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The Role of Aspect in the Composition of Temporal Adverbial Clauses with Adverbs of Quantification*

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1. Introduction

The research described in this paper concerns the semantic interpretation of temporal adverbial clauses such as the *when*-clause *when Mary came home* in (1). In particular, it addresses the interpretation of constructions in which a temporal adverbial clause composes with an adverb of quantification. These constructions describe repeated temporal correspondences between the events or states described by the two clauses they contain. For example, sentence (2), in which a *when*-clause composes with the adverb of quantification *always*, states that on each occasion that Mary came home, Peter was tired.

- (1) Peter was tired when Mary came home.
- (2) Peter was always tired when Mary came home.

I will refer to the clause the *when*-clause adjoins to as the HEAD CLAUSE. The head clause in examples (1) and (2) is *Peter was tired*. The clause following *when* will be referred to as referred to as the ADJUNCT CLAUSE. The adjunct clause in (1) and (2) is *Mary came home*.

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The term EVENTUALITY will be used to refer to both events and states in the model. I assume that the semantic contributions of the clauses in these constructions are descriptions of eventualities. In (1), the head clause contributes an eventuality description which is true of eventualities of Peter being tired, and the adjunct clause contributes an eventuality description which is true of eventualities of Mary coming home¹. These eventuality descriptions will be represented as predicates which are saturated except for an eventuality variable *e*. For example, *Mary came home* receives the translation **come-home**'(*Mary*, *e*). I will adopt the convention of presenting semantic translations in bold type, and furthermore, if part of the translation is not going to be made explicit, it will be left in italics. For example, since it is not directly relevant to the issues at hand, I am not going to give translations of noun phrases, so in the expression above *Mary* is left in italics.

The basic syntax and semantics of these constructions is explored in Johnston 1994a and Johnston 1994b. Johnston (1994a) develops an analysis of these constructions which captures the role of syntactic structure and intonational focus in their interpretation. Johnston (1994b) investigates the interpretation of temporal adverbial clauses and other types of clausal adjuncts, such as *because*-clauses and purpose clauses, and examines their interaction with adverbs of quantification and negation. This paper concerns the roles that the aspectual classes of the eventuality descriptions contributed by the head and adjunct clauses play in the interpretation of constructions with temporal adverbial clauses and adverbs of quantification. We will see that the range of possible interpretations of these constructions is dependent on the distinction between telic and atelic eventuality descriptions. Differences in ontological structure between telic and atelic eventualities result in atelic eventuality descriptions being unable to serve as restrictions because they cannot successfully individuate a domain for quantification over eventualities. These facts provide further evidence in favor of the analysis of the interaction of temporal adverbial clauses with adverbs of quantification presented in Johnston 1994a and Johnston 1994b.

The paper begins with a description of the range of possible interpretations of constructions with *when*-clauses and adverbs of quantification. In Section 3, the role of the aspectual class of the eventuality descriptions contributed by the head and adjunct clauses in determining possible interpretations is demonstrated. Section 4 surveys previous accounts of these constructions and evaluates their ability to account for these facts. Section 5 examines the ontological differences between telic and atelic eventualities. Sections 6-8 present my analysis of these constructions. In Section 9, we see why this analysis predicts the aspect facts, and in Section 10, I show how these facts pose problems for the account proposed by De Swart (1991). The final section provides a summary of the paper and presents some directions for future research.

2. The Head and Adjunct Restriction Readings

If a *when*-clause appears in a sentence with an adverb of quantification, there are two possible interpretations of the sentence depending on whether the head clause or the *when*-clause serves as the restriction of the quantifier. For example, (3) has two possible interpretations.

- (3) Marcia always writes a letter when she is at the cafe.

The first, which I will call the ADJUNCT RESTRICTION READING, is that on all occasions that Marcia is at the cafe, she writes a letter; that is, every time Marcia is at the cafe she writes a letter. The adjunct restriction reading is the reading of a quantificational construction where the restriction is provided by the adjunct. In this reading of (3), the

¹I will abstract away from the semantic contribution of the tense for the purposes of this paper.

adjunct *when she is at the cafe* provides the restriction on the quantifier *always*. The factorization of material into the restriction and nuclear scope in this example can be represented informally as in (4).

- (4) Adjunct Restriction Reading: **always'**{ *when she is at the cafe*} Restriction
[*Marcia writes a letter*] Nuclear scope

The second interpretation of (3), which I call the HEAD RESTRICTION READING, is that on all occasions that Marcia writes a letter, she does so when she is at the cafe; that is, every one of Marcia's letter writings takes place when she is at the cafe. The head restriction reading is the reading of a quantificational construction where the restriction is provided by the head clause. On this reading of (3), the head clause *Marcia writes a letter* provides the restriction. The factorization of material into the restriction and nuclear scope in this example can be represented informally as in (5).

