirical points that will be the target of the forthcoming analysis. These points relate to both the nature of the readings of sentences like (1) and (3), as well as to the syntactic distribution of *again* and positional effects on reading availability.

7.1.1 Repetitive and reversative readings

As mentioned above, it has been often observed that sentences containing *again* and an inchoative verb are ambiguous between a REPETITIVE reading and what will be called a REVERSAL reading, but which is usually called a ‘restitutive’ or a ‘result state’ reading (e.g. Morgan 1969; McCawley 1971; Dowty 1979; Kamp and Rossdeutscher 1994; von Stechow 1996; Jäger and Blutner 2000; Fabricius-Hansen 2001; Beck and Johnson 2004; Beck 2005). The semantic contribution that *again* makes to a sentence is generally recognized to come in the form of a presupposition (c.f. Kamp and Rossdeutscher 1994; von Stechow 1996), so these two types of readings are to be distinguished in terms of their presupposed, rather than asserted, content. The repetitive reading of (1) can be seen as presupposing that the roof underwent a previous transition of the kind encoded by the verb *dry*, whereas the reversative reading can be seen as presupposing that the roof has undergone a previous transition of a kind opposite to the one encoded by *dry*, i.e. a ‘getting wet’ (c.f. Fabricius-Hansen 2001). The two readings are brought out by the following co-texts.[2]

(4) a. I poured a bucket of water on the roof, and it dried. So I poured another bucket of water on it, and **the roof dried again**. (repetitive)

b. The roof got wet, but soon after **it dried again**. (reversal)

The main difference between the two readings of (1) is that the reversative reading, unlike the repetitive one, does not require that the roof ever have undergone a previous transition

[1]Much of the material in this chapter appears in modified form in *The Journal of Semantics*, in Pedersen (2014).

[2]Note that the two readings can also be distinguished intonationally; placing focus on *again* brings out a repetitive reading, while placing focus on the verb brings out a reversative reading.

(i) a. The roof dried AGAIN.

b. The roof DRIED again.

See Beck 2006 for extensive discussion on the role of focus in *again*-ambiguities.

from wet to dry. This type of reading is often described in terms of the restoration of a state – in the case of (1), for example, the presupposition can be characterized in terms of the state of being dry holding previously of the roof (e.g. Dowty 1979; von Stechow 1996; Beck 2005). However, this sort of characterization is not so easily extended to sentences containing verbs like *widen*, *grow* and *rise*, which also participate in *again*-ambiguities but do not have the same sort of lexically-defined result states (c.f. Fabricius-Hansen 2001); the term 'reversative reading' rather than 'restitutive reading' will thus be used in what follows.[3]

As mentioned in the introduction to this chapter, there are fine-grained differences in the *again*-ambiguities found with different inchoative verbs. One important difference is that repetitive readings of sentences with relative verbs like *widen* are felicitous in 'successive-increase' contexts, whereas repetitive readings of sentences with absolute verbs are not; for example, *widen again* can often be used in place of *widen some more*, as in the following example.

(5) Last week, the river widened a lot and reached the flood barrier. This week, **the river widened some more/again** and overflowed onto the bank.

In this context, there are two successive river widenings, the second of which adds to the width that the river attained during the first widening; *the river widened again* can be used to describe the second of these widenings. Importantly, there is no requirement that the river narrowed between the two widenings (though *the river widened again* would also be felicitous in such a context).

Absolute verbs, however, do not allow for the use of *again* in successive-increase contexts. Thus, *the shirt dried again* sounds awkward when used to describe the second increase in dryness in the following example, especially when compared to *the shirt dried some more.*

(6) This morning, I left the soaking wet shirt out in the sun for a few hours. When I took it in, it had dried somewhat but was still quite damp. When I put the shirt outside in the afternoon, **it dried some more/#again**.

Recall that, in Chapter 6, absolute verbs were analyzed as having denotations containing a closed scale, whereas relative verbs were analyzed as having denotations with an open scale. As will be shown below, it is the openness of a relative verb's scale that allows for modification with *again* in successive-increase scenarios.

The observation that sentences with relative verbs are felicitous in successive-increase contexts is important, in that it removes a potential confound that arises when attention is

[3]Some additional justification for this decision comes from the fact that the reversal presupposition can be satisfied by a preceding sentence containing an antonym to the verb modified by *again*, as in (4b).

limited to sentences with absolute verbs. Note that, in its standard construal, the repetitive reading of (1) entails the reversative reading; if the roof became dry twice, it must have gotten wet in between. This entailment might cast some doubt on whether a sentence like (1) is truly ambiguous between a repetitive and a reversative reading, or whether it only has a reversative reading. This doubt is removed when relative verbs are brought into the picture; there are contexts where the repetitive reading of (3) is satisfied but the reversative reading is not – namely, successive-increase contexts like the one described in (5). Hence, atelic verbs provide a useful probe for determining which readings are actually available in particular constructions.

7.1.2 The syntactic position of *again*

The syntactic distribution of *again* is, like many adverbs, somewhat complex; it appears that *again* and the closely related *once again* can adjoin to a wide-range of constituent types.[4] While attention in this chapter will be confined to the typical cases where *again* modifies a verb or a verb phrase, important questions about other uses of *again* remain.

It is generally assumed that the precise position that *again* takes in a sentence determines the content of the presupposition that is introduced; as a consequence, it is argued that the position of *again* can serve to limit the availability of certain readings (McCawley 1971; von Stechow 1996; Beck and Johnson 2004; Beck 2005; Bale 2007). The generalization that has been proposed is that reversative readings are only possible when *again* is suitably close to the inchoative verb. This is most clearly seen by comparing a post-verbal position for *again* with a sentence-initial position; a reversative reading is possible with the former, but ruled out with the latter.

[4] The constituents that *again* and *once again* appear to modify include clauses (iia), adjective-phrases (iib), noun-phrases (iic), adverbs (iid), and even *wh*-words (iie).

(ii) a. Again, the river widened.

b. But the **once-again-single** guy wont mope for long...
`http://www.imdb.com/news/ni47381955/`

c. The **once-again bachelor** was judging the remaining contests at the Los Angeles Ballet School...
`http://www.okmagazine.com/news/ok-exclusive-jake-makes-guest-judge-appearance-bachelor-pad`

d. John ran one hundred metres very quickly. Then he did fifty push-ups – **again very quickly**.

e. **Who again** did you see at the party?

It is left to future work to determine whether the analysis developed below can be extended to these other usages.

(7) a. The river widened again. (repetitive/reversal)
b. Again, the river widened. (repetitive/*reversal)

The ambiguity cannot, however, be generally explained as an ambiguity between verb or VP-adjunction and clause-adjunction, as both types of readings are compatible with a VP-internal position for *again*; this can be demonstrated with more complex ambiguous sentences, like those in (8), which require *again* to be inside the VP.

(8) a. The river didn't widen again.
b. The river has widened again and overflowed the flood barriers/refilled the canal.
c. The river widened again, and the creek did too.
d. The river widened again quickly.

All of these sentences are felicitous in both repetitive and reversal contexts. (8a) demonstrates that *again* can scope below negation without losing a reversative reading; this sentence is felicitous in repetitive and reversal contexts which importantly do not contain a presupposition of a previous failure-to-widen (which would be a third reading of (8a)). (8b) demonstrates that both types of reading are available when *again* appears in a coordinated VP. (8c) shows that *again* can be included in the antecedent for the VP-anaphor *did too*; since the resulting sentence is felicitous in both repetitive and reversal contexts, *again* must be located inside the VP for both readings (note that this sentence bears an additional presupposition pertaining to the creek). Finally, (8d) shows that *again* can appear prior to other VP-modifiers such as manner-adverbs; (8d) is possible in both repetitive and reversal contexts, though perhaps more natural in reversal contexts. From such examples, it can be concluded that both repetitive and reversative readings can be generated with *again* appearing VP-internally.

Confining attention to VP-internal *again*, it is still possible to find evidence that reversative readings require that *again* be in close proximity to the verb. When another VP-modifying adverb intervenes between the verb and *again*, the possibility for a reversative reading is lost. Thus, the only presupposition possible for (9) is that the river previously widened quickly; note that the presupposition introduced by *again* includes all VP-internal material that precedes *again*, and hence in this case includes *quickly*.[5]

[5] In non-typical usages the presupposition of *again* includes material that follows rather than precedes; these are instances of what Bale (2007) calls 'left-adjoining *again*', where *again* modifies a following adverb. An example of such a case is provided in footnote 4.

(9) The river widened quickly again. (repetitive/*reversal)

As expected, when *again* precedes the manner adverb, a reversative reading is definitely possible (and perhaps even preferred).

(10) The river widened again quickly. (repetitive/reversal)

The generalization that reversative readings require *again* to be close to the verb thus holds up even when VP-internal modification is considered. Note that verb-adjacency in the surface string is not required, as transitive sentences also demonstrate a similar ambiguity despite the presence of a noun phrase intervening between the verb and *again*. However, a reversative reading with a transitive VP is still only possible if there is no additional adverb intervening between *again* and the verb (*very* is added to the adverb in (12) to give it extra weight and make a post-verbal position more acceptable).

(11) The road crew widened the highway again. (repetitive/reversal)

(12) a. The road crew widened the highway very quickly again.
(repetitive/*reversal)
b. The road crew widened the highway again very quickly.
(repetitive/reversal)

The working generalization adopted here will be that reversative readings require that *again* be structurally close to the verb (where 'structurally close' needs further elaboration). While this generalization is the generally accepted one and dates back to the earliest accounts of *again*-ambiguities (e.g. McCawley 1971), it should be pointed out that a possible confound exists. It has been recognized that *again* interacts with focus semantics; in particular, when *again* is focused, a repetitive reading is strongly preferred or even forced (Beck 2006). Hence it is possible that in sentences where a reversative reading seems to be ruled out (e.g. sentences where *again* appears sentence-initially), focus semantics, not structural position, conspires against such a reading; this line of reasoning is suggested by Jäger and Blutner (2000) for German *wieder* 'again'. Teasing apart the two proposals is beyond the scope of this chapter, and it will be assumed in what follows that the structural generalization holds, but the question does remain open.

