

The English Perfect is Past¹

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Abstract. This paper argues that the English Perfect is uniformly an embedded Past. This paper shows that differences in meaning between Present Perfect and Past, which are apparently problematic for this theory, are due to the requirement that frame adverbials merge high and directly interact only with the highest tense. Despite attaching high, frame adverbials constrain event time, in the same way modals may constrain temporal interpretation at a distance (Klecha 2016).

Keywords: tense, aspect, perfect, adverbs, frame adverbials, temporal adverbials

1. Introduction

It is well known that in many ways the English Perfect (1) has a very similar meaning to the English Past Tense (2).

(1) John has left.

(2) John left.

As Reichenbach (1947) noted, both constructions convey anteriority of the time associated with the eventuality described by the verb (event time, henceforth ET) with respect to another time. Reichenbach likened the Simple Past to the Present Perfect in that both place event time prior to utterance time (UT). According to Reichenbach, they differ in terms of the placement of a third time parameter, Reference Time (RT); RT coincides with UT in the case of Present Perfect, and with ET in the case of the Simple Past.

Since Reichenbach, temporal semanticists have of course sought to explain the meanings of sentences like (1) and (2) compositionally, rather than by reference to constructions, which as it turns out are clearly divisible into smaller morphological units. The Present Perfect, for example, seems very clearly to be composed of the Present Tense, and a second thing, which we may call the Perfect. A Neo-Reichenbachian approach to English would therefore say that what Present Tense uniformly accomplishes in that language is to identify² RT with UT, and in turn what the Perfect does is to place ET prior to RT.

While it's hard to have clear intuitions about RT (since it is not necessarily associated with either the eventuality described by the verb or the speech event), support for this idea comes from the other things with which the Perfect may combine, for example, past tense.

¹I would like to thank Karlos Arregi, Itamar Francez, Atle Grønn, Sabine Iatridou, Marcin Morzycki, and audiences at SUB 20 and NELS 45. All errors are my own.

²Or associate by some other relation, like *overlap*.

- (3) John had left.

Again, on the Neo-Reichenbachian view, tenses relate UT to RT, thus, in (3), Past Tense places RT prior to UT. Perfect once again places ET prior to RT. In this case, RT may easily relate to a previously mentioned event. For example, in (4b), RT is the event of Daniels walking into the bar, described in (4a).

- (4) a. Daniels walked into the bar.
b. McNulty had left.

So on this view Past Tense contributes the information that RT is prior to UT, while the Perfect contributes the information that ET is prior to RT.

The compositional approach to this issue can be taken to its logical conclusion by positing that what temporal operators like the Present Tense, Past Tense, and Perfect contribute is not a relation between two specified times, (e.g., UT and RT in the case of Present Tense), but rather, that all of these operators contribute only the temporal relation, while the question of which two times they relate is answered entirely by the compositional procedure. This, of course, has to be true to some extent; it can't be that the Perfect morpheme in (4b), for example, states explicitly that RT is later than McNulty's leaving. It must be that the Perfect morpheme takes a temporal argument, which it then relates to its RT argument. In this case, RT is the contextually provided walking-in event; ET is the syntactically provided leaving event.

This paper advances the argument that the only thing temporal operators contribute is a relation, while composition determines which two times they relate. Specifically, this paper makes this argument for the case of the English Perfect, which, as a consequence of this proposal, is semantically unified with the Past Tense. Since the semantics has no way of knowing whether a particular time is an event time or a reference time, a temporal operator cannot be specific to either of them; which of the two it takes as an argument is determined entirely by syntax.³ Past Tense, when it is fed UT and RT, behaves as Reichenbach's Simple Past. When it is fed RT and ET, it behaves as one of Reichenbach's Perfect constructions.

The obstacle to all of this is what Klein (1992) calls the Present Perfect Puzzle. While in many cases, the Perfect can be quite readily reduced to the Past semantically, the *Present* Perfect, which on the account dimly sketched so far should be almost indistinguishable from the Past, differs from it in a number of curious ways. To give one quite famous example, it is incompatible with certain past time adverbials (5b); notice that no such incompatibility exists in other cases, seen in (5c-e).

³This is not say that it's impossible to posit a semantics by which ET and RT are distinguishable. For example, many analysis argue that operators like the Perfect do not manipulate the time associated with an event, but rather the event itself; thus there is a type-difference between E(T) and RT. I discuss such proposals below.

- (5) a. John left the day before.
b. #John has left the day before.
c. John had left the day before.
d. John must have left the day before.
e. Having left the day before, John was unhappy.

The major challenge this paper sets out to overcome, therefore, is this Puzzle – if the Present Perfect is merely the Present plus the Past (and given the assumption of a very light semantics for the Present) why should any differences arise between the Present Perfect and the Past? As I argue in detail below, all of these differences can be identified with the way that these operators interact with temporal adverbials. Given this fact, I propose that the highest temporal operator in any sentence is the only which has a privileged interaction with temporal adverbials, and therefore, the fact that Past fills this role in the case of simple Past, but not in the case of Present Perfect, derives all the crucial contrasts.

