

Not Does More than What the Truth-Functional Negation can Do

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ABSTRACT

This paper investigates a semantic property of sentential negation and a syntax-semantics interface property of lexical aspect and the way sentential negation interacts with it. I show that a puzzling property of negative sentences, namely that they display the sub-interval property without affecting the aspectual property of the predicate involved, is accounted for by giving sentential negation a more sophisticated structure than what is generally assumed.

Building on Rothstein's (1999) mass-count distinction in the eventuality domain, I show that VPs denote relations between count and mass eventualities such that the former instantiates the existence of the latter and that each of the four Vendlerian aspectual classes is defined in terms of the instantiation of the particular type of mass eventualities that are realization of aspectual features.

Keywords: lexical aspect; mass-count distinction; sentential negation; situations.

1 Introduction

This paper examines the semantics and the syntax-semantics interface properties of sentential negation and elements in the verbal domain, namely, Adjective Phrases (APs) and Verb Phrases (VPs) in English. The goal of this paper is to investigate the aspectual properties of the VP and the way sentential negation interacts with them. I show that semantically a Larsonian VP shell is structured in such a way that the denotation of the lower VP is found in the mass domain while that of the upper VP is found in the count domain. This is based on Rothstein's (1999) analysis of the '*be* + AP' structure, where the denotation of AP is found in the mass domain and the function of *be* is to instantiate a set of mass-eventualities denoted by the AP. I show that the denotation of the negative operator is found in the mass-domain on a par with the denotation of AP. In particular, sentential negation has a universal quantificational force whose quantificational structure shares an important property in common with that of 'universal' adjectives as defined by Kamp and Rossdeutscher (1994), where a universal adjective *healthy* denotes a set of individuals *x* such that for every ailment *w*, if there is any, *x* is in a state of being cured of *w*.

The generalization that is derived from this analysis is that the universal quantifier associated with a universal adjective and the negative operator take pre-states as the domain of quantification and the corresponding result-states as their scope. For example, the negative sentence ‘There aren’t stains on the table’ denotes the relation between the set of pre-states (i.e., a set of states that instantiate the existence of stains on the table) and a set of the corresponding result-states (i.e., a set of states obtained as the result of stains becoming non-existent) such that every such pre-state, *if there is any*, is extendable to the corresponding result-state. The non-existential commitment of the domain of quantification as emphasized in italics is shown to follow from the essential nature of the universal quantification involved in the semantics of sentential negation, where a pre-state constitutes an essential or necessary condition for the corresponding result-state to hold. The nature of the pre-state associated with the semantics of sentential negation is made sensitive to the way the state associated with each type of predicate is realized.

With this mechanism, we can satisfactorily account for a puzzling fact about negative sentences, namely, the sub-interval property expressed by a negative sentence leaving intact the aspectual property of the predicate the negative operator is associated with. This proposal also provides a satisfactory account of why negative sentences are generally more context-dependent than their affirmative counterparts. The non-existential commitment on the domain of quantification indicates that what is under discussion in a discourse context is whether the set of pre-states that constitute the domain of the negative operator is empty or non-empty. This explains in a principled manner the context-dependency of negative sentences often discussed in the literature (e.g., Horn 1989), namely that a negative sentence ‘presupposes’ the corresponding affirmative sentence without actually presupposing it.

2 Sentential negation and context dependency: semantics or pragmatics?

2.1 Context dependency as a consequence of speaker denials to assertions

As has often been discussed in the literature (Givon 1978, Horn 1989, among others), negative sentences are more context-dependent than their affirmative counterparts. For example, in the following sentences, the negative sentence in (1a) is interpreted as if its affirmative counterpart (1b) is already in discourse:

- (1) a. My wife isn’t pregnant.
 b. My wife is pregnant. (Givon 1978)

If (1a) is uttered in a context where the listener doesn’t know whether the speaker’s wife is pregnant, the listener’s likely response will be: ‘Oh, I didn’t know that your wife was supposed to be pregnant’. In contrast, the affirmative counterpart (1b) is perfectly fine when it is uttered in a discourse-initial context.

The context-dependency just mentioned above is generally considered to be a conversational implicature (Horn 1989, among others) and as such it is not part of the

semantics of sentential negation. I challenge this conclusion and argue that sentential negation is inherently modal. If sentential negation is inherently modal, then the context dependency just discussed follows naturally without stipulation. In what follows, I present two pieces of evidence to show that sentential negation is inherently modal and hence that the context dependency just discussed is part of the semantics of sentential negation.

2.1.1 *The essential nature of negation*

The term ‘essential’ implies that there is a relation between A and B such that the relation between them is essential. In this way, ‘essential’ is a relational notion and the relation is an asymmetric one. The essential nature of negative sentences implies that negative sentences must denote some type of asymmetric relation. Since essential quantification is non-factual in the sense that it does not commit itself to the existence of the members of the domain of quantification, the essential nature of negative sentences motivates a modal analysis of negation.

Dayal (1998) makes a distinction between the two types of universal quantification—*accidental* and *essential*. The characteristic distinction between the two types she notes is the distinction in the ‘existential commitment’, where the accidental quantification commits itself to the existence of the members of the domain of quantification whereas the essential quantification lacks the existential commitment. To see this, consider the following example from Dayal (1998):

- (2) a. Every student in Mary’s class is working on polarity items.
- b. It happens to be true of every student in Mary’s class that he/she is working on polarity items.
- c. Every student in Mary’s class, by virtue of being in her class, is working on polarity items.

She notes that this sentence is ambiguous between a reading in which membership in the set denoted by the relative clause is accidental and one in which it is essential to the truth of the statement being made. The distinction is reminiscent of the distinction Donnellan (1966) makes between referential and attributive uses of definite descriptions.

According to Dayal, the ambiguity disappears when the phrase *whoever they may be* is added after the modified noun phrase, which isolates the essential reading as in (3a), while the addition of the accidental predicate *happen to* to the main predicate isolates the accidental reading as in (3b):

- (3) a. Every student in Mary’s class, *whoever they may be*, is working on polarity items.
- b. Every student in Mary’s class *happens to* be working on polarity items.

As Dayal notes, the combination of the phrase *whoever they were* and the accidental predicate *happen to* in (3a) or the addition of the phrase *whoever she may be* after the modified noun phrase of a sentence whose preferred reading is the accidental one as in (3b)

leads to ungrammaticality:

- (4) a. *Every student in Mary's class, *whoever they were*, happened to vote for the Republican.
- b. *Every woman standing under that tree, *whoever she may be*, is Mary's best friend.