7.2 Previous accounts of *again*-ambiguities

Previous approaches to explaining *again*-ambiguities fall into two main categories: those which explain the ambiguities in terms of scope (Morgan 1969; McCawley 1971; Dowty 1979;

von Stechow 1995, 1996; Beck and Johnson 2004; Beck 2005), and those in which *again* is assumed to be polysemous (Fabricius-Hansen 1983, 2001; Kamp and Rossdeutscher 1994; Jäger and Blutner 2000).[6] Both types of analysis will be discussed in turn in this section.

The interval semantics described in §4.2.1 will be used in this chapter; some of the key definitions are repeated here. An interval is a dense, gapless subset of a set of points (e.g. moments of time).

(13) Given an infinite set of points M and a dense linear ordering $\preceq$ on M,
i is an interval iff $i \subset M \;\&\; \forall m_1, m_2, m_3 \in M : (m_1, m_3 \in i \;\&\; m_1 \prec m_2 \prec m_3) \rightarrow m_2 \in i$

I_M is the domain of intervals built from the domain M of points. A strict ordering on intervals is derived straightforwardly from the ordering on points.

(14) $i_1 \prec i_2$ iff every point in i_1 precedes every point in i_2.

In an interval semantics, propositions are taken to be functions from intervals to truth-values; properties are taken to be functions from entities to propositions.

(15) a. A proposition is a function $\mathcal{P} : I_M \rightarrow T$
b. A property is a function $\mathcal{R} : E \times (I_M \rightarrow T)$

The infimum and supremum of an interval are defined as follows.

(16) Definitions of Infimum (INF) and Supremum (SUP)
$\forall i \in I_M$:
a. $m \in M$ is the infimum of i iff
$(\forall n \in i : \; m \preceq n) \;\&\; \neg(\exists x \in M : \forall n \in i : x \preceq n \;\&\; m \prec x)$
b. $m \in M$ is the supremum of i iff
$(\forall n \in i : \; n \preceq m) \;\&\; \neg(\exists x \in M : \forall n \in i : n \preceq x \;\&\; x \prec m)$

Initial and final boundary intervals, which were used in the denotation for `BECOME` in Chapter 4, are defined as follows.

(17) Definitions of initial boundary interval and final boundary interval. Given $j, i \in I_M$,
a. $\textsc{ibi}_{j,i}$ iff $j \in I_M \;\&\; \exists k[k \in I_M \;\&\; k \prec i \;\&\; j = k \cup \{\textsc{inf}_i\}]$
b. $\textsc{fbi}_{j,i}$ iff $j \in I_M \;\&\; \exists k[k \in I_M \;\&\; i \prec k \;\&\; j = k \cup \{\textsc{sup}_i\}]$

[6] Dowty (1979) uses scope of expressions in the semantic metalanguage, not the object language, to explain the ambiguity. See Chapter 4, §4.4 for discussion.

Initial and final boundary intervals play an important role in the denotation of BECOME.

(18) $[\![\texttt{BECOME}]\!](\mathcal{P})(i)$ iff $\exists j, \exists k : \textsc{ibi}_{j,i}$ & $\textsc{fbi}_{k,i}$ & $\mathcal{P}(j) = \text{F}$ & $\mathcal{P}(k) = \text{T}$

7.2.1 BECOME and *again*

The BECOME-scope approach to *again*-ambiguities has found its modern form in work by von Stechow (1995, 1996), whose basic framework has since been used to explore other facets of *again*-ambiguities (e.g. Beck and Johnson 2004; Beck 2005; Bale 2007). The key points of this approach were discussed in §4.2.2, and will be briefly recounted here.

One of the defining features of the decompositional approach is that it requires only a single meaning for *again* to derive the readings of ambiguous sentences. The meaning for *again* introduced by von Stechow (1996) has become the standard one for authors working in a decompositional framework; it is essentially the one in (19).

(19) $[\![\texttt{again}]\!](\mathcal{P})(i)$

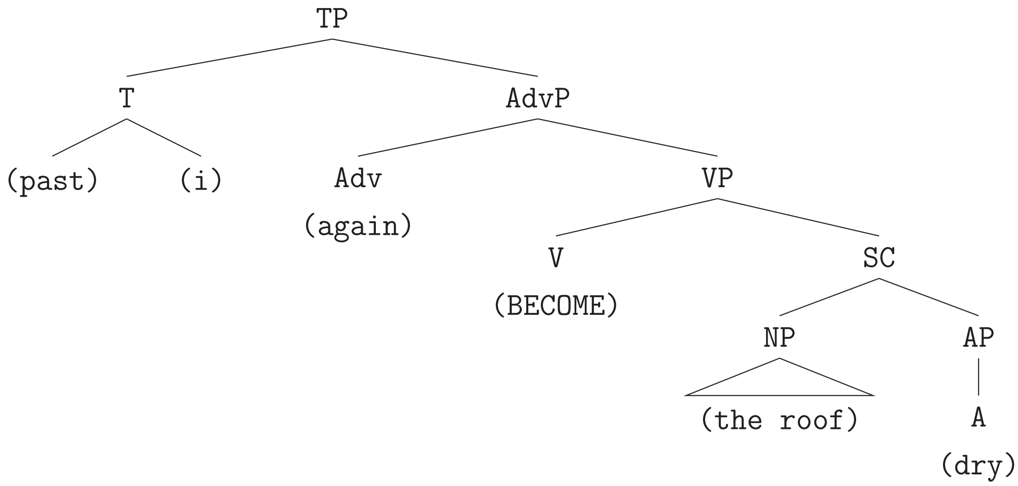
a. is defined only if $\exists i' \exists i''[i'' \prec i' \prec i$ & $\mathcal{P}(i'') = \text{T}$ & $\mathcal{P}(i') = \text{F}]$

b. Where defined, equals T only if $\mathcal{P}(i) = \text{T}$

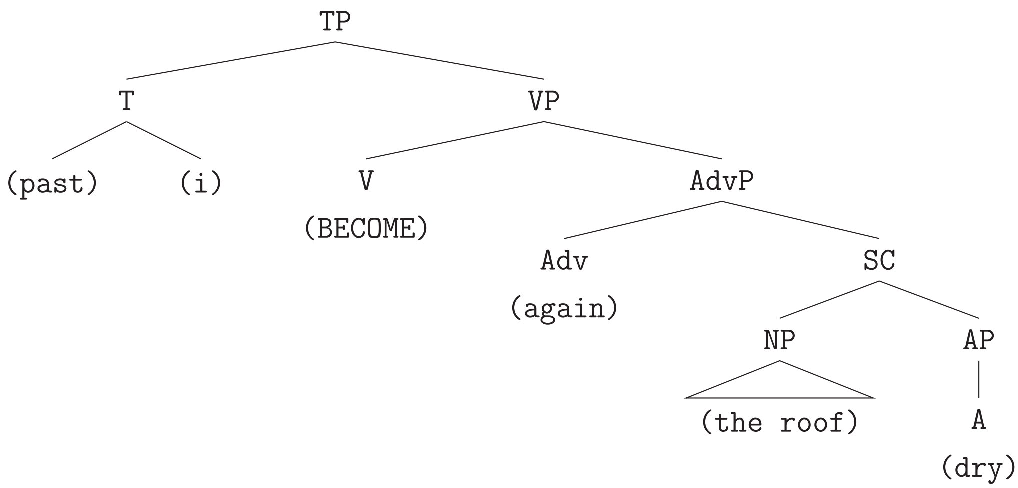
According to von Stechow, $[\![\texttt{again}]\!]$ takes a proposition as input and introduces a presupposition in the form of a definedness condition on intervals; in other words, $[\![\texttt{again}]\!]$ takes a function from intervals to truth-values, and returns a (possibly) partial function of the same type. A proposition that has been modified by $[\![\texttt{again}]\!](\mathcal{P})$ will only be defined for those intervals for which an earlier interval can be found in which the proposition does not hold, and an even earlier interval can be found in which the proposition does hold.

A BECOME/small-clause decomposition of an inchoative verb contains two propositional levels, making available two possible attachment sites for *again*; the ambiguity that arises when *again* modifies such verbs can thus be explained in terms of the specific position of *again*. A repetitive reading results when *again* scopes above BECOME; a reversative reading results when *again* scopes below BECOME. The two LFs associated with the sentence *The roof dried again* are shown below; recall from Chapter 4 that PF transformations such as subject-raising and head-movement will allow both LFs to be paired with the same PF (note also that both LFs presume a pronominal analysis of tense, like that described in Chapter 4).

(20)



(21)



The truth-conditions for the first LF, which generates the repetitive reading of the sentence, are shown in (22); note that i_u is the utterance interval.

(22) $[\![\texttt{again}]\!]([\![\texttt{BECOME}]\!]([\![\texttt{dry}]\!](r)))([\![\texttt{pst}]\!](i))$

a. is defined only if $i \prec i_u$ &
$\exists i' \exists i''[i'' \prec i' \prec i \;\&\; [\![\texttt{BECOME}]\!]([\![\texttt{dry}]\!](r)))(i'') = \mathrm{T} \;\&\; [\![\texttt{BECOME}]\!]([\![\texttt{dry}]\!](r)))(i') = \mathrm{F}]$

b. if defined, equals T iff $[\![\texttt{BECOME}]\!]([\![\texttt{dry}]\!](r)))(i) = \mathrm{T}$

The truth-conditions for the second LF, which generates the reversative (or restitutive) reading, are shown in (23).[7]

[7]In order to allow the presupposition introduced by AGAIN in (23) to project to the sentence level, $[\![\texttt{BECOME}]\!]$ must have the following definedness condition added to its denotation:

(iii) $[\![\texttt{BECOME}]\!](\mathcal{P})(i)$ is defined only if $\mathcal{P}(i)$ is defined.

