# Since ~~Since~~

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This paper concerns what may well be a new puzzle in the tense/aspect area. In order to present the phenomenon that we will be focusing on, we will first lay out our background assumptions.

## 1 The Background

Our discussion is couched within a compositional implementation of the analysis of the Perfect developed by Iatridou et.al. (a version of Extended Now of McCoard 78, Dowty 72, 79). The basics:

- The Perfect introduces a time interval: the "perfect time span" (PTS).

- The Right Boundary (RB) of the PTS is set by Tense.

- The Left Boundary (LB) of the PTS may be set by "perfect adverbials".

- The lower predicate (event) is predicated of the PTS, either directly or mediated by various devices, most notably operators associated with the Perfective or Imperfective.

- When the predicate has the subinterval property, either because of its inherent properties or because it is a derived stative/progressive, we obtain the Universal Perfect (U-Perfect).

- When a predicate is located within the PTS via an existential operator (possibly associated with the Perfective), we obtain the Experiential Existential Perfect (E-Perfect).

For example, (1a) is an E-Perfect with the meaning in (1b):

(1)    a.    Tony has visited Cape Cod since 1990.
        b.    There is a time span (i) whose RB is now/the time of utterance (because of the Present Tense), (ii) whose LB is (some time in) 1990, and (iii) which has a subinterval at which it is true that Tony visits Cape Cod.

And (2a) is a U-Perfect with the meaning in (2b):

(2)    a.    Tony has been living on Cape Cod since 1990.
        b.    There is a time span (i) whose RB is now/the time of utterance (because of the Present Tense), (ii) whose LB is (some time in) 1990, and (iii) for every subinterval of which it is true that Tony lives on Cape Cod.

## 1.1 Compositional Structure

### 1.1.1 Times as Parameters of Evaluation

We will work within an intensional framework. Expressions are evaluated relative to two times: the utterance time and the current evaluation time. The "times" that we will be using are intervals with time points as a limiting case. Times/intervals can be thought of as sets of contiguous time points. One interval containing another can be thought of as a subset-superset relation. We also talk of intervals preceding and succeeding each other. We assume that the utterance time is conceived of as a time point. We keep track of the utterance time throughout the compositional derivation, so that deeply embedded occurrences of adverbials like *now* or embedded occurrences of Present Tense can refer to the utterance time. The other time parameter, the evaluation time, is manipulated by temporal/aspectual operators as we move downwards in a tree. To graphically distinguish the two time parameters, we write the utterance time as a superscript on the left interpretation bracket and the evaluation time as a superscript on the right. Initially, the evaluation time is set to be identical to the utterance time by the following pragmatic principle:

(3)    An utterance of a tree $\phi$ at a time u is true iff $^{u}[\![\phi]\!]^{u} = 1$.

### 1.1.2 Tense

Up high in the sentence, we find Tense. Present tense (re)sets the evaluation time to be identical to the utterance time. Past tense is interpreted as claiming that there is a time before the previous evaluation time of which the rest of the tree is true.

(4)  a.  $^u[\![\textsc{Pres } \phi]\!]^t = 1$ iff $^u[\![\phi]\!]^u = 1$.
     b.  $^u[\![\textsc{Past } \phi]\!]^t = 1$ iff $\exists t' \prec t : {}^u[\![\phi]\!]^{t'} = 1$.

A simple Past tense sentence like "Bill insulted Tony" gets this analysis:[1]

(5)  a.  $[_{TP} \textsc{Past } [_{VP} \text{Bill insult Tony}]]$
     b.  $\exists t \prec u :$ Bill insult Tony at $t$.

### 1.1.3 Aspect

Beneath tense there is a functional projection that is crucially involved in the aspectual specification of the sentence. This functional projection, which we will label 'Asp' for aspect, can contain the featural specification for Imperfective (Imp) or Perfective (Prf). There is considerable literature on the question of how best to capture the meaning of Imp and Prf. Here, since we will just have to settle on some assumption, we will follow IAI and refs in the following:

(6)  a.  $^u[\![\textsc{Prf } \phi]\!]^t = 1$ iff $\exists t' \subseteq t : {}^u[\![\phi]\!]^{t'} = 1$.
     b.  $^u[\![\textsc{Imp } \phi]\!]^t = 1$ iff $\exists t' \supseteq t : {}^u[\![\phi]\!]^{t'} = 1$.