Interestingly, negative sentences allow only the essential readings. Consider the following examples:

- (5) a. *Whatever the situation was*, Peter didn't eat Mary's cookies.
- b. Mary didn't *happen to* eat Mary's cookies.
- c. It *happened to* be true of Peter that he didn't eat Mary's cookies.

(5a) shows that the negative sentence is compatible with the *whatever* phrase, indicating the essential nature of the sentence. (5b) can only have the reading where the accidental predicate *happen to* is interpreted outside the scope of negation as paraphrased in (5c). The fact observed in (5b) indicates that negation somehow makes the content that is negated essential. In other words, while a negative sentence itself can be accidental, negation cannot be.

Another feature of essential quantification is its non-existential commitment or contextual vagueness on the domain of quantification. The following example illustrates the point. In this example, the nature of the set of soldiers who had fought in the Gulf War is left vague:

- (6) We didn't keep the list of names, but the President thanked every soldier who had fought in the Gulf War. (Dayal 1998)

Negative sentences also exhibit a similar type of vagueness, as the following example suggests:

- (7) I'm not sure of the status of the package, but the package didn't arrive.

In this example, the speaker is uncommitted as to the status of the package---whether it is on the way to be delivered or not. In section 4, I will show that the non-existential commitment or contextual vagueness is the heart of the semantics of sentential negation, in the sense that it characterizes the semantic nature of the domain restriction of sentential negation.

2.1.2 Modal subordination

The second piece of evidence to motivate a modal analysis of negation is that a negative sentence can host an inter-sentential anaphora in non-factual contexts. Consider the following examples:

- (8) a. Peter might have bought a Porsche_i.
 b. There isn't anyone who saw him driving it_i, though.
 c. #There is someone who saw him driving it_i.

In (8), the pronoun *it* in (8b) can be anaphorically linked to the indefinite *a Porsche* without assuming that Peter actually bought a Porsche or that there is a Porsche that Peter is associated with. In contrast, (8c) can be felicitously uttered only if there is a Porsche that Peter is associated with. Then (8c) can be used as evidence for the possibility that Peter bought the car, and didn't just borrow it from someone. In other words, on this reading, there is a Porsche that has something to do with Peter and what is at issue is whether Peter bought it or not.

The phenomenon just discussed has been known as *modal subordination* since Robert's (1989) work on this topic. It is called *modal subordination* because in the felicitous cases in the above examples the (b) sentences may be interpreted as a sort of continuation of the (a) sentences without committing the speaker to the existence of a Porsche in (8a).

According to Roberts, the successful anaphoric linkage crucially relies on the mood of an utterance that tells us whether or not it is asserted. For instance, in the following examples (cited from Roberts 1989), the pronoun *it* in (9b) cannot be anaphorically linked to the indefinite *a book* in the antecedent of the conditional, whereas such linkage is possible in (10b):

- (9) a. If John bought a book_i, he'll be home reading it_i by now.
 b. #It_i is a murder mystery. (Roberts 1989)
- (10) a. If John bought a book_i, he'll be home reading it_i by now.
 b. It_i 'll be a murder mystery. (Roberts 1989)

Roberts assumes that if a speaker indicates that a sentence or clause is to be interpreted as true in the actual world, the sentence or clause must be uttered in the factual mood whereas if a clause like the antecedent of a conditional expresses a hypothetical assumption, it must be uttered in a nonfactual mood. According to this criteria, the contrast between (9) and (10) is the contrast in mood: that is, (9b) is uttered in a factual mood whereas (10b) is in a nonfactual mood.

Roberts considers two approaches to account for the successful anaphoric linkage illustrated in (10). One is the *Insertion Approach*, in which the material that contains an anaphoric pronoun is inserted in the scope of the modal operator that contains the antecedent indefinite. The other is the *Accommodation of the Missing Antecedent Approach*, in which the material that contains the antecedent indefinite is accommodated in the restrictor of the modal operator that contains the anaphoric pronoun. Based on the following example, Roberts adopts the latter approach:

- (11) a. A thief might break into the house.
b. He would take the silver. (Roberts 1989)

According to the *Insertion Approach*, the material in (11b), namely, ‘he take the silver’, is inserted (i.e., conjoined with) into the scope of the modal *might* in (11a). However, this would yield the wrong truth-condition since *might* is existential whereas *would* is universal. On the other hand, the *Accommodation of the Missing Antecedent Approach* yields the correct truth-condition since in this case the material that contains the antecedent indefinite ‘a thief break into the house’ is accommodated into the implicit restriction of the modal *would*.

Viewed in this way, the fact that negative sentences can host successful anaphoric linkage indicates that negative sentences are interpreted in a nonfactual mood. Furthermore, the successful anaphoric linkage in the modal subordination context illustrated in (8b) indicates that sentential negation comes with an implicit restriction with respect to which the scope is evaluated. Together with the essential nature of negation as discussed in the previous section, this suggests that sentential negation asymmetrically relates two propositions—one constitutes its restriction and the other its scope.

2.2 Sentential negation and its sub-interval property

Besides their context dependency, negative sentences have sub-interval properties that are characteristic of state-denoting sentences. Thus, in the following example, the state in which Peter didn't run twenty miles holds throughout the interval denoted by the adverb *yesterday*:

- (12) a. Yesterday, Peter didn't run twenty miles.
b. |-----|<----->|-----|

YESTERDAY

This property has led some scholars to argue that negation is a special operator that converts all event descriptions to state descriptions (Bennett & Partee 1972, Dowty 1979, Verkyul 1993, de Swart & Molendijk 1999, among others). This Stativity Hypothesis has been supported by negation's compatibility with durative adverbials as in (13a) and its incompatibility with time-span adverbials as in (14a):

- (13) a. The ship didn't arrive for two days.
b. *The ship arrived for two days.

- (14) a. The ship will not arrive in two days.
 (i) ^{OK}not > in two days
 (ii) *in two days > not
 b. The ship will arrive in two days.

Assuming that durative adverbials are compatible with atelic predicates, contrasts such as the one between (13a) and (13b) have been used in favor of the Stativity Hypothesis of the negative operator. Contrasts such as the one between (14a) and (14b) also support the Stativity Hypothesis assuming that time-span adverbials are only compatible with telic predicates. Thus, states derived by negation are states characterized by non-occurrence of a specific type of event.

However, the Stativity Hypothesis, plausible as it may look, has problems which have been pointed out in the literature. In what follows, I present three such problems.

