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Root transformations & quantificational structure*

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Hooper and Thompson (1973) observe that root transformations (RTs) occur in asserted adverbial adjuncts (*because*-clauses) but not in presupposed ones (*when*/*before*/*after*-clauses). Developing the idea that adverbial clauses can be analyzed semantically as parts of quantificational structures, we argue that RTs are available in adverbs that correspond to the scope of quantification, but not in those corresponding to the restriction. We spell out this view using the semantic theory of *when*/*before*/*after*-clauses developed in Johnston (1994) and the analysis of *because*-clauses in Larson (2004). After briefly reviewing alternative syntactic approaches, and noting difficulties for them, we suggest a "semantic closure" account in which RTs trigger existential closure in an adverbial, binding all available variables in a restriction, and all but the main variable in the scope. As a consequence, RTs induce a vacuous quantification violation in the first case, but not in the second.

In pioneering work, Emonds (1970, 1976) identified an interesting class of transformations whose domain of application appears largely confined to main clauses. Hooper and Thompson (1973) suggest that the availability of these "Root Transformations" (RTs) in syntax correlates with semantic assertion. Specifically, they propose that RTs may occur in clauses expressing asserted content, such as sentence-final *because*-clauses (1a), but not in clauses expressing presupposed content, such as sentence-final temporal clauses (2a,b), or preposed *because*-clauses (3a,b):

(1) a. Mildred drives a Mercedes
[**because** her son, he owns stock in Xerox].

b. Mildred drives a Mercedes
[**because** her son owns stock in Xerox].
Asserts: Mildred's son purchased stock in Xerox.

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(2) a. *Mildred bought a Mercedes
[**when/before/after** her son, he purchased stock in Xerox].

b. Mildred bought a Mercedes
[**when/before/after** her son purchased stock in Xerox].
Presupposes: Mildred's son purchased stock in Xerox.

(3) a. *[**Because** her son, he owns stock in Xerox],
Mildred drives a Mercedes.

b. [**Because** her son owns stock in Xerox],
Mildred drives a Mercedes.
Asserts: Mildred drives a Mercedes.

Semantic quantification theory also invokes the notions of presupposition and assertion (Partee 1991). In typical tripartite quantificational structures, including adverbial quantifications, restrictions correspond to presupposed material whereas scopes correspond to asserted material (4):

(4) a. Always when I eat spicy food I regret it afterwards.

b. **Quant.** **Restriction** **Scope**

Presupposed Asserted

This suggests a potential explanatory connection between RT availability in syntax and semantic function. Suppose the following theses are all true:

- Adverbial clauses forbidding RTs occur in quantificational restrictions.
- Adverbial clauses allowing RTs occur in quantificational scopes.
- Some property of RTs blocks their availability in quantificational restrictions, but permits them in scopes

Then the basic Hooper and Thompson syntax-semantics correlation will have been explained.

In this paper, developing earlier ideas in Sawada and Larson (2004), we investigate whether the explanatory picture just sketched can be sustained for temporal and causal clauses, noting some potentially damaging counter-examples from Johnston (1994). We tentatively conclude that the account is defensible and we suggest "semantic intervention" as the property excluding RTs from quantificational restrictions.

1. Adverbial quantification

Modern formal semantic approaches to quantification are all based on the **relational view of (monadic) quantifiers**, according to which quantifiers express cardinality

relations Q between sets. The first argument of the quantifier corresponds to the restriction on quantification and the second argument corresponds to the scope (5). (6) gives typical analyses, where ALL expresses the subset relation (6a), and where MOST compares the cardinalities of intersection and difference (6b):

(5) **Relational View of (Monadic) Quantifiers**
Q ({x: A(x)}, {y: B(y)})
{x: A(x)} – Restriction argument
{x: B(x)} – Scope argument

(6) a. i. All fish swim.
ii. ALL({x: fish(x)}, {y: swim(y)})
iii. $|\{x: fish(x)\} - \{y: swim(y)\}| = 0$

b. i. Most birds fly.
ii. MOST({x: birds(x)}, {y: fly(y)})
iii. $|\{x: birds(x)\} \cap \{y: fly(y)\}| > |\{x: birds(x)\} - \{y: fly(y)\}|$

Nominal and adverbial quantification differ with respect to the domain of objects quantified over. Nominal quantification appears to range over all entities in the universe of discourse whereas adverbial quantification is more restricted, ranging over sets of times (7a) or eventualities (7b), depending on the analysis:

(7) a. Q (λt[A(t)], λt[B(t)]) (Stump 1981, 1985)
b. Q (λe[A(e)], λe[B(e)]) (Chierchia 1995; de Swart 1993)

Adverbial quantification also commonly involves an unexpressed restriction, whose content is drawn either from context (8a)/(8bi), or derived from the sentence itself (8bii–iv):

(8) a. John usually talks too much.
"In most **contextually relevant situations**, John talks too much."

b. John usually steams Chinese dumplings.
i. "In most **contextually relevant situations**, John steams Chinese dumplings."
ii. "In most **contextually relevant situations where John steams something**, John steams Chinese dumplings."
iii. "In most **contextually relevant situations where John steams dumplings**, John steams Chinese dumplings."
iv. "In most **contextually relevant situations where John deals with Chinese dumplings**, John steams Chinese dumplings."

Following proposals by Rooth (1985), restrictions derived sentence-internally like (8bii–iv) have been widely taken to arise by **association with focus**. Specifically, adverbial quantifiers have been analyzed as focus-sensitive elements that associate with material in their scope. On this view the restrictions in (8bii–iv), for example,

correspond to the focal assignments in (9a–c) (resp.), where the boldfaced materials in (8) and (9) match-up:

(9) a. Usually **John steams** [$_{\text{FOCUS}}$ Chinese dumplings].
b. Usually **John steams** [$_{\text{FOCUS}}$ Chinese] **dumplings**.
c. Usually **John** [$_{\text{FOCUS}}$ steams] **Chinese dumplings**.

Adverbial Qs are widely assumed to exhibit their full argument structure in conjunction with adverbial *if*/*when*/*before*/*after*-clauses (10a–d). The adverbial clause supplies the restriction on quantification whereas the main clause supplies the scope (11a–c) (Kratzer 1986):

(10) a. Sometimes [$_{\text{CP}}$ **if John is sleepy**] he drinks green tea.
b. Usually [$_{\text{CP}}$ **when John cooked**] he steamed Chinese dumplings.
c. John always shaves [$_{\text{CP}}$ **when he is in the shower**].
d. John never washed vegetables [$_{\text{CP}}$ **before eating them**].

(11) a. SOMETIMES (**λe[John is sleepy(e)]**) (λe[John drink green tea(e)])
b. USUALLY (**λe[John cooked(e)]**) (λe[John steamed C. dumplings(e)])
c. ALWAYS (**λe[John in the shower**]) (λe[John shaves(e)])

In the circumstance where *if*/*when*/*before*/*after*-clauses occur without an overt adverbial quantifier (12a), a covert one has been assumed (Heim 1982) (12b):

(12) a. When John visited Paris, he ate in a café.
b. SOMETIME (λe[John visited Paris(e)]) (λe[John ate in a café(e)])

The possibility of a covert adverb, even in sentences with an overt one, correctly predicts ambiguity to arise in examples like (13). On reading (13a), the *when*-clause restricts *always* (14a), so that the sentence speaks of all of John's occasions of visiting Paris. On reading (13b), the *when*-clause restricts a covert adverb *SOMETIME*; *always* quantifies over contextuallly relevant parts of the larger visitation-event. In other words, at all relevant times within John's (possibly single) visit to Paris he ate in a café (14b).

(13) When John visited Paris, he always ate in a café.
a. "In all situations in which John visited Paris, he ate in a café."
b. "At the time John visited Paris, in all relevant situations, John ate in a café."

(14) a. ALWAYS (λe[John visited Paris(e)]) (λe[John ate in a café(e)])
b. SOMETIME (λe[John visited Paris(e)]) (λe[ALWAYS (λe′[C(e) & Π(e′,e)]) (λe′[John ate in a café(e′)])

In all these cases, the if/*when/before/after*-clause restricts an adverb of quantification.

2. *When/Before/After*-clauses, presupposition & RTs

Hooper and Thompson (1973) suggest that "Some adverbial subordinate clauses, such as those beginning with *when*, *before* and *after*, are … always presupposed, and that RTs do not apply within them" (pp. 494–495). They offer (15a–e) (= (251–255) in Hooper & Thompson (1973)) as evidence is support of their basic claim:

(15) a. *Helen and Jack had dinner
[**before into the kitchen trooped the children**].
b. *The villagers all burst into song
[**when in came the bride and groom**].
c. *We were all much happier
[**when upstairs lived the Browns**].
d. *The guests laughed out loud
[**after Mary stopped singing, strangely**].
e. *The customer stomped out
[**after the clerk, I guess, insulted her**].

