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Tense and Adverbial Quantification^{*}

1 Novel Data

Consider (1a) and (1b) below: In (1a), a Q(uantificational)-adverb is combined with an indefinite DP, while (1b) contains a quantificational determiner, the quantificational force of which corresponds to that of the Q-adverb in (1a). It is often assumed (cf. Lewis 1975, Kamp 1981, Heim 1982, Diesing 1990, von Stechow 1994, Chierchia 1995a, Kratzer 1995, Herburger 2000 and many others) that such sentences essentially receive the same interpretation. This is generally referred to as the *quantificational variability effect* (QVE) (Berman 1991).

- (1) (a) A police car is usually blue.
(b) Most police cars are blue.

But whereas (1a) indeed seems to have the same meaning as (1b) at an intuitive level, there are cases where the correspondence exemplified by this pair of sentences breaks down. Consider the contrast between (2a) and (2b) below:

- (2) (a) ^{??}A car that was bought in the eighties is usually blue.
(b) Most cars that were bought in the eighties are blue.

While (2b) is perfectly acceptable, most speakers perceive (2a) to be very strange. It seems that the indefinite DP can only be understood as having scope

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over the Q-adverb. But such an interpretation is very strange, as the property of being of a particular color is stable for a given car under normal circumstances, i.e. the predicate *to be blue* is usually interpreted as an individual level predicate with respect to cars.¹ This raises the question as to why a reading, in which the Q-adverb has scope over the indefinite DP, is blocked in the case of (2a), while it is easily available in the case of (1a).

Interestingly, (3a) is perceived as much better than (2a), while (3b) is deemed to be just as good as (2b), though different in interpretation.²

- (3) (a) A car that was bought in the eighties was usually blue.
 (b) Most cars that were bought in the eighties were blue.

The improved status of (3a) seems to be due to the fact that in contrast to (2a), the indefinite DP in (3a) can be interpreted as falling within the scope of the Q-adverb. The same holds for (4), where both the relative clause verb and the matrix verb are marked for present tense.

- (4) A car that pleases Peter is usually blue.

Our data raise the question of why adverbially quantified sentences that contain indefinite DPs modified by relative clauses, in the absence of intervening factors (cf. sections 4.3, 4.4 and section 5), only show QVEs if the tense of the relative clause verb agrees with the tense of the matrix verb?

2 Existing Analyses

In this section we will discuss three different accounts of QVEs and show that none of them is able to account for the contrast in acceptability between (2a) and (2b). Due to limitations of space, we will have to gloss over many details.

2.1 Q-adverbs as unselective binders

The theories of Heim (1982) (based on Lewis 1975), Diesing (1990), and Kratzer (1995) share the following assumptions:

- Indefinites provide a restricted variable that must be bound by an adverbial quantifier.

¹ Of course, cars can change their color when they are repainted, which means that strictly speaking, *blue* is not a real individual level predicate in this context. Yet, we will ignore this complication throughout this paper.

² We will discuss the interpretative difference in section 4.2.

- Adverbial quantifiers are unselective binders that bind every free variable in their scope, i.e. individual as well as situation/event variables.
- If a sentence does not contain an overt Q-adverb, the restricted variable introduced by an indefinite is bound by a covertly inserted quantifier with either existential or generic force.

Furthermore, according to Kratzer (1995), stage level predicates (which ascribe transitory properties to their individual arguments) come with a spatio-temporal argument, whereas individual level predicates (which ascribe stable properties that typically last a whole lifetime to their individual arguments) do not.

Despite its strangeness, (2a) (repeated below as (5a)) acquires a perfectly coherent interpretation according to these approaches, as there is a free variable (provided by *a car*) which could be bound by the adverbial quantifier.

- (5) (a) ??A car that was bought in the eighties is usually blue.
 (b) $\text{MOST}_x [\text{car}(x) \wedge \text{bought in the 80s}(x)] [\text{blue}(x)]$.

This is exactly the same interpretation that is assigned to (2b) (repeated below as (6a)):

- (6) (a) Most cars that were bought in the eighties are blue.
 (b) $\text{MOST}_x [\text{car}(x) \wedge \text{bought in the 80s}(x)] [\text{blue}(x)]$.

This means that the clear contrast in acceptability between the two sentences cannot adequately be accounted for by these theories.

2.2 Q-adverbs as topic-sensitive binders

Chierchia (1995a) differs from the above view in two respects: Firstly, indefinites are interpreted as regular existentially quantified DPs. When they are topical (which is signalled by de-accentuation), they are turned into predicative expressions via an operation called *existential disclosure* (Dekker 1993) and can later be bound by a c-commanding adverbial quantifier. And secondly, individual level predicates also come with a spatio-temporal argument, but in contrast to the argument introduced by stage level predicates, this needs to be bound by the generic quantifier. So, if the indefinite is de-accented, (2a) (repeated below as (7a)) is interpreted as in (7b) below.

- (7) (a) ??A car that was bought in the eighties is usually blue.
 (b) $\text{MOST}_x [\text{car}(x) \wedge \text{bought in the 80s}(x)] [\text{GEN}_s [\text{in}(x, s)] [\text{blue}(x, s)]]$

But (7b) is of course equivalent to (5b). So again, no reason is offered why (2a) should be unacceptable.

2.3 Situation and event semantic approaches

The theories of Berman (1987), de Swart (1993), von Fintel (1994) and Herburger (2000) share the following assumptions:

- Q-adverbs only quantify over (sets of) situations/eventualities.³
- Restrictor and nucleus are determined on the basis of information structure: The denotation of the whole clause minus the Q-adverb is mapped onto the nuclear scope, while the denotation of the non-focal/topical constituents is mapped onto the restriction.
- Indefinites are interpreted as existentially quantified DPs.
- There is no difference between stage level and individual level predicates with respect to the introduction of situation/eventuality variables.