- (5) Head Restriction Reading: **always'** { *Marcia writes a letter* } Restriction
[*when she is at the cafe*] Nuclear scope

The questions given in (6) and (7) help to distinguish these two readings. The adjunct restriction reading of (3) is a suitable answer to (6) but not to (7), while the head restriction reading of (3) is a suitable answer to (7), but not to (6).

- (6) What does Marcia do when she is at the cafe?
(7) When does Marcia write a letter?

The adjunct restriction reading of (3) can be paraphrased using *if* or *whenever* as in (8) and (9), while the head restriction reading of (3) is a close paraphrase of example (10) with *only*.

- (8) Marcia always writes a letter if she is at the cafe.
(9) Marcia writes a letter whenever she is at the cafe.
(10) Marcia only writes a letter when she is at the cafe.

The two readings can also be distinguished by the syntactic position of the adjunct and the placement of intonational focus. If the *when*-clause is clause-initial, as in (11), then only the adjunct restriction reading is available. If there is focus on the head clause, as in (12), then the adjunct restriction reading is strongly preferred. If there is focus on the adjunct clause, as in (13), then the head restriction reading is strongly preferred.

- (11) When she is at the cafe, Marcia always writes a letter.
(12) Marcia always writes a LETTER when she is at the cafe.
(13) Marcia always writes a letter when she is at the CAFE.

In this paper, these facts are only used as diagnostics for the two readings. For detailed explanation of the influence of syntax and focus on the interpretation of these constructions see Johnston 1994a and Johnston 1994b. I turn now to another factor which determines which readings are available; aspectual class.

3. The Role of Aspect

The following discussion utilizes the aspectual classification into states, activities, accomplishments, and achievements employed by Dowty (1979), which is drawn from the work of Vendler (1967). The sentences in (14a-d) give an example of each class.

(14) Aspectual Classification (Vendler (1967), Dowty (1979)):

- (a) State: Marty is in the shower.
- (b) Activity: Marty is singing.
- (c) Accomplishment: Marty wrote a paper.
- (d) Achievement: Marty noticed someone famous.

I apply this classification both to eventualities in the model and to eventuality descriptions. In example (3), repeated here in (15), the eventuality description contributed by the head clause is an accomplishment, and the eventuality description contributed by the adjunct clause is a state. As was shown in the previous section, this sentence has both a head restriction reading and an adjunct restriction reading.

(15) Marcia always writes a letter when she is at the cafe.

If we reverse the head and adjunct clauses, as in (16), so that the head clause eventuality description is a state and the adjunct clause eventuality description is an accomplishment, the range of interpretations decreases. Example (16) has an adjunct restriction reading, which is that on all occasions that Marcia writes a letter she is at the cafe, but lacks a head restriction reading, which in this case would require that on all occasions that Marcia is at the cafe she writes a letter. This missing reading is paraphrased in (18). Even if there is an intonational focus on the adjunct clause, as in (17), only the adjunct restriction reading is available.

- (16) Marcia is always at the cafe when she writes a letter.
- (17) Marcia is always at the cafe when she writes a LETTER.
- (18) When she is at the cafe, Marcia always writes a letter.

The same pattern shows up for (19), in which the head clause eventuality description is an achievement, and the adjunct clause eventuality description is an activity. It can have both readings, but if the head and adjunct clauses are reversed, as in (20), then only the adjunct restriction reading is available. Example (19) can mean what (21) means, but (20) cannot mean what (22) means.

- (19) Marcia always notices someone famous when she is having dinner at Max's.
- (20) Marcia is always having dinner at Max's when she notices someone famous.
- (21) When she notices someone famous, Marcia is always having dinner at Max's.
- (22) When she is having dinner at Max's, Marcia always notices someone famous.

In examples like (23) and (24), where both the head and adjunct clauses are either states or activities, only an adjunct restriction reading is available. The potential head restriction readings of (23) and (24), paraphrased in (25) and (26), are unavailable.

- (23) Joe is always smoking when he is at the cafe.
- (24) Joe is always at the cafe when he is smoking.
- (25) When Joe is smoking, he is always at the cafe.
- (26) When Joe is at the cafe, he is always smoking.

If both clauses are accomplishments or achievements, as in (27) and (28), then both head and adjunct restriction readings are available.

- (27) Francesca always buys cigarettes when she goes to the store.
- (28) Abe always discovers a new construction when he finds a new informant.

The generalization that emerges from these facts is that a head restriction reading is available if the head clause contains an eventuality description which is telic, an accomplishment or achievement, but one is not available if the head clause contains an eventuality description which is atelic, a state or activity. A head restriction reading is only available if the head clause contains a telic eventuality description. Telic eventuality descriptions describe eventualities with an intrinsic ending point, while atelic eventuality descriptions describe eventualities which lack an intrinsic ending point. In the next section, the ability of previous approaches to account for this sensitivity to aspect is evaluated.