Hooper and Thompson's correlation appears to fit smoothly with the semantics sketched above. Thus *when*/*before*/*after*-clauses uniformly restrict (overt/covert) quantificational adverbs, and in tripartite quantificational structures, restrictions always represent presupposed information. There is **presupposed** to be a domain of individuals satisfying the restriction of which the scope is asserted to hold (16):

(16) a. Always when I eat spicy food I regret it afterwards.
b. **Quant.** **Restriction** **Scope**
Presupposed Asserted

If RTs are blocked in presupposed environments (for whatever reason), then RTs will be expected to be blocked in *when*/*before*/*after* clauses, given that the latter are exactly presupposed environments.

2.1 Asserted *When/Before/After*-clauses?

The preceding result is attractive but immediately encounters problems with the phenomenon of asserted adverbial clauses. Consider the pairs in (17) and (18). With normal intonation, (17a) (based on de Swart 1993) naturally answers (18a), but not (18b). Conversely, (17b) naturally answers (18b), but not (18a):

(17) a. [**After the war ended**] John lived in London.
b. John lived in London [**after the war ended**].

(18) a. **Where** did John live after the war ended?
b. **When** did John live in London?

Answers typically constitute focused/asserted material. As an answer to (18b) therefore, the *after*-clause in (17b) seems to be asserted. Despite this fact, RTs continue to be blocked, as shown in (19):

(19) Q: When did John live in London?
A: *John lived in London [**after the war, it had ended**].

Consider also (20a). (20a) has the reading in (20b), where the *when*-CP restricts the quantificational adverb *always* and is accordingly presupposed. But (20a) also has reading (20c) where the arguments of the quantificational adverb seem reversed. On the reading in (20c), the adverbial clause seems to be asserted material. The two readings are brought out by different emphasis (Rooth 1985).

(20) a. Marty always shaves when he is in the shower.
b. Always (λe[Marty is in the shower(e)]) (λe[Marty shaves(e)])
(cf. *Marty always SHAVES when he is in the shower*.)
c. Always (λe[Marty shaves(e)]) (λe[Marty is in the shower(e)])
(cf. *Marty always shaves when he is in the SHOWer*.)

Readings where the main clause gives the restriction on quantification and where the adverbial clause gives the apparent scope are natural for (21a–d) (from Johnston 1994):

(21) a. Frances always breaks up with lovers when it is raining.
("All the (relevant) times that Frances breaks up with lovers are times at which it is raining.")
b. Sharks usually attack people when they are hungry.
("Most shark attacks occur when the shark is hungry.")
c. Edward always submits an abstract when the deadline is very near.
("Edward's abstract submissions invariably occur at the point where the deadline is very near.")
d. Marcia always goes to the store before it gets dark.
("All Maria's goings to the store occur before it gets dark.")

Since scopal material is asserted, the *when*-clauses in (20a) and (21a–d) appear to be asserted on the relevant readings. Nonetheless, RTs continue to be blocked in all of these examples; cf. (22a,b):

(22) a. Q: When does Marty always shave?
A: *Marty always shaves [**when in the shower, he is**].
b. *Edward always submits an abstract
[**when the deadline, it is very near**].

These results thus appear to challenge the basic Hooper and Thompson correlation between *when*/*before*/*after*-clauses, presupposition/assertion and RT availability. Here we seem to have asserted adverbials in which RTs are nonetheless unavailable.

2.2 A more refined semantics (Johnston 1994)

We believe that the problem of asserted *when*/*before*/*after*-clauses is merely an apparent one and arises from an inadequate semantics. The semantic account of adverbial quantification offered in Johnston (1994) appears to resolve the puzzle and show what's going on. For convenience we will follow Johnston (1994) in talking about an **adjunct restriction reading** of a temporal clause and a **head restriction reading**, defined as below:

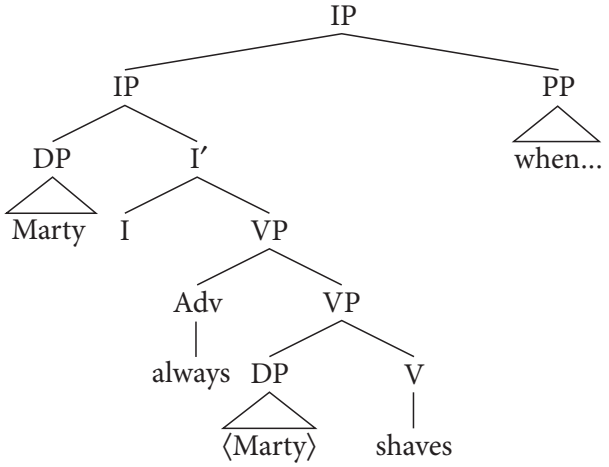
Adjunct restriction reading : *when*/*before*/*after*-clause provides the quantifier restriction.
Head restriction reading: main clause provides the quantifier restriction.

2.2.1 *The adjunct restriction reading*

Johnston (1994) derives the adjunct restriction reading of an example like (23a) via an IP adjunction structures as in (23b), and the general mapping procedure stated in (24):

(23) a. Marty always shaves when he is in the shower.

b.

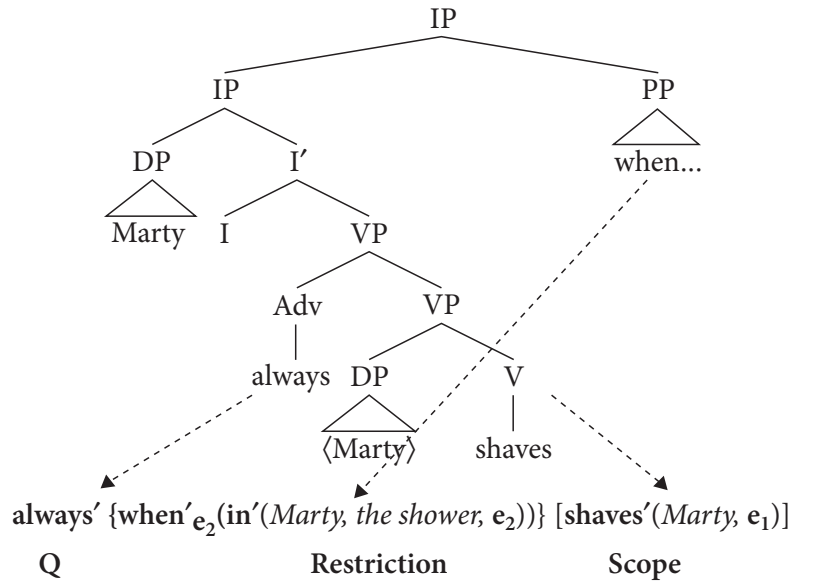


(24) **Determining the Restriction & Nuclear Scope of an Adverb of Quantification**:

i. Make the Q adverb the first element in the tripartite structure.
ii. Factor VP material c-commanded by the Q adverb into the nuclear scope.
iii. Factor material adjoined to IP or in IP Spec into the restriction.

The interaction between structure, mapping principles and interpretation is exhibited explicitly in (25):

(25)



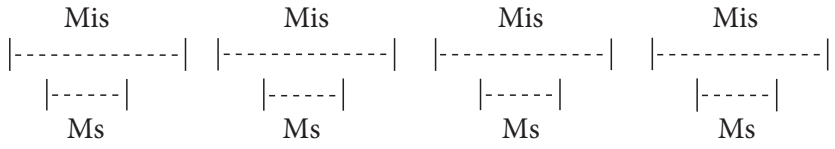
The adverb *always* maps to the quantifier (24i); the IP-adjoined adverbial clause is assigned to the quantifier restriction (24iii); and the VP is assigned to the scope (24ii).

In (25), the expression **when′e$_2$(in′**(*Marty*, *the shower*, **e$_2$**)) denotes a set of time intervals that is derived as in (26). The basic sentence itself (*Marty is in the shower*) is interpreted as denoting a set of events, here the set of all events in which Marty is in the shower (26a). The adverbial *when* denotes an operator that combines with a set of events to yield the "run-time" (RunT) of the maximal event in the set (26b). The run-time of an event is simply its temporal extension: how long it took. In the case of *when Marty is in the shower*, we thus get the interval that is the run-time the maximal event of Marty being in shower (26c).