(23) $[\![\texttt{BECOME}]\!]([\![\texttt{again}]\!]([\![\texttt{dry}]\!](r)))([\![\texttt{pst}]\!](i))$

a. is defined only if $i \prec i_u$ & $\exists i' \exists i''[i'' \prec i' \prec i \ \& \ [\![\texttt{dry}]\!](r)(i'') = \text{T} \ \& \ [\![\texttt{dry}]\!](r)(i') = \text{F}]$

b. if defined, equals T iff $[\![\texttt{BECOME}]\!]([\![\texttt{dry}]\!](r)))(i) = \text{T}$

The truth-conditions in (22) contain a presupposition that there was an earlier instance of the roof's becoming dry, whereas the truth-conditions in (23) contain a presupposition only that there was an earlier instance of the roof's being dry; both sentences assert that the roof became dry during the topic interval i. Because the analysis relies on syntactic scope, the structural generalization discussed in §7.1.2 – that reversative readings are incompatible with *again* being too far from the verb – falls out as a natural consequence.

While the analysis seems to generate adequate truth-conditions for simple sentences with *again*, there are reasons to think it cannot be correct. General issues with the BECOME/small-clause analysis of inchoative verbs were discussed in §4.3 and §6.3; in particular, this type of decompositional analysis overgenerates ambiguities, derives incorrect truth-conditions for many decomposition-internal adverbs, and cannot capture the gradable nature of verbal change. Aside from these general issues, however, there are more specific reasons to think that the BECOME-scope analysis is not the right approach to *again*-ambiguities. These reasons relate to the idiosyncratic availability of reversative (restitutive) readings across languages and speakers. A cross-linguistic survey undertaken by Beck (2005) finds that analogues of *again* in other languages do not universally permit reversative readings. Furthermore, Beck et al. (2009) observe that even in English, *again* does not permit reversative readings for all speakers, a trend which has apparently been increasing over time.[8] Even near synonyms in a single language – like German *wieder* 'again' and *erneut* 'anew' – may differ in their ability to license reversative readings. This general lack of systematicity led Rapp and von Stechow (1999) and Beck (2005) to argue that adverbs like *again* must be individually marked for whether or not they can attach to elements in a decomposition structure, via the appropriate setting of what they call a 'Visibility Parameter' in an adverb's lexical entry. General problems with assuming a 'Visibility Parameter' were discussed in §4.3.2; in short, such a parameter is undesirable because it predicts a level of idiosyncracy that is not attested, and is an ad-hoc solution to the problems of ambiguity overgeneration and variation. As discussed below in §7.4.2, a polysemy account of *again*-ambiguities is in better accordance with the facts concerning cross-linguistic and cross-speaker variation.

[8]Thus, the sentences referred to as ambiguous in this chapter may not be ambiguous for all readers.

7.2.2 Counterdirectional *again*

The decompositional approach to *again*-ambiguities has found competition in the polysemy approach proposed by Fabricius-Hansen (1983; 2001; see also Jäger and Blutner 2000; Kamp and Rossdeutscher 1994). Adopting a Davidsonian event-semantics, Fabricius-Hansen proposes that *again* comes in two versions – a repetitive version and a 'counterdirectional' version. The meaning of repetitive *again* is simply an eventive equivalent of the meaning given in (19). The proposed meaning for counterdirectional *again* is shown in (24).

(24) a. $[\![\texttt{again}_{\texttt{cd}}]\!](\mathcal{R})(x)(e)$ is defined only if $\exists e' : e' \prec e \;\&\; \mathcal{R}_C(x, e') \;\&\; \textsc{res}(e') = \textsc{pre}(e)$

b. Where defined, equals T only if $\mathcal{R}(x)(e) = \mathrm{T}$

This meaning makes use of a number of event-specific metalinguistic definitions. Here, $\mathcal{R}_C$ is the 'counterdirectional counterpart' to the property $\mathcal{R}$; RES is a function that maps an event onto its resulting state, and PRE is a function that maps an event onto its pre-state. The presupposition has the effect that $\textsc{again}_{\textsc{cd}}(\mathcal{R})$ can only be asserted to hold of an object x and event e if x also participates in an event e_1, which is both prior to e and counterdirectional to e, such that the resulting state of e_1 is the pre-state of e. Given these two meanings for *again*, the account will predict a sentence like *the roof dried again* to be ambiguous in the appropriate way, so long as it is assumed that the counterdirectional counterpart to a drying event is a getting-wet event.

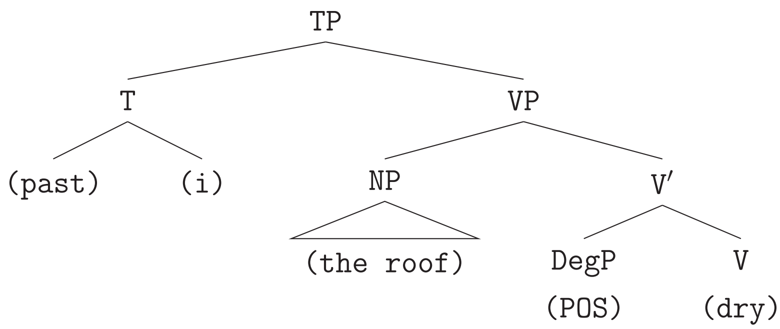
The analysis of *again* argued for below can be viewed generally as a polysemy analysis similar to that proposed by Fabricius-Hansen; however, it offers a number of important improvements over previous analyses of the kind. First of all, the proposed analysis does not treat counterdirectionality as a semantic primitive; instead, the definitions of counterdirectionality and reversal that are necessary for a treatment of *again* are spelled out in terms of independently motivated scalar concepts. Second, previous polysemy analyses have no principled way of accounting for the structural generalization discussed in §7.1.2; since both versions of *again* are of the same syntactic type, both should have the same syntactic distribution, and reversative readings will thus not be predicted to be structurally restricted in the way that they appear to be (c.f. Beck 2005).[9] The polysemy analysis presented below offers a solution to this problem; the meaning for *again* responsible for reversative readings requires access to the scalar meaning associated with a verb, and thus must appear suitably close to the verb to combine with it compositionally.

[9]If, however, the relationship between the position of *again* and the availability of reversative readings is to be explained through focus rather than structure (as Jäger and Blutner 2000 suggest), then this disadvantage disappears.

7.3 A scalar analysis of *again*-ambiguities

The groundwork was laid in the previous chapter for a scalar analysis of *again*-ambiguities; the relevant points of the scalar analysis of inchoative verbs described there will be reviewed briefly. The LF for *The roof dried* in the scalar analysis will be as in (25) (for simplicity, inchoative verbs in this chapter will viewed as monomorphemic).

(25)



Recall that an inchoative verb in the scalar analysis denotes a pair of a scale and a measure-of-change (MOC) function, which is a function from entities and intervals to a pair of degrees on the associated scale.

(26) An inchoative verb V denotes a pair $\langle\langle D, <\rangle, g\rangle$, where:

i. $\langle D, <\rangle$ is a strict ordering on D
($\langle D, <\rangle$ is the scale of V)

ii. g is a function from object-interval pairs into $D \times D$
(g is the MOC function of V)

A property is formed from a verb-denotation using `POS`; the meaning of `POS` is sensitive to the structure of a verb's scale (i.e. whether the scale is top-closed, bottom-closed or open), thus returning different results for different verbs.

(27) $[\![\texttt{POS}]\!](\langle\langle D, <\rangle, g\rangle)(x)(i) = \text{T}$ iff:

i. $g(x)(i) = \langle d, \text{MAX}\rangle$, for some $d < \text{MAX}$ (if $\langle D, <\rangle$ is top-closed)

ii. $g(x)(i) = \langle \text{MIN}, d\rangle$, for some $d > \text{MIN}$ (if $\langle D, <\rangle$ is bottom-closed)

iii. $g(x)(i) = \langle d, e\rangle$, for some $d, e \in D : d < e$ (if $\langle D, <\rangle$ is open)

Since the scale of $[\![\texttt{dry}]\!]$ is top-closed, the interpretation of the LF in (25) will be as follows (where ΔDRY is the MOC-function of $[\![\texttt{dry}]\!]$, and i_u is the utterance interval).

(28) $[\![\texttt{POS}]\!]([\![-\texttt{en}]\!]([\![\texttt{dry}]\!]))(g)([\![\texttt{past}]\!](i))$

a. is defined only if $i \prec i_u$

b. if defined, equals T only if $\Delta\textsc{dry}(g)(i) = \langle d, \textsc{max}_{\textsc{dry}}\rangle$,
for some $d \in D_{\textsc{dry}} : d <_{\textsc{dry}} \textsc{max}_{\textsc{dry}}$

The verbs *blur* and *widen* have bottom-closed and open scales, respectively; thus, the sentences *The TV blurred* and *The river widened* will have truth-conditions like the following.

(29) $[\![\texttt{POS}]\!]([\![-\texttt{en}]\!]([\![\texttt{blur}]\!]))(t)([\![\texttt{past}]\!](i))$

a. is defined only if $i \prec i_u$

b. if defined, equals T only if $\Delta(\textsc{blur})(t)(i) = \langle \textsc{min}_{\textsc{blur}}, d\rangle$,
for some $d \in D_{\textsc{blur}} : \textsc{min}_{\textsc{blur}} <_{\textsc{dry}} d$

(30) $[\![\texttt{POS}]\!]([\![-\texttt{en}]\!]([\![\texttt{wide}]\!]))(r)([\![\texttt{past}]\!](i))$

a. is defined only if $i \prec i_u$

b. if defined, equals T only if $\Delta\textsc{wide}(r)(i) = \langle d, e\rangle$,
for some $d, e \in D_{\textsc{wide}} : d <_{\textsc{wide}} e$

7.3.1 Two meanings for *again*

The proposal developed here is that *again* is polysemous, having one meaning which semantically combines with a property (i.e. a function from entities and intervals to truth-values) and another which combines directly with a verb-denotation. For simplicity, the polysemy of *again* will be represented as a lexical ambiguity, i.e. with two versions of *again*, $\texttt{again}_{\texttt{R}}$ and $\texttt{again}_{\texttt{V}}$. Their meanings are shown in (31) and (32); note that $[\![\texttt{again}_{\texttt{R}}]\!]$ is the meaning for *again* provided by von Stechow (1996), adapted to apply to properties rather than propositions.