2.2.1 *Sub-event properties of negated telic event descriptions*

The first problem has to do with the sub-event and no sub-event contrast between telic and atelic predicates in the scope of negation. The following examples are a case in point:

- (15) a. The package didn't arrive. (Achievement)
 b. Peter didn't run twenty miles. (Accomplishment)
- (16) a. Peter didn't run. (Activity)
 b. Peter wasn't sick. (State)

Telic predicates such as *arrive* and *run twenty miles* in (15) can have sub-event readings in the scope of negation. So, in (15b), for example, the sentence can be true when Peter ran but didn't complete the twenty-mile run. Atelic predicates such as *run* and *be sick* do not have sub-event properties. Thus, in (16), no sub-event of Peter's running holds in (16a). Likewise, no sub-state of Peter's being sick holds in (16b).

These examples are problematic for the Stativity Hypothesis because the negative operator does not seem to stativize the event descriptions in (15).

2.2.2 *Lack of present orientation in negated event descriptions*

The second problem has to do with the interpretation of negated event descriptions in present tense. If negation is a stativizer that converts all the event descriptions to state descriptions as predicted by the Stativity Hypothesis, it is predicted that negated event descriptions, when they occur in present tense, will be interpreted on a par with state descriptions. However, this prediction is not borne out, as the following examples indicate:

- (17) a. Peter doesn't smoke. (Habitual)
 b. Peter smokes. (Habitual)
- (18) a. Peter doesn't love Mary. (Present Orientation)
 b. Peter loves Mary. (Present Orientation)

In English, states and other event descriptions (activities, accomplishments and achievements) differ in the interpretation of the present tense form. With present tense morphology, only states can denote a situation that holds at the utterance time as in (18). Non-state present tense event descriptions have a habitual interpretation as in (17). What is unexpected, given the hypothesis that negation is a stativizer, is that negation fails to yield an ongoing interpretation for all event descriptions. In fact, just like their affirmative counterparts, negated present tense non-state utterances only allow a habitual interpretation.

2.2.3 *Consecutive readings of negated event descriptions in discourse*

States and perfective event descriptions are also distinguished by their role in narratives. While non-state descriptions advance narrative time, states typically fail to do so (Dowty 1986, Kamp and Reyle 1993). The two events in (19a) below are consecutive: Bill's smiling is interpreted as following (and possibly being a consequence of) Mary's looking at him. In contrast, (19b) is interpreted as Bill's smiling having begun (and possibly continuing after) the time when Mary looked at him:

- (19) a. Mary looked at Bill. He smiled.
 b. Mary looked at Bill. He was smiling. (Kamp & Ryle 1993)

A negated event description also advances narrative time, similarly to its affirmative counterpart in (19a). The second sentence in (20a) is interpreted as stating that Bill did not smile as a consequence of Mary's looking at him; that is, the expected reaction of Bill's smiling did not happen. The consecutive reading of the negated event description can be contrasted with the interpretation of a negated state. The overlapping interpretation of the negated state in (20b) is also parallel to its affirmative counterpart in (19b):

- (20) a. Mary looked at Bill. He didn't smile.
 b. Mary looked at Bill. He wasn't smiling. (Kamp & Ryle 1993)

2.3 *Section summary: what do negative sentences denote?*

The essential nature of sentential negation and the fact that negative sentences support modal subordination discussed in section 2.1 indicate that sentential negation relates two propositions p and q such that they are asymmetrically related and that the truth of p is essential to the truth of q . Thus, sentential negation must have at least the following structure:

- (21) [*Neg*: p][q]

In section 2.2, we have seen that even though negative sentences have an important property in common with state descriptions in that both have sub-interval properties, they cannot be identified. The descriptive generalization about negative sentences is that they

display sub-interval properties without affecting the aspectual property of the predicate involved.

Whatever the semantics of sentential negation we come up with, we must be able to capture the two properties summarized above and incorporate them into the semantics of sentential negation. This is what we do in the following two sections. In section 3, I provide a necessary ingredient to account for one of the properties of sentential negation identified in section 2.2, namely the fact that negative sentences that display sub-interval properties without affecting the aspectual property of the predicate involved. To do so, I develop a situation-theoretic analysis of the four Vendlerian aspectual classes of verbs building on Rothstein's (1999) mass-count distinction in the verbal domain. In particular, I argue that semantically a Larsonian VP shell is structured in such a way that the denotation of the lower VP is found in the mass domain while that of the upper VP is found in the count domain. This is based on Rothstein's (1999) analysis of the '*be* + AP' structure, where the denotation of AP is found in the mass domain and the function of *be* is to instantiate a set of mass-eventualities denoted by the AP. I show that the denotation of the negative operator is found in the mass-domain on a par with the denotation of AP. The analysis of sentential negation as a domain shifter sets the stage to account for the fact that sentential negation does not affect the aspectual property of the predicate it interacts with.

In section 4, I define the semantics of sentential negation that accounts for the context dependency discussed in section 2.1. I show that the proposed semantics also provides a principled account of why sentential negation interacts with lexical aspect the way it does.

3 The mass-count distinction in the verbal domain

3.1 Rothstein (1999)

Recently, Rothstein (1999) defended a view different from what Bach (1986) suggested regarding the mass-count distinction in the verbal domain. Unlike Bach, who suggested that the denotation of telic predicates is found in the count domain and that of atelic predicates is found in the mass domain, Rothstein argues that a distinction must be made between VPs and APs, not between telic and atelic predicates. Based on the following examples, she showed that the denotation of VPs, no matter what aspectual class they belong to (i.e., states, activity, achievement or accomplishment), is found in the count domain whereas that of APs is found in the mass domain (see Rothstein 1999 for more examples of this type):

- (22) a. I made Mary know the answer three times.
 b. I made Mary worry three times. (Rothstein 1999)
- (23) a. I made Mary angry/clever (in class) three times.
 b. I made Mary be angry/clever (in class) three times. (Rothstein 1999)

In (22), the counting adverb *three times* can modify either the complement VP or the matrix VP. In contrast, the counting adverb can only modify the matrix VP in (23a) whereas when the copula *be* is present the adverb can modify either the complement or the matrix. The generalization she drew from these types of examples is that (i) the denotation of VPs, whether they are state predicates or others, is found in the count domain; (ii) the denotation of APs is found in the mass domain, and (iii) the function of *be* is to make the denotation of APs countable. Rothstein defines the denotations of VP, AP and *be* respectively as follows:

- (24) a. $\|VP\| = \lambda x.\lambda e. VP(e) \wedge \Theta_1(e) = x$, where Θ_1 is some thematic role.
 b. $\|AP\| = \lambda x.\lambda s. AP(s) \wedge \Theta_1(s) = x$, where Θ_1 is some thematic role.
 c. $\|be\| = INST = \lambda S.\lambda e.\exists s \in S: e = I(s)$, where S is a set of mass-states and I is an ‘instantiation’ function from a set of mass-eventualities to a set of count-eventualities.

