The Influence of Tense in Adverbial Quantification[*]

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We argue that there is a crucial difference between determiner and adverbial quantification. Following Herburger [2000] and von Fintel [1994], we assume that determiner quantifiers quantify over individuals and adverbial quantifiers over eventualities. While it is usually assumed that the semantics of sentences with determiner quantifiers and those with adverbial quantifiers basically come out the same, we will show by way of new data that quantification over events is more restricted than quantification over individuals. This is because eventualities in contrast to individuals have to be located in time which is done using contextual information according to a pragmatic resolution strategy. If the contextual information and the tense information given in the respective sentence contradict each other, the sentence is uninterpretable. We conclude that this is the reason why in these cases adverbial quantification, i.e. quantification over eventualities, is impossible whereas quantification over individuals is fine.

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1 Data

It is usually assumed (cf. Lewis [1975], Heim [1982], von Fintel [1994], Chierchia [1995], Kratzer [1995], Herburger [2000] and many others) that the interpretation of A(dverbially)-quantified sentences such as (1-a) comes out the

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same as the interpretation of (1-b) with a D(eterminer)-quantifier. This is generally referred to as a quantificational variability (QV) effect.

(1)   a.   A police car is usually green.

        b.   Most police cars are green.

But whereas this is true for the above example, it does not hold in general that A-quantified sentences and the corresponding D-quantified ones end up with the same interpretation. We will present data which show that there are A-quantified constructions which are generally judged to be uninterpretable (cf. (2)), though the D-quantified versions of them are considered perfectly fine (cf. (3)):

(2) $^{??}$A car that was bought in the 80s is usually blue.

(3)   Most cars that were bought in the 80s are blue.

The indefinite DP in (2) only seems to get a specific reading with scope over the Q-adverb. This interpretation results in a deviant reading, as the property of having some specific colour 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 of why the reading where the Q-adverb has scope over the indefinite DP is blocked in (2).

    Interestingly, (4) is much better than (2):

(4)   A car that was bought in the 80s was usually blue.

In contrast to this, (5) is just as good as (3) though different in interpretation[2]:

(5)   Most cars that were bought in the 80s were blue.

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[1] Of course, cars can change their colour when they are painted differently, which means that, strictly speaking, *blue* is not an individual level predicate in this context. Yet, we will stick to this assumption in the following.

[2] We will discuss the interpretative difference in section 4.2.

2 Existing Analyses

In this section we want to show that existing analyses cannot explain the difference in acceptability between (2) and (3).

2.1 Q-adverbs as unselective binders

In the theories of Heim [1982] (whose theory is based on Lewis [1975]), Kamp [1981], Diesing [1990], and Kratzer [1995], indefinites provide a restricted variable. If the sentence does not contain a Q-adverb, the restricted variable is subject to existential closure. Otherwise, it is bound by an adverbial quantifier. Adverbial quantifiers are unselective binders that bind every free variable in their scope, i.e. individual as well as situation/event variables. Stage level predicates come with a spatio-temporal argument whereas individual level predicates do not.

Despite its oddity, (2) gets a perfectly coherent interpretation according to these approaches, as there is a free variable (provided by *a car*) which can be bound by the quantifier *MOST*, which is the denotation of *usually*.

(6)   a. $^{??}$A car that was bought in the 80s is usually blue.

        b. $MOST_x \big[car(x) \wedge bought\_in\_80s(x)\big] \big[blue(x)\big]$

This is exactly the same interpretation as the ones that is assigned to (3):

(7)   a.   Most cars that were bought in the 80s are blue.

        b. $MOST_x \big[car(x) \wedge bought\_in\_80s(x)\big] \big[blue(x)\big]$

This means that these theories cannot adequately account for the acceptability differences.

2.2   Q-adverbs as topic sensitive binders

Chierchia [1995] differs from the above view in two respects: Firstly, indefinites
are interpreted as regular existential quantifiers. When they are topic marked,
they are existentially disclosed and can be bound by a c-commanding adverbial
quantifier afterwards. And secondly, individual level predicates also come with
a spatio-temporal argument, but in contrast to a stage level argument it needs to
be bound by the generic quantifier.

(8)   a. $^{??}$A car that was bought in the 80s is usually blue.

       b. $MOST_x \left[car(x) \wedge bought\_in\_80s(x) \right]$
$$\left[GEN_s \big(x \; in \; s \big) \big(blue(x, s) \big) \right]$$

This interpretation is equivalent to the interpretation of (3) (as shown in (7));
and here again, there is no reason why the sentence should be unacceptable.