4. Previous Approaches to the Semantics of *When*

Kratzer (1989:5-6) suggests that Lewis's (1975) treatment of *if*-clauses may be extended to *when*-clauses. Kratzer's claim is that, like *if*-clauses, *when*-clauses have no function other than to provide the domain of some operator. This amounts to a claim that the word *when* is semantically contentless and simply marks the clause which serves as the restriction. De Swart (1991:181) argues that while this may be a tenable position for *when* it does not extend readily to the analysis of similar examples with *before* and *after*, and therefore that *when* should be assigned content. The facts examined here provide a stronger argument against the proposal that *when* is semantically contentless.

Given the starting assumption that *when* simply marks the restriction, the argument goes as follows. It is not immediately obvious why the presence of an atelic eventuality description in the head clause should prevent the head restriction reading. A first hypothesis would be that atelic eventuality descriptions cannot serve as restrictions on adverbs of quantification. At first it appears that this hypothesis fails because in examples like (3), repeated here in (29), the atelic eventuality description *she is at the cafe* serves as the restriction.

(29) Marcia always writes a letter when she is at the cafe.

This suggests that, assuming *when* has no semantic contribution, there is no inherent property of atelic eventuality descriptions that prevents them from being the restriction of an adverb of quantification. It appears to be the case that while telic eventuality descriptions can serve as the restriction of a quantifier both when they are from the head clause and when they are from the *when*-clause, atelic eventuality descriptions can only provide the restriction if they are from the *when*-clause, and not if they are from the head clause. If there is no inherent property of atelic eventuality descriptions that prevents their constituting the restriction of an adverb of quantification, the principles responsible for identification of the material in the sentence that will serve as the restriction would have to be sensitive to whether an eventuality description is both atelic and originated in the head clause. It is undesirable to have a requirement this baroque as one of the principles of the syntax/semantics interface. Those principles should provide a general formula through which syntactic structure is mapped onto semantic representation, and this requirement is too specific to be included.

This argument started with the assumption that it is simply the clausal complement of *when* that is mapped into the restriction in these constructions, and that *when* itself does not make a semantic contribution. If we drop this assumption, it is possible to avoid the unwelcome conclusion reached above. The alternative is to assume that *when* does not simply introduce a clause which becomes the restriction, and that *when* does make a semantic contribution in these constructions. We can then reintroduce the assumption that atelic eventuality descriptions cannot serve as restrictions. In the adjunct restriction reading of example (29), it is the whole *when*-clause including the semantics of *when* that provides the restriction, and the semantic contribution of the *when*-clause can serve as the restriction

on an adverb of quantification. The specific proposal I am going to make is that *when* is an operator which combines with a constituent which contributes an eventuality description to generate a description of intervals; intervals which are the times taken up by maximal eventualities which meet the eventuality description.

An additional problem for Kratzer's proposal is the possibility of head restriction readings. These are also not accounted for by the proposals made in Stump 1985, Farkas and Sugioka 1983, Partee 1984, and Berman 1991. These proposals all account for the adjunct restriction reading, but do not address the head restriction reading, and therefore do not address the role of aspect in determining its availability.

Rooth (1985) provides an account in terms of Association with Focus which captures both readings². In Johnston 1994a and Johnston 1994b, arguments are provided against the proposal that these readings arise through Association with Focus. Rooth's proposal does not address the effect of aspect on the availability of these readings, and his proposal does not account for the facts presented here.

De Swart (1991) develops an account of these constructions which captures both readings, but it does not capture the aspect facts. In Sections 5-9, I present my own analysis. I will return to De Swart's proposal in Section 10 and show how these aspect facts argue against her account. Before going on to the analysis, I want to briefly outline my assumptions regarding the ontology of eventualities.

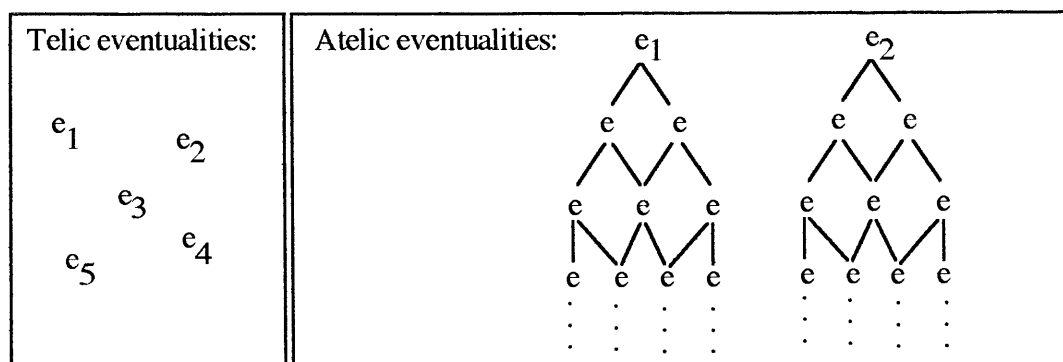
5. Ontological Differences Between Telic and Atelic Eventualities