(31) $[\![\texttt{again}_{\texttt{R}}]\!](\mathcal{R})(x)(i)$

a. is defined only if $\exists i' \exists i'' [i'' \prec i' \prec i \;\&\; \mathcal{R}(x)(i'') = \text{T} \;\&\; \mathcal{R}(x)(i') = \text{F}]$

b. Where defined, equals T only if $\mathcal{R}(x)(i) = \text{T}$

(32) $[\![\texttt{again}_{\texttt{V}}]\!](\langle\langle D, <\rangle, g\rangle) = \langle\langle D, <\rangle, g'\rangle$ such that

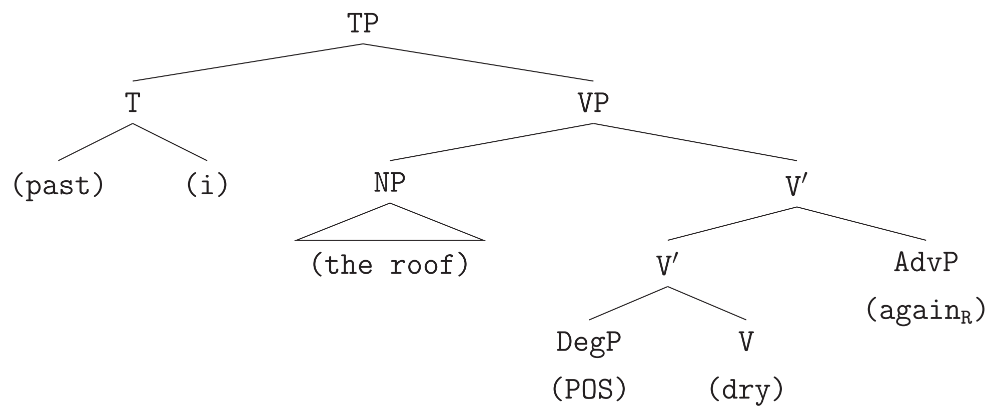
a. $g'(x)(i)$ is defined only if $\exists i' \prec i : [\![\texttt{POS}]\!](\langle\langle D, <^{-1}\rangle, g\rangle)(x)(i') = \text{T}$

b. Where defined, $g'(x)(i)$ equals $g(x)(i)$

$[\![\mathtt{again_R}]\!]$ is the meaning that will generate repetitive readings, while $[\![\mathtt{again_V}]\!]$ is the meaning that will generate reversative readings. The denotation of $\mathtt{again_V}$ makes use of both $[\![\mathtt{POS}]\!]$ and scalar inversion, and is discussed in more detail in §7.3.3.

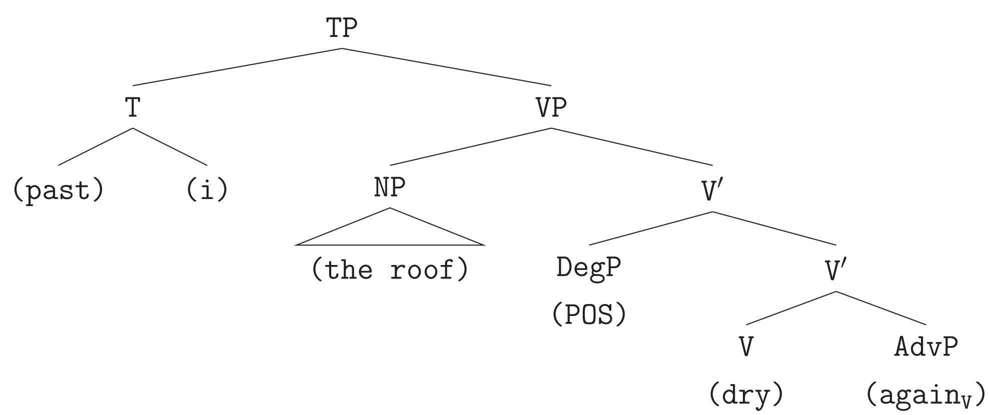
The semantic types of the meanings determine where they can apply. Because $[\![\mathtt{again_R}]\!]$ modifies a property, it can only apply after $[\![\mathtt{POS}]\!]$ has converted a verb-denotation to a property; thus, $\mathtt{again_R}$ must be used whenever *again* appears above the position where this conversion takes place. The repetitive reading of a sentence like *The roof dried again* will be produced by an LF like the following.

(33)



On the other hand, $[\![\mathtt{again_V}]\!]$ applies directly to a verb-denotation, and can only be used before $[\![\mathtt{POS}]\!]$ has applied; it will be the meaning used whenever *again* appears below the position where a MOC-function is converted to a property. For example, the reversative reading of *The roof dried again* will be produced by an LF like the following.

(34)



The two versions of *again*, and how they generate repetitive and reversative readings, will be discussed in turn. In §7.4.2, it will be shown that these two meanings are related in a way that helps explain why they are often linked to a single phonological form, as is assumed to be the case in English.

7.3.2 Repetitive readings

In §7.1.1 it was shown that repetitive readings of sentences with absolute verbs (like *dry* and *blur*) differ importantly from those of sentences containing relative verbs (like *widen*); in particular, it was shown that the latter are felicitous in situations where there are successive-increases in the relevant gradable dimension, whereas the former are not. These differences follow naturally when a scalar approach to inchoative verb meaning is adopted; the scalar analysis of inchoative verbs developed in the previous chapter allows for the correct repetitive readings for each type of verb to be derived using $[\![\texttt{again}_\texttt{R}]\!]$, which is essentially von Stechow's (1996) meaning for *again*.

Consider the truth-conditions for (33), shown in (35), as an example of a repetitive reading for an *again*-sentence with a total verb. The presupposition due to tense is ignored for simplicity.

(35) $[\![\texttt{again}_\texttt{R}]\!]([\![\texttt{POS}]\!]([\![\texttt{dry}]\!]))(r)(i)$

a. is defined only if $\exists i' \exists i''[i'' \prec i' \prec i$ & $[\![\texttt{POS}]\!]([\![\texttt{dry}]\!])(r)(i'') = \text{T}$ & $[\![\texttt{POS}]\!]([\![\texttt{dry}]\!])(r)(i') = \text{F}]$

b. Where defined, equals T only if $[\![\texttt{POS}]\!]([\![\texttt{dry}]\!])(r)(i) = \text{T}$

The presupposition (i.e. definedness condition) of the above requires that, prior to the topic interval i, there was an interval i' distinct from i where the roof undergoes the sort of change required by $[\![\texttt{POS}]\!]([\![\texttt{dry}]\!]))$. The scale of $[\![\texttt{dry}]\!]$ is assumed to be associated with a scale that contains a maximal degree; as such, $[\![\texttt{POS}]\!]([\![\texttt{dry}]\!]))$ will require that an object attain the maximal degree of dryness over the course of an interval. This means that in a successive-increase scenario (one where the roof dries a little bit, and then subsequently dries some more), the presupposition introduced by $[\![\texttt{again}_\texttt{R}]\!]$ will not be met, as the presupposition requires the roof to have previously climbed to the maximal degree on the dryness scale. Hence, *The roof dried again* is not predicted to be substitutable for *The roof dried some more*.

Similarly, *The image blurred again* is not predicted to be substitutable for *The image blurred some more*. The truth-conditions generated for a repetitive reading of *The TV blurred again* are shown in (36).

(36) $[\![\texttt{again}_{\texttt{R}}]\!]([\![\texttt{POS}]\!]([\![\texttt{blur}]\!]))(t)(i)$

a. is defined only if $\exists i'\exists i''[i'' \prec i' \prec i$ & $[\![\texttt{POS}]\!]([\![\texttt{blur}]\!])(t)(i'') = \mathrm{T}$ & $[\![\texttt{POS}]\!]([\![\texttt{blur}]\!])(t)(i') = \mathrm{F}]$

b. Where defined, equals T only if $[\![\texttt{POS}]\!]([\![\texttt{blur}]\!])(t)(i) = \mathrm{T}$

According to the scalar analysis developed in Chapter 6, $[\![\texttt{POS}]\!]([\![\texttt{blur}]\!])$ requires of an object that it begin an interval with the minimal degree of blurriness, and then increase to a non-minimal degree. Although the presupposition introduced by $[\![\texttt{again}_{\texttt{R}}]\!]$ will be met in some 'blur-some-more' situations (those in which the image begins in a non-blurry state), it will be impossible for the assertive content to be satisfied in such situations; the image must first return to the minimal degree of blurriness before increasing in blurriness for the second time.[10]

The situation is different for a relative verb like *widen*. The truth-conditions generated for the repetitive reading of *The river widened again* are shown in (37).