2.3   Situation and event semantic approaches

Following de Swart [1993], von Fintel [1994], and Herburger [2000], Q-adverbs
bind situation or event variables. Indefinites are ordinary existentially quanti-
fied DPs. Quantificational variability then results from binding (minimal) situ-
ations/events that contain just one individual of the relevant sort. It is important
that for each situation, a different individual is chosen so that the the individ-
uals vary with the situations (cf. von Fintel [1994]). This in turn guarantees
the quantificational variability effect. The restriction and the nuclear scope of
the respective Q-adverb are determined on grounds of information structure or
contextual information.

Even in these theories, the semantic representation of (2) still comes out
equivalent to the semantics of (3) shown in (7). This means that without further
assumptions, the situation/event semantic accounts also cannot explain the ob-

served acceptability differences, as there is a perfectly coherent representation for (2) in these approaches:

(9)   a. $^{??}$A car that was bought in the 80s is usually blue.

        b. $MOST_e \left[\exists x.arg(e, x) \wedge car(x) \wedge [\exists e'.buy(e') \wedge theme(e', x) \right.$
        $$\left. \wedge in\_the\_80s(e')]\right] \left[blue(e) \right]$$

3   Conceivable Solution Strategies

As has been shown in the preceding section, none of the existing theories can explain the difference in acceptability between (2) and (3). Before we will present our account of these data, we want to mention briefly two alternative solution strategies that could come to mind, and argue why they cannot be maintained.

3.1   Natural classes?

One could speculate that QV is only possible with indefinites that pick out individuals from a well defined class (cf. Krifka et al. [1995] and Cohen [2001] for generics and natural classes; Greenberg [2002] and Greenberg [2003] for the different behaviour of singular indefinites and bare plurals in generic sentences, i.e. sentences that do not contain an overt Q-adverb[3]). But the fact that the following sentence 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

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[3]   We would like to thank Angelika Kratzer, who drew our attention to the work of Yael Greenberg.

of cars that have been bought in the 80s referred to in the initial example (2).

There also seems to be a difference between temporal and spatial restrictions. Whereas the restriction of the existentially bound variable by a property that refers to a specific time interval renders a sentence with an individual level predicate ungrammatical (as in (2)), restricting it by a property that refers to a specific location is harmless:

(11)   A car that is bought in the car store in Fleet Street is usually blue.

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 also not borne out as the generalization does not hold for non-QV environments:

(12)   It is possible that a car that was bought in the 80s may have had an accident today.

(13)   Every customer recognized a car that was on exhibition in this shop window yesterday.

In (12), the speaker does not need to have a particular car in mind, and in (13) the cars may vary with the customers. This shows that the reason for the unacceptability of (2) cannot be a forced specific interpretation for the indefinite.

4   A Pragmatic Account

We follow von Fintel [1994] and Herburger [2000] in the assumption that D-quantifiers take sets of individuals as arguments, while A-quantifiers take sets of eventualities. The arguments of D-quantifiers are determined grammatically,

while the restriction of A-quantifiers has to be determined solely on the basis of information structure (or contextual information).

We also assume that every quantification comes with a domain restriction (cf. von Fintel [1994], Martí [2003], Stanley [2000], and Stanley [2002]). For individual quantifiers this means that the restrictor set has to be intersected with the denotation of a covert predicate that is determined by the context. In a context[4] as given in (14-a), a sentence such as (14-b) would not be about all apples of the universe, but about all the apples that have been introduced in the previous sentence, i.e. all apples that Peter bought the day before:

(14)   a.   Yesterday, Peter bought apples.

            b.   Every apple tasted awful.

Analogously, domain restriction for events means locating the respective events in time (cf. Partee [1973], Lenci and Bertinetto [1999]). In a context such as (i-a), the event of drinking beer in (i-b) is interpreted as taking place at the same time as the contextually given eventuality in (i-a), i.e. during the time when Peter was at Mary's party (cf. Partee [1973]):

(15)   a.   Yesterday, Peter had a good time at Mary's party.

            b.   He drank beer.

We now claim that the acceptability differences between the initial examples (2) and (3) can be explained on the basis of (conflicting) tense information.

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[4]   Also extra-linguistic contexts can serve to restrict the quantifier domain as in the well-known example of Lewis [1986]:

(i)   a.   *When looking into the fridge, someone says:*
        b.   There is no beer.

Here, (i-b) would not be about beer in general, but only about beer in the respective fridge due to the contextual situation given in (i-a).

4.1 Technical preliminaries

We will explain the technical apparatus by first looking at (3) and explaining why this is a good sentence for which there exists a sensible interpretation that is predicted by our approach.

Due to the presence of the D-quantifier *most*, the sentence is interpreted by employing quantification over individuals x. As every quantification comes with a domain restriction, so does the quantifier *most*, and an additional conjunct $C(x)$ is introduced.[5] Every verbal predicate introduces a variable, which in the default case is bound by an existential quantifier. This quantifier also comes with a domain restriction.