QVEs then come about in the following way: If an indefinite is de-accented, its denotation is mapped onto the restriction of a Q-adverb. Furthermore, the value assigned to the individual variable bound by the existential quantifier may vary with the value assigned to the situation/event variable bound by the Q-adverb. The combination of these factors enables sentences like (1a) (repeated below as (8a)) to be interpreted as in (8b) or – equivalently – (8c).^{4 5}

- (8) (a) A police car is usually blue.
 (b) $\text{MOST}_e [\exists x. \text{police car } (x) \wedge \text{Arg } (e, x)] [\exists x. \text{police car } (x) \wedge \text{Arg } (e, x) \wedge \text{blue}(e)]$
 (c) $\text{MOST}_e [\exists x. \text{police car } (x) \wedge \text{Arg } (e, x)] [\text{blue}(e)]$

The problem with these theories, however, is that they also predict sentences like (2a) (repeated below as (9a)) to have well formed semantic representations like the one given in (9b) below:

³ The term *eventuality* is meant to encompass dynamic as well as static “events”.

⁴ In the following, we will only give simplified representations like (8c), where material that already occurs in the restrictor is not repeated in the nucleus. This is justified on the assumption that theta-roles are assigned exhaustively (cf. Herburger 2000), i. e. that each eventuality contains only one agent, theme, etc. This last assumption furthermore avoids the *requantification problem* (von Fintel 1994, Rooth 1995), which arises in a situation/event semantics approach as a result of the fact that topical indefinites are interpreted twice: Once in the restrictor and once in the nucleus (cf. Krifka 2001, who offers a different solution).

⁵ In the following semantic representations, we will use the term *Argument* for the external arguments of stative predicates such as *blue*, *intelligent* etc., because neither of the existing theta roles seems to be applicable in these cases. Nevertheless, we assume that these roles are also assigned exhaustively (s. footnote 4).

- (9) (a) ??A car that was bought in the 80s is usually blue.
 (b) MOST_e [$\exists x. \text{Arg}(e, x) \wedge \text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{theme}(e', x) \wedge \text{in } 80\text{s}(e')]$]
 [blue(e)]

This means that without further assumptions, the existing situation/event semantics accounts of QVEs cannot explain the observed contrasts either.

3 Conceivable solution strategies

As has been shown in the preceding chapter, none of the existing theories can explain the difference between (2a) and (2b). Before we will present our own account, we wish to mention briefly some conceivable solution strategies that could come to mind, and argue why they cannot be maintained.

3.1 Natural classes?

One could speculate that, for some reason, QVEs only arise with indefinites that pick out individuals from a well defined class (cf. the work on generics and natural classes in Krifka et al. 1995 and the work of Cohen 2001, Greenberg 2002 and Greenberg 2003⁶ on the different behaviour of singular indefinites and bare plurals in generic sentences, i.e. sentences that do not contain an overt Q-adverb). But the fact that sentence (10) is perfectly acceptable shows that this cannot be the correct generalization for the cases discussed here.

- (10) A French linguist with green hair and six toes is usually intelligent.

It will be hard to argue that the class of *French linguists with green hair and six toes* is a natural one or even that this should be a more natural class than the one of cars that were bought in the eighties.

3.2 Specificity?

Alternatively, it could be argued that for some unknown, yet compelling reason, temporally fixed indefinites have to be interpreted specifically. But this assumption is not borne out either, as the generalization does not hold for non-QV environments:

- (11) It is possible that a car that was bought in the eighties had an accident today.
 (12) Every customer recognized a car that was on exhibition in this shop window yesterday.

⁶ We would like to thank Angelika Kratzer for drawing our attention to the work of Yael Greenberg.

In (11), the speaker does not need to have a particular car in mind, and in (12) the cars may vary with the customers.

4 A pragmatic account

We follow von Stechow (1994) and Herburger (2000) in the assumption that D(eterminer)-quantifiers take sets of individuals as arguments, while A(dverbial)-quantifiers take sets of eventualities. The arguments of D-quantifiers are determined grammatically, while the restriction of A-quantifiers must be determined solely on the basis of information structure (or contextual information).

We also assume that every quantification entails covert domain restriction (cf. von Stechow 1994, Stanley 2000 and Marti 2003). For D-quantifiers this means that the restrictor set has to be intersected with the set characterized by a covert predicate that is determined by the context. In a context like the one given in (13a), a sentence such as (13b) would not be about all the apples in the world, but about all the apples that have been introduced in the previous sentence, i.e. all the apples that Peter bought the day before:

- (13) (a) Yesterday, Peter bought apples.
 (b) Every apple tasted awful.

Analogously, domain restriction for events entails, among other things, locating the respective events in time (cf. Partee 1973, Lenci and Bertinetto 1999). In a context such as (14a), the event of drinking beer in (14b) is automatically interpreted as having taken place at some interval that lies within the running time of the eventuality referred to in (14a), i.e. the beer drinking is understood to have occurred at Mary's party (cf. Partee 1973):

- (14) (a) Yesterday, Peter had a good time at Mary's party.
 (b) He drank a lot of beer.

We thus claim that the unacceptability of (2a) can be explained by the fact that there is a conflict between the tense information given by the relative clause verb and the tense information given by the matrix verb.

4.1 Technical preliminaries

We will first explain our technical apparatus in a discussion of example (2b) (repeated below as (15a)). We will show that our approach actually predicts that this is a felicitous sentence for which there exists a sensible interpretation.