Note that this proposal is married to the longstanding proposal that the English Perfect may also be *morphosyntactically* reduced to Past Tense (Hoffman 1966, McCawley 1971, Hoffman 1976, McCawley 1988). On this view, the English form *have/-en* is merely the realization of Past in non-finite contexts, i.e., embedded directly under another Past Tense (5c), embedded directly under a modal auxiliary (5d), or embedding under the adverbial-forming *-ing* (5e). This is supported by the fact that for many verbs, the verbal morphology witnessed in the Past and the Perfect are identical; for example, *leave* is inflected *left* in both (5a) and (5b-e). What is left to be explained, of course, is why for many verbs the morphology is not identical (e.g., *see/saw/seen*), and why the light verb *have* appears, when it does not in the case of the Past. For an account of these facts, see Arregi and Klecha (2015).

This paper proceeds as follows. First I lay out the crucial data that I intend to account for, and sketch how my analysis does so. Then I briefly sketch the analysis in prose. Then I formalize the analysis and provide derivations, before comparing my approach to previous ones and concluding.

2. Ways the Past and Present Perfect Differ

On my analysis, the role of a frame adverbial is to establish the Frame Time, an interval which serves to delimit the range of possible event times. This is essentially similar to the Extended Now or the Perfect Time Span of various accounts of the Perfect (McCoard 1978, Iatridou et al. 2003, Portner 2003, Pancheva and von Stechow 2004), except that the notion is generalized beyond the Perfect. All temporal operators have a Frame Time argument, which may be satisfied by the a frame adverbial. The core of my proposal is that Present Tense, but not the Past, requires that Frame Time overlap its evaluation time. (Typically, and in all cases examined in this paper, the evaluation time of an unembedded temporal operator is utterance time.) Since a Present Perfect clause is one with the Present Tense as its highest temporal operator, it is subject to this restriction; but the Past is

not, since there is no Present Tense present in a simple Past Tensed clause. Crucially, despite the fact that the frame adverbial attaches high, it constrains event time, as is formalized below. In this section I list the main empirical points of divergence between the Present Perfect and the Past, and informally discuss how these differences are accounted for by this proposal, before turning to the complete analysis in following sections.

2.1. Past Time Adverbials

The Present Perfect is, unlike the Past and other Perfects, curiously bad with past time adverbials (PTAs), as illustrated in (5) above. This observation greatly precedes generative linguistics; the earliest observation of it of which I am aware is Pickbourn (1789), who is cited by McCoard (1978). A qualification of this observation comes from Klein (1992), who notes the contrast below, between what he identifies as definite and indefinite PTAs.

- (6) a. #John has left (on) Sunday.
- b. John has left on a Sunday.

This motivates Klein to pursue a theory based on the (in)definiteness of temporal adverbials. However, Portner (2003) argues that what matters is not the (in)definiteness of the adverbial, but whether it lexically picks out a past time interval or not. Portner writes: “[I]t is preferable to stick with a description of the relevant phenomenon as precluding any use of a past time adverbial with the English present perfect, understanding “past time adverbial” to refer only to adverbials which themselves entail pastness, not any adverbial which may be used to describe a past event.” In the case of the indefinite *a Sunday*, there is nothing inherently posterior about it – it quantifies over all Sundays past, present, and future, and the restriction to past Sundays in (6b) is due to the semantics of the perfect, not the adverb. So for the purposes of the PTA generalization, it doesn’t count.⁴ Portner points out that replacing *on a Sunday* with *on a Sunday last month*, which is inherently past, generates infelicity judgments.

- (7) #John has left on a Sunday last month.

In my analysis below, I will simply assume that *on a Sunday last month* is not a constituent; if *last month* is its own PTA, distinct from *on a Sunday*, it would independently run afoul of both Portner’s ban on PTAs and Klein’s ban on definite temporal adverbials. But in the event that such an analysis becomes untenable, I would like to sketch an alternative approach.

⁴This requires assuming that *(on) Sunday* in (6a) is fixed by the context to refer to a specific Sunday in the past, and that checking whether an adverbial entails pastness by itself happens after context does its work. I discuss Portner’s account in more detail below.

First consider (8), which contains a temporal adverbial which is both indefinite and not inherently past oriented. This accords with both Klein's and Portner's versions of the generalization. But next consider (9). The determiner *a* is replaced by *some* which is likewise indefinite, and does nothing to entail pastness. Yet (9) is bad, contrary to both Klein's and Portner's generalizations.

- (8) John has skipped work on a Catholic feast day this year.
 (9) #John has skipped work on some Catholic feast day this year.

This is a matter of scope (or, alternatively, of referentiality). Unlike *a*, the indefinite *some*⁵ is known to take necessarily wide scope, as seen in (10-11).

- (10) a. Bill's crying because he didn't see some player at the game. $\exists > \neg$
 b. Charlie has to read some book for his class. $\exists > \square$
 (11) a. Bill's crying because he didn't see a player at the game. $\exists > \neg$ or $\neg > \exists$
 b. Charlie has to read a book for his class. $\exists > \square$ or $\neg > \exists$

Thus while *some* scopes outside the interval description formed by the *on*-phrase, *a* may scope inside. So *some* behaves more like a definite than typical indefinites in terms of its scope properties, and for this we can credit Klein's attempted generalization.⁶ We can represent the different Frame Times established by the two adverbials as in (12). In the pseudo-formula below, let *t* range over intervals and *u* over instants; assume intervals are just sets of instants.

- (12) a. $\llbracket \dots \text{on some feast day} \rrbracket^g = \exists t[\text{feast-day}(t) \ \& \ \dots \{u \mid u \in t\} \dots]$
 b. $\llbracket \dots \text{on a feast day} \rrbracket^g = [\dots \{u \mid \exists t[\text{feast-day}(t) \ \& \ u \in t]\} \dots]$

Thus *on some feast day* furnishes the Present Perfect with a particular interval for a Frame Time. This Frame Time cannot be past relative to speech time due to the lexical requirement of the Present Tense; but of course it cannot be future relative to speech time due to the semantics of the Perfect.⁷ Since no satisfactory value for *t* can be found, (9) is judged infelicitous.