(26) a. *Marty is in the shower* ⇒ **in'** (Marty, the shower, e)
b. *when* ⇒ λφλi[∃e[MAX(φ)(e) & i = **RunT**(e)]
c. *when Marty is in the shower* ⇒
λi [∃e[MAX(**in'** (Marty, the shower, e)) & i = **RunT**(e)]

Putting this result together with (25), we can read the latter as saying that *Marty always shaves when he is in the shower* is true on the adjunct restriction reading if and only if for each time interval that is the run-time of a maximal event of Marty being in the shower (Mis) there is an interval contained within it corresponding to the run-time of an event of Marty shaving (Ms) (27):

(27)



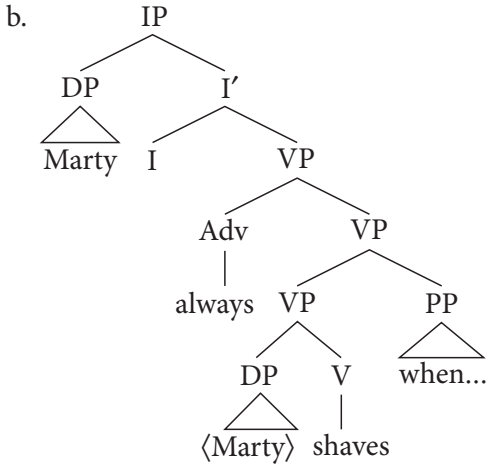
Thus for Johnston, adjunct restriction readings involve quantification over time intervals.

2.2.2 *The head restriction reading*

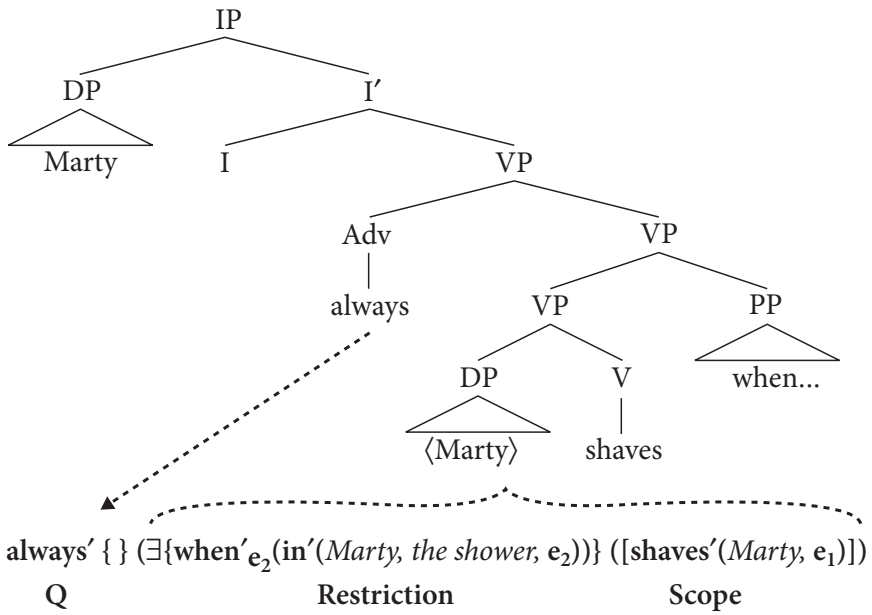
Johnston (1994) derives the **head restriction reading** of (28a) from a different syntactic source – specifically, from the VP adjunction structure in (28b). (29) exhibits the details.

(28) a. Marty always shaves when he is in the shower.

b.



(29)



Observe that the mapping principles in (24) assign no restriction to **always'**. All sentence material is interpreted in the scope. Johnston takes the resulting representation to violate the constraint on vacuous quantification in (30), proposed by Kratzer (1995). In (29) the quantifier **always'** fails to bind a variable in the restrictive clause.

(30) **Prohibition against Vacuous Quantification**: For every quantifier Q, there must be a variable x such that Q binds an occurrence of x in both its restrictive clause and its nuclear scope.

As a semantic repair option, Johnston assumes a process of **eventuality variable binding**, whose effect, in essence, is to copy the scope term into the restriction. Eventuality variable binding yields (31), which satisfies the prohibition against vacuous quantification, and delivers the correct truth-conditions:

(31) **always′**{**shaves′**(*Marty*, $\mathbf{e}_1$)}
(∃{**when′**$\mathbf{e}_2$(**in′**(*Marty*, *the shower*, $\mathbf{e}_2$))}([**shaves′**(*Marty*, $\mathbf{e}_1$)])

According to (31), for each eventuality of Marty shaving (Ms) there is an eventuality of Marty being in the shower and shaving (Mis&Ms) whose run-time contains the interval of the shaving.

(32)

Ms	Ms	Ms	Ms
■	■	■	■
↕	↕	↕	↕
■	■	■	■
Mis&Ms	Mis&Ms	Mis&Ms	Mis&Ms

where RunT(Ms) ⊆ RunT(Mis&Ms)

In contrast to adjunct restriction readings, which involve quantifications over time intervals, head restriction readings involve quantifications over event(ualitie)s directly.

2.2.3 *Implications*

Johnston's representations in (25) and (31) differ sharply from our earlier representations in (20b,c). Firstly, *when* is semantically contentful according to Johnston, and not a simple "restriction marker" contra Lewis (1975), Heim (1982), and Kratzer (1986). As we've seen, *when* contributes the operator in (26b).

Furthermore, Johnston's adjunct and head restriction readings are not simple inverses like (20b,c). Adjunct restriction readings quantify over time intervals whereas head restriction readings quantify over event(ualitie)s.[1]

1. This distinction has a very interesting consequence that Johnston discusses. Johnston observes that examples like (i) and (ii) are not equivalent in their readings. Whereas (i) is ambiguous, having both adjunct and head restriction readings, which can be brought out by stress, (ii) has only an adjunct restriction reading, no matter what stress we apply:

Most importantly for us, however, in Johnston's head restriction readings, the *when*-clause does not become the whole scope, but only part of it. Consider again (31), repeated below, where the *when*-clause is only part of the larger underlined term:

(31) **always′** {**shaves′**(*Marty*, $\mathbf{e}_1$)}
$\underline{(\exists\{\textbf{when′}\mathbf{e}_2(\textbf{in′}(\textit{Marty}, \textit{the shower}, \mathbf{e}_2))\}([\textbf{shaves′}(\textit{Marty},\mathbf{e}_1)])}$
Scope

Moreover, within the scope term the *when*-clause actually functions as a quantifier-restriction on an inner existential quantifier ∃. Thus under Johnston (1994), what we called "asserted adverbial clauses" are in fact not simply asserted. Rather they are part of a larger quantificational structure that is asserted. And within this asserted quantificational structure, the *when*-clause continues to function as a quantifier restriction. If, within this larger quantificational assertion, we are permitted to speak of a presupposed part, then in fact we can preserve Hooper and Thompson's core contention that "adverbial subordinate clauses, such as those beginning with *when*, *before* and *after*, are … always presupposed, and RTs do not apply within them."[2]

(i)	a.	Marty always shaves when he is in the shower.	Ambiguous
	b.	Marty always SHAVES when he is in the shower.	(ARR)
	c.	Marty always shaves when he is in the SHOWer.	(HRR)
(ii)	a.	Marty is always in the shower when he shaves.	Unambiguous!
	b.	Marty is always in the SHOWer when he shaves.	(ARR)
	c.	Marty is always in the shower when he SHAVES.	(**ARR**!)

Johnston traces this difference to aspect and its interaction with quantification. Briefly, quantifiers require as their restrictions predicates that allow one to count the entities involved – i.e. they require **sortal predicates**. *When*-clauses yield predicates of time intervals, which are always sortal, hence adjunct restriction readings are always available with temporal adverbial clauses because they always provide a temporal quantifier with a countable domain. With head restriction readings, however, the situation is different. Here what is functioning as the restriction is not a predicate of time intervals but rather a predicate of event(ualities)s. Unlike time intervals, event(ualities)s are not always countable. For example, whereas telic events appear to be countable, states are not. This means that the availability of a head restriction reading, where the main clause furnishes the restriction, will be sensitive to whether the main clause expresses a countable predicate of events. In (ia) where the main clause *shaves* expresses a telic, countable, sortal predicate of events, a head restriction reading will be available. In (iia) where the main clause *in the shower* expresses a nontelic, noncountable, nonsortal predicate of states, head restriction reading will not be available. See Johnston (1994) for further discussion.

2. This proposal requires a structured notion of presupposition and assertion in which assertions can themselves contain presupposed material, and in which presupposed material can contain asserted material. For further discussion see Herburger (2000).