In other words, the meaning of Prf is that the inner VP is true at some interval $t'$ which is a subinterval of the time of evaluation $t$. Conversely, the meaning of Imp is that the VP is true at an interval $t'$ which is a superinterval of $t$.[2]

We now have everything in place to calculate the meaning of sentences like "Bill was insulting Tony":

(7)  a.  $[_{TP} \textsc{Past } [_{AspP} \textsc{Imp } [_{VP} \text{Bill insult Tony}]]]$
     b.  $\exists t \prec u : \exists t' \supseteq t :$ Bill insult Tony at $t'$.

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[1]We pretend that the LFs we interpret are ones where all the material in the VP has remained *in situ*.

[2]Our meaning for Imp does not introduce other possible worlds which would be necessary if we wanted to capture the full meaning of the English progressive ("John was crossing the street when the truck hit him"). For the purposes of this paper, we will pretend that the English progressive is simply an alternative way of realizing Imp.

This would mean that some past period is surrounded by a complete event of Bill insulting Tony.

### 1.1.4 The Perfect

We will follow IAI in the position that the Perfect corresponds to a functional projection that is immediately dominated by Tense, and which in turn immediately dominates Asp. As mentioned above the Perfect introduces a new interval (the "Perfect Time Span" or PTS) as the evaluation time. The PTS takes the evaluation time it receives from the higher Tense as its Right Boundary and stretches backward in time. This PTS is then fed downward as the new evaluation time to the rest of the tree.

(8)  $^{u}[\![\text{PERF } \phi]\!]^{t} = 1$ iff $\exists t' : RB(t, t')$ and $^{u}[\![\phi]\!]^{t'} = 1$.

(9)  $RB(t, t')$ - $t$ is the Right Boundary of $t'$ - iff
$t \cap t' \neq \emptyset$ and $\exists t'' \subseteq t : t' \preceq t''$.

The Left Boundary of the PTS can be determined by "perfect level adverbials". These are adverbials that appear between the Perfect operator and the Aspect operators lower down. Here is the meaning of *since 1990*:

(10)  $^{u}[\![\textit{since 1990 } \phi]\!]^{t} = 1$ iff $LB(1990, t)$ and $^{u}[\![\phi]\!]^{t} = 1$.

(11)  $LB(t, t')$ - $t$ is the Left Boundary of $t'$ - iff
$t \cap t' \neq \emptyset$ and $\exists t'' \subseteq t : t' \succeq t''$.

There are two things to note:

- According to our analysis, an interval that *since 1990* is true of is one that starts *some time in* 1990. 1990 is a Left Boundary of the PTS iff the PTS starts some time in 1990. This seems correct: our example sentence *Tony has been living on Cape Cod since 1990* leaves it open exactly when in 1990 he started living there.

- This treatment does not by itself predict that *since*-adverbials are perfect-level adverbials. For example, as it stands they could be used to modify the interval introduced by tense. That is, they could say of some kind of extended Present that it stretches back to 1990 and the same might occur with a simple Past. In fact, there are such uses of the German *seit*-adverbials. For English, we need to introduce a stipulation. We quote from von Stechow:

4

For the time being, we require the following:

Perfect-level adverbials:
*since t* must be immediately embedded under PERF

It is not clear what the theoretical status of this stipulation is. Perhaps it can be subsumed under a feature checking mechanism in the sense of the Minimalist Program. It is, of course, precisely this syntactic restructions that makes *since t* a perfect-level adverbial and there seems to be no way of getting rid of this constraint, one of the idiosyncracies of English.

Another way of blocking the structure would be to let *since t* to modify PERF directly. But this would be even more clumsy because PERF could not be an existential quantifier in that case. The adverbial would have to modify the relation $RB$ directly and the existential closure could be made after the modification.

## 1.2   Some Examples

Now, we can calculate the meanings for our two sample perfect sentences. First, the U-Perfect:

(12)    a.    (=(2a)) Tony has been living on Cape Cod since 1990.
        b.    [$_{TP}$ PRES [ PERF since 1990 [$_{AspP}$ IMP [$_{VP}$ Tony live on Cape Cod ]]]]
        c.    $\exists t : RB(u, t)$ and $LB(1990, t)$ and $\exists t' \supseteq t$ : Tony live on Cape Cod at $t'$.