A number of different authors, including Bach (1986), Krifka (1989), Carlson (1981), Allen (1966), Mourelatos (1978), and Taylor (1977), have observed the similarity between the count-mass distinction in nominals and the event-process (telic-atelic) distinction in the aspectual classification of verbal expressions. From Bach (1986) and much related work, the insight I am going to draw is that the structure of the domain of telic eventualities consists of a series of separate atomic elements, while elements of the domain of atelic eventualities each consist of a join semilattice which captures the fact that each atelic eventuality is made up of an infinite number of similar subeventualities³. This difference is represented in the diagram in (30).

²Rooth (1985) develops on Jackendoff's (1972) discussion of the consequences of intonational focus for truth conditions. In his proposal, intonational focus is directly relevant to truth conditional meaning. In these cases, the placement of focus on the head or adjunct clause determines which is not part of the definition of the PSET for the sentence, a second semantic value for the sentence, and the pset serves as the restriction on the quantifier.

³The semantics of plurals will not be addressed here, and the join of telic eventualities is left out in order to simplify the presentation. I recognize the fact that in a full analysis including plurals the join of telic eventualities would be necessary, and assume that it can be formally distinguished from the structure of atelic eventualities.

(30)



This property of atelic verbal expressions is what Bennett and Partee (1974) call the SUBINTERVAL PROPERTY, and Carlson (1981:47) calls PARITIVITY. I will adopt Verkuyl's (1993) term HOMOGENEITY here. In combination with the analysis I propose, it is this difference between telic and atelic eventualities that results in the failure of atelic eventuality descriptions to individuate a domain for quantification.

6. Analyzing *When*-clauses as Descriptions of Intervals

Heinämäki (1978), Hinrichs (1986), and De Swart (1991) all observe the fact that the temporal relation between the eventualities described by the head and adjunct clauses in *when*-clause constructions is dependent on the aspect of the eventuality descriptions. Consider the adjunct restriction readings of (31) and (32). I will refer to the mapping of an eventuality onto the temporal axis as its RUNTIME. The runtime of an eventuality is the interval of time across which it takes place from start to finish. If the head clause eventuality description is telic, then its runtime must be included within the runtime of the adjunct clause eventuality description. In (31), the runtime of the letter writing must take place within the runtime of Marcia being at the cafe. If the head clause eventuality description is atelic, then its runtime must include the runtime of the adjunct clause eventuality description. In (32), the runtime of Marcia being at the cafe must include the runtime of her writing a letter.

- (31) Marcia always writes a letter when she is at the cafe.
 (32) Marcia is always at the cafe when she writes a letter.

The same pattern shows up with temporal expressions which describe intervals such as *between 3 o'clock and 5 o'clock*. In (33), the runtime of Frances writing a letter must be within the interval from 3 o'clock to 5 o'clock. In (34), the runtime of Frances being at the cafe must include the interval from 3 o'clock to 5 o'clock.

- (33) Frances always writes a letter between 3 o'clock and 5 o'clock.
 (34) Frances is always at the cafe between 3 o'clock and 5 o'clock.

If we assume that *when* contributes a relation between eventualities, this dependence on aspect will be have to be encoded within the definition of the truth conditions of *when*. De Swart's analysis makes this assumption and as a result fails to capture the parallel between (31) and (33), and (32) and (34). In the account I propose, *when* is not treated as a relation between eventualities, and *when*-clauses contribute descriptions of intervals. The sensitivity to aspect in both (31) and (32), and (33) and (34) follows from a principle regarding the truth of an eventuality description with respect to an interval. I will first present the truth conditions for *when*-clauses as interval descriptions

and then go on to present the principle regarding the truth of an eventuality description with respect to an interval.

The analysis of *when* utilizes a runtime function **f** which for a given eventuality provides the interval of time which that eventuality maps onto in the temporal domain; its runtime. This is akin to the TEMPORAL TRACE FUNCTION used by Krifka (1989) and the RUNNING TIME FUNCTION used by Lasersohn (1990). It is given in (35).

(35) Runtime Function **f**: **S**->**I**

The semantic contribution of a *when*-clause is not simply a description of the runtime of the eventuality described by the adjunct clause. It is the description of the runtimes of maximal eventualities which meet the eventuality description in the adjunct clause. In order to capture this maximality requirement, a maximal eventuality function **MAX**(ϕ , **e**) is utilized. This function is defined in (36). For a given eventuality description ϕ and an eventuality **e**, **MAX**(ϕ , **e**) is true if and only if **e** meets the description ϕ , and there is no other eventuality meeting that description whose runtime contains the runtime of **e**.