2.3 The syntax-semantics mapping revisited

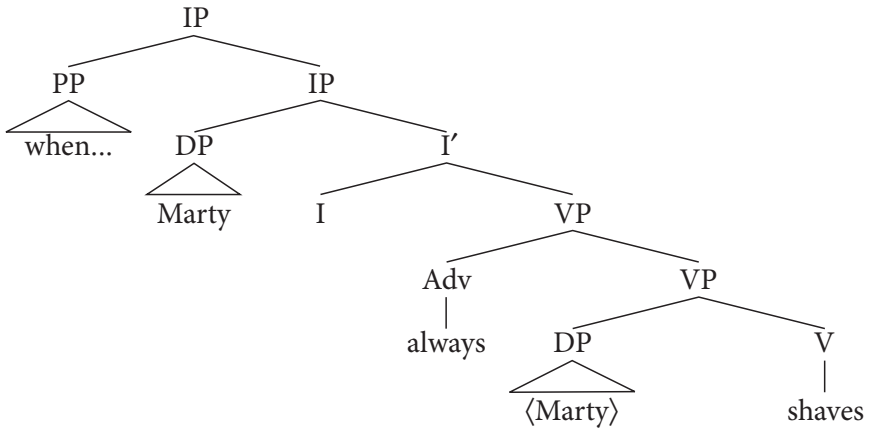
Johnston (1994) does not derive head restriction readings via focus (contra Rooth 1985), but rather calculates them directly from syntactic structure via his mapping principles in (24). In support of this view Johnston points to the fact that (21a–d) (repeated below) get natural head restriction readings without special focal emphasis:

(21) a. Frances always breaks up with lovers when it is raining.
b. Sharks usually attack people when they are hungry.
c. Edward always submits an abstract when the deadline is very near.
d. Marcia always goes to the store before it gets dark.

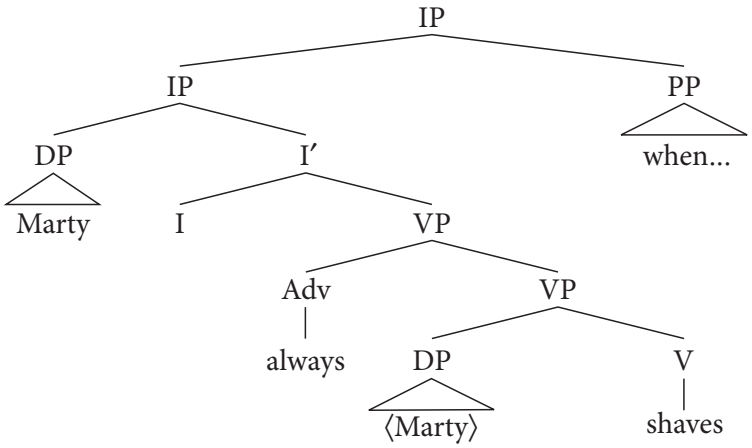
Nonetheless, Johnston's structures and mapping principle (24) seem to us doubtful in some respects.

First of all, Johnston associates adjunct restriction readings with high, IP adjunctions of the *when*/*before*/*after*-clause. On this view, pre- and postposed adverbials are symmetric counterparts (33a,b):

(33) a.



b.



This does not seem correct, however. Reinhart (1983) notes that preposed adverbial clauses do not trigger Principle C violations (Chomsky 1981), but postposed adverbial clauses do (34a,b):

(34) a. When sharks are hungry they usually attack people.
b. *They usually attack people when sharks are hungry.

Furthermore, examples having only adjunct restriction readings allow *when*/*before*/*after*-clauses to be captured by VP ellipsis (35), implying that the adverbial clauses must be able to attach within VP in order to be deleted with it:

(35) Marty always is in the shower when he shaves, and Peter always is Ø too.

We won't attempt to revise Johnston's syntax for *when*/*before*/*after*-clauses, but we do wish to make a general point about the syntax – semantics mapping in adverbial quantification, which appears to us to offer a more promising approach to the question, particularly for sentence-final adverbial clauses.

2.3.1 *Adverbial Qs as indefinite pronouns/pronominal Qs*

Adverbial quantifiers are often compared directly to determiner quantifiers, with the adverbial clause congruent to the NP complement of D (36a)/(36b). Semantically, the adverbial clause is taken to provide the restriction argument, just like NP does (37a)/(37b):

(36) a. Always, **when one travels**, one enjoys the change of scenery.
b. All **travelers** enjoy a change of scenery.

(37)	a.	Always	(**λe[someone-travels(e)]**)	(λe[he/she-enjoys-change-of-scenery(e)])
	b.	All	(**λx[traveler(x)]**)	(λx[enjoy-change-of-scenery(x)])
		Q	**Restriction**	**Scope**

But this view faces the question of why adverbial quantifiers more readily omit their restriction arguments than determiners (38), and why *when*/*before*/*after*-clauses readily occur separated from their quantifier whereas NP complements to determiners never do (39):

(38) a. Never (**when one travels**) does one enjoy delay.
b. No *(**traveler**) enjoys delay.

(39) a. One **always** enjoys the change of scenery **when one travels**.
b. ***All** enjoy a change of scenery **travelers**.

In our view, a better comparison is suggested by the pairings in (40) and (42), with their respective (approximate) semantics in (41) and (43). (40) compares *always*, not

to the universal determiner *all*, but to the universal indefinite pronoun *anyone*. (42) compares *mostly*, not to the simple determiner *most*, but to the pronominal determiner *most*. In both cases, the adverbial clause then ends up congruent, not to the restriction NP, but to a restrictive modifier like a relative clause. The semantic representations in (41) and (43) reflect this change:

(40) a. Always, **when one travels**, one enjoys the change of scenery.
b. anyone **who travels** enjoys a change of scenery.

(41)	a.	Any	(λx[one(x)])	(**λx[travels(x)]**)	(λx[…-change-of-scenery(x)])
	b.	All	(λe[way(e)])	(**λe[someone-travels(e)]**)	(λe[…-change-of-scenery(e)])
		Q	**Restr**	**Modifier**	**Scope**

(42) b. Mostly, **when one travels**, one enjoys the change of scenery.
a. Most **who travel** enjoy a change of scenery.

(43)	b.	Mostly	(λe[C(e)])	(**λe[someone-travels(e)]**)	(λe[…-change-of-scenery(e)])
	a.	Most	(λx[C(x)])	(**λx[travels(x)]**)	(λx[…-change-of-scenery(x)])
		Q	**Restr**	**Modifier**	**Scope**

Indefinite pronouns like *anyone*, *everywhere*, *everything*, etc. seem to incorporate their nominal restriction argument (*-way*, *-where*). Similar incorporated nominal morphology occurs with adverbs like *al-ways* and *some-times*. Thus we suggest that adverbial quantifiers like *always, sometimes, anytime*, etc. be thought of as **adverbial indefinite pronouns**.

Pronominal quantifiers (*many, few, most*, etc.) can take an unexpressed pro-nominal restriction. The same seems true of counterpart adverbs (*mostly, often, rarely*). Thus we suggest that adverbial quantifiers like *mostly, often, rarely*, etc. be thought of as **pronominal adverbial quantifiers**.

If adverbial clauses in adverbial quantifications do not correspond to NPs in nominal quantification, but rather to modifiers like relative clauses, this would explain both their invariable optionality (38a) and their ability to appear discontinuously from their quantifiers (39a). Optionality is simply the reflex of their being modifiers, and not complements like NP. As for discontinuity, the phenomenon would be parallel to extraposed relatives (44a,b).[3]

3. This proposal may also illuminate an important implicit assumption in Johnston (1994): that adverbial quantifiers are uniformly count quantifiers. This assumption is crucial to explaining the asymmetry in (i) and (ii) discussed in Footnote 1. If adverbial quantifiers could

(44) a. Often when it involves computers a job pays well
[$_{AdvC}$ **when it involves computers**].
b. As for jobs, many that involve computers pay well
[$_{RC}$ **that involve computers**].

Specifically, we would expect sentence final adverbial clauses (on their adjunct restriction readings) to be located wherever extraposed relative clauses are positioned.[4]

3. *Because*-clauses, presupposition & RTs

Hooper and Thompson (1973) note a complex distribution for the RTs identified by Emonds (1970) in sentences with *because*-clauses. They distinguish **non-restrictive *because*-clauses**, which supply the reason for the speaker's assertion or question (45a), from **restrictive *because*-clauses**, which supply the reason for the main clauses events (45b):

(45) a. Sam is going out for dinner, because I just talked to his wife.
b. Sam is going out for dinner because his wife is cooking Japanese food.
(= (224–225) in H&T 1973)

In sentences with final restrictive *because*-clauses, the adverbial permits RTs (46a–g), whereas the main clause does not (47a–c):[5]

(46) a. Helen and Jack stopped eating
[**because into the kitchen trooped the children**].
b. The villagers burst into song
[**because in came the bride and groom**].
c. We were all much happier
[**because upstairs lived the Browns**].
d. The guests laughed out loud
[**because Mary stopped singing, strangely**].