(16)   a. Most cars that were bought in the 80s are blue.

   b. $MOST_x \left[car(x) \wedge [\exists e'.buy(e') \wedge theme(e', x) \wedge past(e') \right.$
   $$\wedge in\_the\_80s(e') \wedge C(e')] \wedge C'(x) \big]$$
   $$\big[\exists e.arg(e, x) \wedge pres(e) \wedge blue(e) \wedge C(e)\big]$$

To indicate that a context restriction belongs to a quantifier, we have underlined the corresponding terms in formula (16). In case of quantification over eventualities, the restriction temporally locates an eventuality e within an interval i_e. This means that C is of the form e @ i_e:

(17)   a. Most cars that were bought in the 80s are blue.

   b. $MOST_x \left[car(x) \wedge [\exists e'.buy(e') \wedge theme(e', x) \wedge past(e') \right.$
   $$\wedge in\_the\_80s(e') \wedge e' \ @ \ i_{e'}] \wedge C'(x)\big]$$
   $$\big[\exists e.arg(e, x) \wedge pres(e) \wedge blue(e) \wedge e \ @ \ i_e\big]$$

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

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[5]   Note that in contrast to von Fintel [1994] and Martí [2003] we assume that this domain restriction is added at the latest possible position, because it is determined by overt information that has been mentioned before.

(18) $e @ i_e := \tau(e) \subseteq i_e,$

   where $\tau(e)$ denotes the running time of e.

In words, $e @ i_e$ means that e—in case of verbs denoting dynamic eventualities (i.e. achievements, accomplishments and activities, see Vendler [1957])—takes place /holds at some time during the interval i_e or, in case of a stative verb/property, exhausts $i_e{}^6$.

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

(19)   a. $pres(e) := t_0 \in \tau(e)$
           b. $past(e) := \tau(e) < t_0$

4.2   The interval resolution strategy

The free interval variables i in (17) have to be fixed by overt or contextual information as far as it is available.

   We assume the following pragmatic strategy for the temporal localization of the events, what we will call the **interval resolution strategy**:

(20)   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

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6   Following Bach [1986] (among many others, see also Rothstein [2003] and references therein for a recent discussion), we assume that statives (as well as activities) are homogenous with respect to their internal structure. In 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 that $e @ i_e$ picks out those subeventualities of the state under discussion that lie in the interval i_e. Analogous to the case of activities, only the maximal eventuality (i.e. the one exhausting the whole interval) is taken into account when computing the truth conditions of the sentence. This is because quantification over infinite sets is no reasonable operation.

event.

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 the following: If there is overt information about the time in which a respective event e has to be located, this information has to be taken to instantiate the interval i_e. This would be the case in example (15-a) where the event of Peter's having a good time at Mary's party has to be located during the interval denoted by *yesterday*. In (15-b) on the other hand, there is no overt interval in which the beer drinking event has to be located. Here, contextual information has to be taken into account—which corresponds to point (2.) of the interval resolution strategy given in (20). According to this strategy, the event of Peter's beer drinking is interpreted during some contextually given time interval which in this case is the running time of some other contextually given salient event, i.e. the time when Peter was at Mary's party. The concept of local proximity plays a role here. Contextual information which has been introduced immediately before the event to be located is more appropriate to function as restriction for this event than material that has been presented much earlier. This is reflected in the interval resolution strategy in (20) where local information (point 2.) is to be preferred over non local one (point 3.).

Quantification over individuals

In case of (17), repeated here as (21), there are two intervals which have to be resolved: i_e and $i_{e'}$.

(21)   a. Most cars that were bought in the 80s are blue.
          b. $MOST_x \left[car(x) \wedge [\exists e'.buy(e') \wedge theme(e', x) \wedge past(e') \right.$

$$\wedge in\_the\_80s(e') \wedge e' @ \underline{i_{e'}}] \wedge C'(x)\Big]$$
$$\Big[\exists e.arg(e,x) \wedge pres(e) \wedge blue(e) \wedge e @ \underline{i_e}\Big]$$

For the relative clause event e' which has to be located in the interval $i_{e'}$, there is overt information, i.e. *the 80s*. The interval has to be instantiated with the explicitly mentioned interval *the 80s*. Concerning i_e, there is neither overt information in the matrix clause nor any other interval information in the same domain, which is the nucleus. Therefore the third option of the interval resolution strategy in (20) comes into play and the interval could be resolved contextually by taking information from the other domain, i.e. by the running time of e':

(22)   a. Most cars that were bought in the 80s are blue.

b. $\#MOST_x \Big[car(x) \wedge [\exists e'.buy(e') \wedge theme(e',x) \wedge past(e')$
$$\wedge in\_the\_80s(e') \wedge e' @ \underline{80s}] \wedge C(x)\Big]$$
$$\Big[\exists e.arg(e,x) \wedge pres(e) \wedge blue(e) \wedge e @ \underline{\tau(e')}\Big]$$

