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The morphosemantics of past tense*

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1. Introduction

This paper argues that the English Past Tense and (so-called) Perfect Aspect are morphosyntactic variants of the same underlying operator. This is motivated by the old observation that Past Tense and the Perfect Aspect have, in English, two obvious things in common. The first is anterior-time semantics; both (1a) and (1b) locate an event of John's leaving in the past with the respect to the time of their utterance.

- (1) a. John left.
b. John has left.

The second is morphology; the lexical verbs in (1a) and (1b) are inflected identically.

Of course, the challenge in pursuing this analysis lies in the non-totality of these similarities. While (1a–b) demonstrate that the Past and Present Perfect are, in some matrix contexts, truth-conditionally identical, their meanings come apart in the following context.

- (2) a. A: Oh, I saw Mary at the party.
b. Yeah. I didn't talk to her.
b'. Yeah. I haven't talked to her.

(2b) denies the existence of a speaking event within the timespan of the party; (2b') denies the existence of a speaking event within a larger timespan; possibly the maximal timespan. So in this context they are truth-conditionally distinct. Additionally, for certain verbs, like *eat*, the morphology is not identical either.

*We'd like to thank John Goldsmith, Jason Merchant, and Jerry Sadock for insightful discussion on the morphosyntax of English verbal inflection and the relation between our analysis and previous literature, as well as Itamar Francez, and the audience at NELS 45 for useful comments and questions.

- (3) a. John ate.
b. John has eaten.

This paper focuses on the morphosyntactic challenges that this account faces. We argue that present perfects like (3b) consist of a Past Tense scoped over by a Present Tense; likewise Past Perfects (4a) consist of two Past Tenses stacked, and perfects under modal auxiliaries (4b) or in infinitival contexts (4c) are simply instances of a Past Tense as well.

- (4) a. John had left.
b. John must have left.
c. John is believed to have left.

After briefly outlining a semantics which can account for divergences like (2) in §2, we elaborate on the following morphosyntactic proposal in §3: Past tense requires that the verb after it bears an inflectional feature, which is spelled out as *-en*, as in (3b). However, a verb which carries both this feature and a finiteness feature spells out as 'true' past morphology, as in (3a); but these two forms are syncretic for some verbs. Finally, the presence of multiple functional heads in the TAM domain (e.g., two tenses) can trigger feature conflict and therefore dummy-verb insertion à la Bjorkman (2011). Since the finiteness feature which triggers true past morphology only appears on the highest verb in a finite clause, dummy-verb-insertion prevents this feature from reaching the lexical verb.

2. Semantics

In this section we provide abbreviated arguments for a unifying semantic analysis of the past and the perfect in English. First, some preliminaries are in order. Following von Stechow (1995) we assume that tenses relate three temporal arguments: What can be called the evaluation time (EvT), what can be called the reference time (RT), and frame time (FrT). If t and u are times, let $t * u$ mean " t and u overlap".

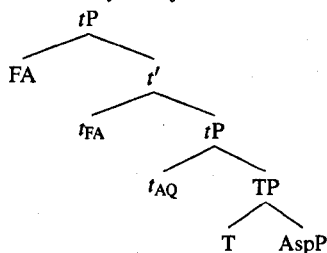
- (5) *Preliminary inventory of English tenses*
a. $[[\text{PRES}_n]]^g = \lambda p \lambda u \lambda t [g(n) * t \ \& \ g(n) \in u \ \& \ p(g(n))]$
b. $[[\text{PAST}_n]]^g = \lambda p \lambda u \lambda t [g(n) < t \ \& \ g(n) \in u \ \& \ p(g(n))]$

In the above denotations, $g(n)$ is RT, t is EvT, and u is FrT. Note that for the highest operator in a matrix¹ clause, EvT is bound to speech time. Similarly, the RT of the highest operator in a clause is often called topic time, while the RT of the lowest operator in a clause is usually event time.

¹We do not discuss tense in subordinate clauses.

We make important assumptions about the syntax of tense, summarized in (6).