(36) Definition of Maximal Eventuality Function :

$$\text{MAX}(\phi, e) = 1 \text{ iff } [\phi(e) \ \& \ \sim\exists e' [\phi(e') \ \& \ (e \neq e') \ \& \ (f(e) \subseteq f(e'))]]$$

The semantic contribution of *when* is an operator which combines with an eventuality description ϕ to yield a description of intervals which are the runtimes of maximal eventualities which meet ϕ , as in (37)⁴. The semantic representation of *when Marcia is at the cafe* is as in (38).

(37) The Semantic Contribution of *when*: $\lambda\phi \lambda i [\exists e [\text{MAX}(\phi, e) \ \& \ [i = f(e)]]]$

(38) $\lambda i [\exists e [\text{MAX}(\text{at}'(\text{Marcia}, \text{the cafe}, e), e) \ \& \ [i = f(e)]]]$

This is a description of intervals **i** such that there is a maximal eventuality of Marcia being at the cafe whose runtime is **i**. A further motivation for treating *when*-clauses as interval descriptions is that in other constructions they are directly equated with times. For example, in (39), *when I am in my office* is equated with *a good time to reach me*. The analysis proposed here accounts both for constructions with *when*-clauses and adverbs of quantification and for examples like (39).

(39) When I am in my office is a good time to reach me.

In constructions like (33) and (34), there is quantification over intervals, and the head clause contributes an eventuality description which serves as the nuclear scope. The basic truth conditions assigned to the quantifier *always* in this paper are that each member of the set of entities picked out by the restriction must meet the condition in the nuclear scope. To account for constructions like those in (33) and (34), and also those in (31) and (32), we need a definition of how it is that an eventuality description can be true of an interval. As was shown above, this is dependent on the aspect of the eventuality description. I employ a function **g**(ψ , **i**), defined in (40). If the eventuality description ψ is telic, then there must be an eventuality meeting ψ whose runtime is contained within the

⁴Constructions in which both eventuality descriptions are telic require a further revision of these truth conditions. *When*-clauses contribute a pair of intervals: the runtime and the aftermath of the eventuality described by the adjunct clause. This revision is presented in detail in Johnston 1994b Chapter 3 Section 5.

interval i . If the eventuality description ψ is atelic, then there must be an eventuality meeting ψ whose runtime contains the interval i ⁵.

- (40) (i) If ψ is a telic: $\mathbf{g}(\psi, i) = 1$ iff $\exists e [\psi(e) \ \& \ [f(e) \subseteq i]]$
(ii) If ψ is an atelic: $\mathbf{g}(\psi, i) = 1$ iff $\exists e [\psi(e) \ \& \ [i \subseteq f(e)]]$

The definition of $\mathbf{g}(\psi, i)$ correctly predicts the truth conditions of (33) and (34). Now that the truth conditions of *when* have been established, and the truth of an eventuality description with respect to an interval is defined, the analysis of the adjunct restriction reading and head restriction reading can be presented. I propose that on the adjunct restriction reading the adverb of quantification quantifies over intervals, while on the head restriction reading it quantifies over eventualities.

7. Adjunct Restriction Readings Involve Quantification over Intervals

I assume that the adjunct restriction reading results from the *when*-clause being mapped into the restriction of the adverb of quantification. In Johnston 1994a and Johnston 1994b, I argue that this results from IP adjunction of the *when*-clause. The head clause is within VP and is mapped into the nuclear scope. For example (3), repeated here as (41), the factorization into restriction and nuclear scope is as in (42). Filling in the semantics for *when* and the translation of the head clause, results in the representation in (43).

- (41) Marcia always writes a letter when she is at the cafe.
(42) **always'**{ *when she is at the cafe* } [*Marcia writes a letter*]
(43) **always'**{ $\lambda i [\exists e_1 [\mathbf{MAX}(\mathbf{at}'(\textit{Marcia}, \textit{the cafe}, e_1), e_1) \ \& \ [i = f(e_1)]]]]$ }
[**write'**(*Marcia, a letter, e₂*)]

The restriction on the quantifier is a description of an interval and so the quantification is over intervals. The nuclear scope contains a description of an eventuality. The quantifier requires that each interval which meets the description in its restriction meet the condition in the nuclear scope, an eventuality description. The function \mathbf{g} defines how an eventuality description can be true of an interval. Since the eventuality description is telic, each interval is required to include the runtime of an eventuality of Marcia writing a letter. This captures the truth conditions of the adjunct restriction reading of (41). For each maximal interval for which Marcia is at the cafe, there must be an eventuality of Marcia writing a letter whose runtime is contained within that interval.