This claims that there is an interval stretching backwards from now (the utterance time) to some time in 1990, which is part of a potentially larger interval at which Tony lives on Cape Cod. Now, if Tony lives on Cape Cod at a particular interval, that means in fact that he lives there *throughout* that interval, since *live* has the subinterval property. Thus, we have successfully derived the U-Perfect reading of (12a).

Let's turn to the other example:

(13)    a.    (=(1a)) Tony has visited Cape Cod since 1990.
        b.    [$_{TP}$ PRES [ PERF since 1990 [$_{AspP}$ PRF [$_{VP}$ Tony visit Cape Cod]]]].
        c.    $\exists t : RB(u, t)$ and $LB(1990, t)$ and $\exists t' \subseteq t$ : Tony visit Cape Cod at $t'$.

Here, the PTS between now and (some time in) 1990 is claimed to contain an interval at which Tony visits Cape Cod. This is the E-Perfect.[3]

We should mention one more kind of example. There are in fact E-Perfect readings with predicates that usually have the subinterval property. The following can, at least marginally, be read as an E-Perfect:

(14)    Tony has lived on Cape Cod since 1990.

The reading is forced with an explicit existential operator:

(15)    Tony has lived on Cape Cod at least once since 1990.

Even with progressives, such E-Perfect readings are sometimes available:.

(16)    Have you ever been running when it started to rain so hard you had to stop?

We can derive such examples either by positing a PRF projection on top of the subinterval predicate (including those that may be introduced by an IMP phrase), or by introducing an extra layer of existential quantification (analogous to the explicit *at least once* in (15)).[4]

This concludes our overview of the analysis of the Perfect that we will be assuming. We realize that we have glossed over many issues and ignored many alternatives. We think that the puzzle we explore in the following arises in any reasonable analysis of the Perfect and should be of interest therefore even to people who have severe doubts about our assumptions. Before we turn to the puzzle, we need to introduce one more set of preliminary data.

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[3]As it stands, our meaning does not exclude that the visit is ongoing at the utterance time. In fact though, it seems one would have to say *Tony has been visiting Cape Cod (ever) since 1990* or even *Tony has been on a visit to Cape Cod since 1990.* If we wanted to exclude such a reading for (13a), we could explore making PRF introduce a *proper* subinterval of the previous evaluation time.

[4]There is one more possibility: we might explore the possibility that the perfect-level adverbials, rather than being mere predicates of intervals, themselves introducing quantification over parts of the PTS. In that case, the adverbials could be ambiguous between E-readings ("some time in the PTS") and U-readings ("throughout the PTS"). This is in fact what IAI proposed. There are at least two reasons to be skeptical about such a solution: (i) As IAI note, many temporal adverbials can be used both with E and U readings. Positing a rampant ambiguity in the adverbials would miss a generalization. The optional presence of an existential quantifier over parts of an interval is a more economical solution. (ii) Later in this paper, we will present an argument that suggest that the putative existential *since* and universal *since* are deemed identical by an ellipsis process, suggesting that there is in fact no such ambiguity in *since* itself.

## 2 Clausal Complements to *Since*

In (1a)/(2a), the argument of the perfect adverbial *since* is *1990*, which we have assumed is interpreted as the name of an interval, which is exactly the kind of argument *since* is looking for. There are other possibilities. *Since* can also take names or definite descriptions of events as its argument:

(17)     since the World Cup, since Meadow's graduation ceremony

For such cases, we assume that there is a mediating function from events to the time interval they occupy. This gets inserted into the logical structure to provide *since* with the kind of argument it needs.[5]

 More interesting are cases where *since* takes a clausal complement. Intuitively in such cases, the LB of the PTS is the time of the event described in the complement of *since*:

(18)     a.    Tony has visited Cape Cod two times since Bill insulted him.
         b.    Tony has been living on Cape Cod since Bill insulted.

Iatridou (2001) argued that in such cases, the *since*-adverbial contains a definite description of a time interval, here, the time at which Bill insulted Tony. This was argued partially on the basis of the fact that for these sentences to be felicitous there must be a unique salient event of Bill insulting Tony:

(19)     a.    Bill insulted Tony several times: once in 1990, once in 1993 and
               then again in 1997.
         b. #It has been 11 / 8 / 4 years since Bill insulted Tony.[6]
         c. #Tony has been living on Cape Cod since Bill insulted him.
         d. #Tony has visited Cape Cod two times since Bill insulted him.