---

be mass quantifiers, then head restriction readings would be predicted to possible in the case where the main clause expresses an atelic eventuality, contrary to fact. Interestingly, indefinite pronouns are uniformly count quantifiers.

4. The idea that temporal clauses have the semantic status of (extraposed) relative clauses is proposed in Larson (1982).

5. (46a,b) are identified by Emonds (1970) as exhibiting Directional Adverb Preposing. (46c–g) display (respectively) PP Substitution, Adverb Dislocation, Complement Preposing, Direct Quote Preposing and Tag Question Formation. We should note that not all individuals seem to accept RTs freely in *because*-clauses. Our own judgments track those of Hooper and Thompson and below we will assume their basic correctness.

e. The customer stomped out
[**because the clerk, I guess, insulted her**].

f. ?Max left the room [**because "I won," Alice exclaimed**].

g. Max was quiet [**because Alice was sleeping, wasn't she?**].

(47) a. *__In came Jerry__ because it was raining.
b. *__That house there are ghosts in it__ because they like it there.
c. *__Sitting in the corner was Tom__ because he'd hidden grandma's teeth.
(= (234–236) in H&T 1973)

In sentences with initial restrictive *because*-clauses, the pattern seems to reverse. RTs become possible in the main clause (48), but largely unavailable in the adverbial clause (49):

(48) a. Because Helen and Jack had stopped eating
[**into the kitchen trooped the children**].

b. Because the villagers had burst into song
[**in came the bride and groom**].

c. Because we had invited them warmly
[**upstairs lived the Browns**].

d. Because the guests laughed out loud
[**Mary stopped singing, predictably**].

e. Because the customer stomped out
[**the clerk, I guess, blushed**].

f. ?Because Max left the room [**"I won," Alice exclaimed**].

g. Because Max was quiet [**Alice fell asleep, didn't she?**]

(49) a. *?[**Because into the kitchen trooped the children**]
Helen and Jack stopped eating.

b. *?[**Because in came the bride and groom**]
the villagers burst into song.

c. *?[**Because upstairs lived the Browns**]
we were all much happier.

d. ?[**Because Mary stopped singing, strangely**]
the guests laughed out loud.

f. *?[**Because "I won," Alice exclaimed**] Max left the room.

g. *?[**Because Alice was sleeping, wasn't she?**] Max was quiet.

Hooper and Thompson analyze the situation in (46) and (47) as follows: in a sentence with a (final) restrictive *because*-clause, the main clause represents presupposed information and the adverbial clause represents asserted information. RTs are permitted

in asserted, but not presupposed, environments, hence, RTs are permitted in a (final) restrictive *because*-clause, but not in the main clause (50):

(50) [Sam went out for dinner] [because his wife cooked Japanese food].
Main Clause ***Because*-clause**
Presupposed **Asserted**
***RTs** **RTs ✓**

On this analysis, initial restrictive *because*-clauses would have the expected associations in (51):

(51) [Because his wife cooked Japanese food] [Sam went out for dinner]
***Because*-clause** **Main Clause**
Presupposed **Asserted**
***RTs** **RTs ✓**

This result seems correct, as shown by the evidence in (52) and (53). (52a) is naturally answered by (52b), but not by (52c). Similarly, "Right?" in (53a) seeks confirmation of Sam's reason for going out to dinner; "Right?" in (53b) seeks confirmation only of Sam's going out to dinner:

(52) a. Why did Sam go out to dinner?
b. Sam went out for dinner
[because his wife cooked Japanese food].
c. ??[Because his wife cooked Japanese food]
Sam went out for dinner.

(53) a. Sam went out for dinner because his wife cooked Japanese food. Right?
b. Because his wife cooked Japanese food, Sam went out for dinner. Right?

Answers are asserted and confirmation questions refer back to asserted material. In both cases, the preposed *because*-clause is not behaving as if it is asserted.

3.1 The semantics of *because*-clauses

In analyzing *when*/*before*/*after*-clauses, we derived their resistance to RTs from their status as presupposed elements. And we derived their status as presupposed elements from their semantic function as quantifier restrictions. It's natural to wonder whether similar connections can be made with *because*-clauses. More precisely, since the availability of RTs with *because*-clauses does seem to track their status as asserted vs. presupposed, is it possible to derive the latter from quantificational structure? In fact, the possibility of doing so requires us to develop our semantics in an interesting way.

3.1.1 *Because as propositional relation*

Cause is often analyzed semantically as expressing a relation between propositions. For example, Dowty (1972, 1979) offers the semantic account in (54), based on Lewis' (1973) account of counterfactuals. Here **CAUSE** is a binary relation between propositions φ, ψ:

(54) a. **[φ CAUSE ψ]** is true iff (i) φ is a causal factor for ψ, and (ii) for all other φ' such that φ' is a causal factor for ψ, some ¬φ world is more similar to the actual world than any ¬φ' world is.

b. **φ is a causal factor for ψ** iff there is a series of sentences φ, φ_1,…, φ_n, ψ (for n ≥ 0) such that each member of the series depends causally on the previous member.

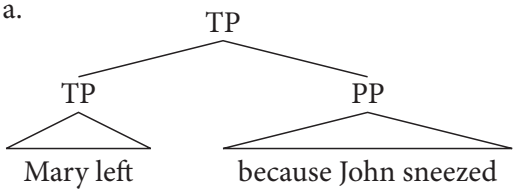
c. **φ depends causally on ψ** iff φ, ψ and ¬φ □→ ¬ψ are all true.

Given this basic view of *cause*, it's natural to analyze *because* as expressing a propositional connective as well, viz., as **BECAUSE**. Indeed, *cause* and *because* are plausibly just inverses of each other, so that φ **BECAUSE** ψ iff ψ **CAUSE** φ. Analyses of *because* as a sentential connective expressing a relation between propositions are in fact commonplace. For example, Johnston (1994) offers the propositional analysis in (55):

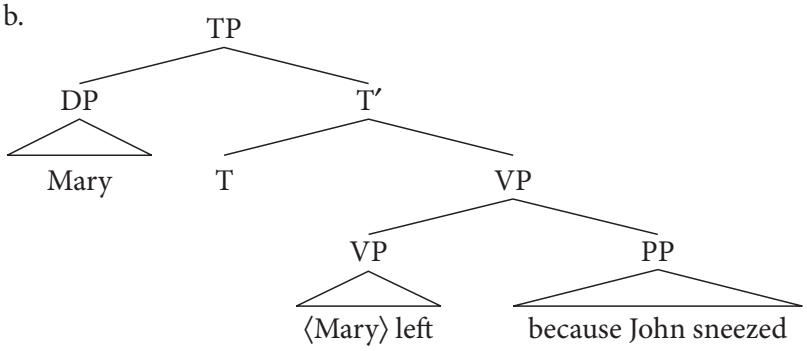
(55) **because'(X,Y)** is true iff X and Y are propositions and X, the result, is true as a result of Y.

These sentential connective analyses fit a traditional syntax involving high attachment of *because*-clauses to a proposition-denoting phrase (TP, VP) (56):

(56) a.



b.



Nonetheless they do not appear to be compatible with the leading idea we are pursuing here. In the semantics for *because* given above, the main and adverbial clauses are not related as parts of a quantificational structure. Consequently these analyses provide no clear way of deducing the informational structure of *because*-constructions from quantificational semantics. There is no way of deducing presupposed versus asserted information under the binary sentence connective view, and hence no way to deduce RT availability. This suggests we should seek a different semantics for *because*, one with quantificational structure.

3.1.2 *Because as event relation*

Davidson (1967) departs from the traditional propositional view, analyzing CAUSE as a binary relation between event(ualitie)s: one eventuality e causes another e′ (57). Taking sentences quite generally to express quantifications over events (58a,b) (where we ignore tense), CAUSE will then connect event quantifications (58c):

(57) CAUSE(e, e′)

(58) a. *John sneeze* → ∃e[sneezing(e,j)]
b. *Mary leave* → ∃e′[leaving(e′,m)]
c. *John's sneezing made Mary leave* →
∃e∃e′[sneezing(e,j) & **CAUSE**(e,e′) & leaving(e′,m)]

Larson (2004) proposes a development of this view wherein sentence final *because*-clauses involve structured event quantification as in (59). Here the main clause material gives the restriction on quantification and the subordinate *because*-clause supplies the scope: [6]

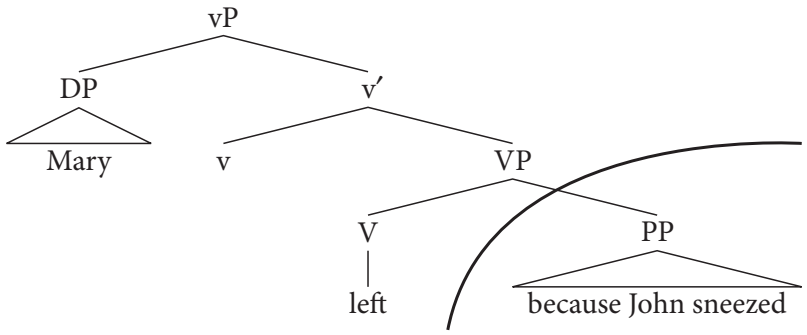
(59) a. Mary left [**because** John sneezed]
b. ∃e′ [leaving(m,e′)] [∃e[sneezing(j,e) & **CAUSE(e,e′)**]]
Q **Restr** **Scope**
"For some leaving by Mary, it was because John sneezed"

Larson (2004) argues that this semantics for sentence final *because*-clauses fits neatly with a right-descending syntax under a minor variant of Diesing's quantificational

6. We assume here and below that existential event quantifiers, and existential quantifers generally, can have full proportional quantifier structure, including a restriction and a scope. See Herburger (2000) for development of this idea.