For an example like (44), the adjunct restriction reading can be represented as in (45). The quantification is over the runtimes of eventualities of Marcia writing a letter. Since the eventuality description in the nuclear scope is atelic, the quantification requires that each interval be contained within an interval which is the runtime of an eventuality of Marcia being at the cafe. This captures the truth conditions of (44). For each interval in which Marcia writes a letter, there must be an eventuality of Marcia being at the cafe whose runtime contains that interval.

- (44) Marcia is always at the cafe when she writes a letter.
(45) **always'**{ $\lambda i [\exists e_1 [\mathbf{MAX}(\mathbf{write}'(\textit{Marcia}, \textit{a letter}, e_1), e_1) \ \& \ [i = f(e_1)]]]]$ }
[**at'**(*Marcia, the cafe, e₂*)]

⁵An alternative proposal, capturing the same idea, is to treat \mathbf{g} as a type-changing operator which defines how an eventuality description can be type-changed to an interval description for the purposes of interval quantification. This approach enables the quantifier to be treated as a generalized quantifier over intervals.

8. Head Restriction Readings Involve Quantification over Eventualities

On the head restriction reading, it is the head clause which serves as the restriction on the adverb of quantification. In Johnston 1994a and 1994b, I argue that the head restriction reading results from the adjunct being adjoined to VP, and both the head clause and the adjunct being factored into the nuclear scope. I propose that the head clause and adjunct clause compose in the same way that they do in existential uses of *when* in which there is no adverb of quantification. The *when*-clause serves as the restriction for an existential quantifier, and the head clause serves as the nuclear scope. For example (3), repeated here as (46), the resulting representation is as in (47).

(46) Marcia always writes a letter when she is at the cafe.

(47) $\text{always}'\{ \} [\exists\{\lambda i [\exists e_1 [\text{MAX}(\text{at}'(\text{Marcia}, \text{the cafe}, e_1), e_1) \ \& \ [i = f(e_1)]]]]\}$
 $[\text{write}'(\text{Marcia}, \text{a letter}, e_2)]]$

In order to account for the fact that the head clause serves as the restriction, I introduce a process of EVENTUALITY VARIABLE BINDING. In Johnston 1994b, I show how this process is involved in a wide range of constructions including the composition of adverbs of quantification with embedded WH-clauses, as discussed by Berman (1991), and the composition of adverbs of quantification with *because*-clauses and purpose clauses. The idea is that an adverb of quantification may bind an eventuality variable within its nuclear scope, and that as a result the eventuality description of which the variable is an argument serves as the restriction. In this case, *always* binds e_2 and (46) is interpreted as in (48).

(48) $\text{always}'e_2\{\text{write}'(\text{Marcia}, \text{a letter}, e_2)\}$
 $[\exists\{\lambda i [\exists e_1 [\text{MAX}(\text{at}'(\text{Marcia}, \text{the cafe}, e_1), e_1) \ \& \ [i = f(e_1)]]]]\}$
 $[\text{write}'(\text{Marcia}, \text{a letter}, e_2)]]$

The expression in the restriction is a description of eventualities of Marcia writing a letter, and it is those eventualities which are quantified over. Each of those eventualities is required to satisfy the expression in the nuclear scope, which is also a description of an eventuality. It is a description of eventualities whose runtimes are included in the runtimes of eventualities of Marcia being at the cafe. The interpretation in (48) requires that each eventuality of Marcia writing a letter be one which takes place within an interval which is the runtime of a maximal eventuality of Marcia being at the cafe. This captures the truth conditions of the head restriction reading of (46). It requires that on all occasions that Marcia writes a letter, she is at the cafe. The analysis presented here accounts for both the head and adjunct restriction readings. In the next section, we see how this analysis accounts for the aspect facts described in Section 3.

9. Explaining the Absence of a Head Restriction Reading

The generalization established in Section 3 was that a head restriction reading is available if the eventuality description in the head clause is telic and not if it is atelic. Given the analysis proposed above and the assumptions regarding the nature of telic and eventualities in the model, these facts are predicted. The analysis of the head restriction reading of an example like (16), repeated here in (49), would be as in (50).

(49) Marcia is always at the cafe when she writes a letter.

- (50) **always'** e_2 {**at'**(*Marcia, the cafe, e_2*) }
 $[\exists \{ \lambda i [\exists e_1 [\text{MAX}(\text{write}'(\textit{Marcia, a letter, } e_1), e_1) \ \& \ [i = f(e_1)]]]] \}$
 $[\text{at}'(\textit{Marcia, the cafe, } e_2)]]$

This requires that each eventuality of Marcia being at the cafe is such that its runtime contains the runtime of an eventuality of Marcia writing a letter. The problem is that given the homogenous nature of atelic eventualities, the atelic eventuality description in the restriction will pick out not just maximal eventualities of Marcia being at the cafe but also all of their component subeventualities. Furthermore, this reading would require that each one of those subeventualities, even those that are just momentary, contain the runtime of an eventuality of Marcia writing a letter. As a result, (50) can never be true. The infinite nature of the domain may in itself be enough to rule out this reading. If not, the awkwardness of the reading will make it inaccessible.