Meanwhile, *on a feast day* sets the Frame Time as the (discontinuous) interval consisting of all feast days. This interval's earliest instant is prior to speech time, and its latest is after speech time, so in a sense this Frame Time may be said to overlap speech time. Given a precise characterization

⁵Not to be confused with indefinite *s'm*, which can combine with only plural or mass nouns.

⁶Alternatively, it could be that *some* appears to always take wide scope because it is in fact referential, while *a* is truly an existential quantifier. Either way, it is definite-like in its scope.

⁷I assume pragmatic considerations prevent the feast day in question from being the day of utterance.

(given below) of the Present's requirement that Frame Time overlap speech time in this sense, we can say that *on a feast day* (and other typically indefinite adverbials) is not a PTA, but *on some feast day* (along with definite adverbials) is, at least for the purposes of the PTA generalization. Thus, the original generalization about the Present Perfect and PTAs is preserved. Moreover Portner's caveat is sharpened, and the importance of Klein's observation can be seen as well.

2.2. Domain Size

When no adverbial is present, Past Tense gives rise to a highly contextualized temporal domain compared to Present Perfect.

- (13) *Al*: I saw Jo at the party.
a. *Ed*: Did you talk to her?
b. *Ed*: Have you talked to her?

One way to summarize the distinction between these two is again in terms of definiteness; (13a) asks about a talking event at *the salient past time*, while (13b) asks whether there is a talking event at *a(ny) past time*. However, it's also true that Past Tense does not require a definite event time, especially when there is an overt frame adverbial. (14) requires there only to be one event of the speaker seeing Sue, and it may be at any time within Frame Time.

- (14) I saw Sue yesterday.

And indeed, even (13a) does not ask about a specific instant of time – rather, it asks whether there are any talking events *during* the party, whose runtime here acts as Frame Time. Thus I argue that every tensed clause has a Frame Time, and in the absence of an overt frame adverbial, this is contributed by context.

So both Past and Present Perfect can be construed as being indefinite, in the sense of introducing existential quantification over times;⁸ in (13) they only differ in the size of the domains that their existential quantifiers range over, i.e., Frame Time. While (13a) asks about talking events *at the party*, (13b) asks about talking events *since the party* or perhaps *ever* – both are acceptable.

As captured by the analysis I present below, this reduces to the first observation, that the Present Perfect is incompatible with PTAs. The Frame Time in (13a) is not constrained to overlap speech

⁸In fact I will assume that existential quantification comes from a covert quantifier, which is complementary distribution with quantificational adverbials like *always*, but this point is not relevant now.

time, so it can be freely identified with the salient interval, namely the runtime of the party. The Frame Time in (13b), however, must overlap speech time, so in this context, a satisfactory Frame Time must be accommodated. Considerations of relevance may require that this interval also has something to do with the the party – thus we may end up with a domain that extends from the party to beyond speech time. But we just as easily can end up with the maximal interval, if the resulting assertion can be construed as relevant.

2.3. Lifetime Effects and Their Ilk

So-called lifetime effects can be observed with the Present Perfect cases but not the Past. Thus the contrast in felicity judgments between (15b-15c) correlates with the livingness of the subject.⁹ No such contrast exists with the simple Past (cf. (15a)). A similar case is the unacceptability of (16b), noted by McCoard (1978) and highlighted by Portner (2003); compare to the acceptability of (16a).

- (15) a. Einstein visited Princeton.
- b. #Einstein has visited Princeton.
- c. Obama has visited a federal prison.
- (16) a. Gutenberg invented the printing press.
- b. #Gutenberg has invented the printing press.

Inoue (1979) argues that (15b) is bad because the event it describes is not repeatable at speech time. The same can be said of (16b). For Inoue, this is because repeatability at speech time is simply a consequence of the *current relevance* of the event, or of the event description. Thus, for her, Present Perfect and Past differ in that only the former requires an element of current relevance; many other analyses share a similar element. I agree with Inoue's proposal that the contrast in (15) is about repeatability,¹⁰ and argue that this extends to (16). I do not agree, however, that this has anything to do with current relevance. Rather, I argue that this is an implicature which arises by comparison with the Past Tense.

Use of the simple Past Tense conveys that no events bearing the description provided by the VP will occur after speech time¹¹ and within Frame Time. I will call this the Future Non-occurrence Inference (FNI); I am not aware of any author who has previously made this observation.¹² Contrast

⁹Importantly, at the time of the writing of this paper, Albert Einstein is dead, and Barack Obama is alive.

¹⁰Strictly speaking, I argue that it's about future occurrence rather than repeatability.

¹¹More carefully, evaluation time.

¹²Many authors (e.g., Altshuler and Schwarzschild 2013) have discussed the simple Past's Cessation Inference, the inference – triggered by use of Simple Past with a stative predicate – that the state described by the VP does not hold at present. I believe these are a special case of the FNI, but I do not have space to give this argument proper support.

(17a) and (17b). While (17b) allows the possibility that the addressee will eat between speech time and the end of the day, (17a) conveys that the addressee will not eat during that period. Likewise, (18a) gives rise to the inference that that John will not get up to talk again today, while (18b) leaves that possibility open.