The event e would then be interpreted as being located within the same period as e', which is during the 80s. But this would directly clash with the semantics of present tense:

(23)   a. Most cars that were bought in the 80s are blue.

b. $\#MOST_x \Big[car(x) \wedge [\exists e'.buy(e') \wedge theme(e',x) \wedge \tau(e') < t_0$
$$\wedge in\_the\_80s(e') \wedge \tau(e') \subseteq 80s] \wedge C(x)\Big]$$
$$\Big[\exists e.arg(e,x) \wedge \underline{t_0 \in \tau(e)} \wedge blue(e) \wedge \underline{\tau(e) \subseteq \tau(e')}\Big]$$

Formula (23) is inconsistent with the situation that the speech time t_0 is not contained in the eighties:

$$t_0 \notin \tau(e) \subseteq \tau(e') \subseteq 80s$$

The only option left for the interval resolution strategy to create a coherent interpretation is to instantiate the time interval with the whole time axis:

(24)   a. Most cars that were bought in the 80s are blue.

        b. $MOST_x \left[car(x) \wedge [\exists e'.buy(e') \wedge theme(e', x) \wedge \tau(e') < t_0 \right.$
$$\wedge in\_the\_80s(e') \wedge e' \ @ \ 80s] \wedge C(x)]$$
$$\left[\exists e.arg(e, x) \wedge t_0 \in \tau(e) \wedge blue(e) \wedge e \ @ \ \underline{i_{world}}\right]$$

This then means: *Most cars bought in the 80s are presently blue.*

    However, in (5)—the variant of (2), in which the matrix predicate is set to past tense—the interval of the matrix clause can be set to the running time of e'. Here, there is no time clash due to the past tense marking of the matrix clause verb:

(25)   a. Most cars that were bought in the 80s were blue.

        b. $MOST_x \left[car(x) \wedge [\exists e'.buy(e') \wedge theme(e', x) \wedge past(e') \right.$
$$\wedge in\_the\_80s(e') \wedge e' \ @ \ 80s] \wedge C(x)]$$
$$\left[\exists e.arg(e, x) \wedge \underline{past(e)} \wedge blue(e) \wedge \underline{e \ @ \ \tau(e')}\right]$$

The meaning is: *Most cars bought in the 80s were blue when they were bought.*

    But still it would be possible to set the interval to the whole time axis according to point (3.) of the strategy above. This leads to a different reading for this sentence that indeed seems to be available:

(26)   a. Most cars that were bought in the 80s were blue.

        b. $MOST_x \left[car(x) \wedge [\exists e'.buy(e') \wedge theme(e', x) \wedge past(e') \right.$
$$\wedge in\_the\_80s(e') \wedge e' \ @ \ 80s] \wedge C(x)]$$
$$\left[\exists e.arg(e, x) \wedge past(e) \wedge blue(e) \wedge e \ @ \ \underline{i_{world}}\right]$$

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

(27) a. Most cars that were bought in the 80s were blue.

b. $MOST_x \big[car(x) \wedge [\exists e'.buy(e') \wedge theme(e', x) \wedge \tau(e') < t_0$
$\wedge in\_the\_80s(e') \wedge e' @ 80s] \wedge C(x)\big]$
$\big[\exists e.arg(e, x) \wedge \underline{\tau(e) < t_0} \wedge blue(e) \wedge e @ i_{world}\big]$

This means that the *blue* eventuality has to end before the speech time. Under the assumption that *blue* is regarded as an individual level predicate with respect to cars, this triggers the expectation on the side of the hearer that the respective cars do not exist any longer. 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 is i_{world} are picked out (see footnote 6). On the other hand, past tense marking would keep it from doing so if those cars would still exist (without having changed their colour). This is because past tense forces those eventualities to end before the speech time, while there are larger eventualities of the cars being blue that lie within the interval i_{world}: namely those comprising the whole time of existence of the cars. That means, using past tense one would not give as much information with respect to the chosen interval as possible, if the cars would still exist. If, on the other hand, the cars do not exist anymore, past tense marking would allow to pick out the largest eventualities of the respective cars being blue that lie within the given interval i_{world}. Therefore, the hearer automatically assumes that the respective cars indeed do not exist anymore[7].

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[7] As has been pointed out to us by Manfred Krifka, there is another possibility for resolving i_e in case of (5) (repeated here as (i-b)), namely to a contextually salient interval. In a context such as (i-a), it would be the year of 1995 or more precisely the time when the second-hand car market took place:

(i) a. Talking about the second-hand car market in 1995.

b. Most cars that were bought in the 80s were blue.