(6) Schematic syntax of tense



We assume that above T is a functional projection, t^0 , which hosts a frame adverbial (FA) in its specifier, which satisfies the FrT argument of tense. FAs include *tomorrow*, *last Tuesday*, and *the day before*. These expressions must be licensed by t^0 , and thus cannot appear elsewhere; the upshot of this is that there must be exactly one FA per clause. We also analyze adverbs of quantification (AQs) as t^0 heads. AQs can bind the RT of a tense, among other things (Lewis 1975). AQs include *always*, *sometimes*, *once*, and *often*.

To see how this works in simple cases, consider the following inventory.

(7) Preliminary partial inventory of temporal adverbials

- a. $\llbracket \text{yesterday} \rrbracket^g = \text{day}_{-1}(g(0))$
- b. $\llbracket \text{once}_t \text{ tP} \rrbracket^g = \lambda t [\exists u [\llbracket \text{tP} \rrbracket^{g/n}(t)]]$
- c. $\llbracket \text{tFA} \rrbracket^g = \lambda x [x]$

- (8) a. John danced once yesterday.
- b. $[_{tP} \text{ yesterday } t_{FA} [_{tP} \text{ once}_3 [_{TP} \text{ PAST}_3 [_{vP} \text{ John dance }]]]]$
- c. $\llbracket (8b) \rrbracket^g = \lambda t [\exists u [u < t \ \& \ u \in \text{day}_{-1}(g(0)) \ \& \ \text{dance}(j)(u)]]$

To account for simple sentences like (9) (Partee 1973) we must assume i) that the inventory includes a null, pronominal FA which refers to a salient interval, and ii) that RT may be bound by a default rule of existential closure.

(9) I didn't turn the stove off.

Following Bach (1967), McCawley (1988), Klein (1994), and others, we argue that the perfect is simply an alternative morphosyntactic realization of the past; thus the present perfect consists of the past embedded directly under the present. A consequence of this approach is that the theory sketched above predicts the meanings of the present perfect and the past to be identical. A difficulty for this approach (and for any account of the perfect) is what Klein (1992) calls the Present Perfect Puzzle: The fact that past time temporal adverbials are compatible with the simple past, but not the present perfect.

- (10) a. John ate yesterday.
 b. *John has eaten yesterday.

A simple explanation for this might be that the frame adverbial interacts with the higher temporal operator, and therefore must overlap the RT of that operator. In (10a), the highest operator is past tense, while in (10b), it is present tense. This would mean that the present perfect, but not the past, would require a frame adverbial which overlaps speech time.

But there is a problem with this approach: The past perfect does not require FrT to overlap the RT of the higher operator (11). Moreover, even in present perfects (12), FAs clearly constrain event time (i.e., RT of the lower operator) rather than topic time (RT of the higher operator).

- (11) a. Herc went to stake out Omar's house last Tuesday.
 b. But Omar had left the day before.

- (12) I have eaten three times today.

RT of the higher operator in (11b), provided by context, is the time of Herc's going to stake out Omar's house (which is somewhere within last Tuesday). But the FA *the day before* places the event within an interval (last Wednesday) which does not contain that time. Likewise, in (12), the FA *today* intuitively describes an interval which contains three eating events, not an interval which contains three which are posterior to eating events.

To account for this we propose that the highest temporal operator constrains the FA the same way it constrains its RT; but without requiring RT and FrT to overlap. And while the highest operator constrains the FA, the FA constrains only event time. This is a kind of 'action at a distance', since these requires FAs not to be in a local relationship with the event-denoting constituent; This is similar to how attitude verbs and other modals constrain the event times of the clauses they embed, as described by Klecha (2014); thus we adopt a version of his compositional procedure.

Klecha (2014) argues that modals may constrain the temporal possibilities of their pre-jacents because world arguments may encode temporal information. To account for this intuition, he replaces the typical notion of *world* (on $W \times T$ frames) with *history* from Branching Times models. For ease of exposition, we define histories in familiar $W \times T$ terms.