Due to the presence of the D-quantifier *most*, the sentence is interpreted as quantifying over individuals x . Every quantifier is connected to a domain restriction, including the quantifier *most* in our example, which introduces the conjunct $C(x)$.⁷ Note that every verbal predicate introduces an eventuality variable which in the absence of an overt Q-adverb is bound by a covert existential quantifier (or by a covert generic quantifier if the respective sentence requires a generic interpretation). Of course, each covert quantifier is connected to a domain restriction.

- (15) (a) Most cars that were bought in the 80s are blue.
 (b) $\text{MOST}_x [\text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \text{past}(e') \wedge \text{in } 80\text{s}(e') \wedge C'(e')] \wedge C''(x)]$
 $[\exists e. \text{Arg}(e, x) \wedge \text{pres}(e) \wedge \text{blue}(e) \wedge C(e)]$

In case of quantification over individuals, the restriction, among other things, serves to locate an eventuality e within an interval i_e . This means that $C(e)$ takes on the form $e @ i_e$.

- (16) (a) Most cars that were bought in the eighties are blue.
 (b) $\text{MOST}_x [\text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \text{past}(e') \wedge \text{in } 80\text{s}(e') \wedge e' @ i_e] \wedge C''(x)]$
 $[\exists e. \text{Arg}(e, x) \wedge \text{pres}(e) \wedge \text{blue}(e) \wedge e @ i_e]$

Temporal location of an event within an interval is defined as follows:

- (17) $e @ i_e := \tau(e) \subseteq i_e$,
 where $\tau(e)$ denotes the running time of e .

In words, $e @ i_e$ means that e , in the case of verbs denoting dynamic eventualities (i. e. achievements, accomplishments and activities, cf. Vendler (1957)), takes place at some time during the interval i_e or, in the case of a stative verb/a property, exhausts i_e .⁸

⁷ C is to be understood as a variable ranging over contextually inferred predicates. Note that in contrast to von Stechow (1994) and Marti (2003), we assume that this domain restriction is added at the latest possible position, because it is determined by overt information that has been introduced previously.

⁸ Following Bach (1986) (among many others, s. Rothstein 2003 and references therein for recent discussion), we assume that statives (as well as activities) are homogenous with respect to their internal structure. In the case of stative verbs such as *to be French*, the state of *being French* for a given individual denotes an infinite set of *being French* eventualities, the largest of which is the maximal eventuality in which the property of being French holds for the individual under consideration. Under this view, it follows directly that $e @ i_e$ picks out only those subeventualities of the state under discussion that lie in the interval i_e . Analogous to activities, only the maximal eventuality (i.e. the one exhausting the whole interval) is taken into account

We assume the following (simplified) semantics for tense information relative to the speech time t_0 :

- (18) (a) $\text{pres}(e) := t_0 \subseteq \tau(e)$
 (b) $\text{past}(e) := \tau(e) < t_0$

4.2 The interval resolution strategy

The free interval variables i in (16b) need to be resolved, requiring the use of both overtly given and contextually inferable information.

More specifically, we assume that there is a pragmatic strategy that determines how available information is used in order to locate eventualities temporally. We call this the *interval resolution strategy*. It works according to the following principles:

- (19) 1. Take overt information.
 2. If not available: Take contextual information from the same domain (restrictor vs. nucleus), i. e. the running time of another salient eventuality.
 3. If not available: Take contextual information from the other domain, or take the default time interval i_{world} , which denotes the whole time axis.

The principle behind this strategy is as follows: If there is overt information concerning the time when an event e takes place, this information must be used in order to instantiate the interval i_e . This is the case in example (15a), where the event of Peter's having a good time at Mary's party must be located during the interval denoted by *yesterday*. In (14b) on the other hand, there is no overt material that denotes an interval in which the beer drinking event has to be located. In this example, contextual information must be taken into account, corresponding to point (2.) of the interval resolution strategy. According to the strategy, the event of Peter's drinking beer has to be located at some contextually given time interval. In the example, this is the running time of another contextually given salient event, i.e. the time during which Peter was at Mary's party. Local proximity is an important concept in this analysis; contextual information mentioned immediately before the event to be located is more appropriate as a restriction to the respective event than material that has been presented much earlier. This is reflected in the interval resolution strategy, according to which local information (point 2.) is required to be preferred over non-local information (point 3.).

when computing the truth conditions of the sentence.

4.2.1 Quantification over individuals

In the case of (16), repeated here as (20), there are two intervals which are to be resolved: i_e and $i_{e'}$.

- (20) (a) Most cars that were bought in the eighties are blue.
 (b) $\text{MOST}_x [\text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \text{past}(e') \wedge \text{in } 80\text{s}(e') \wedge e' @ i_e] \wedge C''(x)]$
 $[\exists e. \text{Arg}(e, x) \wedge \text{pres}(e) \wedge \text{blue}(e) \wedge e @ i_e]$

Overt information is provided in connection with the relative clause events e' , which must be located in the interval $i_{e'}$: the interval denoted by the PP *the eighties*. Therefore, $i_{e'}$ needs to be instantiated with this interval. For i_e , on the other hand, there is neither a constituent that denotes an interval nor any other indirect interval information given within the same domain (which is the nucleus). Point (3.) of the interval resolution strategy given in (19) therefore gains relevance. According to this principle, the first option to resolve i_e would be to instantiate it with the running time of the relative clause events (this counts as information from the other domain, i. e. from the restrictor).⁹ This would result in the following representation:

- (21) (a) Most cars that were bought in the eighties are blue.
 (b) $\text{MOST}_x [\text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \text{past}(e') \wedge \text{in } 80\text{s}(e') \wedge e' @ 80\text{s}] \wedge C''(x)]$
 $[\exists e. \text{Arg}(e, x) \wedge \text{pres}(e) \wedge \text{blue}(e) \wedge e @ \tau(e')]$