The fact that atelic eventualities can serve as restrictions when they are in a *when*-clause is also predicted. The adjunct restriction reading of an example like (3), repeated here in (51), is represented in (52). Since it is the *when*-clause that serves as the restriction, and not the atelic eventuality description alone, the restriction can individuate a domain for quantification. The expression contributed by the *when*-clause picks out maximal eventualities of Marcia being at the cafe and requires the runtime of each to contain the runtime of an eventuality of Marcia writing a letter.

- (51) Marcia always writes a letter when she is at the cafe.
 (52) **always'**{ $\lambda i [\exists e_1 [\text{MAX}(\text{at}'(\textit{Marcia, the cafe, } e_1), e_1) \ \& \ [i = f(e_1)]]]$ }
 $[\text{write}'(\textit{Marcia, a letter, } e_2)]]$

I mentioned earlier that De Swart (1991) provides an account of the head and adjunct restriction readings. We will see in the next section that her proposal cannot be extended to account for the aspect facts.

10. De Swart 1991

In De Swart's account, the semantic contribution of the temporal connective is in the nuclear scope on both the head restriction reading and the adjunct restriction reading. The head restriction reading of (51) in her account is represented as in (53). The adjunct restriction reading is as in (54). Both readings are taken to involve quantification over events⁶. Each event is required to be in the **WHEN** or **WHEN'** with an event which meets the description in the other clause.

- (53) **ALWAYS (MARCIA WRITE A LETTER,**
 $\{e_2 \mid \exists (\text{MARCIA AT THE CAFE, WHEN}'e_2)\}$)
 (54) **ALWAYS (MARCIA AT THE CAFE,**
 $\{e_1 \mid \exists (\text{MARCIA WRITE A LETTER, WHEN}_{e_1})\}$)

For the purposes of her analysis, De Swart assumes that states can be treated as count-like objects in the ontology, just like telic events. This enables her proposal to explain the adjunct restriction reading in (54). The quantification in this case is over

⁶De Swart uses the term 'event' to refer to what I have here been calling an 'eventuality'. Her term 'event' refers to both telic and atelic eventualities.

eventualities of Marcia being at the cafe. Presumably, her countable atelic eventualities are what in my treatment are maximal atelic eventualities. Each of these eventualities is required to be in the **WHEN** relation with an event of Marcia writing a letter.

The problem with the assumption that states (and other atelic eventualities) are countable is that it fails to explain the absence of a head restriction reading for examples like (16), repeated here in (55). De Swart's account assigns the representations in (56) and (57) to the adjunct restriction reading and head restriction reading of (55). Given her assumption that atelic eventualities are countable, her analysis predicts that the head restriction reading represented in (57) should be available for (55), and it is not.

(55) Marcia is always at the cafe when she writes a letter.

(56) **ALWAYS (MARCIA WRITE A LETTER,**
 $\{e_1 \mid \exists (\text{MARCIA AT THE CAFE, WHEN}_{e_1})\}$)

(57) **ALWAYS (MARCIA AT THE CAFE,**
 $\{e_2 \mid \exists (\text{MARCIA WRITE A LETTER, WHEN}_{e_2})\}$)

The problem that these facts pose for De Swart's account go deeper than the assumption that states are count-like. If we make the alternative assumption that states and other atelic eventualities are not count-like and are in fact homogenous and mass-like, De Swart's proposals account for the absence of a head restriction reading for (55). As in my proposal, the atelic eventuality description in the restriction fails to individuate a domain for quantification. The problem with this move is that we no longer expect an adjunct restriction reading to be available for (51). The atelic eventuality description in the restriction in (54) will fail to individuate a domain for quantification. The problem this proposal faces is that by assuming that the temporal connective is always in the nuclear scope the crucially asymmetrical nature of these constructions is obscured.

11. Summary and Conclusions

This paper illustrated the role of aspectual distinctions in the interpretation of constructions with *when*-clauses and adverbs of quantification. These constructions can have two readings: the adjunct restriction reading, where the adjunct clause provides the restriction, and the head restriction reading, where the head clause provides the restriction. It was shown that the head restriction reading is only available if the eventuality description contributed by the head clause is telic and not if it is atelic. The adjunct restriction reading is always available regardless of the aspects of the two eventuality descriptions.