2.1 Definitions

Define worlds and times in the usual way. Times may be instants or intervals. Histories, then, are pairs of a world and a time. We use s as the type for histories, ω the type for worlds, and τ the type for times. Assume a Neo-Davidsonian theory of events, which are type ε . We use the variables h, i, j, k for histories, and s, t, u, v for times. If u, v are instants, then $[u, v] := \{t \mid u \leq t \leq v\}$, and $(u, v) := \{t \mid u < t < v\}$. $[u, v]$ and (u, v) are also defined accordingly. For a world w , times t, u and a history h , where $h = \langle w, t \rangle$, we define the following terms:

- (13) a. $\omega(h) := w$
 b. $\tau(h) := t$.
 c. $h|u$ is defined iff $\tau(h) \cap u \neq \emptyset$; if defined, $h|u := \langle \omega(h), \tau(h) \cap u \rangle$.

2.2 The Verb Phrase

Verb phrases are intensional properties of events.

- (14) *VPs; Type $\langle \varepsilon, \omega t \rangle$*
 $\llbracket \text{VP} \rrbracket = \lambda e \lambda w [\text{VP}'(e, w)]$

VPs combine with an aspectual head to form an AspP, which is the complement of T. English has two aspectual heads, the null perfective and the imperfective, realized as *be*-*ing*. We do not discuss the imperfective any further in this paper.

- (15) *English aspectual inventory; Type $\langle \langle \varepsilon, \omega t \rangle, \langle \tau, st \rangle \rangle$*
 a. $\llbracket \text{IMPFV} \rrbracket = \lambda P_{\langle \varepsilon, \omega t \rangle} \lambda t \lambda h [\exists e [P(e, \omega(h)) \ \& \ \tau(h|t) \subseteq \tau(e)]]$
 b. $\llbracket \text{PRV} \rrbracket = \lambda P_{\langle \varepsilon, \omega t \rangle} \lambda t \lambda h [\exists e [P(e, \omega(h)) \ \& \ \tau(h|t) = \tau(e)]]$

We assume that declarative sentences are functions from a time and a history to a truth value. Truth is defined in the following way.

- (16) *Truth.* ϕ uttered at time t in world w is true iff $\llbracket \phi \rrbracket^{\mathcal{S}^t / 0}(t)(\langle w, (-\infty, \infty) \rangle) = 1$.

2.3 Tense and frame adverbials

We give tenses the following denotations.

- (17) *Inventory of English tenses*
 a. $\llbracket \text{PRES}_n \rrbracket^{\mathcal{S}} = \lambda p \lambda u \lambda t \lambda h [g(n) * t \ \& \ p(h|u)(g(n)) \ \& \ u * t]$
 b. $\llbracket \text{PAST}_n \rrbracket^{\mathcal{S}} = \lambda p \lambda u \lambda t \lambda h [g(n) < t \ \& \ p(h|u)(g(n))]$

Following Klecha (2014), present tense is more accurately analyzed as nonpast tense, but this is not directly relevant to this proposal, so we simplify by analyzing it as a true present.

Frame adverbials function to constrain the history argument that is fed to the prejacent of tense. There is nothing in either denotation that requires the RT to overlap FrT; but present tense does require that FrT overlap EvT. (Note that we could add a comparable requirement to past tense, that FrT overlap the interval $(-\infty, t)$, but this doesn't gain us anything.) Consider how this affects the interpretation of a sentence like (18).

- (18) a. I didn't turn the stove off yesterday.
 b. $[\text{not } [_{IP} \text{yesterday } t_{FA} [\exists [_{TP} \text{PAST}_3 [_{\text{AspP}} \text{PRV } [_{VP} \text{I turn off stove }]]]]]]]$
 c. $\lambda t \lambda h [-\exists u [u < t \ \& \ \exists e [\text{tos}(e, \omega(h) \text{day}_{-1}(g(0)))] \ \& \ \tau(h|\text{day}_{-1}(g(0))|u) = \tau(e)]]]$