In (24), VPs denote sets of count-eventualities and APs denote sets of mass-eventualities. The copula *be* denotes a relation between a set of count-eventualities and a set of sets of mass-eventualities whose function is to instantiate a set of mass-eventualities denoted by an AP. Thus, in Rothstein’s analysis, it is the contribution of the copula *be* that makes the denotation of a VP composed of the copula and an AP countable.

I adopt Rothstein’s mass-count distinction and the function of *be* as a domain shifter. In the following section, I show that her analysis has a natural extension to the domain of VPs in general.

3.2 A situation-theoretic analysis of the four Vendlerian aspectual classes

This section presents a situation-theoretic reformulation of Rothstein’s mass-count distinction in the verbal domain as summarized in section 3.1 above. The decision to do so is mainly due to the semantics of sentential negation to be developed in section 4. As shown in section 2.1, the semantics of sentential negation requires that intensionality be built into its semantics due to its essential nature and non-factuality that supports modal subordination. In section 3.2.1, I introduce a version of situation semantics developed in Kratzer (1989) and provide a reformulation of Rothstein’s analysis of the copula *be* in situation-theoretic terms. The section 3.2.2 presents a situation-theoretic analysis of the four Vendlerian aspectual classes of verbs building on Rothstein’s analysis of ‘*be* + AP’.

3.2.1 Kratzer’s situation semantics: some basics

This section presents the basics of a Kratzerian Situation Semantics (Kratzer 1989). First, throughout this paper, a situation-based ontology is assumed. Specifically, a model for interpreting natural language is a tuple $M := \langle S, D, W, <, \| \| \rangle$, where:

- (25) a. S is the set of possible situations.
 b. D is the set of possible individuals. $D \subseteq S$.

- c. W is the set of possible worlds, maximal elements with respect to $\leq$.
- d. $<$ is a partial ordering on S .
- e. $\| \cdot \|$ is the interpretation function.

The partial ordering on S satisfies at least the following condition: for all $s \in S$ there is a unique $s' \in S$ such that $s \leq s'$ and for all $s'' \in S$: if $s' \leq s''$, then $s'' = s'$. Notice, then, that $\leq$ imposes a mereological summation structure to S , with each world being the supremum of a complete join semilattice and each situation being part of a world. This in its turn implies that one individual can only be part of one possible world, which requires adopting some version of the counterpart theory, as advocated by Lewis (1968), to speak about possible alternatives of an actual individual.

The type theory of Kratzer's Situation Semantics is standard, except for the fact that the domain of expressions of type e , the set of individuals, is a subset of S and the domain of expressions of type t is the power set of S ($\uparrow(S)$), the set of sets of situations. Propositions, then, are sets of situations: the set of situations in which the proposition holds.

Finally, the notion of minimal situation is relevant for our purposes:

- (26) A situation is a minimal situation in which p is true if and only if it has no proper parts in which p is true.

In other words, minimal situations are stripped-down situations that contain just enough to support propositions.

Given that the mass-count distinction in terms of a Davidsonian theory of eventualities has a natural extension to the domain of situations, we can reinterpret Rothstein's (1999) the semantics of the predicative copula *be* in situation-theoretic terms as follows:

- (27) $\|be\| = INST = \lambda S_m. \lambda s_c. \exists s_m \in S_m \wedge s_c = I(s_m)$, where S_m is a set of mass-situations.

In (27), the predicative copula *be* denotes a function (INST) that takes a set of mass-situations (s_m) as its domain and yields a set of count-situations (s_c) that instantiate the set of mass-situations. Note that since the domain of situations is partitioned into the count and mass domains, the set of count situations and that of mass situations are disjoint. Thus, count and mass situations are not ordered in terms of the part-of relation, but rather they are related in terms of the instantiation function INST.

3.2.2 Arguments for a situation-theoretic analysis of the four Vendlerian aspectual classes of verbs

This section argues for an extension of Rothstein's (1999) analysis of the '*be* + AP' construction to the domain of VP in general. To do so, let us introduce the notion of aspectual classification of verbs as presented in Smith (1997) in terms of *situation* aspect classes, which

is based on the Vendlerian classification of verbs classes. Following Rothstein (2004), *situation* aspect classes are expressed by the features [stage] and [telic] as in the following:

(28) The situation aspect classes

	[stages]	[telic]
a. State	–	–
b. Activity	+	–
c. Achievement	–	+
d. Accomplishment	+	+

The feature [stage] distinguishes activities/accomplishments and states/achievements. Activities and accomplishments are grouped together for reasons that are rather clear. They both can be said to ‘go on’ in the sense that the situation develops from one stage to another as time goes on. In other words, both accomplishments and activities are ‘dynamic’. In contrast, states and achievements cannot naturally be said to ‘go on’. States are essentially static and as such no stages can be distinguished. Similarly, achievements denote instantaneous states of affairs and as such the events described are too short to define stages. The feature [telic] singles out event descriptions with an inherent endpoint.

I argue that the aspectual properties of verbs or VPs are defined in terms of the instantiation of some type of state in the sense of Rothstein’s (1999) analysis of the predicative copula *be* + AP as the instantiation of mass-states denoted by AP. To do so, I follow Kamp and Rossdeutscher’s (1994) analysis of process verbs such as *cure* which entails that there is a state corresponding to RES(CURE)(*u*, *v*), a result-state which obtains when an individual *u* is cured of a disease *v* and presupposes a state corresponding to PRE(CURE)(*u*, *v*), a pre-cure state. Borrowing Kamp and Rossdeutscher’s state concepts RES and PRE and an intermediary state concept TRN, a transition state concept, between RES and PRE which I introduce in what follows, I argue that a VP denotes a set of count-situations that instantiate a set of mass-situations denoted by one of the state concepts mentioned above of the four Vendlerian verb classes. Reinterpreting this analysis in terms of the situation semantics adopted here requires that mass-situations be a realization of a particular combination of the aspectual features [stage] and [telic] as in the following:

- (29) a. $\|love\| = \lambda y. \lambda x. \lambda s_c. \exists s_m [(\text{PRE}(\text{BECOME}(\neg \text{LOVE}))) (x, y, s_m) \wedge s_c = I(s_m)]$
 b. $\|arrive\| = \lambda x. \lambda s_c. \exists s_m [(\text{RES}(\text{ARRIVE})) (x, s_m) \wedge s_c = I(s_m)]$

State predicates such as *love* in (29a) are defined in terms of a set of count-situations s_c that instantiate a set of mass-situations s_m denoted by a pre-state concept PRE. Achievement predicates such as *arrive* in (29b) are defined in terms of a set of count-situations that instantiate a set of mass-situations denoted by a result-state concept RES.