The events e would then be interpreted as being located within the same interval as the events e' – i.e. *the eighties*. But this would directly clash with the semantics of present tense:

- (22) (a) Most cars that were bought in the eighties are blue.
 (b) $\# \text{MOST}_x [\text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \tau(e') < t_0 \wedge \text{in } 80\text{s}(e') \wedge e' @ 80\text{s}] \wedge C''(x)]$
 $[\exists e. \text{Arg}(e, x) \wedge t_0 \subseteq \tau(e) \wedge \text{blue}(e) \wedge \tau(e) \subset \tau(e')]$

As the speech time t_0 is not contained within the eighties, the tense specification within the nucleus is contradictory:

⁹ We assume here and in all the formulas to follow that the variable e' mentioned in the tense specification $e @ \tau(e')$ is dynamically bound by the existential quantifier that binds the variable introduced by the relative clause verb (cf. Staudacher 1987, Groenedijk and Stokhof 1991 and Chierchia 1995b for details with respect to the principles of dynamic binding). Note that this causes the running times of the matrix eventualities to vary along with the running times of the relative clause eventualities.

$$t_0 \subseteq \tau(e) \subseteq \tau(e') \subseteq 80s, \text{ contradicting } 80s < t_0.$$

The other option specified in point (3.) of the interval resolution strategy must therefore be taken: i_e has to be instantiated with the whole time axis i_{world} . The resulting representation is given in (23):

- (23) (a) Most cars that were bought in the eighties are blue.
 (b) $\text{MOST}_x [\text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \tau(e') < t_0$
 $\wedge \text{in } 80s(e') \wedge e' @ 80s] \wedge C''(x)]$
 $[\exists e. \text{Arg}(e, x) \wedge t_0 \subseteq \tau(e) \wedge \text{blue}(e) \wedge e @ i_{world}]$

Let us now consider (3b) (repeated below as (24a)), the variant of (2b) in which the matrix predicate is in the past tense. In this case, there is no difficulty in taking the first option specified in point (3.) of the interval resolution strategy. The running times of the matrix eventualities e can be equated with the running times of the relative clause eventualities e' , as there is no tense clash as a result of the past tense marking of the matrix verb:

- (24) (a) Most cars that were bought in the eighties were blue.
 (b) $\text{MOST}_x [\text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \tau(e') < t_0$
 $\wedge \text{in } 80s(e') \wedge \underline{e' @ 80s}] \wedge C''(x)]$
 $[\exists e. \text{Arg}(e, x) \wedge \underline{\tau(e) < t_0} \wedge \text{blue}(e) \wedge \underline{e @ \tau(e')}]$

The meaning is thus: *Most cars bought in the eighties were blue when they were bought*. Note that we do not get to know whether the respective cars are still blue today. This is simply left open.

It is also possible to take the second option specified in point (3.) above, and instantiate the matrix interval with the whole time axis. This leads to a different reading of the sentence, which indeed seems to be available:

- (25) (a) Most cars that were bought in the eighties were blue.
 (b) $\text{MOST}_x [\text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \tau(e') < t_0$
 $\wedge \text{in } 80s(e') \wedge e' @ 80s] \wedge C''(x)]$
 $[\exists e. \text{Arg}(e, x) \wedge \text{past}(e) \wedge \text{blue}(e) \wedge e @ i_{world}]$

The past tense demands $\tau(e)$, i. e. the time of being blue, to end before the speech time t_0 :

- (26) (a) Most cars that were bought in the eighties were blue.
 (b) $\text{MOST}_x [\text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \tau(e') < t_0$
 $\wedge \text{in } 80s(e') \wedge e' @ 80s] \wedge C''(x)]$
 $[\exists e. \text{Arg}(e, x) \wedge \underline{\tau(e) < t_0} \wedge \text{blue}(e) \wedge \underline{e @ i_{world}}]$

This means that the eventuality of being *blue* has to have ended before the speech time. Under the assumption that *blue* is regarded as an individual level predicate with respect to cars, this triggers the hearer's expectation that the respective cars no longer exist.

We take this to be a consequence of our analysis of individual level predicates. On the one hand, only the maximal eventualities of cars being blue that lie within the respective interval (which in this case is i_{world}) may be picked out. On the other hand, the past tense marking of the matrix verb requires those eventualities to end before the speech time. Both requirements are only met if the cars quantified over no longer exist. There would otherwise be a greater eventuality of those cars being *blue* that lies within the interval i_{world} , i.e. one comprising the whole time of the cars' existence, which would then extend beyond the speech time.

This means that using the past tense, one does not provide as much information as possible with respect to the chosen interval (which is i_{world}) if the cars quantified over still exist. If, on the other hand, those cars no longer exist, a past tense marking provides the greatest eventuality of the respective cars being blue that lie within this interval. The hearer therefore automatically assumes that the cars quantified over no longer exist.¹⁰

This effect is reminiscent of the facts discussed by Kratzer (1995) and Musan (1997) as *life time effects*. Consider the sentence below:

(27) Gregory was from America.

If (27) is uttered out of the blue, it implicates that Gregory is dead at the speech time. If, on the other hand, the sentence is embedded in a context like the one given in (28a), no such implication arises. Phrased in our terms, this difference could be explained as follows (cf. Musan 1997 for a very similar solution): In (27), the eventuality of *being from America* is located within i_{world} . In (28b), on the other hand, it is most likely understood as coinciding with the running time of the event in (28a).

- (28) (a) Yesterday, I met Gregory and Paul.
 (b) Gregory was from America, (while Paul was from Australia).

¹⁰ As has been pointed out to us by Manfred Krifka, there is another way to resolve i_e in the case under discussion. If the sentence is embedded in a certain context such as the one given in (a) below, i_e could also be resolved to the time specified by this context.