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.

This effect is reminiscent of the facts discussed by Kratzer [1995] and Musan [1997] under the label *life time effects*. Consider the sentence in (28):

(28)   Gregory was from America.

If the sentence is uttered out of the blue, it implicates that Gregory is dead at the speech time (or has changed his citizenship). The very same effect arises in the second reading of (5) given in (27).

To summarize the findings of this section, we claim that (3) is fine 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 is 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}.

Quantification over eventualities

In case of (2), repeated as (29), matters are different.

(29) $^{??}$A car that was bought in the 80s is usually blue.

Regarding adverbial quantification, it is not the syntax that determines restrictor and nucleus, but information structure (or contextual information): Non-focal/topical material is mapped onto the restrictor, focal material is mapped

onto the nuclear scope (cf. among others Chierchia [1995], Krifka [1995], Partee [1995], Rooth [1995], Herburger [2000]). In this example, the matrix predicate *blue* is focussed, and therefore it is 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 the eventuality variable introduced by the matrix verb ends up in the same domain as the eventuality variable introduced by the relative clause internal verb—namely in the restrictor of the adverbial quantifier *usually*. This contrasts with the situation in (3), where the two variables are interpreted in different domains: The variable introduced by the relative clause verb 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 this quantifier. This, together with the fact that the matrix eventuality variable also needs to be restricted by a time interval, has the consequence that the interval resolution strategy given in (20) works differently in the two cases. Now consider the semantic representation of (2) (repeated here as (30)) in detail:

(30)   a. $^{??}$A car that was bought in the 80s is usually blue.

   b. $MOST_e \left[\exists x.arg(e, x) \wedge car(x) \wedge [\exists e'.buy(e') \wedge theme(e', x) \right.$
$$\left. \wedge past(e') \wedge in\_the\_80s(e') \wedge C(e')] \wedge C'(x) \wedge C(e)\right]$$
$$\left[pres(e) \wedge blue(e)\right]$$

As mentioned above, the domain restriction $C(e)$ for the adverbial quantifier *usually* must include the constraint $e @ i_e$, where i_e has 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 about the event 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 in (20), i_e has to

be equated to the interval denoted by the running time[8] of e':

(31)   a. $^{??}$A car that was bought in the 80s is usually blue.

b. $MOST_e \left[\exists x.arg(e,x) \wedge car(x) \wedge [\exists e'.buy(e') \wedge theme(e',x) \right.$
$\wedge past(e') \wedge in\_the\_80s(e') \wedge e' \text{ @ } 80s] \wedge C'(x) \wedge e \text{ @ } \underline{\tau(e')} \big]$
$\left[pres(e) \wedge blue(e) \right]$

As e' takes place in the 80s and e is located during the running time of e', only events located in the 80s, i.e. before the speech time t_0, will be considered in the restrictor whereas the nucleus requires the events to include the speech time:

(32)   a. $^{??}$A car that was bought in the 80s is usually blue.

b. $MOST_e \left[\exists x.arg(e,x) \wedge car(x) \wedge [\exists e'.buy(e') \wedge theme(e',x) \right.$
$\wedge \tau(e') < t_0 \wedge in\_the\_80s(e') \wedge \tau(e') \subseteq 80s] \wedge C'(x) \wedge \underline{\tau(e) \subseteq \tau(e')} \big]$
$\left[\underline{t_0 \in \tau(e)} \wedge blue(e) \right]$

This necessarily yields an empty intersection of restrictor and nucleus and thus accounts for the oddity of (2).

As this oddity is not due to a grammatic but due to 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 for them. Still, (2) will be much less natural than (3), where it is not necessary for the speaker to construct a matching context 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

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[8]   Compare this to example (15-b), where, in the given context, the second event of Peter's beer drinking has to be interpreted in the running time of the eventuality of the first sentence—i.e. when he was at Mary's party—due to the local proximity of the two sentences. We assume that the mechanism is the same in the case discussed in (30). Here also, one cannot help but interpret the sentence with the interval i_e set to the running time of the the salient relative clause event, as this is local information.

out. This can be seen in (4), repeated here as (33):

(33)   a. A car that was bought in the 80s was usually blue.
        b. $MOST_e \left[\exists x.arg(e,x) \wedge car(x) \wedge [\exists e'.buy(e') \wedge theme(e',x) \right.$
        $\wedge past(e') \wedge in\_the\_80s(e') \wedge e' \ @ \ 80s] \wedge C(x) \wedge \underline{e \ @ \ \tau(e')}\right]$
        $\left[\underline{past(e)} \wedge blue(e)\right]$

Here, instantiating i_e with the running time of e' which is located in the 80s does not lead to a contradiction with the past tense information in the nucleus.

