A Unified Analysis of Temporal *in*-adverbials

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1. Introduction. Given their behavior with the perfect, temporal *in*-adverbials are often seen as NPIs.

1) a. *Mary has had a seizure in days. b. Mary hasn't had a seizure in days.

However, in the absence of the perfect, these adverbials do not show the same polarity sensitivity.

2) a. Mary destroyed her career in seconds. b. Mary didn't destroy her career in seconds.

We will refer to the instances of temporal *in*-adverbials in (1) as *perfect-level* uses and in (2) as *VP-level* uses. We account for this contrast by assuming (i) temporal *in*-adverbials must activate a set of alternatives and, (ii) they fall under the scope of a silent counterpart of *even*. With these assumptions, we can account for the deviance of temporal *in*-adverbials in upward monotone environments at the Perfect-level, while encountering no such restriction at the VP-level.

2. The Framework. The adverbial *in days* can be assumed to be relativized to some contextually provided number of days *C*, and predicate of a time interval *t* that its span is *C*-days.

3) $\textbf{in days}_C(t) = 1$ iff $\mu(t) = \text{C-days}$

We assume that like many Polarity Sensitive Items, *in days* obligatorily activates a set of alternatives **[Ch13]**. The meanings of these alternatives differ from the meaning of the prejacent only insofar as the time span they assign to *t* is greater or smaller than *C*-days.

4) $\text{Alt}(\textbf{in days}_C) = \{ \textbf{in days}_{C'} \mid C' < C \vee C' > C \}$

We furthermore propose that *in days* falls under the scope of E, a covert counterpart of *even* which operates on the alternatives in (4).

5) $E_{Alt}(p) = p \wedge \forall q \in Alt : p <_\pi q$,

Where $p <_\pi q$ states that p is less likely than q w.r.t. some relevant probability measure π

A parallel analysis is assumed for all temporal *in*-adverbials.

3. VP-Level Predicates. We assume that the time span to which *in seconds*$_C$ is applied in (2a) is the runtime of the destroying event, resulting in the meaning in (6).

6) $\exists e$: *e* is an event of Mary destroying her career $\wedge \mu(\tau(e)) = \text{C-seconds}$

Two types of alternatives are available for (6), viz., those where the destroying took more than C-seconds (7a), and those where it took less (7b).

7) a. $\exists e$: *e* is an event of Mary destroying her career $\wedge \mu(\tau(e)) = C^+\text{-seconds}$

b. $\exists e$: *e* is an event of Mary destroying her career $\wedge \mu(\tau(e)) = C^-\text{-seconds}$

Since these alternatives are logically independent from the prejacent, E will rely on a contingent probability distribution, placing the prejacent as the least likely alternative. We assume that alternatives less likely than the prejacent are pruned by considerations of relevance, given the absurdity of *e.g.* a career being destroyed in less than seconds. Evidence for the obligatory presence of E as opposed to other alternative-sensitive operators comes from the deviance of examples like (8).

8) *Mary destroyed her career in years.

There exists for (8) an alternative where Mary's career was destroyed in *e.g.* a few seconds (measured in fractions of years). Context lets us know that this alternative is less likely than the prejacent. Assuming that its relevance prevents it from being pruned, as it is not absurd, the prejacent of (8) will not be the least likely alternative, and so E's requirement in (5) will never be met. We claim this contextual contradiction is responsible for the deviance of (8).

4. Upward-Monotonicity and the Perfect. Let us assume for (1a) the LF schema below.

9) [E [[PERF in-days$_C$] [PRFV [Mary has had a seizure]]]]

The perfective (PRFV) denotes a set of events in which there is an event contained within the temporal index of the assignment function **[Kl94, a.o.]**.

10) $[\![\text{PRFV}]\!]^t = \lambda P_{vt}.\ \exists e: P(e) \wedge \tau(e) \subseteq t$

Following **[It02]**, we take the perfect (PERF) to create a time interval right bounded by tense. In the case of the present perfect, this right boundary is the utterance time *u*.

11) $[\![\text{PERF}]\!]^u = \lambda p_{st}.\ \exists t\text{: RB}(u, t) \wedge p(t)$

It is assumed here that in perfect-level uses, temporal *in*-adverbials receive the interval created by the perfect as their argument. Thus, the sentence in (1a) carries the meaning in (12).