- (i) (a) There was a second hand car market in this town in 1995.
 (b) Most cars that were bought in the eighties were blue.

In this case, i_e can be set to the time when the second hand car market mentioned took place. This is predicted by our approach because according to point (3.) of the interval resolution strategy, non-local contextual information can be taken into account.

To summarize the results of this section, we claim that (2b) is acceptable for the following reasons:

- D-quantification does not bind eventualities.
- The predicate *to be blue* in the nuclear scope introduces an existentially bound eventuality variable e .
- This eventuality can be located in an interval that is independent of the one given in the relative clause.
- There is no interval information in the nuclear scope.
- The interval i_e can be set to the default interval i_{world} .

4.2.2 Quantification over eventualities

In the case of (2a) (repeated below as (29)), matters are different:

(29) ??A car that was bought in the eighties is usually blue.

In adverbial quantification, it is not the syntax that determines restrictor and nucleus, but the information structure (or contextual information). Non-focal/topical material is mapped onto the restrictor, while the focal material is mapped onto the nuclear scope (cf. among others Chierchia 1995a, Krifka 1995, Partee 1995, Rooth 1995, Herburger 2000). More specifically, we assume the mapping algorithm of Herburger (2000), already discussed in section 2.3.

In the case of (2a), at least if it is uttered out of context, the most natural assumption is that the matrix predicate *blue* is focused. It is therefore mapped onto the nuclear scope. Furthermore – and this is crucial for our account – the eventuality variable introduced by *blue* is bound by the adverbial quantifier *usually* in the restrictor as well as in the nuclear scope. This has the consequence that in (2a) the eventuality variable introduced by the matrix verb ends up in the same domain as the eventuality variable introduced by the relative clause verb – i.e. in the restrictor of the adverbial quantifier *usually*.

This contrasts with the situation in (2b), in which the two variables are interpreted in different domains. The variable introduced by the verb of the relative clause is interpreted in the restrictor of the determiner quantifier *most*, while the variable introduced by the matrix verb ends up in the nuclear scope of the quantifier. This, together with the fact that the matrix eventuality variable also needs to be restricted by a time interval, leads to the interval resolution strategy working differently in the two cases. Now consider the semantic representation of (2a) (repeated below as (30)) in detail:

- (30) (a) ??A car that was bought in the eighties is usually blue.
 (b) $\text{MOST}_e [\exists x. \text{Arg}(e, x) \wedge \text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \text{past}(e') \wedge \text{in } 80\text{s}(e') \wedge C'(e')] \wedge C''(x) \wedge C(e)] [\text{pres}(e) \wedge \text{blue}(e)]$

As mentioned above, the domain restriction $C(e)$ for the adverbial quantifier *usually* must include the constraint $e @ i_e$, where i_e is to be resolved. As there is no overt information with respect to i_e in the matrix clause, the only available interval information originates from the information concerning the events e' in the relative clause. This is information originating from the same domain, i.e. from the restrictor, and according to the interval resolution strategy, i_e must be equated to the interval denoted by the running time of the events e' :¹¹

- (31) (a) ??A car that was bought in the eighties is usually blue.
 (b) $\text{MOST}_e [\exists x. \text{Arg}(e, x) \wedge \text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \text{past}(e') \wedge \text{in } 80\text{s}(e') \wedge e' @ 80\text{s}] \wedge C''(x) \wedge e @ \tau(e')] [\text{pres}(e) \wedge \text{blue}(e)]$

As the events e' take place in the eighties and the events e are located during the running times of the events e' , only events located in the eighties, i.e. before the speech time t_0 , will be considered in the restrictor, whereas the nucleus requires e to include the speech time:

- (32) (a) ??A car that was bought in the eighties is usually blue.
 (b) $\text{MOST}_e [\exists x. \text{Arg}(e, x) \wedge \text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \tau(e') < t_0 \wedge \text{in } 80\text{s}(e') \wedge \underline{e' @ 80\text{s}}] \wedge C''(x) \wedge \underline{e @ \tau(e)}] [\underline{t_0 \subseteq \tau(e)} \wedge \text{blue}(e)]$

This by necessity yields an empty intersection of restrictor and nucleus and thus accounts for the strangeness of (2a).

As this strangeness is not due to a grammatical, but rather a pragmatic principle, it is to be expected that the unacceptability is not absolute. For some speakers it might be possible to construct contexts in which the sentence is fine. Still, (2a) is much less natural than (2b), where it is not necessary for the hearer to construct a matching context in order to be able to interpret the sentence adequately.

Obviously, if the information in the matrix clause is non-contradictory in this respect, one expects the utterance to be felicitous, which is in fact borne out. This can be seen in (3a), repeated below as (33a):

¹¹ Compare this to our example (14b), in which, in the context given, the event of Peter's beer drinking must be interpreted as being located in the interval denoted by the running time of the immediately preceding sentence – due to the local proximity of the two sentences. Obviously, local proximity also plays a role in the example under discussion, as the running time of the relative clause is salient local information.

- (33) (a) A car that was bought in the eighties was usually blue.
 (b) $\text{MOST}_e [\exists x. \text{Arg}(e, x) \wedge \text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \tau(e') < t_0 \wedge \text{in } 80\text{s}(e') \wedge e' @ 80\text{s}] \wedge C''(x) \wedge e @ \tau(e')] [\tau(e) < t_0 \wedge \text{blue}(e)]$

In this case, instantiating i_e with the running time of the respective eventuality e' (which must be located in the eighties) does not lead to a contradiction, as the past tense information in the nucleus requires the events quantified over to be located at an interval that is prior to the speech time.