Our approach predicts example (2) to be out 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', which is located in the past.

- This clashes with the present tense information in the nuclear scope.

- The intersection of restrictor and nucleus is necessarily empty.

4.3   Explicit interval setting

Consider (34), which is fine in spite of the fact that it is structurally almost identical to (2): The matrix verb is marked for present tense, while the verb in the relative clause is marked for past tense. Obviously, what makes the difference is the presence of the adverb *nowadays* in the matrix clause[9].

(34)   a. A car that was bought in the 80s is usually rusty nowadays.
        b. $MOST_e \left[\exists x.arg(e,x) \wedge car(x) \wedge nowadays(e) \wedge [\exists e'.buy(e') \right.$

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[9]   We assume that *nowadays* is not focussed and hence mapped onto the restrictor.

$$\wedge theme(e', x) \wedge past(e') \wedge in\_the\_80s(e') \wedge e' \text{ @ } 80s]$$
$$\wedge C(x) \wedge e \text{ @ } i_e\big] \big[pres(e) \wedge rusty(e)\big]$$

Let us assume for concreteness that *nowadays* introduces an interval of contextually specified size which is constrained to include the speech time, and locates the eventuality introduced by the verb it modifies within this interval.[10] As this is overt information, (34) is predicted to be fine by the interval resolution strategy given in (20): The interval i_e does not need to be set to the running time of the eventuality denoted by the relative clause verb, but can or—according to point (1.) of the interval resolution strategy given in (20)—has to be set to the interval denoted by the overt interval information introduced by *nowadays*. In this case, there is no clash between the temporal information in the restrictor and the temporal information the present tense marking of the matrix verb contributes to the nuclear scope:

(35)   a. A car that was bought in the 80s is usually rusty nowadays.
         b. $MOST_e \big[\exists x.arg(e, x) \wedge car(x) \wedge nowadays(e) \wedge [\exists e'.buy(e')$
$$\wedge theme(e', x) \wedge past(e') \wedge in\_the\_80s(e') \wedge e' \text{ @ } 80s]$$
$$\wedge C(x) \wedge \underline{e \text{ @ } nowadays}\big] \big[\underline{pres(e)} \wedge rusty(e)\big]$$

As can easily be seen, the present tense information in the matrix clause does not clash with the interval information of the restrictor, and the sentence is therefore felicitous.

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[10] As has been pointed out to us by Manfred Krifka and Alex Grosu, it is not obvious why *nowadays* introduces such an interval whereas present tense does not and therefore does not lead to an interval resetting. Possibly, *nowadays* behaves just like *still* and *meanwhile* in that it presupposes an interval in the past (cf. the following two subsections), which would be an alternative explanation for the felicity of (34). We will have to leave this question for future work.

4.4 Interval setting induced by presuppositions

Just as (34), also (36) is fine, in spite of differing tenses in matrix and relative clause. This seems to be due to the presence of the adverbial *still* in the matrix clause.

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

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

(37) $\text{still}(P, e) = P(e) \wedge e \ @ \ t$, *where e is the eventuality of the matrix event predicate P (be roadworthy).*

We assume that *still* takes two arguments: As a first argument, it takes the eventuality predicate P denoted by the intermediate verbal projection that it modifies and that has already been applied to all its individual arguments. We assume these arguments to be base generated inside the verbal projection (cf. Koopman and Sportiche [1991]). Therefore, the eventuality predicate 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 directly represented 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, and in the next step combines with the respective eventuality variable.

What is crucial for our purposes is that apart from its rather trivial assertion, *still* also triggers a presupposition (cf. Löbner [1999], Smessaert and ter Meulen [2004], among others):

(38) $\exists t'.salient(t') \wedge t' < t \wedge \forall t''.[t' \leq t'' < t \rightarrow \exists e'.e' @ t'' \wedge P(e')]$,

where t is the time interval that is introduced by its lexical content, cf. (37).

For this presupposition to be satisfied in the case of (36), there has to be a salient time interval t' which is located before t where the eventuality e of being roadworthy held. This property has to persist during the time until t starts. In this example, the explicitly mentioned interval denoted by the eighties can serve to locally satisfy the presupposition: It is plausible to assume that the respective cars already had the property of being roadworthy at the time when they were bought.

As before, the overtly introduced interval t (originating from the lexical content of *still*) serves to determine the interval i_e. As t follows t', which is set to the 80s due to the presupposition binding, t is an interval following the 80s and can thus include the speech time.

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

           b. $MOST_e \ \big[\exists x.arg(e, x) \wedge car(x) \wedge [\exists e'.buy(e') \wedge theme(e', x)$

$\wedge past(e') \wedge in\_the\_80s(e') \wedge e' @ 80s] \wedge C(x) \wedge e @ t\big]$

$\big[pres(e) \wedge roadworthy(e)\big]$,

where t follows the 80s due to presupposition resolution.