- (17) a. Did you eat today?
b. Have you eaten today?
- (18) a. Every time John got up to talk today, you burst out laughing.
b. Every time John has gotten up to talk today, you have burst out laughing.

Two points must be made in order to explain the contrasts in (15-16) by way of the contrast in (17). First, although Past is lexically associated with the FNI, it does not appear when Past is embedded under Present, i.e., in the Present Perfect. In the next section, this is shown to follow from the formalization of the proposal (mentioned above) that only the highest temporal operator in a given clause interacts with that clause's frame adverbial. Thus, although the embedding of the Past under the Present has a very limited semantic effect, one effect it does have is to essentially eliminate the FNI.

The second point is that a speaker who wishes to describe a past event of Einstein visiting Princeton has a choice between uttering (15a) and (15b). As argued by Stump (1985), such a speaker will be inclined to select the less marked one, i.e., the Simple Past.¹³ Because the Simple Past is less marked, choosing the Present Perfect gives rise to the implicature that the Simple Past cannot be honestly uttered.¹⁴ If the frame adverbial overlaps the present, satisfying Present's requirement, then the Past and Present Perfect are identical, except for the FNI. Thus, choosing the Present Perfect implicates a denial of the FNI – in other words, it implicates that there at least *could be* more instances of the VP-event in the future portion of Frame Time.¹⁵ This is inappropriate in the cases of Einstein's visit to Princeton or Gutenberg's invention of the printing press, since these events are not repeatable.

One further wrinkle involving lifetime effects is that they seem to be particularly sensitive to the subject. The following contrast was first observed by Chomsky (1970).

- (19) a. #Einstein has visited Princeton.
b. Princeton has been visited by Einstein.

¹³Note that the present analysis makes a very good case for the unmarkedness of the Past compared to the Present Perfect; the Past consists of a morphosyntactic subset of the Present Perfect.

¹⁴Alternatively, this could be handled by appeal to Maximize Presupposition (Schlenker 2012), or exhaustivity operators in syntax. See also Pancheva and von Stechow (2004) for another account which relies on pragmatic comparison of Present Perfect and Past.

¹⁵This is slightly different from Inoue's formulation, which is that the VP-event be repeatable *at* speech time.

What this suggests for the present analysis is that the implicature normally derived by comparison with the equivalent Past sentence is not available. Consider the simple Past version of (19a); its acceptability depends greatly on the context.

- (20) a. Tell me something interesting about an Ivy League school.
b. #Princeton was visited by Einstein.
- (21) a. Tell me about something interesting that happened in 1947.
b. Princeton was visited by Einstein.

Given a context where there is no salient Frame Time, we are likely to accommodate the maximal interval as the Frame Time. With such a Frame Time, the Future Inference produced by the Past is that Princeton will be the recipient of no further visits ever (perhaps because Princeton is no more); thus the infelicity judgment. In a context where the salient Frame Time is the year 1947, no special inference arises; this is because the year 1947 is entirely prior to speech time, so the requirement that there be no visits to Princeton after speech time and within Frame Time is trivially satisfied.

What's surprising about (19b) and (20) is that they seem to indicate that, for the purposes of the Future Inference, what is meant by 'VP-event' indicates visits by Einstein to Princeton in (19a), but simply visits to Princeton in (19b). Thus, it cannot be that the Past tense takes its complement to strictly, compositionally determine the event description that is relevant for the Future Inference. Rather, it must be that the event description at play in the Future Inference is determined by context, and with the compositional semantics having a strong but not deterministic influence on said context.

2.4. The U-Perfect

Consider (22). It can be answered affirmatively in two distinct situations (among others) given in (23a-23b).

- (22) Has John been in the garden since 5?
- (23) a. There was an interval between 5 and now in which John was in the garden.
b. At every interval between 5 and now, John was in the garden.

These two verifying conditions are sometimes characterized as distinct readings, prompting the terminology *existential perfect* and *universal perfect*. What is relevant here is not so much the duration of the state being described, but whether it continues at speech time or not. This is possible with the Perfect but not the Past. (24a) is compatible with a situation where the being-here-state continues through speech time, while (24b) is not.

- (24) a. I have been in the garden all day.
b. I was in the garden all day.

The inability of the Past to allow for continuation into the present is accounted for by the Future Inference discussed above. The Future Inference requires that (24b) is only acceptable if there are no states of the speaker being in the garden in the future, within the day in question. Since the semantics of *all day* requires that the state of being in the garden lasted the entirety of the day in question that has so far elapsed, the Future Inference can only be verified in a situation where either i) the day in question is over, or ii) the state will not persist at all into the future.¹⁶ In the former case, utterance time is not contained in the day in question, thus the sentence does not entail that the being-in-the-garden state extends to utterance time. In the latter case, since the state will not persist at all into the future, it cannot reasonably extend into the present, given the infinitely small gap between the present and the future.¹⁷

I consider (22) and (24a) to be cases of generality rather than ambiguity (a la Inoue 1979), so my account won't say anything special about the distinction between the so-called existential and universal readings. However, a bit more does need to be said about *since*, a frequent constituent of universal perfects. It can appear with the Perfect, but not the Past (25).

- (25) #Was John in the garden since 5?