To summarize the results of this section, our approach predicts (2a) to be unacceptable for the following reasons:

- A-quantification binds the eventuality variable e in the restrictor and in the nuclear scope.
- Domain restriction forces e to be located in an interval i_e .
- Due to contextual information in the restrictor, i_e has to be resolved to the running time of e' .
- This clashes with the present tense information in the nuclear scope.
- The intersection of restrictor and nucleus is inevitably empty.

4.3 Explicit interval setting

Interestingly, (34a) is acceptable in spite of the fact that it is structurally almost identical to (2a). The matrix verb is marked for present tense, while the relative clause verb is marked for past tense. As can be seen by comparing (34a) to the minimally distinct example (34b), what makes the difference is the presence of the adverb *nowadays* in the matrix clause, not the nature of the matrix verb itself.

- (34) (a) A car that was bought in the eighties is usually rusty nowadays.
 (b) [?]A car that was bought in the eighties is usually rusty.

The initial representation of (34a) is the following:

- (35) (a) A car that was bought in the eighties is usually rusty nowadays.
 (b) $\text{MOST}_e [\exists x. \text{Arg}(e, x) \wedge \text{car}(x) \wedge [\exists e'. \text{buy}(e') \wedge \text{Theme}(e', x) \wedge \text{past}(e') \wedge \text{in } 80\text{s}(e') \wedge e' @ 80\text{s}] \wedge C''(x) \wedge \text{nowadays}(e) \wedge e @ i_e] [\text{pres}(e) \wedge \text{rusty}(e)]$

Let us assume for the sake of concreteness that *nowadays* introduces an interval of contextually specified size that is constrained to include the speech time, and locates the eventuality introduced by the verb it modifies within this inter-

val.¹² Furthermore, it is intuitively clear that this interval does not extend far enough into the past to include the interval introduced by the internal adverb of the relative clause *the eighties*, i.e. the local context seems to influence the choice of the interval denoted by *nowadays*.

As the adverb *nowadays* counts as overt information, (34a) is predicted to be acceptable in accordance with the interval resolution strategy. The interval i_e must not be set to the duration of the respective eventuality denoted by the relative clause verb, but – according to point (1.) of the interval resolution strategy – needs to be set to the interval denoted by *nowadays*. In this case, there is no clash between the temporal information in the restrictor, and the temporal information that the present tense marking of the matrix verb contributes to the nuclear scope. The sentence is therefore felicitous:

- (36) (a) A car that was bought in the eighties is usually rusty nowadays.
 (b) MOST_e [$\exists x$. Arg(e, x) \wedge car(x) \wedge [$\exists e'$. buy(e') \wedge Theme(e', x) \wedge past(e') \wedge in 80s(e') \wedge e' @ 80s] \wedge C''(x) \wedge nowadays(e) \wedge e @ nowadays] [pres(e) \wedge rusty(e)]

An obvious question is whether this also works with our initial example, i. e. whether the addition of the adverb *nowadays* also improves the status of (2a) (repeated below as (37a)). This seems to be the case, as is evidenced by the fact that (37b) is at least more acceptable than (37a):

- (37) (a) [?]A car that was bought in the eighties is usually blue.
 (b) [?]A car that was bought in the eighties is usually blue nowadays.

Nevertheless, in spite of its improved status (in comparison to (37a)), (37b) is still strange. This seems to be due to the fact that (37b) strongly implicates that the respective cars were not already blue at the time when they were bought, i. e. *blue* can no longer be interpreted as a true individual level predicate with respect to cars.

Note that the same implicature is triggered in the case of (36a) – the only difference being that it is quite natural to assume that cars have not already been rusty at the time when they were bought. One possible explanation for this implicature is that adding the adverb *nowadays* causes interval resetting in

¹² As has been pointed out to us by Manfred Krifka and Alex Grosu (p. c.), it is not clear why *nowadays* introduces such an interval whereas the present tense marking of the matrix verb does not, and therefore does not lead to an interval resetting. One obvious solution would be to assume that this is due to the fact that the denotation of *nowadays* is (most plausibly) mapped onto the restrictor, while the denotation of the matrix verb (including the tense specification) is mapped onto the nucleus. Point (1.) of the interval resolution strategy would then have to be changed accordingly: Take overt information from the same domain.

the restrictor (otherwise i_e would simply be instantiated with $\pi(e')$), with the hearer assuming that there is a reason why it has been added in the first place.

4.4 Interval resetting induced by presuppositions

Consider (38) below, which is just as acceptable as (34a) – in spite of differing tenses in matrix and relative clause. In this case, the presence of the adverbial *still* in the matrix clause seems to be the relevant factor.

(38) A car that was bought in the 80s is usually still roadworthy.

We assume that *still* is similar to *nowadays* in that it introduces an interval t in which the matrix eventuality e has to be located. Besides that, it does not add much to the semantic content:

(39) $\text{still}(P, e) = P(e) \wedge e @ t$,
 where e is the eventuality variable introduced by the respective verb (here, *be roadworthy*),
 while P is the (denotation of the) intermediate projection of this verb (see below).

As shown in (39), we assume that *still* takes two arguments: First, it takes an eventuality predicate P , where P is the (denotation of the) intermediate projection of the verb that results from applying the denotation of this verb to its individual argument(s).¹³ Therefore, P denotes a function from eventualities to truth values.

The second argument is the eventuality variable introduced by the respective verb. In line with Kratzer (1995), we assume that the eventuality arguments of verbs are represented directly in the syntax: They are generated in the outermost specifier position of the verbal projection. Under the assumption that *still* is adjoined directly below the eventuality argument, it first combines with the denotation of the intermediate verbal projection below it (i. e. P), and in the next step combines with the respective eventuality variable.