What about activity and accomplishment predicates? Unlike state and achievement predicates, activity and accomplishment predicates are dynamic in the sense that they move events associated with the predicates from one stage to another. They only differ in that

accomplishment predicates have a natural end-point whereas activity predicates don't. In terms of features, activity and accomplishment predicates differ only in the feature [telic]. Thus, in order to characterize the feature that these predicates have in common, we need a state concept that corresponds to [+stage]. I argue that the state in question in fact exists, and I call it a transition state. The existence of this is evidence by the following example:

(30) The white paper (gradually) became red.

In (30), a state in which the paper is white constitutes a pre-state and a state in which the paper is red corresponds to a result-state. Besides these states, there is a third state that is neither a pre nor a result state, a state corresponding to a transition from the paper being white to the paper being red. I call this state a transition state and the corresponding state concept TRN.

A transition state differs from pre or result states in that a transition state is a collection of stages that contains an onset of change and a stage immediately before the coda that entails the end-point. Pre-states do not entail that an individual is in the process of change and result-states denote states resulting from a change. I propose the following scale that relates these states:

(31) $s_0 >_t s_1 >_t s_2$, where s_0 = a pre-state; s_1 = a transition state; s_2 = a result-state; $>_t$ is a proper order that temporally orders these three states.

(32) a. s_2 : RES(C)
 b. s_1 : TRN(C)
 c. s_0 : PRE(C), where C is some process concept.

In (31), $s_0 >_t s_1 >_t s_2$ indicates that these states are mutually exclusive (i.e., there is no overlapping among them). The scale that these states are associated with is ordered in terms of 'separation' a notion is adopted from Kamp and Rossdeutscher (1994). For example, a state resulting from an individual u being cured of a disease v (i.e., RES(CURE)(u, v)) is characterized in terms of a complete or maximal cure of the disease whereas a pre-state of a disease being cured does not entail that the curing process has started. The existence of a state that is in a transition from not being cured to being cured indicates that a transition state characterizes some separation of an individual from a disease. Given that we have a transition state, pre-states are characterized in terms of no separation of an individual from a disease.

Now we can define the other two types of verbs, namely activities and accomplishments as follows:

(33) a. $\|run\| = \lambda x. \lambda s_c. \exists s_m [(\text{TRN}(\text{RUN}))(x, s_m) \wedge s_c = l(s_m)]$
 b. $\|eat\| = \lambda y. \lambda x. \lambda s_c. \exists s_m [(\text{RES}(\text{DO}(\text{TRN}(\text{EAT}))))(x, y, s_m) \wedge s_c = l(s_m)]$

The activity verb *run* in (33a) is defined in terms of a set of count-situations that instantiate a set of transition states. The definition of the accomplishment verb *eat* in (33b) is complex in that it has a transition state concept built into the definition. This is due to the fact that accomplishment verbs are like activity verbs but differ from them in that they have an inherent end-point, which is realized by RES in (33b).

Although the instantiation function *INST* is defined as part of the lexical meaning of the verbs in (29) and (33), there is good reason to derive it syntactically without stipulating it as part of the lexical meaning of each verb. I argue in what follows that this function is licensed by the small 'v' and that VP, the complement of v, denotes a set of mass-situations subject to the instantiation by the locating function licensed in the specifier of v.

Evidence in favor of not introducing *INST* in (29) and (33) lexically comes from the two types of adverbials discussed by Bowers (1993; 2001), namely, manner adverbials such as *quickly* and result adverbials such as *perfectly*. Building on Bowers' insight on the distribution of these adverbials, I argue that manner adverbials are modifiers of the vP that function as predicates of count-situations whereas result adverbials are modifiers of the lower VP that function as predicates of mass-situations.

Bowers (1993; 2001) showed that there is a distributional difference between manner adverbials such as *slowly* and *quickly* and result adverbials such as *poorly* and *perfectly*. Bowers argued that manner adverbials are modifiers of a higher V and result adverbials are modifiers of a lower V. He provides the following examples to make the point:

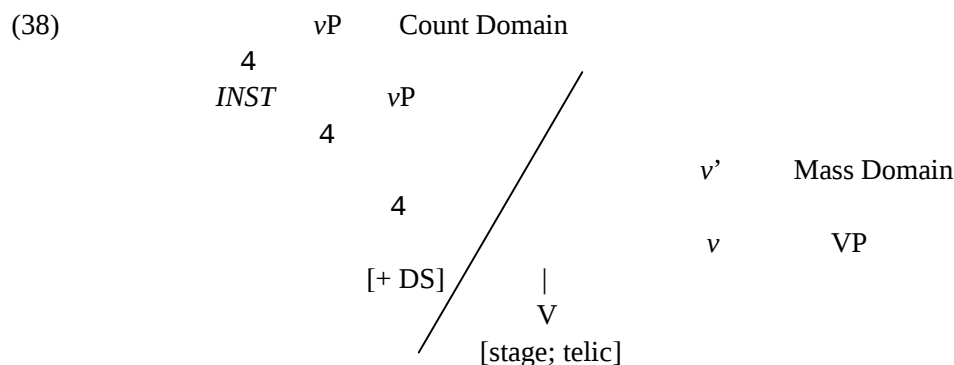
- (34) a. Bill (*poorly/slowly) recited his lines (poorly/slowly).
 b. John (*perfectly/immediately) learned French (perfectly/immediately).
- (35) a. John immediately learned French perfectly.
 b. *John perfectly learned French immediately.

The examples in (34) show that result adverbials cannot occur pre-verbally whereas manner adverbials can be either pre- or post-verbal. The examples in (35) show that manner and result adverbials are not interchangeable.