(37) $[\![\texttt{again}_{\texttt{R}}]\!]([\![\texttt{POS}]\!]([\![\texttt{widen}]\!]))(t)(i)$

a. is defined only if $\exists i'\exists i''[i'' \prec i' \prec i$ & $[\![\texttt{POS}]\!]([\![\texttt{widen}]\!])(t)(i'') = \mathrm{T}$ & $[\![\texttt{POS}]\!]([\![\texttt{blur}]\!])(t)(i') = \mathrm{F}]$

b. Where defined, equals T only if $[\![\texttt{POS}]\!]([\![\texttt{widen}]\!])(t)(i) = \mathrm{T}$

The property $[\![\texttt{POS}]\!]([\![\texttt{widen}]\!])$ only requires of an object that it begin an interval with a degree of width less than that with which it finishes the interval. As a result of this weaker requirement, the definedness condition in (37) will be met in a situation where the river undergoes two successive widenings (the second of which occurs during the topic interval i), with no narrowing in between; the assertion will also be satisfied in such a situation. Note that this is exactly the same sort of situation where *The river widened some more* is true. Note in addition that both the presupposition and assertion of a repetitive reading of *The river widened again* are predicted to also be satisfied in situations in which two widenings are separated by a narrowing.

The scalar analysis of verbs adopted here thus derives subtly different repetitive readings for absolute and relative verbs without requiring different decompositions. The differences derived are an indirect consequence of the independently motivated assumption that $[\![\texttt{POS}]\!]$ places stronger requirements on verbs whose associated scales have maximal or minimal

[10]Some of the infelicity of using *The image blurred again* in a 'blur-some-more' situation may result from the fact that *The image blurred* arguably presupposes (or at least strongly implicates) that the image was crisp; note that it is more felicitous to use *The image didn't blur* in a situation where a image remains crisp, then to use it to describe a image which has always been blurry (in fact, using the sentence in the latter scenario typically requires heavy stress on *blur*). Likewise for *The roof didn't dry*.

degrees than on verbs whose scales lack such degrees. Ultimately, then, it is the type of scale that an inchoative verb is associated with that determines the nature of the repetitive reading it exhibits with *again*.

7.3.3 Reversative readings

The version of *again* that generates reversative readings, i.e. $[\![\texttt{again}_{\texttt{V}}]\!]$, is assumed here to apply to a verb-denotation, and return a verb denotation; its semantic type thus differs from $[\![\texttt{again}_{\texttt{R}}]\!]$, which applies to a property. Because $[\![\texttt{again}_{\texttt{V}}]\!]$ modifies a verb directly, it must appear below the position where a MOC-function is converted to a property (as shown in (43)). The presupposition generated by $[\![\texttt{again}_{\texttt{V}}]\!]$ will be one of prior ANTONYMOUS SCALAR CHANGE; this presupposition will come in the form of a definedness condition on the MOC-function of the modified verb. The definition of $[\![\texttt{again}_{\texttt{V}}]\!]$ in (32), repeated below, makes use of both $[\![\texttt{POS}]\!]$ and scalar inversion. Since $[\![\texttt{POS}]\!]$ is sensitive to the scale structure of a verb when determining the requirements of a positive form property, the presupposition introduced by $[\![\texttt{again}_{\texttt{V}}]\!]$ will vary according to the scale of the verb that is modified.

(32) $[\![\texttt{again}_{\texttt{V}}]\!](\langle\langle D,<\rangle,g\rangle) = \langle\langle D,<\rangle,g'\rangle$ such that

a. $g'(x)(i)$ is defined only if $\exists i' \prec i : [\![\texttt{POS}]\!](\langle\langle D,<^{-1}\rangle,g\rangle)(x)(i') = \mathrm{T}$

b. Where defined, $g'(x)(i)$ equals $g(x)(i)$

The combination of $[\![\texttt{POS}]\!]$ and scalar inversion can be viewed as a formalization in scalar terms of Fabricius-Hansen's (2001) notion of counterdirectionality (a notion which, as mentioned in §7.2.2, was understood as a primitive notion). To see that this is the case, consider again the maximal verb *dry*, which is assumed to denote the pair $\langle\langle D_{\text{DRY}},<_{\text{DRY}}\rangle,\Delta\text{DRY}\rangle$. Because $<_{\text{DRY}}$ is top-closed, $[\![\texttt{POS}]\!](\langle\langle D_{\text{DRY}},<_{\text{DRY}}\rangle,\Delta\text{DRY}\rangle)$ will require of an object and interval that the object attain the maximal degree of dryness over the course of the interval. However, because $<_{\text{DRY}}$ is top-closed (only), the inverse scale $<^{-1}_{\text{DRY}}$ will be bottom-closed (only). Thus, $[\![\texttt{POS}]\!](\langle\langle D_{\text{DRY}},<^{-1}_{\text{DRY}}\rangle\rangle$ will require of an object and interval that the object begin the interval with the minimal degree of $\langle D_{\text{DRY}},<^{-1}_{\text{DRY}}\rangle$, and then move up on that scale. However, this equates to beginning the interval with the maximal degree of dryness (i.e. the maximal degree of $\langle D_{\text{DRY}},<_{\text{DRY}}\rangle$) and then decreasing in dryness (i.e. moving down according to $<_{\text{DRY}}$). Hence, $[\![\texttt{again}_{\texttt{V}}]\!]([\![\texttt{dry}]\!])$ will return a pair $\langle\langle D_{\text{DRY}},<_{\text{DRY}}\rangle,\Delta\text{DRY}'\rangle$, where $\Delta\text{DRY}'$ is defined for an object x and interval i only if during an interval prior to i the object x began at MAX_{DRY} and decreased in dryness, i.e. only if x became wet during a prior interval.

Note, similarly, that the inverse scale of a bottom-closed scale like $\langle D_{\text{BLUR}},<_{\text{BLUR}}\rangle$ will be top-closed. This means that $[\![\texttt{again}_{\texttt{V}}]\!]([\![\texttt{blur}]\!])$ will return a pair $\langle\langle D_{\text{DRY}},<_{\text{DRY}}\rangle,\Delta\text{BLUR}'\rangle$, where $\Delta\textsc{blur}'$ is defined for an object and interval only if during a prior interval the object transitioned from a non-minimal degree of blurriness to the minimal degree, i.e. only if the object became crisp (i.e. not blurry) during a prior interval.

Finally, the inverse of an open scale will also be an open scale. This means that $[\![\texttt{again}_\texttt{V}]\!]([\![\texttt{widen}]\!])$ will return a pair $\langle\langle D_{\textsc{wide}}, <_{\textsc{wide}}\rangle, \Delta\textsc{wide}'\rangle$, where $\Delta\textsc{wide}'$ is defined for an object and interval only if during a prior interval the object decreased in width; it does not matter which particular degree of width the object began or finished this prior interval with, so long as the final degree is less wide than the initial degree.

It should now be apparent that $[\![\texttt{again}_\texttt{V}]\!]$ will correctly derive reversative readings for *again*-sentences with inchoative verbs. Given the proposed definition for $[\![\texttt{again}_\texttt{V}]\!]$, the LF in (43) receives the following truth-conditions:

(38) $[\![\texttt{POS}]\!]([\![\texttt{again}_\texttt{V}]\!]([\![\texttt{dry}]\!]))(r)(i)$

a. is defined only if $\exists i' \prec i : \Delta\textsc{dry}(r)(i') = \langle \textsc{max}_{\textsc{dry}}, d\rangle$, for some $d <_{\textsc{dry}} \textsc{max}_{\textsc{dry}}$

b. Where defined, equals T only if $\Delta\textsc{dry}(r)(i) = \langle d, \textsc{max}_{\textsc{dry}}\rangle$, for some $d <_{\textsc{dry}} \textsc{max}_{\textsc{dry}}$

Because $[\![\texttt{again}_\texttt{V}]\!]$ (like $[\![\texttt{again}_\texttt{R}]\!]$) only affects the presuppositional content of a sentence, the assertive content of the truth-conditions is the same as that of (33), namely that $[\![\texttt{POS}]\!]([\![\texttt{dry}]\!])(r)(i)$ is true. The definedness condition of (38) will be met only if, prior to the asserted drying, the roof went from $\textsc{max}_{\textsc{dry}}$ to a non-maximal degree of dryness – i.e. if the roof previously got wet. The presupposition generated can thus be accurately called a reversative presupposition, and is distinguished from a repetitive one; the presupposition can be met even if the roof has never previously dried (i.e. never previously gone from a non-maximal degree of dryness to $\textsc{max}_{\textsc{dry}}$).

The truth-conditions for the repetitive reading of the *The TV blurred again* will be the following:

(39) $[\![\texttt{POS}]\!]([\![\texttt{again}_\texttt{V}]\!]([\![\texttt{blur}]\!]))(t)(i)$

a. is defined only if $\exists i' \prec i : \Delta\textsc{blur}(t)(i') = \langle d, \textsc{min}_{\textsc{blur}}\rangle$, for some $d >_{\textsc{blur}} \textsc{min}_{\textsc{blur}}$

b. Where defined, equals T only if $\Delta\textsc{blur}(t)(i) = \langle \textsc{min}_{\textsc{blur}}, d\rangle$, for some $d >_{\textsc{blur}} \textsc{min}_{\textsc{blur}}$

The definedness condition of these truth-conditions will be met only if, prior to asserted blurring of the image, the image went from a non-minimal degree of blurriness to $\textsc{min}_{\textsc{blur}}$ – i.e. if the image got crisp. Note that the reversative readings of *again*-sentences with total and partial verbs like *dry* and *blur* intuitively involve the restoration of the result-state associated with the verb. This is captured in the present analysis by the fact that

$[\![\texttt{POS}]\!]$ (active in the assertion and presupposition of a sentence) is sensitive to maximal and minimal degrees. Together, the presupposition and assertion of (38) imply the existence of two distinct intervals in which the roof is maximally dry, and the presupposition and assertion of (39) imply the existence of two distinct intervals in which the image has some non-minimal amount of blur.