If modifiers like *for the first/second/last time* etc. are added then we can rescue (19b-d) by making one particular occurrence salient.

 Note also that in (18) the PTS is empty of the type of event described in the *since*-clause. In other words, there is no event of Bill insulting Tony between LB and RB. As pointed out in Iatridou 2001, it won't do to assume

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[5]Of course, one could also say that *since* is slightly ambiguous. One homonym would be the one we defined and the other would take an event as its argument and return the same result as its relative would have if it had been applied to the time interval the event occupies. Take your pick.

[6]This sentence is an instance of the type of perfect that Iatridou 2001 was concerned with.

that a covert *for the last time* is always present in a *since*-clause because then a sentence like (20a) would have to have the status of (20b):

(20)  a.  It has been three years since his cat died.
      b. #It has been three years since the last time his cat died.

That is, there is no meaning of *last* in the *since*-clause; the *since*-clause is used felicitously only if there is a single salient event. In short it is a definite singular.

How exactly is this interpretation of the *since*-clause derived when its argument is clausal? First, note that there is a type mismatch. The meaning for *since* that we are working with is one that needs to combine with a time interval. But here the complement to *since* is a sentence. The extension of a sentence is a truth-value, its intension is a predicate of times (a proposition). So, can't we just say then that an operator intervenes that takes us from a predicate of times to *the* time it is true of, given that we just suggested that there is a definite description underneath *since*? That won't work because the times that "Bill insulted Tony" describes are times in the past of which Bill insulted Tony. That is not what *since* takes as its argument. Rather we suggest that the definite operator originates inside the clausal complement. More precisely, we suggest that the operator originates as the argument to a silent temporal preposition AT. Since this preposition wants a time interval as its argument but the operator is a definite operator, the operator needs to move out. It lands just under *since*.

(21)  $^{u}[\![\phi \ \text{AT} \ i]\!]^{t} = 1$ iff $^{u}[\![\phi]\!]^{t} = 1$ and $^{u}[\![i]\!]^{t} = t$.

(22)  a.  since [$_{TP}$ PAST [$_{VP}$ [$_{VP}$ Bill insult Tony] [AT Op ]]].

      b.  since Op $\lambda t$ [$_{TP}$ PAST [$_{VP}$ [$_{VP}$ Bill insult Tony] [ AT $t$ ]]].

Now, all the operator has to do is to deliver to us the time $t$ such that Bill insulted Tony at $t$. In other words, the operator is a function from predicates of times to the unique time they are true of. In essence, the interpretation of the operator is *the time at which*.

There is one complication. The clausal complement to *since* can also contain a predicate with the subinterval property:

(23)  Tony has been happy since he lived on Cape Cod.

But what is "the" time at which Tony lived on Cape Cod? If Tony ever lived on Cape Cod, there are many past intervals at which he lived there, namely

all the subintervals of the maximal stretch of time throughout which he lived on Cape Cod. So, how can the definite reference succeed? We suggest that the definite here in fact picks out the maximal interval of which the property holds. This is not unheard of for definite operators.[7]

In the above reasoning, the movement of the operator is semantically motivated but we can see it in the syntax as well, through the existence of lower readings of the kind associated with movement of operators (Larson 19xx). Sentence (24a) can be interpreted as (24b):

(24)  a.  He has been to the Cape two times since Mary believes that Bill insulted him.
      b.  He has been to the Cape two times since the time at which, according to Mary, Bill insulted him.

Predictably, the movement cannot cross an island: (25a) cannot be interpreted as (25b):

(25)  a.  He has been to the Cape many times since Mary heard the rumour that Bill insulted him.
      b.

From now on we will consider as given the existence of operator movement inside a *since*-adverbial with a clausal complement.

## 3   The Puzzle

We are now in a position to look at the data that are the center of this paper. Consider the following sentence:[8]

(26)    Tony has been happy since he has been taking Prozac.

The morphosyntax in the matrix clause is one that permits the U-Perfect reading, in fact the most salient reading in this case. This means that Tony's happiness extends throughout the PTS. How is the PTS determined here? Its RB is the utterance time, as we are dealing with a Present Perfect. But what is its LB? From what we have said so far, LB is provided by the complement of *since* and it is the type of event that PTS is empty of, as per our discussion of (18). What about in (26), however? Here it seems that the

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[7]We will soon have to revise this conception of the meaning of the operator one more time.