Intuitively speaking, what a manner adverb modifies in (34) and (35) is a process or an event involved in the predicates in these examples whereas a result adverb modifies the quality of the event entailed by these examples. Thus, in (35a), for example, the process or the event of learning French was immediate whereas it is the quality of the event entailed by the sentence that was judged as perfect. This intuitive semantic difference is further evidenced by the following examples, where result adverbs are compatible with AP complements of causative *make* whereas manner adverbs are not:

- (36) Mary made her son (perfectly) polite (perfectly).
- (37) Mary made her son (*quickly) quiet (*quickly). (Rothstein 1999)

Rothstein (1999) discussed the incompatibility of a manner adverb directly modifying AP as in (37) but didn't discuss the compatibility of a result-adverb with AP in (36). Given the contrast between (36) and (37), we can infer that result adverbs are modifiers of mass-situations and that manner adverbs are modifiers of count-situations. Building on Rothstein's (1999) distinction between count- and mass-eventualities, the contrast in compatibility between manner and result adverbs in the AP causative construction illustrated in (36) and (37) indicates that result adverbs are modifiers of mass-situations whereas manner adverbs are modifiers of count-situations. Given the distributional difference between manner and result adverbs in the domain of VPs discussed above, we are in a position to generalize the distinction between count and mass-situations to the domain of VPs including not only VPs constructed from *be* and an AP but also those constructed from the four Vendlerian verb classes. To this end, I propose the following structure of *vP*:



- (39)
- a. $[-\text{stage}; -\text{telic}]: \|VP\| = \lambda s_m. (\text{PRE}(\text{BECOME}(\neg P)))(x_{1\dots n}, s_m)$
 - b. $[+\text{stage}; -\text{telic}]: \|VP\| = \lambda s_m. (\text{TRN}(P))(x_{1\dots n}, s_m)$
 - c. $[-\text{stage}; +\text{telic}]: \|VP\| = \lambda s_m. (\text{RES}(P))(x_{1\dots n}, s_m)$
 - d. $[+\text{stage}; +\text{telic}]: \|VP\| = \lambda s_m. (\text{RES}(\text{DO}(\text{TRN}(P))))(x_{1\dots n}, s_m)$

In (38), VP denotes a set of mass-situations. Thus, its denotation is in the mass domain as indicated in (38). The type of mass-situation the VP denotes depends on the combination of the aspectual features [stage; telic] as illustrated in (39). In (39a), VP denotes a set of mass-situations that instantiate a pre-state concept. In (39b), VP denotes a set of mass-situations that instantiate a transition state concept. In (39c), VP denotes a set of mass-situations that instantiate a result-state concept. In (39d), VP denotes a set of mass-situations that instantiate a complex state concept constructed from transition and result state concepts.

In (38), *vP* denotes a set of count-situations. Thus, its denotation is in the count domain as indicated in (38). The instantiation function *INST* is licensed by the complex of *v*+*V* created after *V* adjoins to *v*. I assume that *v* carries a feature [+DS] ('domain shifter') that licenses *INST*. The nature of *INST* is determined by the aspectual features of the *V* adjoined to *v*. When the *V* has features $[-\text{stage}; -\text{telic}]$, it denotes *BE*, which makes *vP* a state predicate. When the *V* has features $[+\text{stage}; -\text{telic}]$, it denotes *DO*, which makes *vP* an activity

predicate. When the V has features [–stage; +telic], it denotes *BECOME*, which makes vP an achievement predicate. Finally, when the V has features [+stage; +telic], it denotes *BECOME*, which makes vP an accomplishment predicate. Note that both achievement and accomplishment predicates are telic predicates. However, they differ in the respective internal structures. In the case of achievement predicates, *BECOME* instantiates a set of mass-situations of the result-state type whereas in the case of accomplishment predicates, *BECOME* instantiates a set of mass-situations of the result-state type that in turn is mediated by a transition state concept.

3.2.3 Sentential negation as a domain shifter

Recall that Rothstein's (1999) analysis of the copula *be* is a domain shifter that takes a set of mass-situations as its domain and a set of count-situations as its range. The function of *be* in her analysis is to present mass-states denoted by APs from a count perspective. I show in what follows that sentential negation does the opposite. That is, sentential negation is a domain shifter that takes a set of count-situations as its domain and a set of mass-situations as its range. The following examples provide evidence that this is the case:

- (40) a. John isn't being polite to his uncle.
b. John is being not polite to his uncle.

In (40), it is in (40a) that the negative marker *not* expresses sentential negation. *Not* in (40b) can only express constituent negation. The examples indicate that in order for *not* to express sentential negation the domain that the negative operator applies to must be in the count domain. The failure of *not* to express sentential negation shows that *not* cannot operate on the denotation of AP which is mass in the present analysis. The negative operator as a domain shifter provides a natural explanation of why that is the case. Furthermore, the negative operator as a domain shifter also provides a step toward the explanation of why negative sentences have sub-interval properties without affecting the aspectual property of the predicate that negation interacts with.

4 The semantics of sentential negation

4.1 Sentential negation and 'universal' adjectives

In section 2.1, I suggested that sentential negation is relational in the sense that it asymmetrically relates two propositions such that the truth of one is essential to the truth of the other. The goal of this section is to find out what exactly is the nature of this relation is. To do so, let me introduce a particular type of lexically driven inference discussed in Kamp and Rossdeutscher (1994). The type of inference in question has to do with the inferential behavior of two types of adjectives such as *healthy* vs. *sick*, *safe* vs. *dangerous*, *dry* vs. *wet*, to name a few. Kamp and Rossdeutscher (henceforth, K&R) call the former type of

adjectives ‘universal’ and the latter type ‘existential’. The terms are based on the way these types of adjectives behave in the two sets of inferences to be discussed in what follows.

K&R point out that universal adjectives such as *healthy* and existential adjectives such as *sick* behave differently with respect to the validity of certain inferences. Consider the following set of inferences adapted from K&R:

- (41) a. A tourist comes down with typhoid.
After three weeks, the tourist is *healthy*.

∴ The tourist recovers from typhoid in these three weeks.
- b. A tourist recovers from typhoid.
After three weeks, the tourist is *sick*.

∴ The tourist comes down with typhoid in these three weeks.