The truth-conditions for the reversal reading of *The river widened again* will be the following:

(40) $[\![\texttt{POS}]\!]([\![\texttt{again}_\texttt{V}]\!]([\![\texttt{wide}]\!]))(r)(i)$

a. is defined only if $\exists i' \prec i : \Delta\textsc{wide}(r)(i') = \langle d, e\rangle$, for some $d, e : e <_{\text{WIDE}} d$

b. Where defined, equals T only if $\Delta\textsc{wide}(r)(i) = \langle d, e\rangle$, for some $d, e : d <_{\text{WIDE}} e$

Because the scale $\langle D_{\text{WIDE}}, <_{\text{WIDE}}\rangle$ does not have a maximal or minimal degree, the definedness condition of in (40) is weaker than that of (38) or (39); in particular, the definedness condition of (40) requires only that, prior to the asserted widening, the river decreased on the scale of width – i.e. that it narrowed. Thus, the reversative reading generated by $[\![\texttt{again}_\texttt{V}]\!]$ for an open-scale verb like *widen* does not involve the re-attainment of a standard degree in the same way that a reversative reading with a closed-scale verb does.

There is an important link between the meaning of $\texttt{again}_\texttt{V}$ and antonymy, as scalar inversion has been invoked in analyses of the latter. That is, it has been proposed that antonymous pairs of verbs like *widen/narrow* and *dry/(get) wet* make use of inverse pairs of scales (e.g. Winter 2006). If antonyms are taken to involve scalar inversion in this way, then the present analysis correctly predicts that a reversal presupposition can be satisfied by a preceding sentence containing a verb antonymous to the one modified by *again*.

(41) a. The roof got wet, but it soon dried again.

b. The river narrowed, but it soon widened again.

One might object to the present analysis on the grounds that the meaning $[\![\texttt{POS}]\!]$ is involved in both the presupposition and assertion of a reversative *again*-sentence, but enters into both in different ways; $[\![\texttt{POS}]\!]$ enters into the presupposition via $[\![\texttt{again}_\texttt{V}]\!]$, and enters into the assertion directly via the syntactic presence of POS. Instead of this, one might look for a way for $[\![\texttt{again}_\texttt{V}]\!]$ to compositionally combines with $[\![\texttt{POS}]\!]$; for example, one might take the meaning of $\texttt{again}_\texttt{V}$ to be as follows.

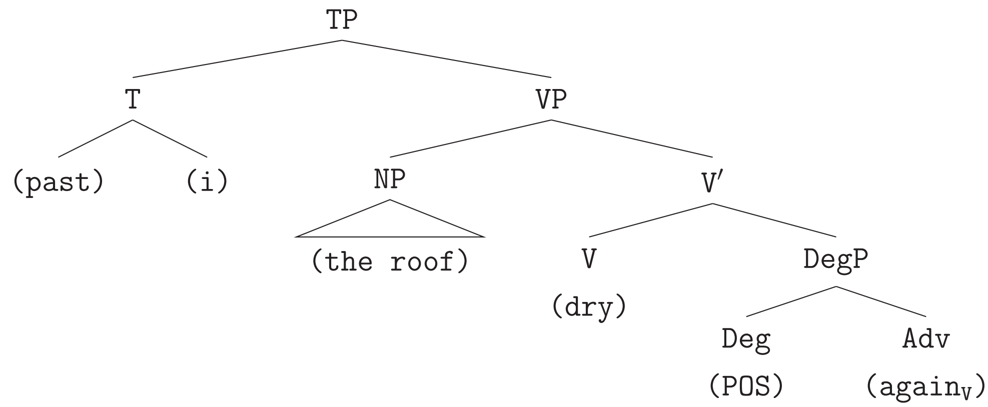
(42) $[\![\texttt{again}_\texttt{V}]\!](f)(\langle\langle D, <\rangle, g\rangle)(x)(i)$

a. is defined only if $\exists i' \prec i : f(\langle\langle D, <^{-1}\rangle, g\rangle)(x)(i') = \text{T}$

b. Where defined, equals T only if $f(\langle\langle D, <\rangle, g\rangle)(x)(i) = \text{T}$

This meaning would require an LF where $\mathtt{again_V}$ modifies POS, i.e. an LF like the following.

(43)



The truth-conditions for this LF, given the meaning in (42), will be the same as in (38); ⟦POS⟧ will enter into both the presuppositional and assertive content of the sentence.

Deciding between the meaning for $\mathtt{again_V}$ in (42) and the earlier meaning will require taking into account sentences containing *again* followed by a measure-phrase. It is often assumed that measure-phrases like *a little bit* or *three metres* occupy the same syntactic position as POS, i.e. that measure-phrases and POS are in complementary distribution. With the meaning in (42), a measure-phrase can be expected to enter into both the presuppositional and assertive content of a sentence; thus, *The river widened again three metres* should presuppose *The river narrowed three metres*. Assuming the earlier meaning for $\mathtt{again_V}$ in (32), a measure phrase can be expected to enter into the assertive content of the sentence only; *The river widened again three metres* should only presuppose *The river narrowed*. The meaning in (42) will thus predict (44) to sound odd (since the presupposition introduced by *again* will not be met), whereas the meaning in (32) will predict it to sound natural.

(44) The river narrowed by (exactly) two metres, then it widened again by three metres.

As the judgments are not completely clear, more research will be needed to determine which prediction is more accurate.[11]

7.4 Discussion and comparison

It has been shown in the preceding two sections that a polysemy analysis of *again* which includes a scale-sensitive meaning can generate the correct repetitive and reversative readings for different inchoative verbs. In this section, it will be considered how the present analysis

[11] My own judgments about (44) are not very clear, but tend to toward a judgment of oddity.

measures up against the traditional BECOME-scope analysis advocated by e.g. von Stechow (1996) and Beck (2005).

7.4.1 Structural properties

One main advantage of the present proposal is uniformity – to capture the *again* facts correctly, the syntactic structures of ambiguous sentences do not need to vary according to the particular inchoative verb involved. Instead, the different behaviour that different verbs exhibit with *again* fall out from differences in scale structure. The account thus differs in this regard from that of von Stechow (1996), who argues that the fine differences between absolute and relative verbs should be handled by decomposing the former into BECOME plus a bare-form adjective, and the latter into BECOME plus a comparative. The problems with adopting a multiple-decomposition analysis of inchoative verbs were discussed in §4.3.6; the present non-decompositional proposal avoids these problems entirely.

Although the proposed analysis is non-decompositional, it differs importantly from previous polysemy accounts in that it still has a structural component. The semantic types of the two version of *again* differ, with $[\![\texttt{again}_\texttt{V}]\!]$ having a type similar to a degree-modifier, and the $[\![\texttt{again}_\texttt{R}]\!]$ having the type of a predicate-modifier. This has the consequence that $[\![\texttt{again}_\texttt{V}]\!]$ can only be used when *again* is in a structural position adjacent to an inchoative verb; $[\![\texttt{again}_\texttt{V}]\!]$ needs access to the scalar component of the verb meaning, and access to this component is lost as one moves up in the structure. Thus, when *again* appears above the position where a verbal positive form is derived (i.e. above POS), it can only be analyzed as $[\![\texttt{again}_\texttt{R}]\!]$. The structural generalization discussed in §7.1.2 – that a reversative reading requires a position for *again* that is suitably close to the verb – thus falls out as a natural consequence of the present analysis. For example, if one assumes that manner adverbs like *quickly* modify properties, then it is predicted that only a repetitive reading should be possible when *again* follows a manner adverb; that is, (45) will only be interpretable if *again* is analyzed as $\texttt{again}_\texttt{R}$.[12]

(45) The river widened quickly again.

$[_{S}$ the river $[_{VP}$ $[_{V'}$ $[_{V'}$ $[_{V}$ widen] POS] quickly] $\texttt{again}_\texttt{R}$]]

Unlike previous polysemy analyses, then, the structural generalizations fall out from the present analysis as naturally as they do from a traditional decompositional analysis.[13]

[12] Note also that the manner adverb in (45) is in the scope of *again*, and is thus predicted (correctly) to enter into the repetitive presupposition that is generated.

[13] It has been often noted that fronting *again* also eliminates the possibility of a reversative reading – see (7b). Note that von Stechow (1996) originally characterized the repetitive meaning of *again* as a propositional

7.4.2 Inter-language and cross-linguistic variation

In §7.2.1 it was pointed out that attested cross-linguistic and cross-speaker variations in the availability of reversative readings for *again*-sentences poses a problem for the BECOME-scope decompositional account; furthermore, the 'Visibility Parameter' solution proposed by Rapp and von Stechow (1999) and Beck (2005) is undesirable for reasons that were discussed in §4.3.2. In the present analysis, language and speaker variation is predicted, and the mechanics are straightforward – they simply involve differences in lexicon, with one language/speaker pairing a single phonological form with both $[\![\texttt{again}_{\texttt{V}}]\!]$ and $[\![\texttt{again}_{\texttt{R}}]\!]$, and another assigning distinct phonological forms to the two meanings.

Although a polysemy approach to repetitive/reversal ambiguities avoids the problem of overgeneration without recourse to a Visibility Parameter, such an approach faces a different challenge when faced with the cross-linguistic and cross-speaker data – namely, to explain why the proposed polysemy exists at all, and why it is relatively common in the world's languages. As it currently stands, the two meanings proposed for *again* do not bear an obvious resemblance to each other, and it is unclear why languages would repeatedly choose to assign them the same phonological form (PF). However, a closer look reveals that these two meanings are in fact connected, supporting the idea that they might be grouped together in the lexical entry of a polysemous adverb. In discussing the various meanings of *wieder* (the German equivalent to *again*), Fabricius-Hansen (2001) notes certain implicational connections between the concept of a reversal/restitution and the concept of a repetition, which are argued to justify a polysemy analysis of repetitive/reversal ambiguities. The adoption in the present proposal of scalar semantic notions allows for the conceptual connections observed by Fabricius-Hansen (2001) to be stated more precisely than has previously been the case, and thus to provide support for a polysemy analysis of *again* which includes a scalar component.