But this is due to the peculiar nature of *since*. It is a frame adverbial, and thus, contributes Frame Time. But it is also parasitic upon reference time, which it uses to determine the right bound of Frame Time. Since in the case of the Past, reference time is event time, if Past combines with *since*, event time will required to be at reference time but within Frame Time, an impossibility. Only in the case of the Perfect, when RT and ET are dissociated, is *since* usable.

2.5. Results and Relevance

The Present Perfect can have so-called result state readings, which the Past cannot.

¹⁶As with all things, allowances must be made for imprecision. (24b) can be truthfully and felicitously uttered if the day is not technically over and the state will technically persist into the future, so long as the day is *essentially* over, or the state will not persist *substantially* into the future. See Lasersohn (1999), Lauer (2013), Klecha (2014a).

¹⁷It could be argued that all states that end have a last moment, and we could ask ourselves about the truth of (24b) in a situation where the last moment of the speaker being the garden was speech time. I'm not sure it's possible to get clear judgments about such cases, but to be safe we could alter the Future Inference so that it excluded VP-eventualities in the future *and* present. Either way, this inference is neutralized when Past is embedded under Present, so it has no effect on the Perfect.

- (26) *John walks in to find the room torn apart and Bill laying on the floor, with no glasses on.*
 a. *Bill: I lost my glasses.*
 b. *Bill: I have lost my glasses.*
- (27) *Same context, but Bill is wearing his glasses.*
 a. *Bill: I lost my glasses.*
 b. *Bill: #I have lost my glasses.*

While the Past is fine in both contexts, the Present Perfect can seemingly only be used in the context where the result state of the event described by the VP holds at speech time. In the cases above, the event described by the VP is a glasses-losing event, so the result state is a state of the glasses being missing. This is one fact which the present analysis does not capture. But it may yet be given a pragmatic explanation; again this would rely on the notion that a speaker must have a good reason for uttering the more marked form over the less marked one (see Lauer (2013) for more on implicatures of this sort). In this case, the choice of FT which extends beyond ET all the way to the present implicates that something relevant is true in the interval between ET and present. Unfortunately, this is not as easy to formalize as the scalar implicature analyzed to above, and risks falling into the pragmatic wastebasket. More needs to be said on the topic.

3. The Analysis, Informally

In this section I sketch out the complete picture of the analysis, before formalizing it in the following section.

3.1. Adverbs

As is discussed in more detail below, all temporal operators have a Frame Time argument, which frame adverbs, like those listed in (28), satisfy. The tenses are also associated with temporal indices, which correspond to Reference Time, and which may be bound by frequency adverbs, like those listed in (29).

(28) *Frame Adverbs:* pro_n , yesterday, last month, since XP, at XP...

(29) *Frequency Adverbs:* \emptyset_\exists , once, every time, three times, all day...

Two adverbs should be noted here: The pronominal frame adverb and the existential frequency adverb, both of which are covert. Importantly, there is no covert existential frame adverb.

Frame adverbs attach high in the structure, above all temporal operators. As has been alluded to before, this is what allows Present Tense to interact with the adverbs in the case of Present Perfect,

thus ruling out any frame adverbs which do not overlap evaluation time. Klein (1992), however, rejects this possibility on the basis that frame adverbs can modify event time. This is certainly true; consider (30).

- (30) Today I have sneezed three times.

Clearly, *today* acts as a domain restrictor to *three times*. It clearly constrains the range of possible event times, and not reference time; if it constrained the latter, it would do so entirely without informative affect.

However, as Klecha (2016) has argued, certain expressions may constrain the range of possible temporal interpretation at a distance. Klecha in particular examines modals and attitude verbs which constrain the possible value of RT of the clauses they embed, despite not have a local compositional relationship with the tenses of those clauses. For example, *think* allows for present/past RTs, while *hope* additionally allows for future times (31). Thus I argue that frame adverbials, through the same mechanism, constrain event time, despite attaching high. The formal details are given in the next section.

- (31) a. John thinks she feels better {today/*tomorrow}.
b. John hopes she feels better {today/tomorrow}.

One last stipulation: I assume that Frame Adverbials (at least referential ones, which can satisfy the FT argument of the highest temporal operator) are mediated by a functional head (F[FT]), whose order is fixed relative to other (quantificational) frame and frequency adverbs.

- (32) a. Peter denied the lord [three times]_{Freq} [tonight]_{Frame}.
b. ?Peter denied the lord [tonight]_{Frame} [three times]_{Freq}.
(33) a. Peter denied the lord [three days]_{Frame} [this week]_{Frame}.
b. *Peter denied the lord [this week]_{Frame} [three days]_{Frame}.

3.2. Temporal Operators

Each temporal operator (tense or aspect) relates three temporal arguments: An evaluation time, a reference time, and a frame time (FT) à la von Stechow (1995). The evaluation time argument of each temporal operator is represented in the present theory as a lambda-abstract, and is thus controlled by the temporal operator which embeds it (namely, it is satisfied by the RT of the embedding temporal operator). The reference time argument of each temporal operator is represented

as an index on the temporal operator. Thus the reference time is interpreted as a variable, to be bound by a quantificational operator (by default, an existential).