[8]Such sentences were first noted by Iatridou in her paper on "Temporal Existentials".

PTS is not just empty of the eventuality described in the *since*-adverbial (henceforth "*since*-event" as opposed to matrix event). On the contrary, the *since*-event holds throughout the PTS as well. In other words, according to (26), Tony started being happy when he started taking Prozac and the time of his being happy and his taking Prozac extends up until and including the time of utterance.[9] We will call the interpretation of (26) "simultaneous reading" (SR).

The first question that has to be asked is which two things are actually simultaneous. Above we spoke as if it were the case that in SR the *since*-event and the matrix event must coincide temporally. But actually this is so only derivatively. What actually proves to be the case is that in SR the *since*-event coincides temporally with the matrix PTS. Because in (26) the matrix event fills out the PTS, we derive by transitivity the fact that the *since*-event temporally coincides with the matrix event. But we can tease the ingredients apart by enforcing an E-Perfect reading of the matrix Perfect. Then it becomes clear that the *since*-event temporally coincides with the matrix PTS and not with the matrix event. Consider the following:

(27)    Tony has been to the Cape two times since he has been taking Prozac.

Clearly (27) is a case of E-Perfect. In short, in SR the *since*-event temporally coincides with the matrix PTS.

We see that we can have SR regardless of whether the matrix Perfect is a U-Perfect or an E-Perfect. What about the clausal complement of *since*? Are there any morphosyntactic conditions that need to be fulfilled by the complement of *since* for SR to arise? In (27) and (26) the *since*-adverbial contains a Perfect. It turns out that a Perfect inside the *since*-adverbial is not just possible but necessary for SR: all of the sentences in (28) and (29) lack SR (in fact, for some speakers (29a,b) are ungrammatical).[10]

(28)    a.    Tony has been happy since he took Prozac.

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[9]Strictly speaking, our analysis will not quite deliver what we say about the meaning of (26) here. What we derive is that throughout the time from when Tony started taking Prozac until now Tony has been happy. This leaves open that he started being happy before he started taking Prozac. We believe that an implicature is responsible for the inference that he started being happy only when he started taking Prozac. This implicature can be cancelled:

(i)    Tony has been happy since he has been taking Prozac, and perhaps even longer.

[10]Throughout the paper we will be ignoring the causal reading of *since*.

b. Tony has been to the Cape twice since he took Prozac

(29) a. Tony has been happy since he was/*is in the hospital.
  b. Tony has been to the Cape twice since he was/*is in the hospital.

So for SR, we need a Perfect in the *since*-adverbial. In the cases of SR that we have seen so far (26)/(27), the Perfect in the *since*-adverbial has U-Perfect morphosyntax (perfect of an imperfective) and as we will soon see, also a U-Perfect interpretation. The next question then is whether we can have SR with an E-Perfect in the *since*-adverbial. The answer is no. In fact, an E-Perfect inside the adverbial leads to ungrammaticality, a fact which will be explained later in the paper:

(30) *Tony has been happy since he has visited the Cape.

To summarize, for SR, there is no requirement on the type of Perfect the matrix may contain but the Perfect in the *since*-adverbial must be a U-Perfect.

Once we realize that the *since*-adverbial must contain a Perfect, it follows automatically that there is another PTS involved, namely the PTS corresponding to the Perfect in the adverbial. We have then the matrix-PTS and the *since*-PTS.

Having noted that the *since*-adverbial contains a Perfect and therefore has its own PTS, we can now proceed to what we believe is the most appropriate paraphrase for (26), namely:

(31) Tony has been happy since the time since which he has been taking Prozac.

In (31) we see which two intervals the simultaneity relation holds of in SR. We said earlier that it is the matrix PTS, not the matrix event-time that is involved. Now we see that it is the *since*-PTS that is involved, not the time of the *since*-event. But since in the adverbial there is a U-Perfect, its predicate holds throughout the adverbial PTS; hence the illusion that simultaneity holds between the matrix PTS and the time of the adverbial's predicate. In short, in SR, it is the two PTSs that are simultaneous. In the next section we attempt to find (31) in (26).