Mapping Hypothesis (Diesing 1992). According to the latter, the lowest predicate in VP maps to the scope and higher material maps to the restriction (60):

(60)

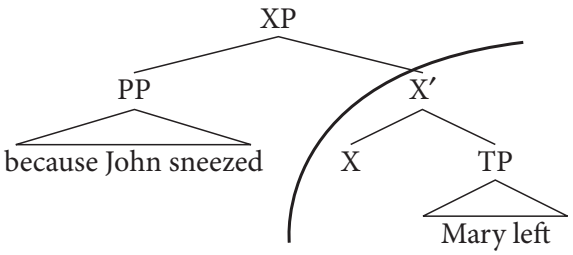


Q	Restriction	Scope
∃	λe′[leaving(m,e′)]	λe′[∃e[sneezing (j,e) & **CAUSE(e, e′)**]]

Whereas in right-ascending analyses like (56a) or (59b), *because*-clauses are outermost adjuncts, tracking their semantic analysis as propositional operators, in the right-descending analysis, *because*-clauses are innermost complements, tracking their semantic analysis as Q-scopes under the Mapping Hypothesis.[7]

This picture can be extended to sentence initial *because*-clauses under the proposal of Reinhart (1983) that these occupy a higher projection (XP) (61):

(61)



Q	Restriction	Scope
∃	λe′[∃e[**CAUSE(e, e′)**] & sneezing(j,e)]]	λe[leaving(m,e)]

Again the lowest event predicate maps to the scope, and the higher residue yields the restriction.

7. Larson (2004) suggests that the low attachment of because-clauses reflects their status with respect to event individuation. For Davidson (1967), causal relations individuate events: events with the same causes and effects are the same event. Suppose then that the θ-hierarchy responsible for complement projection reflects individuation. Lowest, innermost status for *because*-clauses would then make sense: in determining event identity, causal relations outrank space-time location, manner, participants, etc. and hence come closest to V.

3.2 *Because*-clauses and Q adverbs

The event quantificational analysis can capture all the core data of the sentential/propositional account. For example, Johnston (1994) notes the ambiguity of (62a), which he describes as expressing a **quantifier head reading** versus a **quantifier adjunct reading**. On the quantifier head reading, the *because*-clause tells us why a certain general quantificational state holds (62b). On the quantifier adjunct reading, the *because*-clause tells us why individual states determined by the quantifier obtain (62c):

(62) a. Leopold always sold shares because he needed money.
b. **Quantifier head reading**: "On all relevant occasions, Leopold sold shares, and the reason for this pattern was that he needed money"
c. **Quantifier adjunct reading**: "On all occasions that Leopold sold shares, he reason for doing so was that he needed money"

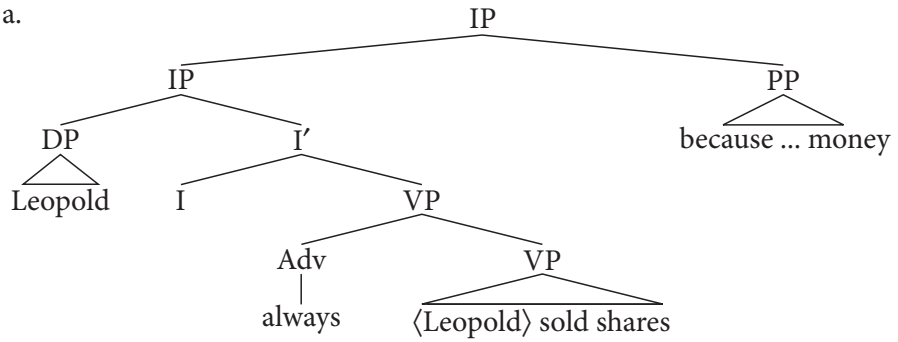
As Johnston notes, some sentences naturally favor one reading over the other. Thus (63a) naturally favors the quantifier head reading: the *because*-clause tells us why Frankie always misses the bus. (63b) naturally favors the quantifier adjunct reading: the *because*-clause tells us the reason for each of Leopold's bank robberies.

(63) a. Frankie always misses the bus because he is a slow runner.
b. Leopold always robs a bank because he needs money fast.

Johnston himself analyzes this ambiguity as a matter of the relative scope of the quantificational adverb and the *because*-clause. On the quantifier head reading, the *because*-clause has high attachment (to IP) and takes scope above the Q-adverb (64):

(64) **Quantifier Head Reading**

a.



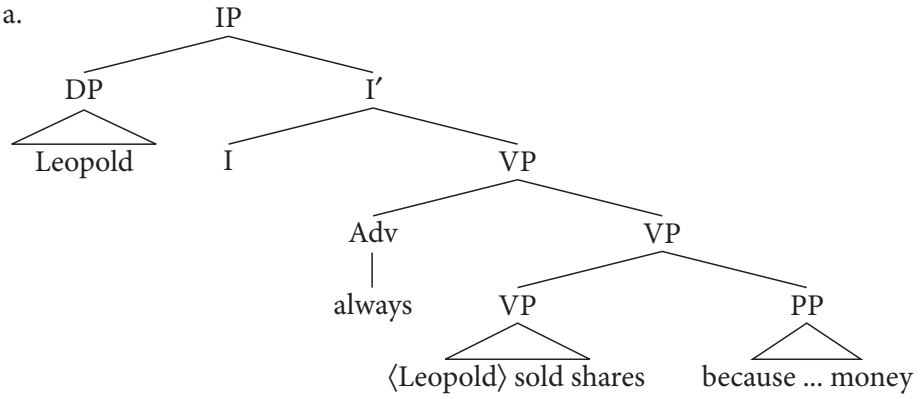
b. **because′(always** { **C** } [**sell′**(*Leo, shares,* $\mathbf{e_1}$)], **need′**(*Leo, money,* $\mathbf{e_2}$))

Q **Restr** **Scope**

On the quantifier adjunct reading, the *because*-clause has low attachment (to VP) and takes scope beneath the Q-adverb (65a):

(65) **Quantifier Adjunct Reading**

a.



b. **always′** { } [**because′**(**sell′**(*Leo, shares,* $\mathbf{e}_1$)) **need′**(*Leo, money,* $\mathbf{e}_2$)]

Q **Restr** **Scope**

c. **always′** { **sell′**(*Leo, shares,* $\mathbf{e}_1$}

[**because**(**sell′**(*Leo, shares,* $\mathbf{e}_1$)) **need′**(Leo, money, $\mathbf{e}_2$)]

The low attachment yields an initial semantic representation like (65b), with an empty restriction ("{ }"). Eventuality variable binding repairs this representation yielding (65c), which avoids a vacuous quantification violation: **always'** binds $\mathbf{e}_1$ in both the restriction and the scope.

3.3 Quantifications as states

Johnston's ambiguity can be captured in the event relation analysis of *because* by reanalyzing quantifications as states that can themselves enter causal relations. Thus under our previous view, quantificational relations like ALL were binary, involving two set arguments (66a). On the revision recommended here, we augment this relation to include an additional state argument e* (66b), which can then enter into causal relations.[8]

(66) a. ALL ({x: A(x)}, {y: B(y)}) **Old View**
{x: A(x)} – Restriction argument
{x: B(x)} – Scope argument

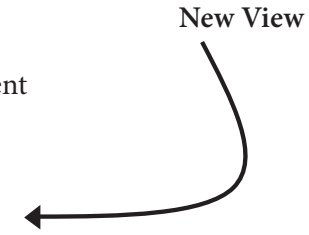
8. See Barwise and Perry (1985) for the closely related idea of quantificational situations within the framework of Situation Semantics.

b. Q ({x: A(x)} , {y: B(y)} , **e***)

{x: A(x)} – Restriction argument

{x: B(x)} – Scope argument

e* – State argument



To see how this helps us with Johnston's ambiguity, consider first the quantifier head reading of (62a) *Leopold always sold shares because he needed money*, according to which a certain quantificational pattern (*Leopold always sold shares*) is caused by a certain state (*Leopold needed money*). We can capture this reading as in (67), where the quantificational state e* is caused by e, the state of Leo needing money.