It is crucial for our purposes that apart from its rather trivial assertive content, *still* also triggers a presupposition (cf. Löbner 1999, Smessaert and ter Meulen 2004, among others; see also Zybatow and Malink 2003), which is given below:

(40) $\exists t'. \text{salient}(t') \wedge t' < t \wedge \forall t''. [t' \leq t'' < t \rightarrow \exists e'. e' @ t'' \wedge P(e')]$,
 where t is the time interval introduced by the lexical content of *still* (cf. (39)).

¹³ We assume that these arguments are base generated inside the verbal projection (cf. Koopman and Sportiche 1991).

For this presupposition to be satisfied in the case of (38), there has to be a salient time interval t' which is located before t , t being the interval for which the *be roadworthy* eventuality e holds with respect to the cars introduced by the indefinite. Furthermore, this property must persist during the period until t starts. In this example, the explicitly mentioned interval denoted by the adverb *the eighties* can serve to satisfy the presupposition locally. It is plausible to assume that the respective cars already had the property of being roadworthy at the time when they were bought.

As discussed above, the overtly introduced interval t (originating from the semantic content of *still*) serves to determine the interval i_e . As t follows t' , which is set to *the eighties* due to presupposition binding (cf. van der Sandt (1992)), t is an interval following *the eighties* and can thus include the speech time.¹⁴

- (41) (a) A car that was bought in the eighties is usually still roadworthy.
 (b) MOST_e [$\exists x$. Arg(e , x) \wedge car(x) \wedge [$\exists e'$. buy (e') \wedge Theme(e' , x) \wedge past (e') \wedge in 80s(e') \wedge e' @ 80s] \wedge C''(x) \wedge e @ t] [pres(e) \wedge roadworthy(e)],
 where t follows *the eighties* due to presupposition binding.

5 Causally related eventualities

The following examples are all felicitous, in spite of the fact that each of them exemplifies the constellation that led to pragmatic deviance in our initial set of examples, i.e. the relative clause verbs are marked for past tense, while the matrix verbs are marked for present tense, and there is no overt interval setting:

- (42) A car that was made in the eighties is usually blue.
 (43) A house that was built in the 19th century usually has a gabled roof.
 (44) A lawyer who was educated in Berlin is usually competent.
 (45) A man who was in jail during the eighties usually has a Bruce Lee tattoo.

What all the sentences have in common is that the states denoted by the matrix verbs can plausibly be interpreted as being (at least indirectly) caused by the relative clause eventualities.

¹⁴ Sentence (41) is phrased as similarly to our initial example (2a) as possible. But since the sentence cannot reasonably be uttered with a true individual level predicate (which *blue* is assumed to be with respect to cars; cf. the discussion of (37b) above), the matrix predicate had to be substituted. As can be seen below, the sentence is unacceptable with a true individual level predicate:

(i) ??A car that was bought in the 80s is usually still a BMW.

We assume that this is due to the fact that *still* is superfluous as it only adds a presupposition which is already part of the meaning of the individual level predicate *be a BMW*.

In examples (42) – (45), the relative clause internal predicate denotes a set of telic events. The sentences all require an interpretation for which the culmination point of the respective telic event coincides with the respective matrix state. With verbs of creation such as the ones given in (42) and (43), this is trivially true, because properties are usually only ascribed to existing entities. In (44), this is due to the specific relation between the relative clause event and the matrix state.

In (45), where the internal predicate of the relative clause denotes a state without a culmination point, the sentence is still interpreted to mean that, with respect to each man, the matrix state is the result of an (unspecified) event that happened at some point during the running time of the relative clause state. This means that the respective individual cannot have been in the state denoted by the matrix verb at a time before the eventuality of the relative clause began, and furthermore that there is some – however indirect – connection between the two eventualities.

Interestingly, sentences become strange if a predicate is chosen in the matrix clause that cannot be interpreted as denoting a state indirectly caused by the respective relative clause eventuality. Compare (44) to (46) and (45) to (47):

(46) ??A lawyer who was educated in Berlin is usually blond.

(47) ??A man who was in jail during the eighties usually has blue eyes.

We assume that (42) – (45) are felicitous for the following reason: It is impossible to convey the intended meanings of the sentences by using past tense in both relative and matrix clause, due to the interval resolution strategy. On the other hand, overt interval resetting by using the adverb *nowadays* (as in (34a)) is not an option either, because of the temporal proximity of the relative clause eventualities and matrix eventualities.¹⁵

Consider in detail what happens if the matrix verb in example (43) is set to past tense:

(48) A house that was built in the 19th century usually had a gabled roof.

This sentence gets the following reading: Most houses in the 19th century were built with a gabled roof, and it implies that at least some of those houses do not exist any more at the speech time (this is due to a *lifetime effect*, as described for (27)). Note, however, that the interval resolution strategy predicts a different reading which is virtually impossible to get: According to this reading,

¹⁵ Recall from the discussion of (34a) that the starting point of the interval denoted by *nowadays* is automatically interpreted as lying at a certain distance from the end point of the relative clause eventuality.

most houses that were built in the 19th century had a gabled roof before they were built. Furthermore, nothing is implied about the existence of those houses at the speech time.

This second reading is predicted by the interval resolution strategy for the following reason: If e (where e is the eventuality of having a gabled roof) is interpreted as holding at the same time as $\tau(e')$ (where $\tau(e')$ denotes the running time of the relative clause event), the corresponding representation for (48) is as follows:

- (49) (a) A house that was built in the 19th century usually had a gabled roof.
 (b) $\text{MOST}_e [\exists x. \text{Arg}(e, x) \wedge \text{house}(x) \wedge [\exists e'. \text{build}(e') \wedge \text{Theme}(e', x) \wedge \text{past}(e') \wedge 19c(e') \wedge e' @ 19c] \wedge C''(x) \wedge e @ \tau(e')] [\text{past}(e) \wedge \text{gabled_roof}(e)]$

This would imply that the gabled roof was already a property of the respective houses before the process of building them was finished. But this is highly implausible, and certainly not what sentence (48) is supposed to express.