Basically the same reasoning applies to the following example[11]:

(40)   A car that was bought in the 80s usually broke meanwhile.

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[11] The sentences in (34), (36), and (40) are construed as parallel as possible to the initial example sentence (2). But as the respective sentences cannot reasonably be uttered with individual level predicates (which *blue* is assumed to be with respect to cars), the matrix predicate had to be substituted. As can be seen in the following, the sentences are out with true individual level predicates:

We assume that *meanwhile* has the same lexical content as *still*, but introduces a different presupposition:

(41) $\exists t'.salient(t') \wedge t' < t \wedge [\neg \exists e'.e' @ t' \wedge P(e')]$

As it is plausible to assume that the respective cars did not have the property of having been broken at the time when they were bought, (40) is also predicted to be fine: Again, the presupposition introduced by the adverb can be satisfied locally, and the matrix eventualities can be located in an interval that is compatible with the present tense information in the nuclear scope.

5   Causally Related Eventualities

The following examples are all fine, 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 80s 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 80s usually has a Bruce Lee tatoo.

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

(ii) $^{??}$A car that was bought in the 80s is usually a BMW meanwhile.

In the case of *meanwhile*, the presupposition can never be fulfilled whereas in case of *still*, the temporal adverbial is superfluous as it only adds a presupposition which is already introduced by the very definition of an individual level predicate.

What all the sentences have in common is that the states denoted by the matrix verbs are interpreted as being (at least indirectly) caused by the relative clause eventualities. In examples (42) to (44), the relative clause internal predicate denotes a set of telic events. The sentences are interpreted as saying that the culmination point of the telic event coincides with the matrix state. With verbs of creation 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 relative clause internal predicate denotes a state without a culmination point, it is still required that the matrix state does not hold of the respective individual when the relative clause internal eventuality starts.

Once a different predicate is chosen in the matrix clause, the sentences become odd. Compare (44) to (46):

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

The reason for the felicity of examples (42) to (45) seems to be the fact that it is impossible to convey the correct meanings of the sentences by using past tense in both relative and matrix clause. To put it differently, the possibility of expressing the correct meaning of the respective sentence with past tense as in (4) blocks the possibility to use present tense for the matrix clause (as in (2)).

Consider an example similar to (43), but with past tense also in the matrix clause:

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

This sentence either means that at least some houses with the respective property do not exist any more at the speech time (which is a reading with a life time effect as described for (5)) or that houses that were built in the 19th century used to have a gabled roof before they were built, which is a very implausible

reading.

According to the interval resolution strategy given in (20), this is predicted. If e (where e is the eventuality of having a gabled roof) is interpreted as holding at the same time as e' (where e' denotes the time when the relative clause internal event takes place), the corresponding representation for (47) is as follows:

(48) $MOST_e \big[\exists x.arg(e, x) \wedge house(x) \wedge [\exists e'.build(e') \wedge theme(e', x)$
$\wedge\, past(e') \wedge 19c(e') \wedge e' \,@\, 19c] \wedge C(x) \wedge e \,@\, \tau(e')\big]$
$\big[past(e) \wedge gabled\_roof(e)\big]$

This would imply that the gabled roof was already a property of the respective houses when they were built. This is not what sentence (43) is supposed to express.

If, on the other hand, the third step of the interval resolution strategy in (20) is taken, and the matrix interval is set to the whole time axis, the sentence comes to mean that most (maximal) eventualities that stand in a thematic relation to a house that was built in the 19th century are eventualities of having a gabled roof that end before the speech time. This however implies that the respective houses do not exist anymore, and a life time effect obtains. This does not correspond to the intended meaning of (43) either. Furthermore, it means violating the interval resolution strategy given in (20), as this would only allow the matrix interval to be set to the running times of the respective relative clause eventualities.

Therefore the strategy which was helpful before (example (4)), namely to set the matrix predicate to past tense, is no way to go in the above examples. In that case, according to the interval resolution strategy given in (20), i_e would be instantiated with the interval that denotes the running time of the relative clause eventuality. But here, e does not hold at this stage. So the only way to express the intended meaning of the sentence is to set the matrix predicate to present tense and then directly take the last step of the interval resolution strategy given

in (20) and instantiate the interval i_e with the whole time axis[12].

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

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

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

In (49) and (50), either a life time effect is triggered or in case of (49), the sentence is interpreted in a way that the state of being competent was already true at the time the education event started. In case of (50), the sentence gets the interpretation that the state of having a Bruce Lee tatoo was already true for a person before the respective person came to jail. This is predicted because the relative clause internal event and the matrix predicate are assumed to take place at the same time according to the interval resolution strategy.