# 4  Deriving SR

How do we get (26) to have the meaning in (31)?

## 4.1 What Doesn't Work

Our first idea might be to use the same technique that we employed with "Tony has been happy since he lived on Cape Cod". Here is the LF we would get for the *since*-clause in (26):

(32)  since Op $\lambda t$ [$_{TP}$ PRES [ PERF [$_{AspP}$ IMP [$_{VP}$ [$_{VP}$ he take Prozac] [ AT $t$ ]]]]]].

What *since* is given as its argument in (32) is the definite description: "the time $t$ such that there is a PTS stretching backwards from now such that that PTS is included in a time $t'$ which is a time at which Tony takes Prozac and which is identical to $t$". Because the operator tries to find the maximal time that satisfies the description, the time referred to is in effect the time interval from now backwards to when Tony started taking Prozac. Now, this would be the argument given to *since*. There are two major problems with this.

1. We get a rather trivial meaning for (26). All it would claim is that Tony's started being happy some time in the large interval between when he started taking Prozac and now. So, it would be true if he started being happy yesterday while he started taking Prozac last year. As we have shown, this is not what (26) means.

2. Even if we could dream up some way of getting the right meaning, it seems that we can show that *since* cannot take an interval as its argument that reaches all the way to now. Imagine that Tony has been taking Prozac since the beginning of this month. So, under the analysis we're considering the argument of *since* is just the interval that we could refer to with *this month*. But in fact we cannot use *this month*:

(33)   a.   Tony has been happy since he has been taking Prozac.
       b. #Tony has been happy since this month.

We conclude that this attempt fails.


## 4.2 What Works

Here it is step by step. We suggest that we should take seriously the apparently adequate paraphrase of (26) in (31). We propose that in fact, the complement of *since* in (26) contains its own *since*-adverbial. This lower

*since* has in its argument position our definite operator $Op$. As before, a temporal description is formed by moving the covert operator:

(34)  a.  since $Op$ $\lambda t$ [ PRES [ PERF [ IMP [ [ he take Prozac ] [ since $t$ ]]]]]].

  b.  simplified notation:
      since [ $Op_t$: he has been taking Prozac since $t$ ]

This temporal description can QR:

(35)  [$Op_t$: he has been taking Prozac since $t$] $\lambda t'$ Tony has been happy since $t'$.

After QR, the lower *since*-phrase can be ellided since parallelism is satisfied:

(36)  [$Op_t$: he has been taking Prozac ~~since $t$~~] $\lambda t'$ Tony has been happy since $t'$.

In other words, (26) is a case of Antecedent Contained Deletion.

## 4.3   The Interpretation of $Op$

We are not quite done. For us to get the right interpretation for (26), we need closely consider what interval is picked out by "the time since which Tony has been taking Prozac". Assume that Tony started taking Prozac at 3 p.m. on October 28, 1998. Then it is true that Tony has been taking Prozac since 1998. It will also be true that Tony has been taking Prozac since October 1998. It will also be true that Tony has been taking Prozac since late October 1998. And so on: there are many intervals that contain the actual starting point of Tony's taking Prozac. So, we might think that we should simply pick out the smallest such interval: that will deliver the actual starting point.

But no: it gets worse. Strictly speaking it is also true that Tony has been taking Prozac since early 2000. Why? Because our semantics delivers an *at least since*-reading. If we infer from someone claiming "Tony has been taking Prozac since early 2000" that early 2000 is when Tony started taking Prozac, that is to be seen as a quantity implicature. Because of the presence of these intervals, there won't even be a minimal interval in the set of intervals that the operator operates on.

So, how can the starting point be found? We suggest that what the operator does is find in the set of intervals that interval from whose presence in the set we can deduce the presence of all the others in the set. Intuitively,

the operator finds "the most informative" interval in the set. And that will be the smallest leftmost interval in the set.

Note that it is not just for our construction that we need this procedure. It is also needed for a question like this:

(37)     Since when has Tony been taking Prozac?

We said earlier that we follow the argumentation in Iatridou according to which the content of the argument of the *since*-clause provides a definite description. In this section we argued that this definite description should be interpreted as picking out the most informative interval, rather than the unique or the largest interval, which would have been the expected move if we were dealing with a common semantics for the determiner *the*. A standard Link-style semantics for *the* would look as follows:

(38)     *The $\phi$* is defined only if there is a maximal object $x$ st. $\phi(x)$. When defined *the $\phi$* refers to the maximal object $x$ st. $\phi(x)$.