If, on the other hand, the third step of the interval resolution strategy is taken, and the matrix interval is set to the whole time axis, the sentence comes to mean that most (maximal) eventualities thematically related to houses built in the 19th century are eventualities of having a gabled roof that end before the speech time.¹⁶ This however implies that the respective houses no longer exist, and a lifetime effect obtains.

Let us now suppose a speaker neither wants to express the implausible reading given in (49), nor imply that most houses with gabled roofs that were built in the 19th century do not exist anymore at the speech time. Instead, she wants to make a generalization about (probably still existing) houses that were built in the 19th century. In this case, the only natural strategy seems to set the matrix verb to present tense, and directly take the last step of the interval resolution strategy given in (19), i. e. to instantiate the interval i_e with the whole time axis.¹⁷

Thus, sentence (43) (repeated below as (50a)) is interpreted as shown in (50b):

- (50) (a) A house that was built in the 19th century usually has a gabled roof.
 (b) $\text{MOST}_e [\exists x. \text{Arg}(e, x) \wedge \text{house}(x) \wedge [\exists e'. \text{build}(e') \wedge \text{Theme}(e', x) \wedge \text{past}(e') \wedge 19c(e') \wedge e' @ 19c] \wedge C''(x) \wedge e @ i_{\text{world}}] [\text{pres}(e) \wedge \text{gabled_roof}(e)]$

¹⁶ The fact that (48) requires such a reading shows that the interval resolution strategy may be violated if there is an obvious reason for violating it: Obeying it would result in a reading that is obviously not the intended one.

¹⁷ Point (1.) of the interval resolution strategy cannot be applied, because there is no overt information. Point (2.) is not an option either, as this would lead to the same contradiction as shown for example (2a).

According to (50b), the sentence states that most (maximal) eventualities that are related thematically to a house that was built in the 19th century (in a specific manner) are eventualities of having a gabled roof that include the speech time. This seems to be the correct meaning.

The same logic applies to the other examples in (42) – (45): In each case, the strategy that was helpful in the case of (3a) – i.e. to set the matrix verb to past tense – is not possible if one wishes to express an (at least indirect) causal relation between the relative clause eventuality and the matrix eventuality, because

(a) following the interval resolution strategy would force a reading according to which the running time of the matrix eventualities is included in the running time of the relative clause eventualities, and

(b) violating the interval resolution strategy and instantiating i_e with the whole time axis would result in an unintended lifetime effect.

Therefore, the only available option is to set the respective matrix verbs to present tense, and instantiate i_e with i_{world} – in violation of the interval resolution strategy.

The proposed mechanism seems to be confirmed by the following facts:

(51) A lawyer who was educated in Berlin was usually competent.

(52) A man who was in jail during the 80s usually had a Bruce-Lee tattoo.

In both (51) and (52), either a lifetime effect is triggered or the sentences get a reading according to which the matrix states are already true of the respective individuals at the time when the relative clause eventualities start. Thus, they are no legitimate alternatives to (44) and (45) respectively if, on the one hand, a causal relation between the two eventualities is to be expressed, and if, on the other hand, the speaker does not seek to trigger a lifetime effect.

In this section we have shown that the interval resolution strategy may be violated if this is the only way to express a certain meaning.¹⁸

¹⁸ As Graham Katz (p.c.) has pointed out to us, there are related data that are problematic for our account:

(i) ^(?)A song that was popular in the eighties usually has electronic beats in it.

Though it is not only possible, but necessary that the respective songs already had electronic beats in them when they were popular, the sentence is still quite acceptable. We can only speculate why this should be so. Perhaps the intended meaning cannot adequately be expressed by using the past tense variant in this case either, as it is relevant to state explicitly that the respective songs still exist at the speech time. (If the past tense were to be used, and the running times of the eventualities quantified over were set to the running times of the relative clause eventualities, it would simply remain unclear whether the respective songs still exist at the speech time).

6 Summary

Based on a set of new observations, we have argued for an analysis of Q-adverbs as exclusive binders of eventuality variables. We have shown that the availability of QV-readings in sentences with indefinite DPs containing a relative clause is sensitive to the interaction of the tense markings of the respective clauses (matrix clause vs. relative clause). QV is generally only possible if the tenses agree.

We have argued for the existence of a pragmatic strategy that temporally locates the eventualities bound by the Q-adverb in an interval determined on the basis of available information. This pragmatic mechanism is sensitive to locality considerations. In the absence of overt information, the eventualities that are quantified over are located within the same interval as the running times of the respective relative clause eventualities, since these count as interval information originating from the same domain (i.e. the restrictor). If this information concerning the temporal location of the respective eventualities contradicts the information constituted by the tense marking of the respective matrix verbs (which are interpreted in the nuclear scope), the resulting structures are semantically vacuous.

Furthermore, we have explained why in certain well defined cases the interval resolution strategy does not rule out the otherwise infelicitous structures mentioned above. This was either due to the presence of adverbs that overtly introduce an interval in which the eventualities quantified over could be located, or to a specific relation holding between the relative clause and the matrix eventualities: If matrix eventualities can naturally be interpreted as having been (at least indirectly) caused by the relative clause eventualities, the respective sentences are felicitous. We have accounted for this effect by showing that skipping an otherwise obligatory step of the interval resolution strategy and resolving the contextual variable responsible for the temporal location of eventualities to the whole time axis is the only way to express the intended meanings of the respective clauses, i.e. to express the causal relations between the respective relative clause and matrix eventualities.

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