12) $\exists e$: seizure(m,e) $\wedge\ \tau(e) \subseteq$ [u − C-days, u]

Two types of scalar alternatives will be activated for (12), those with a larger interval (13a), and those with a smaller interval (13b).

13) a. $\exists e$: seizure(m,e) $\wedge\ \tau(e) \subseteq$ [u − C^+-days, u]

b. $\exists e$: seizure(m,e) $\wedge\ \tau(e) \subseteq$ [u − C^--days, u]

An eventuality being contained in some interval *t* entails being contained in some *t'*$\supset$*t*. It follows that the alternatives in (13a) are entailed by the prejacent, whereas those in (13b) entail it. Since the alternatives in (13b) entail the prejacent, they cannot be less likely than it. Assuming these stronger alternatives are relevant and cannot be pruned, the alternatives must fall under the scope of an Exh operator so as to break their monotonicity. This will allow E to access a contingent probability distribution.

14) $\text{Exh}_{\text{Alt}}(p) = p \wedge \forall q \in \text{Alt} : p \not\subseteq q \rightarrow \neg q$

15) [E Exh [[PERF in-days$_C$] [PRFV [Mary has had a seizure]]]]

Exh will negate the alternatives in (13b). This implies that a seizure eventuality is contained within the interval [u − C-days, u], but that no seizure occurred within (u-C-days, u]. This results in a contextual contradiction, as it implies a seizure eventuality is contained within the interval [u − C-days, u − C-days], which is a single point in time. We take this contextual contradiction to be the cause of (1a)'s infelicity.

5. Downward-Monotonicity and the Perfect. We assume the LF in (16) for (1b) (Exh is again obligatory to obtain a contingent probability distribution). The prejacent states that no seizure occurred in the interval right-bounded at *u* lasting C-days.

16) [E Exh [not [[PERF in-days$_C$] [PRFV [Mary has had a seizure]]]]]

17) $\forall e$: seizure(m,e) $\rightarrow\ \tau(e) \not\subseteq$ [u − C-days, u]

The alternatives on which Exh operates are those in (18).

18) a. $\forall e$: seizure(m,e) $\rightarrow\ \tau(e) \not\subseteq$ [u − C^+-days, u]

b. $\forall e$: seizure(m,e) $\rightarrow\ \tau(e) \not\subseteq$ [u − C^--days, u]

The alternatives in (18a) now entail the prejacent, whereas those in (18b) are entailed by it. The former will thus be negated by the obligatory Exh, leading (1b) to carry the obligatory inference in (19), where all intervals right-bounded at *u* greater than [u − C-days, u] will contain a seizure eventuality.

23) $\forall t$: t > [u − C-days, u] $\rightarrow\ \exists e$: seizure(m,e) $\wedge\ \tau(e) \subseteq$ t

This is a prediction which accords with **[It19]**'s observation that this type of inference is indeed non-cancellable with perfect-level uses of temporal *in*-adverbials. Furthermore, they note an additional inference whereby (1b) implies that a seizure was expected earlier. This inference is predicted given the obligatory presence of E in (16), from which it follows that the likelihood of a seizure occurring in C-days is strictly less than any seizure occurring closer to the time of utterance.

6. Conclusion. We have proposed a unified analysis of temporal *in*-adverbials according to which these obligatorily activate a set of alternatives over which a silent counterpart of *even* must operate. When applied to predicates of events, no polarity sensitivity is observed given that the alternatives are in this context logically independent. In perfect-level uses, however, the logical relation between the alternatives and the obligatory use of an Exh operator account for their behavior as NPIs. We conclude that the polarity sensitivity of such adverbials is a function of the logical relationship between the alternatives they obligatorily activate. It remains an open question why VP-level uses of temporal *in*-adverbials are

incompatible with atelic predicates and why perfect-level uses are incompatible with the imperfective aspect.

References: [Ch13] Chierchia, Lo*gic in Grammar*; [It02] Iatridou, Anagnostopoulou and Izvorski, *Some Observations about the Form and Meaning of the Perfect*, [It19] Iatridou & Zeijlstra, *The Complex Beauty of Boundary Adverbials*, [Kl94] Klein, *Time in Language*