The two inferences appear to be symmetric, yet the conclusion in (41a) follows from the two premises whereas the conclusion in (41b) doesn’t. According to K&R, the conclusion in (41a) is a logical consequence derived from the two premises based on the semantics of the adjective *healthy*. K&R attribute the contrast in validity to the universal nature of *healthy* and the existential nature of *sick* and propose the following semantics of these adjectives:

- (42) a. $\|healthy\| = \lambda s.\lambda x.\forall w[AILEMENT(w, s) \rightarrow RES(CURE)(x, w, s)]$
b. $\|sick\| = \lambda s.\lambda x.\exists w[AILEMENT(w, s) \wedge PRE(CURE)(x, w, s)]$

Given the semantics of these adjectives defined in (42), let us examine how the semantics account for the contrast in validity between (41a) and (41b). The first premise in (41a) entails that the tourist has typhoid, the onset of which is deduced from the second premise, that is, the onset of the three-week period. Given the semantics of *healthy* defined in (42a), the Universal Instantiation rule applies, which removes the antecedent of the universal quantifier and we obtain the result-state. The result-state $RES(CURE(the-tourist, typhoid))$ (i.e., the state of the tourist being cured of typhoid) obtains sometime within the three-week period. Since the existence of the tourist having typhoid is instantiated at the onset of the three-week period, given the result-state being instantiated, we can infer that there is a change of state event that takes place sometime within the three-week period that is immediately preceded by the state of the tourist having typhoid and immediately followed by the result-state. The change of state in question is one from the state of the tourist having typhoid to the state of his being cured of typhoid, which takes place sometime within the three-week period. In other words, the change of state is one in which the tourist recovers from typhoid in these three weeks. This is equivalent to the conclusion stated in (41a); therefore, the inference is valid.

The account of the invalidity of (41b) can be brief. Given the existential nature of *sick* defined in (42b), it is clear that Universal Instantiation cannot apply. Consequently, we

cannot derive a relevant pre-cure state (i.e., $\text{PRE}(\text{CURE}(\text{the-tourist}, \text{typhoid}))$) or a change of state that corresponds to the conclusion in (41b).

Now, let us consider the following inference involving negation:

- (43) Black stains appear on the table.
 After three hours, there aren't stains on the table.

 $\therefore$ Black stains disappear from the table in these three hours.

Interestingly, in (43), negation in the second premise patterns with *healthy* in (41a) in that negation contributes to the validity of the argument. What is crucial for the validity of the inference illustrated in (43) is that sentential negation must incorporate a change of state built into its semantics. This is the driving force to account for the logical validity illustrated in (43). In the next sub-section, I propose a semantics of sentential negation that incorporates this change of state.

4.2 A situation-theoretic analysis of the semantics of sentential negation

In the possible situation semantics adopted here, proposition denote sets of possible situations, or characteristic functions of such sets, and all predicates are evaluated with respect to possible situations. Given the essential nature of negation, in the present analysis, we treat negation as a modal operator and it is defined as follows:

- (44) a. $\|Neg\|^c = \lambda P. \lambda s_m. \forall s' [[\min(f_c(s)) = s' \wedge s' \in \|\text{PRE}(\text{BECOME}(\neg P))\|] \rightarrow \exists s'' [s' \leq s'' \wedge s'' \in \|\text{RES}(\text{BECOME}(\neg P))\| \wedge s = g(s \in \|P\|)]]$
 b. The grinding function is that function $g: C \rightarrow M$ such that for every $c \in C$:
 $g(c) = \cup \{x \in M: xKc\}$, where K is the relation 'material part of'.

The definition in (44a) incorporates a change of state from P to not P , where ' P ' constitutes a set of pre-states and 'not P ' a set of result-states. The nature of the change is from the potential realization of the property P to the potential being not realized. The nature of P is contingent on the aspectual property of P , which I come back to shortly. Thus, (44a) denotes the relation between sets of properties P and situations s such that every minimal situation s' that is accessible from s and instantiates a pre-state concept ($\text{PRE}(\text{BECOME}(\neg P))$) is extendable to a situation s'' of which s' is a part and instantiates the result-state concept ($\text{RES}(\text{BECOME}(\neg P))$). The pre-state here corresponds to a state of becoming not P , which entails that P holds. The result-state corresponds to a state obtained after becoming not P . This amounts to meaning that every pre-state is extendable to its corresponding result-state, that is, 'no degree of P -ness'.

P in (44a) is a predicate variable that represents a VP denotation. The denotation of VP is a set of count-situations represented as s in (44a). ' g ' denotes a grinding function, a function

from count-situations to mass-situations. The result of g applying to count-situations is the sum of all count-situations s_c that instantiate P . The grinding function as defined in (44b) is a homomorphism, preserving crucial ordering relations, so that if a is a part of the plural individual $a + b$, then the stuff making up a is a part of the stuff making up $a + b$. Thus, what *Neg* does is to present from a mass perspective the complement set of the set of count-situations denoted by the VP. The semantics of sentential negation thus defined functions as a the domain shifter discussed in section 3.2.3. It is a domain shifter that takes a set of count-situations as its domain and a set of mass-situations as its range.

' f ' in (44a) denotes an accessibility relation in the sense of Kratzer's conversational background (1991). It is a function from evaluation situations s to possible situations s' that are accessible from s . 'min' is an operator that picks up minimal situations from the result of f applying to s . The nature of the accessibility relation denoted by f is determined by the lexical property of the negative operator in interaction with properties of the utterance context c . The modality associated with the negative operator is circumstantial. The circumstantial accessibility relation is *realistic* in the sense of Kratzer (1991) in that it assigns to every situation a set of facts that the speaker knows up to the point of utterance. Thus, given the semantics of negation defined in (44a), if adding the proposition expressed by $\text{PRE}(\text{BECOME}(\neg P))$ to the set of accessible situations conforms the facts of the world provided by the accessible situations, that is, the addition does not contradict with the context assumed up to the point of utterance, then the consequent expressed by $\text{RES}(\text{BECOME}(\neg P))$ also holds; otherwise, the antecedent denotes an empty set and the whole proposition is rendered to be true whether or not the consequent is true. However, the consequent cannot be true if the antecedent is false. This is because the consequent denotes a result-state and a result-state presupposes a pre-state from which the result-state follows. Thus, the consequent cannot be rendered true; otherwise, it would be a presupposition failure. Therefore, in order for the sentence to be true in this context, both the antecedent and the consequent have to be false. This means that given the semantics of negation defined in (44a), the result-state can only be inferred if the corresponding pre-state is instantiated in the evaluation situation. This is what happens in the valid inference we have considered in (43) above.

In (43), the first premise entails that there are black stains on the table, and from the temporal specification in the second premise, the existence of the black stains takes effect at the onset of the three-hour period; hence, the existence of black stains on the table is instantiated in the evaluation situation. This information becomes part of what the speaker knows about the world. Given that the set of black stains is a subset of the set of stains, the effect of adding the pre-state in the antecedent clause, namely, the set of situations in which there are stains on the table, is to instantiate the consequence by instantiating the proposition in the antecedent clause. From this, we can infer that there is a state resulting from black stains becoming non-existent. The conclusion follows from the fact that there is a change of state that is inferred from the state where there are black stains on the table followed by a state resulting from the disappearance of black stains on the table, which takes place sometime within the three-hour period.