(67) **Quantifier Head Reading**
∃e*[**Always**(C, λe′[Leo sell shares(e′)], e*) &
∃e[Leo need money(e) & **CAUSE**(e,e*)]]

For the quantifier adjunct reading, on which the *because*-clause tells us why individual states determined by the quantifier obtain, we suggest the representation in (68). Here it is individual states of selling shares e′ that are caused by states of Leo needing shares e.

(68) **Quantifier Adjunct Reading**
a. **Always**(C, λe′[Leo sell shares(e′) & ∃e[Leo need money(e) & **CAUSE**(e,e′)]], e*) → eventuality variable binding →
b. **Always**(λe′[Leo sell shares(e′), λe′[Leo sell shares(e′) & ∃e′[Leo need money(e) & **CAUSE**(e,e′)]], e*)

(65) is analogous to the head restriction reading of a temporal adverbial clauses, where the main clause ultimately supplies restriction on **always'** through eventuality variable binding. As Johnston notes (62a) has no reading equivalent to adjunct restriction reading, where the *because*-clause actually supplies the restriction (69):

(69) **Adjunct Restriction Reading**
Always(λe[∃e′[Leo need money(e) & **CAUSE**(e′,e)]],
λe[Leo sell shares(e)], e*)
"Every eventuality caused by the state of Leopold needing money is an eventuality of Leopold selling shares."

We conjecture that this reading is unavailable for the same reason, discussed by Johnston (1994) (see Footnote 1, this paper) that head restriction readings are unavailable with non-telic main clauses: the **CAUSE** relation obtains between eventualities of all types, hence the event predicate λe′[∃e[Leo need money(e) & **CAUSE**(e,e′)]] (the set of eventualities caused by an eventuality of Leo's needing money) is simply

indeterminate with respect to countability – it's not a sortal predicate. Since it is non-sortal, a quantifier cannot count over it. But this is exactly what is required of a restriction predicate. Hence (69) is not licit, and the reading is not available.

4. Root transformations and semantic structure

Under our quantificational analysis of *because*-clauses, informational status of *when*/*before*/*after*-clauses and *because*-clauses tracks their semantic function; and this informational status also tracks RT availability:

– Adverbial clause denotes presupposed material
  Adverbial clause functions as quantificational restriction
  RTs disallowed.
– Adverbial clause denotes asserted material
  Adverbial clause functions as quantificational scope
  RTs permitted.

The correlation between informational status and semantic function suggests an approach to RT availability different than the one adopted by Hooper and Thompson (1973). Rather than taking RT availability to follow from informational status, with semantic function a correlate, we might try to deduce RT availability from semantic function, with informational status a simple consequence of the latter. To assess the prospects of such an approach, we first look briefly at current accounts of RT availability.

4.1 Syntactic accounts

Current analyses typically try to derive RT distribution from syntactic considerations, involving either "clause size" or intervention effects.[9]

4.1.1 *Clause "Size"*

Haegeman (2003) suggests that RTs are possible only in constructions with a fully expanded left periphery as proposed by (Rizzi 1997). A clause with a fully expanded left periphery contains the set of syntactic positions exhibited in (70a), including Sub, Top*, Focus, etc. These clauses allow RTs because the positions in question are

9. Emonds own approach to RT syntax (1970, 1976) appeals to the so-called "Structure-preserving Constraint". This analysis is further developed in Emonds (1985, 2004). Due to space limitations, we will not attempt to discuss this line of thinking here.

precisely the ones targeted by root transformational operations like preposing. Clauses may be "truncated" in their left peripheries, however, possessing a reduced set of positions (70b). Such truncated clauses do not allow RTs because the relevant positions are simply unavailable:

(70) a. (Sub) Top* Focus Force Fin IP
(Full Left Periphery Allows RTs)

b. Sub Fin IP
(Truncated Left Periphery Forbids RTs)

On Haegeman's view, adverbial clauses allowing RTs have fully projected left peripheries, whereas adverbial clauses blocking RTs have truncated left peripheries.

Sawada and Larson (2004) also suggest a "clause size" analysis, although one less worked out than Haegeman (2003).[10] In brief, they suggest that an additional existential quantifier in the semantics of *because* vs. *when*/*before*/*after* corresponds to a head (X) whose specifier position is available to host RTs (71a–c):

(71) a. *when/before/after* $[_{YP}$ ...]
b. *because* $[_{XP}$ $[_{X'}$ ∃e $[_{YP}$ ...]]]
c. *because* $[_{XP}$ her son $[_{X'}$ ∃e $[_{YP}$ he owns stock in Xerox]]]

Clause size analyses now appear problematic to us, for the simple reason that adverbial clauses don't behave invariantly with respect RT availability. As we've seen, *because*-clauses allow RTs in final position (46), whereas in preposed position they do not (49).[11] On a clause size account, this would seem to require *because* to project its complement clause differently (full/truncated) according to its position. It's unclear how this dependency of internal structure on external position could be encoded syntactically.

4.1.2 *Syntactic intervention*

An alternative approach to RT availability appeals to syntactic intervention. Haegeman (2010, this volume) hypothesizes that temporal and conditional clauses involve fronted

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10. Sawada (2000) shows that the notion of clause size, including size of adverbial clauses, plays a very important role in traditional Japanese grammar, where it is used to explain the distributions of various grammatical phenomena, much as it does in modern "cartographic" approaches.

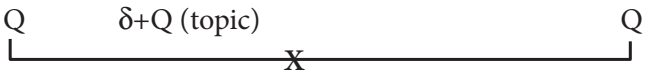
11. Hooper and Thompson (1973, p.495, Footnote 16) observe a similar effect with certain when-clauses. They note that examples like (i) seem well-formed:

(i) We were just about to unveil the statue
[**when in swept Mrs. Von der Vogelweide**].

The latter seems to us a reasonable candidate for an asserted *when*-clause.

wh-operators, which she analyzes as bearing a Q feature. She further proposes that preposed RT items like topics also bear the Q feature (in the complex δ+Q). RTs inside a temporal or conditional clause will then blocks the featural relation between OP bearing Q (*when*) and its trace (72):

(72) *when this problem you are able to solve when



Haegeman's appeal to an operator in temporal clauses is based on the groundbreaking work of Geis (1970a,b), who observed that *when*/*before*/*after*-adverbials show long distance readings indicative of movement. Thus examples like (73) are ambiguous, as Geis notes, according to whether adverbial *when* is associated with its immediate complement clause (*she said*) or with the more deeply embedded CP (*she was there*):

(73) I saw Mary in NYC [**when** she said [she was in Paris]]

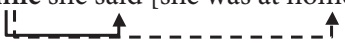
"I saw Mary in NYC at a time t such that she said at t that she was in Paris"
"I saw Mary in NYC at a time t such that she said that she was at t in Paris"

Geis analyzes this ambiguity as reflecting different clauses of origin for the moved item when (74):

(74) a. I saw Mary in NYC [**when** she said [she was in Paris] when]
b. I saw Mary in NYC [**when** she said [she was in Paris when]]

Geis also observes that not all temporal clauses show long distance readings; for example, *while*-clauses do not (see also Larson 1990). Thus (75) has only the pragmatically odd reading according to which I saw Mary during the time that she was speaking certain words. It does not have the more natural reading where I saw her during the time she was at home. (75) contrasts in this respect with a true relative clause structure like (76), which in fact does exhibit both of the readings in question:

(75) I saw Mary in NYC **while** she said [she was at home sleeping].



"I saw Mary in NYC during the time t such that she said at t that she was at home sleeping."
#"I saw Mary in NYC during the time t such that she said that she was at home sleeping at t."

(76) I saw Mary in NYC **during the time** she said she was at home sleeping.

This contrast between temporal connectives is unsurprising. Adverbial *when*-is transparently related to interrogative and relative clause *when* and in fact derives from the

former historically. *Before-* and *after*-clauses descend from Indo-European comparatives (equivalent to *earlier than/later than*), which also involve operator movement. By contrast, *while* (like *since*) has no such operator-linked history.

Nonetheless, *while* clauses block RTs in English, just like *when*/*before*/*after* clauses do.