I model FT as a lambda-abstracted argument as well. This is because FT is in many cases saturated by a non-binding operator, like *yesterday* or *today*. However, as mentioned above, frame adverbs must be constrained to only combine with the highest temporal operator in a clause, to prevent, for example, *yesterday* combining with a Past Tense that is embedded under a Present in the Present Perfect. For this reason I assume that Present and Past tense both bear a second index, corresponding to a FT, which they plug into the FT argument of the temporal operator below them. Thus it is only the highest temporal operator that has a FT argument that can be freely saturated by referential frame adverbs, introduced by F[FT]. Another function of F[FT] is to existentially close any FT-variables or RT-variables still free in its complement. But this still allows for the binding of the FT of lower temporal operators by quantification frame adverbs which appear below F[FT]. An example of this is in (34); while *this month* provides FT for Present Tense, *(on) every Tuesday* binds FT of the embedded Past, i.e., the Perfect.

(34) This month, I've danced every Tuesday.

The heart of the analysis is that Present and Past Tense each impose distinct requirements on their FT. Present Tense requires that its FT overlap or abut its evaluation time. Past Tense requires there be no VP-type events after its evaluation time and within its FT. Embedding Past Tense under Present Tense produces a semantics which is very similar to the Past Tense, in that event time must ultimately be in the past, but differing in the inferences regarding FT. Since Present is highest temporal operator, FT must overlap utterance time. Moreover, Past Tense's requirement, the FNI, is essentially eliminated, because its FT is existentially closed by F[FT]. Thus the FNI is true as long as some interval can be found such that there are no VP-type events at a time after the evaluation time of the embedded Past Tense and within the interval. If the interval $(-\infty, x]$ is chosen (where x is the evaluation time of Past Tense), then the FNI is trivially true.

4. The Analysis, Formally

I assume a $W \times T$ frame (Thomason 1984) plus events (Davidson 1967). I use $\langle \epsilon \rangle$ as the type for events; $\langle t \rangle$ for truth values; $\langle s \rangle$ for worlds; and $\langle i \rangle$ for times. An interval is a set of times, type $\langle i, t \rangle$. Following (Klecha 2016), a *history* (type $\langle h \rangle$) is a world-interval pair.¹⁸ Some more notational devices: If $h = \langle w, T \rangle$, then $\omega_h = w$ and $\tau_h = T$, while τ_e is the run-time (an interval) of an event e . A few more important notational elements:

- (35) a. $act(w, t) := \langle w, (-\infty, t] \rangle$; $fut(w, t) := \langle w, (t, \infty) \rangle$
b. $RB(T) := \iota s [\forall t [\neg \exists u [u < t \ \& \ \forall v \in T [u > v]] \rightarrow s \leq t]]$

¹⁸I use s, t, u, v as variables for instants, S, T, U, V for intervals, w for worlds, and h, i, j, k for histories.

- c. $T \circ u := 1$ iff $LB(T) \leq u \leq RB(T)$
- d. $h|U := \langle \omega_h, \tau_h \cap U \rangle$

The actual history a world w at t (35a) is the history which has w as its world component and the interval $(-\infty, t]$ as its temporal component; the future of a world w at t is the same history but with (t, ∞) as its temporal component. The right boundary (RB) of an interval T (35b) is defined whether or not T has a right-most instant; so, if $T = (x, y]$ and $U = (x, y)$, $RB(T) = RB(U) = y$; left boundary (LB) is defined likewise. An interval T quasi-overlaps an instant u (35c) iff u is in T or u is either the left or right boundary of T ; given the definition of left and right boundary, T can quasi-overlap u without overlapping it. Finally, $h|U$ (35d) is merely the history which is just like h except its temporal component is intersected with U .

I assume a declarative sentence has the type $\langle i, ht \rangle$, where a sentence S uttered in world w at time t is true iff $\llbracket S \rrbracket^g(t)(act(w, t)) = 1$. I assume that VPs are of type $\langle \epsilon, st \rangle$. I will use $\langle a \rangle$ as the type for assignments; this will be necessary to model the binding functions of certain expressions (F[FT]). Functional elements relevant to temporal interpretation are hierarchically ordered according to (36); their denotations are given in (37).

(36) $F[FT] (> F[RT]) > T (> T[PST]) > Asp > VP$

(37) *The Functional Inventory*

- a. $\llbracket Asp[IMP] \rrbracket^g = \lambda P_{\langle \epsilon, st \rangle} \lambda T \lambda v \lambda h [\exists e [P(e)(\omega_h) \ \& \ v \subseteq \tau_e \ \& \ \partial v \in \tau_{h|T}]]$
- b. $\llbracket Asp[PRF] \rrbracket^g = \lambda P \lambda T \lambda v \lambda h [\exists e [P(e)(\omega_h) \ \& \ \exists t \in \tau_{h|T} [\tau_e = [v, t] \ \& \ \partial v \in \tau_{h|T}]]]$
- c. $\llbracket T[PRS]_{j,k} \rrbracket^g = \lambda R_{\langle it, iht \rangle} \lambda T \lambda v \lambda h [g(j) \geq v \ \& \ R(g(k))(g(j))(h|T) \ \& \ \partial T \circ v]$
- d. $\llbracket T[PST]_{j,k} \rrbracket^g = \lambda R_{\langle it, iht \rangle} \lambda T \lambda v \lambda h [g(j) < v \ \& \ R(g(k))(g(j))(h|T) \ \& \ \partial \neg \exists t [R(T)(t)(fut(\omega_h, v))]]]$
- e. $\llbracket F[FT] \rrbracket^g = \lambda \hat{R}_{\langle it, ihat \rangle} \lambda T \lambda v \lambda h [\exists g' \approx_\tau g [\hat{R}(T)(v)(h)(g')]]$

For lack of space, I will not discuss the semantics of the aspectual heads. The symbol ∂ is used to introduce presuppositions. Each tense's restrictions on FT are modeled as presuppositions. They are clearly projected, given their persistence in, e.g., question environments – but the specific choice of presupposition rather than another kind of projected inference is purely an assumption. Note that the Present Tense's FT presupposition is stated with quasi-overlap; this allows for apparently past time frame adverbials which are nonetheless acceptable (*before*, *recently*, etc.). Note also that Present Tense is given here as a non-past. The definition of truth above, which builds in a non-future temporal frame, accounts for the usual inability of the Present to achieve future reference in matrix contexts; see Kaufmann (2005), Klecha (2016) for more details.