The above discussion indicates that, generally, when we utter a negative statement, we don't know whether or not the pre-state holds in the evaluation situation. On the pragmatic side, this means that in uttering a negative statement, we consider whether the pre-state holds or not. If we assume it does, we hypothetically add it to the set of accessible situations and evaluate the consequence with respect to the modified set of accessible situations. If we assume it doesn't, adding it to the set of accessible situations leads to a contradiction; consequently, the antecedent is rendered false and the whole statement is rendered to be true only if the consequent is false (otherwise, this would result in a presupposition failure as mentioned above).

Now that quantification is over possible situations accessible from the set of evaluation situations, the non-existential commitment characteristic of the essential quantification follows naturally without stipulations.

5 Sentential negation and its interaction with lexical aspect

5.1 Sentential negation and scales

The semantics of sentential negation proposed in section 4.2 provides a principled account of the way negation interacts with lexical aspect. In section 3.2.2, I proposed a situation-theoretic analysis of the four Vendlerian aspectual classes of verbs building on Rothstein's (1999) mass-count distinction in the verbal domain.

Given the semantics of sentential negation defined in (44a), the negative operator operates on the scale proposed in section 3.2.2 repeated here as (45) and (46):

(45) $s_0 >_t s_1 >_t s_2$, where s_0 = a pre-state; s_1 = a transition state; s_2 = a result-state; $>_t$ is a proper order that temporally orders these three states.

(46) a. s_2 : RES(C)
 b. s_1 : TRN(C)
 c. s_0 : PRE(C), where C is some process concept.

In (45), $s_0 >_t s_1 >_t s_2$ indicates that these states are mutually exclusive (i.e., there is no overlapping among them). As in (46), the scale that these states are associated with is ordered in terms of 'separation' a notion is adopted from Kamp and Rossdeutscher (1994).

The semantics of sentential negation defined in (44a) incorporates a change of state from a potential realization of the property P to the potential being not realized. Given the semantics of the four Vendlerian aspectual classes of verbs, this 'potential realization of the property P' is translated as 'potential instantiation of a set of mass-situations denoted by a vP '. One of the properties of negative sentences, namely their sub-interval property that does not affect the aspectual property of the predicate, is a consequence of the semantics of sentential negation that incorporates a change of state together with the semantics of the four

Vendlerian aspectual classes of verbs proposed above. In the next sub-section, I will illustrate how the proposed system works.

5.2 *Solutions to the problems of the Stativity Hypothesis*

5.2.1 *Sub-event properties of negated telic event descriptions*

The *sub-event* problem for the Stativity Hypothesis has a natural solution within the system developed here. Given the scale proposed in (45) and (46) above, the change of state from a potential instantiation of a set of mass-situations denoted by achievement or accomplishment VP to the potential being not realized predicts that the event denoted by these predicates is either in a transition state or a pre-state. Thus, in the following examples, the package is either on the way to being delivered (a transition state of the package being delivered) or in a state prior to the initial stage of delivery (a pre-state of the package being delivered) in (47a). The example that involves an accomplishment predicate in (47b) has a similar explanation:

- (47) a. The package didn't arrive.
b. Peter didn't run twenty miles.

The fact that negated activity event descriptions and state descriptions do not have sub-event properties is also predicted by the proposed analysis:

- (48) a. Peter didn't run.
b. Mary doesn't love Peter.

In (48a), the potential instantiation of the property of running was not realized. Given the scale in (46), the negation of a transition state entails a pre-state of running. No sub-event holds for activity predicates. In (48b), the potential instantiation of the property of loving is not realized. No sub-event holds in this case either.

5.2.2 *Lack of present orientation in negated event descriptions*

The change of state built into the semantics of sentential negation also accounts for the lack of present orientation in negated event descriptions:

- (49) a. Peter doesn't smoke.
b. Mary doesn't love Peter.

In (49a), a potential instantiation of the property P, namely Peter's habit of smoking is not realized, which gives the habitual reading (49a). (49b) is as illustrated in section 5.2.1. The present orientation follows without stipulations.

5.2.3 *Consecutive readings of negated event descriptions in discourse*

The contrast in the discourse interpretation between negated event and state descriptions is interesting in that the account involves the contribution of the accessibility function defined as part of the semantics of sentential negation proposed in (44a). Essentially, the accessibility function is a *conversational background* in the sense of Kratzer (1991). It functions as Stalnaker's notion of a *common ground*, a set of possible worlds believed to hold by the discourse participant. The contrast between negated event and state descriptions in the following Kamp and Ryle (1993) examples is explained in the present analysis in terms of the interaction of the accessibility function and the change of state built into the semantics of sentential negation:

- (50) a. Mary looked at Bill. He didn't smile.
 b. Mary looked at Bill. He wasn't smiling.

In (50), the first sentence enters into the discourse participants' common ground. This means that a situation in which Mary looked at Bill becomes part of the accessibility function. Then the second sentence in (50) is evaluated with respect to this modified accessibility function. In the case of (50a), the potential instantiation of Bill's smiling at Mary is interpreted as a potential instantiation of Bill's smiling at Mary as a reaction to Mary's looking at Bill being not realized. This gives us the expected consecutive reading. In the case of (50b), the potential instantiation of Bill's smiling in progress is interpreted as the potential instantiation of Bill's smiling in progress at the time when Mary looked at Bill and the potential was not realized at the time. This gives us the expected overlapping reading associated with this example.

6 Conclusion

In this paper, I have shown that sentential negation is inherently modal: it relates two propositions p and q where p is asymmetrically related to q , which is more complex in structure than is assumed for the standard analysis of sentential negation as a one-place propositional operator. This accounts for the non-existential commitment or contextual vagueness associated with negative sentences in general.

Rothstein's (1999) analysis of *be* + AP is extended to VPs that belong to the four Vendlerian aspectual classes. I argued that VPs denote sets of count-situations that instantiate a set of mass-situations denoted by the four Vendlerian aspectual classes of verbs. This has been shown to provide a natural explanation of why sentential negation interacts with lexical aspect the way it does.

Sentential negation is a domain shifter that takes count-situations as its domain and mass-situations as its range. This together with the semantics of sentential negation accounts for its sub-interval property without affecting the aspectual property of the predicate that negation interacts with.

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