(77) a. *Helen and Jack had dinner
[**while into the kitchen trooped the children**].
(cf. *Helen and Jack had dinner [before into the kitchen trooped the children])

b. *The villagers all burst into song
[**while in came the bride and groom**].
(cf. *The villagers all burst into song [after in came the bride and groom].)

c. *We were all much happier
[**while upstairs lived the Browns**].
(cf. We were all much happier [when upstairs lived the Browns].)

d. *The guests laughed out loud
[**while Mary was singing, strangely**].
(cf. *The guests laughed out loud [after Mary stopped, strangely].)

e. *The customer stomped out
[**while the clerk, I guess, insulted her**].
(cf. *The customer stomped out [after the clerk, I guess, insulted her].)

This fact raises a clear puzzle for Haegeman's syntactic intervention account. If the presence of operator movement in temporal clauses is diagnosed by the presence of temporal ambiguities, then, *cetris paribus*, we would expect the absence of temporal ambiguities to indicate an absence of operator movement, and hence to predict the possibility of RTs. Nonetheless, RTs continue to be blocked even where temporal ambiguities are not found.

As a final problem for the syntactic intervention account of RT availability, we may note again the nonuniform behavior of *because*-clauses. An intervention account would seem to require operator structure in initial *because*-clauses, blocking RTs, but exclude operator structure in final *because*-clauses, allowing RTs. Again it is simply unclear how this coordination of internal structure and external position could be secured.

4.2 Semantic closure

In place of the syntactic intervention account, we want to tentatively suggest an alternative based on a notion of what we will call **semantic closure**. Analyses of

quantification within Discourse Representation Theory (Kamp 1981; Heim 1982) routinely posit an important asymmetry between the restriction and the scope, Both contain a variable bound by the quantifier, but the scope in addition undergoes **existential closure**, which captures all remaining variables within it. Thus in (78), the restriction remains as is, but the scope undergoes existential closure, which binds all variables within it apart from the main quantificational variable x:

(78) a. Every man owns a donkey.

	Q	**Rest**	**Scope**	
b.	∀x	[man(x)]	[donkey(y) & own(x,y)]	
c.	∀x	[man(x)]	∃**y**[donkey(**y**) & own(x,**y**)]	"Existential closure"

This view is faithful to our intuitive picture of quantification in which we are given a domain of entities by the restriction, and evaluate the sentence as true if Q-many of these entities can be truthfully asserted of the scope. Assertions must be truth-evaluable, hence all variables in it must be bound; asserted formulae must be closed (cf. Krifka 1992). Restrictions are a different matter; they must provide us with a predicate to identify the members of the domain quantified over.

Given these points we might reason as follows. Hooper and Thompson's basic (1973) observation is that RTs track asserted environments. The key feature of assertions is that they are semantically closed. Suppose then that the presence of "high, left elements," whether produced by movement (Topicalization) or by base generation (Left Dislocation), is interpreted as assertion, i.e. suppose that a projection containing an RTs triggers closure in the head that it combines with.

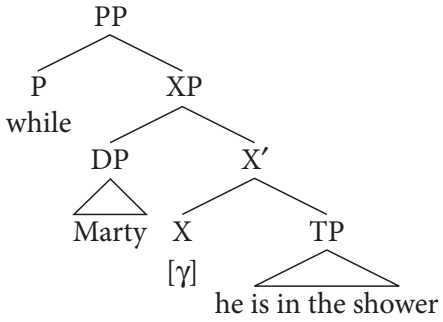
Then RTs will be possible only where closure is possible. RTs will be possible in scopes but not restrictions.

To see how this proposal works technically, consider first the case of *while*-clauses. Adapting Johnston's (1994) treatment of *when*, we might take the normal contribution of *while* and its normal process of combination to go as in (79), where f is some function like Johnston's "run-time" which derives an interval of time points from n event (in this case, a state):

(79) a. *Marty is in the shower* ⇒ **in'**(Marty, the shower, e)
b. *while* ⇒ λφλi[∃e[MAX(φ)(e) & i = f(e)]
c. *while Marty is in the shower* ⇒
λi [∃e[MAX(**in'**(Marty, shower, e)) & i = f(e)]

Suppose now that *while* combines with a structure XP containing a root transformation, for example, a left dislocation. We assume X the head of XP, to bear a feature [γ] triggering existential closure when XP combines with *while* (80):

(80) ***While*-Clause (in the Restriction)**



[γ] = "close projection"

The semantic result will be a closed expression, as shown in (81). The presence of a root transformation triggers closure on all variables in PP, including the main event variable e (81c). This means that *Marty, he is in the shower* does not denote an open event sentence of the kind required for a restriction.

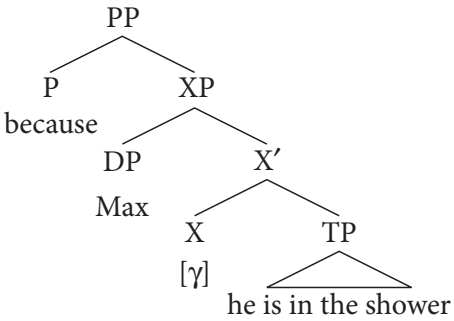
(81) a. *Marty, he is in the shower* ⇒ λe[**in′**(Marty, the shower, e)]
b. *while* ⇒ λφλi[∃e[MAX(φ)(e) & i = f(e)]
c. *while Marty, he is in the shower* ⇒ **closure** ⇒
∃**i** [∃e[MAX(**in′**(Marty, shower, e)) & **i** = f(e)]

A similar story can be told for *because*. The normal contribution of *because* and its normal process of combination might be taken to go as in (82). *Because* takes an event predicate and yields an event predicate in return; the latter is satisfied by all events caused by the event denoted by the complement of *because*, in this case, all events caused by an event of Marty being in the shower (82b):

(82) a. *because* ⇒ λφλe[∃e′[**CAUSE**(e′,e) & (φ)(e)]
b. *because Marty is in the shower* ⇒
λe[∃e′[**CAUSE**(e′,e) & (**in'**(Marty, shower, e′))]

Suppose now that *because* attempts to combine with a left dislocation structure (83). X the head of XP, once again triggers existential closure in PP (84):

(83) ***Because*-Clause (in the Restriction)**



(84) a. *because* ⇒ λφλe[∃e′[**CAUSE**(e′,e) & (φ)(e′)]
b. *Marty, he is in the shower* ⇒ λe[**in'**(Marty, the shower, e)]
c. *because Marty, he is in the shower* ⇒ **closure** ⇒
∃**e** [∃e′[**CAUSE**(e′,**e**) & (**in'**(Marty, shower, e′))]

Again closure captures all variables, making the *because*-PP a closed sentence and hence unsuitable as a quantificational restriction.

Now let us consider what happens in the scope. Recall that in the scope of quantification existential closure applies to every variable except the main variable given by the restriction. In the scope, existential closure always ignores the main quantificational variable (cf. 78c). Now when a *because*-clause appears in the scope under the analysis of *because* in Larson (2004) and discussed above, the variable given by the restriction is the event variable e. This means that when we do existential closure in the scope we capture every variable apart except e. The result is shown in (85):

(85) ***Because*-Clause (in the Scope)**
because Marty, he is in the shower ⇒ **closure** ⇒
∃ [∃e′[**CAUSE**(e′, e) & (**in'**(Marty, shower, e′))]
↑
unbound main variable!

The result is (essentially) vacuous closure. The main event variable e remains unbound and uncaptured. Hence *because Marty, he is in the shower* still denotes an event predicate and can still serve as the scope of quantification.

This account may appear to be a kind of trick insofar as when the adverbial clause appears in the restriction we close all of its variables whereas when the adverbial clause appears in the scope we close off all but the main quantificational variable. But in our view this simply reflects the fundamental "procedural" asymmetry between restrictions and scopes, namely that in quantifications, we first determine a domain of quantification and then evaluate elements of that domain against a scope. This implies that, at the point where we are testing elements against the scope, we know what variable we are dealing with. When we are dealing with the restriction we are not in the same position: we haven't, as it were, already selected a variable that we know is exempt from closure. These remarks do not settle the technical question of how e is formally identified as the main variable in (85) and made exempt from closure. But, as we have indicated, this seems to be part of a wider question about quantification generally and hence we leave it for further investigation.

5. Conclusion

In this paper, following earlier work in Sawada and Larson (2004), we have pursued the observation by Hooper and Thompson (1973) that root transformations appear to

occur in asserted but not presupposed environments. We have argued for the view that *when*/*before*/*after*-clauses and *because*-clauses can be analyzed semantically as parts of quantificational structures, and that RT availability tracks occurrence in the scope term. This result suggests the possibility of a semantic account of RT availability. We briefly reviewed alternative syntactic approaches, noting difficulties for them. In their place, we tentatively suggested a "semantic closure" account in which RTs trigger existential closure in an adverbial, binding all available variables in a restriction, and all but the main variable in the scope.

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