Therefore, there is no other possibility to express the intended meaning than to use present tense in the respective matrix clauses. This accounts for the felicity of (42) to (45)[13].

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

[13] As Graham Katz has pointed out to us, there are related data which are problematic for our account:

(i)   A song that was popular in the 80s 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 perfectly fine. We can only speculate that this could be due to the fact that here also, the intended meaning of the sentence cannot adequately be expressed by the past tense variant of it. This could be because only present tense in the matrix clause expresses that the 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): In the standard case, QV is 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 that is determined on the basis of available information. This pragmatic mechanism is sensitive to locality considerations: In the absence of overt information, it locates the eventualities quantified over in the same interval as the running times of the respective relative clause eventualities, as these count as interval information originating from the same domain (i.e. the restrictor). If this information about 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 deviant. We have explained why in certain well defined cases the interval resolution strategy given in (20) does not rule out the otherwise infelicitous structures from above. This is either due to the presence of adverbs that overtly introduce an interval in which the eventualities can be located, or due to a specific relation holding between the relative clause and the matrix eventualities: If the matrix eventualities can naturally be interpreted as having been (at least indirectly) caused by the relative clause eventualities, the respective sentences are fine. We 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 (sometimes indirect) causal relations between the respective

eventualities.

7   Outlook

As Alex Grosu has pointed out to us, the grammaticality difference between (51) and (52) seems to have a similar origin as the acceptability differences of the data discussed in this paper:

(51)   *A car that would be designed by Mary is usually blue/will usually be blue.

(52)   A car that would be designed by Mary would usually be blue.

(51) seems odd for the following reason: The subjunctive marking of the relative clause verb indicates that the eventualities quantified over are located at non-actual worlds, while the indicative marking indicates that they are located at the actual world. In (52), there is no such clash: Both verbs indicate that quantification is over a set of eventualities that are located at non-actual worlds. Further research could include the comparison of the exact conditions for the ungrammaticality of (51) with the interval resolution strategy as presented in the preceding sections.

In Endriss and Hinterwimmer [in preparation] we show that the interval resolution strategy in tandem with the fact that temporal Q-adverbs such as *usually* are only able to quantify over temporally scattered eventualities (in the following referred to as the *coincidence constraint*, cf. Zimmermann [2003] for a related constraint for the interpretation of the adverb *occasionally*, based on Lasersohn [1995]) also accounts for contrasts like the following:

(53)   The people that gave a talk at the conference on kangaroos usually were intelligent.

(54)   *The people that listened to Peter's talk at the conference on kangaroos
         usually were intelligent.

(55)   The people that listened to Peter's talk at the conference on kangaroos
         were intelligent for the most part.

In (53), quantification ranges over the parts of the maximal sum eventuality the
agent of which is the maximal plural individual of people that gave a talk at the
conference on kangaroos. The sentence means that most of those parts are also
part of the sum eventuality of being intelligent. (We assume that adverbial quan-
tifiers may not only take sets, but also genuine plural objects as their arguments,
cf. the discussion of determiner quantifiers in Matthewson [2001]). A natural
partition of the maximal sum eventuality would be the division into eventuali-
ties with a different agent each (cf. Nakanishi and Romero [2004]) which in turn
accounts for the quantificational variability effect. In (54), however, the maxi-
mal sum eventuality introduced by the relative clause verb consists of parts that
necessarily coincide temporally, as there is only one talk by Peter at the con-
ference on kangaroos. According to the interval resolution strategy, the running
times of the parts of the matrix eventuality quantified over by the Q-adverb
have to be set to the respective running times of the parts of the relative clause
events. As a result of this, the running times of the eventualities quantified over
also coincide, and the coincidence constraint is violated.

As has been pointed out in Nakanishi and Romero [2004], adverbs such as
for the most part behave differently in this respect. To these adverbs, any plural
eventuality whatsoever is welcome (cf. (55)).

In Cohen [2001], Greenberg [1998], Greenberg [2002], and Greenberg [2003],
it is shown that there are crucial differences between singular indefinites and
bare plurals with respect to generic interpretations. It also seems that bare plu-
rals do not have to obey the interval resolution strategy to the same degree as
singular indefinites.

(56)　　　Cars that were sold in the eighties are usually blue.

For some speakers, (56) seems to be better than (2) which can only be due to the singular/plural contrast of the subject.[14]

Apart from singular/plural contrasts, word order seems to play a role in the interpretation of the respective adverbially quantified sentences[15]:

(57)　　　Usually, a car that was sold in the eighties is blue.

Sentence (57) is clearly much better than (2).

In future work, we plan a deeper investigation of these phenomena as well as an in depth comparison of the behaviour of singular and plural indefinites with respect to the interval resolution strategy.

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[15]　This example is also due to Jason Stanley.

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