We saw above that this definition will bring about a presupposition failure in the case of the definite description in a *since*-clause, as there is no unique (maximal or minimal, for that matter) interval that will fit. For this reason we suggested that the definite description picks out the maximally informative interval. Does this mean that the argument of the *since*-clause is a special type of definite description? von Fintel, Fox and Iatridou (in progress) suggest the opposite, namely that the definite description in a *since*-clause showcases exactly the canonical meaning of *the*, which in fact, should in general replace the Link-style semantics for *the*. Instead of (38), they propose (39):

(39)     *the $\phi$* is defined only if there is a unique individual $x$ such $\phi(x)$ is a maximally informative proposition among the true propositions of the form $\phi(x)$. When defined *the $\phi$* refers to the individual $x$ st. $\phi(x)$ is the maximally informative true proposition of the form $\phi(x)$.

For quite a few cases, Link's definition and (39), will pick up the same individual but there are many cases (in addition to the one focused on above) where the two definitions make different predictions. Look, for example, at the totally acceptable (40) and (41):

(40)     I have the amount of flour sufficient to bake a cake

(41)     The number of Greek soldiers who together can destroy the Trojan army

14

According to (38), the DPs *the amount of flour sufficient to bake a cake* and *the number of Greek soldiers who together can destroy the Trojan army* are undefined and therefore (40) and (41) should suffer from presupposition failure. The reason is that there is no maximal amount of flour that is sufficient to bake a cake; there is no maximal number of Greek soldiers that together can defeat the Trojan army. If an amount of flour $f$ suffices to bake a cake then any amount larger than $f$ will also do; If a number $s$ of soldier can get the job done then any number larger than $s$ will also. So there is no maximal amount of flour or number of soldiers to be found. In fact, what we are picking out in (40) and (41) is the minimal amount of flour and the minimal number of Greek soldiers. Hence Link's definition predicts a presupposition failure for these sentences.

According to (39), however, the article *the* is defined because it picks out the minimal amount of flour and the smallest number of soldiers. It does this exactly because the most informative amount and number is the smallest amount $f$ and smallest number $s$ in (40) and (41). This is because it is with $f$ and $f$ that all the sentences containing amounts $m_{\text{¿}} f$ and numbers $n_{\text{¿}}s$ are asymmetrically entailed. And if we had picked an $m$ or $n$ larger than $f$ or $s$ then the propositions containing $m$ and $n$ would not have entailed the propositions with amount $q$ and number $r$, where $f \prec q \prec m$ and where $s \prec r \prec n$.

Von Fintel, Fox and Iatridou also discuss cases where Link's definition predicts an acceptable sentence because *the $\phi$* is defined according to (38), but where in fact the sentence suffers from presupposition failure because *the $\phi$* is not defined according to (39).

## 5  Further Issues

There are several issues that need to be addressed before we can rest.

### 5.1  Preposition Stranding

In cases of ACD in prepositional phrases (as in Larson (19xx)), the ellipsis of the proposition itself is optional:

(42)    He lived in whatever town you lived (in).

But in SR, the proposition must elide:

(43)    *Tony has been since he has been taking Prozac since.

What is this difference due to? Preposition stranding of *in* is possible and optional:

(44)  a.  In which city does he live?
      b.  Which city does he live in?

Preposition stranding of *since* is not possible (we will return to why this might be so:

(45)  a.  Since when have you been living on the Cape?
      b.  *When have you been living on the Cape since?

So it is the stranding of *since* in (43) that explains its ungrammaticality. Danny Fox (p.c.) suggests that what happens in (26) is that it is the deletion of stranded *since* that rescues the structure, along the lines of salvation by deletion, of the type proposed in Lasnik () and Merchant ().