Let $g' \approx_\tau g$ in (37e) be true iff g' is an assignment just like g , except regarding the values of time-denoting variables. The frame-time adverbial head F[FT] therefore existentially closes any free time-denoting variables in its scope. Thus any RT or FT variable will be existentially closed,

unless a frequency adverb appears below F[FT] to bind RT of an operator, or a quantificational frame adverb appears below F[FT] to bind FT of an operator. This captures the requirement seen in (32) and (33) that frequency adverbs and quantificational frame adverbs must scope below (appear to left of) a referential frame adverb. Since these kinds of adverbs bind open variables, such variables must still be open to be bound by them. Referential frame adverbs cannot appear below F[FT] because a) they cannot bind variables, and b) they cannot satisfy the FT argument of the highest tense (this would create a type clash with F[FT]). Referential frame adverbs cannot bind variables because temporal adverbs in general cannot undergo QR, as witnessed by the fact that sentences with multiple quantificational temporal adverbs can only take surface scope (38).

- (38) a. I ate meat on a Friday three times that year. $3 > \exists; \# \exists > 3$
b. I ate meat three times on a Friday that year. $\#3 > \exists; \exists > 3$

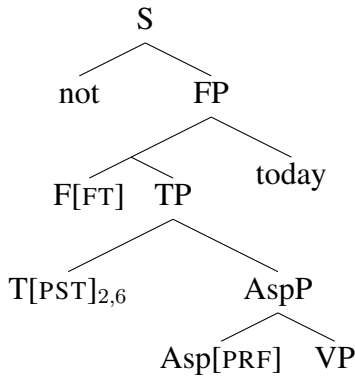
We are now in a position to give an analysis for *since* which captures its incompatibility with the simple Past (seen in (25)). This badness is due to a peculiar property of *since* – it is *essentially* a frame adverb, but it makes use of RT to construct FT. This actually requires *since* to be in complementary distribution with F[FT]. It also must be stipulated that *since*’s index match that of the highest temporal operator in the clause.

$$(39) \quad \llbracket \text{since}_j \rrbracket^g = \lambda t \lambda \hat{R}_{\langle it, i\hat{h}at \rangle} \lambda v \lambda h [\exists g' \approx_{\tau} g [\hat{R}([t, g'(j)])](v)(h)(g')]]$$

4.1. Sample Derivations

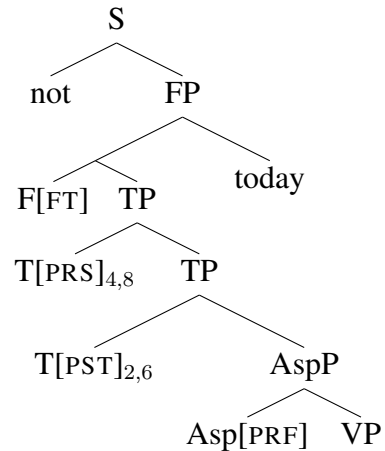
- (40) I didn’t check the mail today.

- (42) *Structure of (40)*



- (41) I haven’t checked the mail today.

- (43) *Structure of (41)*



- (44) *Unreduced Truth-Conditions of 42, uttered in w at t_0 under assignment g*
 $\neg \exists t_2, U_6[t_2 < t_0 \ \& \ \exists e[\text{check-mail}(e)(\omega_{\langle w, (-\infty, t_0] \rangle | \text{day}(t_0)})] \ \& \ \exists u \in \tau_{\langle w, (-\infty, t_0] \rangle | U_6 | \text{day}(t_0)}[\tau_e = [t_2, u]] \ \& \ \partial t_2 \in \tau_{\langle w, (-\infty, t_0] \rangle | U_6 | \text{day}(t_0)} \ \& \ \partial \neg \exists v[\exists e'[\text{check-mail}(e')(\omega_{\text{fut}(\omega_{\langle w, (-\infty, t_0] \rangle, t_0)})} \ \& \ \exists s \in \tau_{\text{fut}(\omega_{\langle w, (-\infty, t_0] \rangle, t_0) | \text{day}(t_0)}[\tau_{e'} = [v, s]] \ \& \ \partial v \in \tau_{\text{fut}(\omega_{\langle w, (-\infty, t_0] \rangle, t_0) | \text{day}(t_0)}]]]$

As in Cable (2013) I assume that presuppositional content applied to a variable which is existentially bound outside of the presupposition reduces to non-presuppositional content. Applying this reduction, as well as reducing the omega and tau terms, and eliminating the trivial U_6 yields (45).