Previous accounts of these constructions do not account for this sensitivity to aspect. The two previous accounts which address both the adjunct restriction reading and the head restriction reading are those of Rooth (1985) and De Swart (1991). Rooth's account in terms of Association with Focus does not account for the aspect facts, and there is independent evidence against the proposal that Association with Focus is involved in these constructions (Johnston (1994a, 1994b)). De Swart's account does not capture these facts because it assumes that with respect to these constructions atelic eventualities are countable, like telic eventualities. Even without this assumption, De Swart's analysis cannot account for these facts in principle because the contribution of the temporal connective is in the nuclear scope on both readings.

An account was proposed in which *when*-clauses contribute interval descriptions. The intervals described are the runtimes of maximal eventualities which meet the eventuality description contributed by the clausal complement of *when*. The adjunct restriction reading

results from IP adjunction of the *when*-clause. In this position, the *when*-clause is factored into the restriction of the adverb of quantification. Since the *when*-clause is an interval description, the quantification on the adjunct restriction reading is over intervals. The eventuality description contributed by the head clause is factored into the nuclear scope. A function $g(\psi, i)$ which describes how an eventuality description ψ can be true of an interval i is introduced. If the eventuality description ψ is telic, there must be an eventuality which meets that description, and whose runtime is contained in the interval i . If the eventuality description ψ is atelic, there must be an eventuality which meets that description, and whose runtime contains the interval i . This definition captures the truth conditions of these constructions and the parallel between these constructions and related quantificational constructions with other adjuncts which describe intervals, such as *between 3 o'clock and 5 o'clock*.

The head restriction reading results from VP adjunction of the *when*-clause. In this case, both the head clause and the adjunct are factored into the nuclear scope, and they compose as an existential quantification. Through a process of eventuality variable binding, the adverb of quantification binds the eventuality variable of the eventuality description contributed by the head clause, and it serves as the restriction of the adverb of quantification. On the head restriction reading, the quantification is over eventualities.

The assumption is made that atelic eventualities have a mass-like homogenous nature. They are represented as join semilattices in the model. Telic eventualities are count-like and are atomic entities in the model. Given this assumption, which is supported by work by Bach (1986) and others, the analysis proposed accounts for the absence of a head restriction reading for constructions with atelic head clause eventuality descriptions. On the head restriction reading, the restriction contains the eventuality description contributed by the head clause. If that eventuality description is atelic, it will pick out all of the subeventualities of all of the atelic eventualities of which it is true, and it fails to individuate a domain for quantification. Given the semantic contribution of *when*, a *when*-clause which contains an atelic eventuality description can serve as a restriction because the *when*-clause picks out the runtimes only of maximal atelic eventualities.

As demonstrated in Johnston 1994a and 1994b, the analysis proposed here also accounts for the roles of the syntactic position of the adjunct and the placement of intonational focus in determining the availability of the head and adjunct restriction readings. Support for this analysis has been strengthened further here by its success in accounting for the aspect facts. Although the presentation here concerns constructions with *when*-clauses and *always*, the analysis proposed has a considerably wider range of application. The same sensitivity to the aspect of the head clause eventuality description is found with a wide range of other temporal adjuncts and with other adverbs of quantification.

I would like to finish with discussion of a couple of directions for further work. These concern the possible interpretations of constructions with the progressive and with iterative predicates.

It is generally the case that a clause in the progressive cannot provide the restriction for an adverb of quantification. For example, (58) lacks a head restriction reading. It cannot mean that all eventualities of Marcia writing a letter take place at the cafe.

(58) Marcia is always writing a letter when she is at the cafe.

What is interesting about this case is that although the inherent aspect of the eventuality described, letter writing, is telic, a head restriction reading is not available.

Given a more fully developed ontology of eventualities, and a more developed model of the interaction of lexical and inherent aspect, this fact should be accounted for. In the cases addressed earlier in this paper it is the homogenous nature of atelic eventualities in the domain that results in the atelic eventuality description being unable to pick out a domain for quantification. The progressive takes a different view on the domain of eventualities. In that view, subeventualities of telic eventualities are available and may be picked out by the description. The incorporation of the progressive into the analysis remains as a direction for further work.

Another direction for further work concerns clauses which express iteration, such as *Marcia wrote letters* in (59). Standard tests for telicity classify *wrote letters* as atelic, as shown in (59).

(59) Marcia wrote letters for two hours / *in two hours.

(60) Marcia always wrote letters when was at the cafe.

Dahl (1981:79) and Smith (1991:73-74) both claim that iterative predicates of this kind should be classified as atelic. However, if the head clause contains an iterative predicate, the head restriction reading is available. For example, (60) can mean that on all occasions that Marcia wrote letters, she was at the cafe. It may be that the crucial distinction that is relevant to the availability of a head restriction reading is in fact not telic vs. atelic but some other classification which cross cuts that one. Another possibility is that the classification of *wrote letters* as atelic is incorrect. These options remain to be addressed in future investigation of these constructions.

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