## 5.2  Alternatives

One might wonder whether the spirit of our account could be maintained while changing the technicalities. Two suggestions have been made:

1. von Stechow: deletion under PF-adjacency

2. Zimmermann: posit silent SINCE just as we posited silent AT.

## 5.3  Absence of E-Perfects in *Since*-Complements

We have seen by now plenty of examples where the *since*-clause contains a U-Perfect. However, we also saw that an E-Perfect cannot appear in a *since*-clause:

(46)  *Tony has been happy since he has visited the Cape

Why should this be? Given what we have said so far, we should exclude two possible derivations for (46). The first derivation we have to exclude is one with the *since*-clause containing the operator AT, as with the examples where there is a past tense in the *since*-clause:

(47)  Tony has been happy since he visited the Cape

The other derivation that we have to exclude is the one where the *since*-clause contains another *since*-clause, as with the sentences yielding the SR reading.

Let us start by trying to exclude the first possible derivation for (46). What is wrong with (48):

(48)     since Op $\lambda t$ [$_{TP}$  [$_{VP}$ [$_{VP}$ he has visited the Cape] [ AT $t$ ]]].

Here we will venture that the reason is that in English, we do not have access to the event time in the Present Perfect (the famous "Present perfect Puzzle"), evidenced by examples like (49):

(49)     *John has left at yesterday

For this reason, there is no AT operator to be had, so to speak. This predicts that in languages like German, which don't have the Present Perfect Puzzle, a sentence like (51) should be fine with the derivation in (48), and this

(50)     Er ist gestern     abgreist.
         He is  yesterday departed.
         "He has left yesterday."

(51)     Tony ist glücklich seit   er  das Cape besucht hat.
         Tony is  happy     since he the Cape visited  has.
         "*Tony has been happy since the time he has visited the Cape at."

The second derivation that we need to exclude is the one in which there is a *since*-clause inside the *since*-clause. This would make (52) parallel to (53), which is in our narrative what underlies the SR.

(52)     Tony has been happy since the time *since which* he has visited the Cape

(53)     Tony has been happy since the time *since which* he has been taking prozac

Why is (53) an option but (52) is not? We would like to propose that the reason that (52) is bad is the same reason for which (54) is:

(54)     *Since when have you lived on the Cape two times?[11]

In other words, we cannot extract the italicized items in (53). On the other hand, (54) is fine, as doing the relevant extraction in a U-Perfect is fine:

(55)     Since when have you been living on the Cape?

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[11]This has an irrelevant acceptable reading under which it is a somewhat rhetorical question akin to *Since when do you like artichokes?* Note by the way that the artichoke question is that rare animal of a *since* that does not trigger the perfect.

Why is this extraction not possible in the case of the E-Perfect? There are two possible ways to go at this point. Fox and Hackl (2004) discuss (54) as reported in a previous version of the current paper. They argue that its unacceptability is due to the fact that it is not possible to satisfy the presupposition of the definite description in the *since*-clause. The reason is that the domain of time is dense. As a result it is not possible to find *the* time since which an event happened. On the other had, (55) is fine because the definite description picks out the time at which the living on the Cape started.

The above explanation will account for the unacceptability of (54) and therefore of that of (52). However, we should point out that there appears to be a broader constraint against certain adjunct extractions in an E-Perfect:

(56)    a.  *How have you travelled to India since I saw you last?
        b.   How have you been travelling to India since I saw you last?

(57)    a.   How many times have you traveled to India since I saw you last?
        b.   Where have you traveled since I saw you last?

(58)    a.  *Why have you read Anna Karenina twice [since 1990]$_F$?
        b.   Why have you been reading Anna Karenina [since 1990]$_F$?

The account of Fox and Hackl does not extend in any obvious way to these examples. It may well be the case that the E-Perfect is some sort of weak island, though we do not know at this point why this should be so.

In summary, at this point we have two ways to account for the unacceptability of (52). But whichever way proves right, there is good reason to believe that the unacceptability of (54) underlies the unacceptability of (52).

## 5.4  *Since*-Deletion in Other Languages

We noted earlier that in principle it is hard to explain why *since*-adverbials in English only occur with the perfect. And sure enough, other languages are not so picky. In German for example, U-readings are produceable with a simple present:

(59)    Tony nimmt seit   1990 Prozac.
        Tony takes   since 1990 Prozac
        'Tony has been taking Prozac since 1990.'

As we might expect, we find the same SR readings that we have attributed to *since*-deletion:

(60)    Tony ist glücklich seit   er  Prozac nimmt.
        Tony is   happy       since he Prozac takes
        'Tony has been happy since he has been taking Prozac.'

The same facts hold in Bulgarian and Greek.