First of all, note that certain repetitions imply a reversal on a scale. For example, a repetition of the property $[\![\texttt{POS}]\!]([\![\texttt{dry}_{\texttt{V}}]\!])$ implies that a reversal takes place on the dryness scale; in other words, a situation that includes two roof-dryings (a repetition) will necessarily

(rather than a property) operator; there is no reason to think that this meaning, shown below, might not be a third one associated with *again*, as the shift in meaning between a propositional operator and a corresponding property operator is straightforward (as in analyses of coordination; see Partee and Rooth 1983 for example).

(iv) $[\![\texttt{again}_{\texttt{P}}]\!](\mathcal{P})(i)$

a. is defined only if $\exists i', \exists i'' : i'' \prec i' \prec i$ & $\mathcal{P}(i'') = \text{F}$ & $\neg\mathcal{P}(i') = \text{T}$

b. Where defined, equals T only if $\mathcal{P}(i) = \text{T}$

Like $[\![\texttt{again}_{\texttt{R}}]\!]$, this meaning will only generate repetitive readings, as it will only be possible when *again* appears at the clausal level, and thus above the position where the $[\![\texttt{POS}]\!]$ operation applies.

include as a sub-part a situation where the roof gets wet and then dries (a reversal). Similarly, repetitions involving positive change on lower-closed scales (e.g. repetitions of $[\![\texttt{POS}]\!]([\![\texttt{blur}]\!])$) also imply scalar reversals. More formally, where V is a verb-denotation whose scale is top-closed or bottom-closed,

(46) $[\![\texttt{again}_{\texttt{R}}]\!]([\![\texttt{POS}]\!](V))(x)(i) \models [\![\texttt{POS}]\!]([\![\texttt{again}_{\texttt{V}}]\!](V))(x)(i)$

Of course, not all repetitions imply a reversal. As discussed in §7.1.1, repetitions involving relative verbs like *widen* do not in general imply reversals, since repetitions of such properties can take the form of 'successive-increases' on a scale.[14] Nonetheless, the fact that some repetitions do systematically imply reversals could potentially help provide one route to the proposed polysemy: through a combination of syndecdoche (whereby the expression used to describe a repetition might also come to be associated with an implied reversal) and meaning extension (whereby this association is extended to reversals in general), the PF associated with $[\![\texttt{again}_{\texttt{R}}]\!]$ could potentially be extended to cover $[\![\texttt{again}_{\texttt{V}}]\!]$.

Second, note that all scalar reversals contain as part of them some sort of repetition. This is most apparent with reversals involving maximal or minimal degrees. Consider, for example, a reversal on the scale $\langle D_{\text{DRY}}, <_{\text{DRY}}\rangle$ which involves a return to MAX_{DRY}. In this case, the reversal is one in which an object moves down on the dryness scale from the maximal degree, and then subsequently returns to this maximal degree. But such a situation is one which contains a repetition as well – namely, a repetition of the property of bearing the maximal degree of dryness. A reversal situation involving movement to and then away from a minimal degree also implies a repetition, in this case a repetition of bearing a non-minimal degree of the gradable property. Linguistically, these implications result in the following inferences.

(47) a. The roof got wet, then dried again. ⇒ The roof is dry again.
b. The image got crisp, then blurred again. ⇒ The image is blurry again.

These inferences are predicted by the present analysis; where $\langle\langle D, <\rangle, f\rangle$ is an adjective-denotation associated with a closed scale, and $\langle\langle D, <\rangle, \Delta f\rangle$ is the corresponding verb denotation,

(48) $[\![\texttt{POS}_{\texttt{V}}]\!]([\![\texttt{again}_{\texttt{V}}]\!](\langle\langle D, <\rangle, \Delta f\rangle))(x)(i) \models [\![\texttt{again}_{\texttt{R}}]\!]([\![\texttt{POS}_{\texttt{A}}]\!](\langle\langle D, <\rangle, f\rangle))(x)(\text{SUP}_i)$

The situation is slightly more complicated for reversals that do not involve movement to or from a maximal or minimal degree (i.e. those involving open scales), but these too contain

[14]Furthermore, repetitions of non-gradable properties, e.g. $[\![\texttt{kick}]\!]([\![\texttt{ball}]\!])$, are possible as well, which by definition cannot involve a reversal on a measurement scale.

repetitions, though of a weaker property. Consider a situation where a river narrows and then subsequently widens, i.e. a reversal on the scale $\langle D_{\text{WIDE}}, <_{\text{WIDE}}\rangle$. This situation implies a repetition of a property 'be d-wide', for some degree d; that is, if an object decreases and then increases in width, there will necessarily be some degree of width that the object possessed, then did not possess, then did possess again (of course, the particular degree(s) will depend on the particular situation). Formally, this implication can be represented as follows:

(49) $[\![\texttt{POS}]\!]_V([\![\texttt{again}_{\texttt{V}}]\!](\langle\langle D, <\rangle, \Delta f\rangle))(x)(i)$
$\models \exists d : [\![\texttt{again}_{\texttt{R}}]\!]([\lambda y \lambda h. f(y)(h) \geq d])(x)(\textsc{sup}_i)$

The corresponding linguistic inference is that for any situation in which (50a) is true, it should be possible to find some sentence of the form in (50b) that is also true, where 'MP' is replaced by some actual measure phrase (like *ten metres*).

(50) a. The river narrowed, then widened again.
b. The river is (at least) MP wide again.

The observation that all reversals contain repetitions might provide another route to the proposed polysemy, one that also involves syndecdoche and meaning extension. One could imagine that a term used to describe reversals might come to be associated with the particular repetitions inherent in reversals, and from there might be extended to repetitions in general; in this way, the PF for $[\![\texttt{again}_{\texttt{V}}]\!]$ might be extended to cover $[\![\texttt{again}_{\texttt{R}}]\!]$.

While establishing the basis of specific cases of polysemy would likely involve looking into the history of specific languages and language families, the above considerations show that, although $[\![\texttt{again}_{\texttt{V}}]\!]$ and $[\![\texttt{again}_{\texttt{R}}]\!]$ appear to be quite different, there is still enough of a connection between them to justify their constituting two meanings of a polysemous *again*. The fact that the connections between the two meanings require some work to uncover might also explain why they are not paired with a single PF in all languages/dialects, and hence explain the attested cross-linguistic and cross-speaker variation.[15]

[15] It is worth noting that in an earlier stage of English, *again* had an even wider range of meanings than it does now and was also found in a prefixal form (the sole surviving example being the verb *gainsay*). See the OED entries on 'again' and 'again-, *comb. form*' for historical details. The present association of a single phonological form with both $[\![\texttt{again}_{\texttt{V}}]\!]$ and $[\![\texttt{again}_{\texttt{R}}]\!]$ may thus be indicative of an earlier state of the language that is currently undergoing change; Beck et al. (2009) observe that reversative readings with *again* have been becoming less frequent over time, possibly as a result of the Latinate prefix *re-* being introduced into the language. Many of the obsolete verbs with the *again-* prefix listed in the latter entry have been replaced with verbs containing the prefix *re-*, e.g. *again-new* 'renew'. Note that German *wieder* (which incidentally also gives rise to repetitive/reversal ambiguities) also appears as a non-obsolete prefixal form, e.g. in *wiedergeben* 'to restore'.

7.4.3 More complex sentences with *again*

This chapter has focused on the semantics of simple sentences containing *again* and an inchoative verb. Of course, *again* is not limited to appearing in such sentences, and a few words should be said regarding how the present analysis applies to some of the more syntactically-complex sentences that *again* appears in.

On the surface, transitive sentences with *again* seem to offer counter-evidence to the proximity generalization discussed in §7.1.2; the direct object can intervene between the verb and *again* without ruling out a reversative reading. (There is also the question of whether the subject enters into the presupposition, which is not important for present purposes.)[16]

(51) John widened the driveway again. (repetitive/reversal)

The possibility for a reversative reading of such sentences is perhaps not so problematic when they are provided with a more substantial syntactic analysis. Adverbs in English are generally unable to intervene between the verb and direct object (examples from Johnson 1991, p.580).

(52) a. *Mikey visited quietly his parents.
b. *Betsy sung loudly the anthem.
c. *Chris hit quickly the dog.

An influential proposal by Kratzer (1996), adopted in many syntactic accounts, has the agent of a transitive sentence introduced by a separate 'voice' head; following suggestions by Johnson (1991), Kratzer proposes that transitive objects are generated as specifiers to the verb, and that the lexical verb raises and adjoins with the voice head AG. In the case of a transitive sentence containing an inchoative verb like *widen*, this movement can be assumed to target the verb itself, rather than the property created by `POS`:[17]

(53) [John [$_{\text{VC}}$ AG [the driveway [$_{\text{VP}}$ [$_{\text{V}}$ widen] POS]]]] $\Rightarrow$
[John [$_{\text{VC}}$ widen-AG [the driveway [$_{\text{VP}}$ t POS]]]]

This type of analysis will allow *again* to be adjoined directly to the verb in a transitive sentence, while ruling out the possibility of *again* appearing between the verb and the

[16] See Bale 2007 for extended discussion of subjectless presuppositions with *again*.
[17] Evidence for this comes from the fact that overt degree-modifiers (like comparatives and measure-phrases) must follow the direct object.

(v) a. John widened the driveway [more than the garage/three metres].
b. *John widened [more than the garage/three metres] the driveway.

noun-phrase object in the surface string. Thus, transitive sentences will be predicted to be ambiguous just as their intransitive counterparts are.

(54) John widened the driveway again.

a. REVERSAL:
`[ John [`$_{VC}$` widen-AG [ the driveway [`$_{VP}$` [ `t` again`$_V$` ] POS ] ] ] ]`

b. REPETITIVE:
`[ John [`$_{VC}$` widen-AG [ the driveway [`$_{VP'}$` [`$_{VP}$` `t` POS ] again`$_R$` ] ] ] ]`

Whether the details of this particular syntactic analysis are correct or not, the ability for objects to intervene between the verb and *again* without ruling out reversative readings can plausibly be seen as a consequence of more basic syntactic principles governing verb and argument movement.[18]

Again-ambiguities have also been discussed in the context of more complex VPs like resultatives and double-object constructions (e.g. Beck and Johnson 2004; Beck 2005). Thus, Beck (2005) observes that the following sentence has both a repetitive and a reversative reading.