- (45) *Reduction of (44)*
 $\neg \exists t_2[t_2 < t_0 \ \& \ \exists e[\text{cm}(e)(w)] \ \& \ \exists u \in [LB(\text{day}(t_0)), t_0][\tau_e = [t_2, u]] \ \& \ t_2 \in [LB(\text{day}(t_0)), t_0] \ \& \ \partial \neg \exists v[\exists e'[\text{cm}(e')(w) \ \& \ \exists s \in (t_0, RB(\text{day}(t_0))][\tau_{e'} = [v, s]] \ \& \ v \in (t_0, RB(\text{day}(t_0))]]]$

Eliding some aspectual details, (45) entails that there is no time t_2 prior to t_0 but within the day of utterance at which a mail-checking event occurred, and presupposes that there is no time after t_0 within the day of utterance at which there are any mail-checking events.

- (46) *Unreduced Truth-Conditions of (43), uttered in w at t_0 under assignment g*
 $\neg \exists t_2, u_4, U_6, V_8[u_4 \geq t_0 \ \& \ t_2 < u_4 \ \& \ \exists e[\text{check-mail}(e)(\omega_{\langle w, (-\infty, t_0] \rangle | V_8 | \text{day}(t_0)})] \ \& \ \exists u \in \tau_{\langle w, (-\infty, t_0] \rangle | U_6 | V_8 | \text{day}(t_0)}[\tau_e = [t_2, u]] \ \& \ \partial t_2 \in \tau_{\langle w, (-\infty, t_0] \rangle | U_6 | V_8 | \text{day}(t_0)} \ \& \ \partial \neg \exists v[\exists e'[\text{check-mail}(e')(\omega_{\text{fut}(\omega_{\langle w, (-\infty, t_0] \rangle | \text{day}(t_0), t_0)})} \ \& \ \exists s \in \tau_{\text{fut}(\omega_{\langle w, (-\infty, t_0] \rangle | \text{day}(t_0), t_0) | V_8}[\tau_{e'} = [v, s]] \ \& \ \partial v \in \tau_{\text{fut}(\omega_{\langle w, (-\infty, t_0] \rangle | \text{day}(t_0), t_0) | V_8} \ \& \ \partial \text{day}(t_0) \supseteq t_0]]]$
- (47) *Reduction of (46)*
 $\neg \exists t_2[t_2 < t_0 \ \& \ \exists e[\text{cm}(e)(w)] \ \& \ \exists u \in [LB(\text{day}(t_0)), t_0][\tau_e = [t_2, u]] \ \& \ t_2 \in [LB(\text{day}(t_0)), t_0] \ \& \ \partial \text{day}(t_0) \supseteq t_0]$
- (48) *Implicature of (43), uttered in w at t_0 under assignment g*
 $\diamond \exists v, e'[\text{cm}(e')(w) \ \& \ \exists s \in (t_0, RB(\text{day}(t_0))][\tau_{e'} = [v, s]] \ \& \ v \in (t_0, RB(\text{day}(t_0))]]]$

The definition of truth requires u_4 to be t_0 ; U_6 and V_8 can be eliminated as before. Crucially, the entire presupposition contributed by Past Tense can be eliminated as well, since it is trivially easy to find an interval which does not contain a time after t_0 at which mail is checked (namely, any interval which ends at or before t_0). As discussed above, the choice of Present Perfect over Past implicates that Past's presupposition may be false;¹⁹ this is given in (48). This implicature is what captures lifetime effects. Note also that substitution of the adverb *today* with past-time referring one (like *yesterday*) would clearly give rise to presupposition failure.

¹⁹More carefully, the implicature is that the presupposition simply *is* false; this requires amending the Past's presupposition to be something more along the lines of "in no worlds is there a time...". A related concern is that, following Klecha (2014b), future reference requires mediation by a modal. Inserting a modal element into Past's presupposition solves both of these issues.

5. Conclusion and Comparison

This account is most similar to Portner (2003) and other ‘extended now’ accounts. This analysis, however, replaces the extended now with the notion of Frame Time, which is not specific to the Present or the Perfect. It also provides a formal, compositional analysis for how adverbs directly determine Frame Time. Like Inoue (1979), I argue that the Present Perfect gives rise to a repeatability inference, which accounts for lifetime effects. However, unlike Inoue I argue this repeatability inference arises by comparison to a non-repeatability inference which is lexically associated with the Past. As far as I know, I am the first to propose that Past is associated with this inference.

Most of all, this account differs from recent attacks on the Present Perfect Puzzle in that it is also unifies Perfect with Past. Crucially, while embedding Past under Present has no effect on primary entailments, it introduces a distinct presupposition (requiring FT to overlap speech time) while neutralizing the usual presupposition of Past, which is replaced with the implicature of repeatability. Naturally, this account requires a morphosyntactic account to go along with it; for that, see Arregi and Klecha (2015).

I do not claim that constructions labeled “Perfect” cross-linguistically are embedded Pasts, although it’s possible many could be. There is a lot of room for crosslinguistic variability; any given language may lack the overlap requirement on its Present Tense; or the FNI on the Past Tense; or may have different presuppositions in their place. Many languages (e.g., Palatinate German) may lack a Simple Past²⁰ entirely, which would prevent any implicature arising by comparison of Present Perfect to Past. Languages may have distinct operators which trigger spell-out of the equivalent of *have*, but which are not the Present Tense; thus in these languages what is glossed as Present Perfect may consist of OP + PAST, for some yet unanalyzed OP.

Many details here are left unspecified or require significant further elaboration. These unspecified details and unelaborated elaborations will have to wait, for reasons of space. However this paper has shown that an analysis of Perfect as Past can account for the Present Perfect Puzzle at least as well as any other.

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²⁰In other words, Past in these languages is required to be embedded under Present.

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