(55) Sally hammered the metal flat again. (repetitive/reversal)

The repetitive reading has the entire action of Sally hammering the metal flat occurring for a second time. The reversative reading has the metal being returned to a previously-held flat state through Sally's hammering. From the present perspective, resultative sentences can be shown to provide a useful example of how reversal-type readings can be derived in different ways – in particular, they can be taken as a demonstration that reversative readings can be generated without ⟦`again`$_V$⟧ being used at all. Resultative constructions quite transparently involve a stative property; they are often taken to be analyzed in terms of a stative small-clause that combines with an activity verb. Semantically, a causal operator is introduced to relate the meanings of these two expressions, whereby the activity encoded by the verb causes the state expressed by the small-clause; this causative meaning is introduced either by a null `CAUSE` head (e.g. Kratzer 2011; Tomioka 2006) or by the construction itself (e.g. Goldberg 1995; Jackendoff 1990; Levin and Rappaport Hovav 1995; von Stechow 1995). Assuming

[18] Assuming manner adverbs are right-adjoined, such an analysis will also correctly predict that when *again* is preceded by a manner adverb, only a repetitive reading is possible.

(vi) John widened the driveway quickly again. (repetitive/#reversal)
`[ John [`$_{VC}$` widen-AG [ the driveway [ [ [ `t` POS ] quickly ] again`$_R$` ] ] ] ]`

the latter, a resultative sentence will have something like the following syntactic analysis (ignoring tense and voice phrases).

(56) Sally hammered the metal flat.

`[ Sally [`$_{\texttt{VP}}$` hammer [ the metal [`$_{\texttt{AP}}$` flat POS ] ] ] ]`

The same sort of analysis is argued to apply to other complex predicates; Beck and Johnson (2004) provides a similar analysis for double object constructions, and Beck (2005) for goal-PP constructions.

As discussed above, a scalar analysis of inchoative verbs contrasts with a traditional decompositional analysis in rejecting the idea that lexical inchoative verbs syntactically embed a stative property. However, this does not rule out the possibility that more complex predicates do embed a stative property. If one adopts a syntactic analysis for resultatives similar to that in (56), there will be two places where *again* can adjoin – to the whole VP, or to only the small-clause property. Note that in both cases *again* is adjoining to a property-denoting expressions, and thus in both cases must be $\texttt{again}_{\texttt{R}}$.

(57) Sally hammered the metal flat again.

a. REPETITIVE:

`[ Sally [`$_{\texttt{VP}'}$` [`$_{\texttt{VP}}$` hammer [ the metal [`$_{\texttt{AP}}$` flat POS ] ] ] again`$_{\texttt{R}}$` ] ]`

b. REVERSAL:

`[ Sally [`$_{\texttt{VP}}$` hammer [ the metal [`$_{\texttt{AP}'}$` [`$_{\texttt{AP}}$` flat POS ] again`$_{\texttt{R}}$` ] ] ] ]`

Adjunction to the VP property as in (57a) will produce a repetitive reading, where the property of hammering the metal flat holds of Sally for a second time. Adjunction to the small-clause property as in (57b) will have the effect of producing a reversal-like reading, where Sally's hammering causes the metal to return to a flat state. This latter reading is generated even though the presupposition that (57b) bears does not pertain to negative-change on a measurement-scale (since it was not generated with $[\![\texttt{again}_{\texttt{V}}]\!]$); instead, the presupposition will require a prior interval where the property $[\![\texttt{POS}]\!]([\![\texttt{flat}]\!])$ was true of the metal. Note, however, that a reversative reading of (56) can be paraphrased with the following sentence, when the second clause is understood as having a reversative reading; in this paraphrase, the reversal presupposition is generated with $[\![\texttt{again}_{\texttt{V}}]\!]$.[19]

(58) As a result of Sally's hammering, the metal flattened again.

... `[ the metal [`$_{\texttt{VP}}$` [`$_{\texttt{V}'}$` [`$_{\texttt{V}}$` flatten ] again`$_{\texttt{V}}$` ] POS ] ]`

[19] The paraphrase is possible because *flat* is a maximal adjective, and thus *flatten* gives rise to an inference to the adjectival bare-form. See Wechsler 2005 for discussion on the role of scales in resultative constructions.

What this demonstrates is that, in a scalar analysis, there are multiple ways of generating a reversative-like reading. More specifically, a reversative reading is derived differently for a complex VP (like a resultative) than it is for a simple VP with a lexical inchoative verb; in the former case it is derived with $[\![\texttt{again}_{\texttt{R}}]\!]$, and in the latter with $[\![\texttt{again}_{\texttt{V}}]\!]$. This makes an important prediction: that certain adverbs might generate reversative readings with complex VPs but not with lexical verbs – this will be the case if the adverb in question is associated with the meaning $[\![\texttt{again}_{\texttt{R}}]\!]$ but not $[\![\texttt{again}_{\texttt{V}}]\!]$. In fact, this prediction seems to be borne out; Beck (2005) observes that there are languages (or dialects of languages) exhibiting an *again*-expression that allows reversative readings with resultative-type constructions, but not with lexical inchoative verbs; unlike the traditional decompositional approach, the present polysemy analysis can account for such variation without recourse to something like the Visibility Parameter discussed in Chapter 4.[20]

7.5 Summary

In this chapter, it was demonstrated how *again*-ambiguities can be explained in a scalar approach to the meaning of inchoative verbs, which does not involve decomposing such verbs into BECOME and a stative small-clause. The analysis of *again*-ambiguities offered here assumed that *again* is polysemous, having a scale-sensitive reversative meaning as well as a property-modifying repetitive meaning; these meanings were shown to be related in ways that makes their association with a single PF not unexpected. The polysemy analysis of *again*-ambiguities was argued to be preferable to the standard BECOME-scope analysis, in particular with how it can explain cross-linguistic and cross-speaker variation in reading availability without recourse to an ad-hoc solution like the Visibility Parameter of Rapp and von Stechow (1999) and Beck (2005).

The analysis of *again* provided here points to the possibility that perhaps what the traditional 'decomposition adverbs' *again* and *almost* have in common is the potential to access the measure function and measurement scale used by a verb; *almost*, which is also argued to give rise to ambiguities, has also been analyzed using scalar semantics (see Chapter 6, §6.3.2.2). The proposal that *again* also has a scalar component thus goes some way to linking the meanings of these two adverbs, and to isolating the property that distinguishes them from those adverbs which do not give rise to ambiguities. By explaining the ambiguities found with such adverbs in ways that rely on the scalar components of verb-meaning

[20]In particular, Beck finds that certain speakers of Hungarian and of Mandarin have these judgements about reversative readings.

rather than on the scope of decompositional heads, a major obstacle to generally replacing decompositional structures with scalar meanings is removed.

Chapter 8

Conclusion

In this dissertation it was argued that, by assigning lexical items denotations that involve scalar or scale-sensitive meanings, one can construct analyses of adverbs and adverbial modification that are preferable on theoretical and empirical grounds to those which are constructed using traditional decompositional structures. Adverbs like *again*, which give rise to ambiguities when combined with inchoative verbs, have traditionally been taken as providing evidence for syntactic decomposition; it was shown that, in a scalar approach to verb meaning, one way to explain adverbial-ambiguities like those found with *again* is to assume that the adverb involved is polysemous, having a scale-sensitive meaning that can apply directly to a verb, as well as a (related) meaning that applies to a larger structure such as a verb-phrase. It was also shown that a scalar analysis of inchoative verbs is preferable to an analysis that posits widespread multi-clausal decomposition, on more general grounds; among other problems, the latter type of analysis results in the overgeneration of adverbial ambiguities, as well incorrect truth-conditions for sentences which appear to have adverbs in decomposition-internal positions.

A number of important issues remain unresolved, however. One issue is the asymmetry between pre-states and result-states with respect to deictic reference (i.e. the fact that *that way* in *The door opened and stayed that way* is naturally understood as standing for *open*, whereas the same phrase in *The door opened, and before opening it had been that way for awhile* cannot be understood as standing for *closed* without additional context). This asymmetry was not addressed in the scalar approach, and provides one area for future exploration.

Another issue that was not adequately dealt with here is the 'result-state' readings of durative adverbials like *temporarily* and *for*-phrases. It seems unlikely that these result-state readings are a consequence of durative modifiers having scale-sensitive meanings, since these readings are available even when inchoative verbs appear with degree modifiers that are usually taken to 'close-off' access to a verb's scalar meaning (as in e.g. *The image blurred* *slightly for a few minutes*). Such examples indicate there must be a way for durative modifiers to access the duration of a result-state that does not rely on accessing the scalar component of verb-meaning. This perhaps calls for additional structure in the VP, or for verb-meanings that are enriched in some additional way.

Finally, more cross-linguistic work and historical work is needed on those adverbs, like cross-linguistic correlates of *again* and *almost*, which on the present approach might be expected to have scale-sensitive meanings in addition to other related non-scalar meanings. A polysemy analysis was proposed here for *again*, and some suggestions for how this polysemy might arise were offered; future cross-linguistic and historical research might be able to lend support to these suggestions.

In closing, the arguments offered here against the traditional decompositional analysis of inchoative verbs suggest that it is time for this type of analysis, present in some form since the time of the Generative Semantics movement, to be replaced with an approach that involves suitably enriched denotations for adjectives, verbs, and adverbials. The formal structures proposed in analyses of gradability provide one possible – and promising – source for pursuing this enrichment.

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