First of all, by (16), (18a) is true if $\llbracket (18a) \rrbracket^g(t)(\langle w, (-\infty, \infty) \rangle) = 1$. Second, recall that for any interval t , $\omega(h|t) = \omega(h)$. Thus $\omega(h|\text{day}_{-1}(g(0))) = \omega(h)$. Finally, observe that for any time t , if $t \subseteq \tau(h)$, then $\tau(h|t) = t$. So, simplifying where possible, (19) represents the desired truth conditions of (18a) uttered at time t in world w .

$$(19) \quad \neg \exists u [u < t \ \& \ \exists e [tos(e, w) \ \& \ u \cap \text{day}_{-1}(g(0)) = \tau(e)]]$$

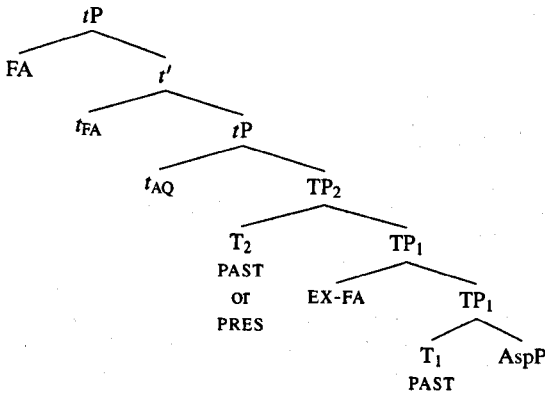
2.4 Perfects

To analyze, e.g., the present perfect as a case of Past Tense embedded under Present Tense, the FrT argument of the Past Tense must be accounted for. We assume that there is an operator which existentially binds the FrT argument of the lower Past Tense. We assume that in general FAs must be located in Spec, tP to check a case-like feature, but that this operator lacks this feature; this captures i) the fact that this operator can bind the FrT argument of the lower tense but cannot bind the FrT argument of the higher tense; and ii) the fact that normal FAs cannot bind the FrT argument of the lower tense.

$$(20) \quad \llbracket \text{EX-FA} \rrbracket^g = \lambda R_{\langle \tau, \langle \tau, st \rangle \rangle} \lambda t \lambda h [\exists u [R(u)(t)(h)]]$$

Schematically, the structure of a perfect therefore looks like (21).

(21) Structure of perfects



This derives the desired pattern. First consider a past perfect, i.e., a case of past embedded under past.

- (22) a. Omar had left the day before.
 b. $[_{tP} \text{the-day-before } t_{FA} [_{TP} \text{PAST}_3 [\exists [_{TP} \text{EX-FA} [\text{PAST}_4 [_{AspP} \text{PRV VP}]]]]]]$

- c. $\llbracket \text{Omar had left the day before} \rrbracket^g =$
 $\lambda t \lambda h [g(3) < t \ \& \ \exists u [\exists v [u < g(3) \ \& \ \exists e [\text{omar-leave}(e, \omega(h|v|\text{day}_{-1}(g(3)))) \ \& \ \tau(h|v|\text{day}_{-1}(g(3))|u) = \tau(e)]]]]]$

Simplifying along the lines of (18) and (19), (22a) uttered at t in w is true iff (23) is true.

- (23) $g(3) < t \ \& \ \exists u [u < g(3) \ \& \ \exists e [\text{omar-leave}(e, w) \ \& \ u \cap \text{day}_{-1}(g(3)) = \tau(e)]]]$

This is as desired; nothing requires RT of the higher tense ($g(3)$) to overlap FrT.

Next consider the present perfect. The badness of (24a) is derived.

- (24) a. #John has eaten yesterday.
 b. $[_{TP} \text{yesterday } t_{FA} [_{TP} \text{PRES}_3 [\exists [_{TP} \text{EX-FA} [\text{PAST}_4 [_{\text{AspP}} \text{PRV VP}]]]]]]]]$
 c. $\llbracket \text{John has eaten yesterday} \rrbracket^g =$
 $\lambda t \lambda h [g(3) * t \ \& \ \exists u [\exists v [u < g(3) \ \& \ \exists e [\text{john-eat}(e, \omega(h|v|\text{day}_{-1}(g(0)))) \ \& \ \tau(h|v|\text{day}_{-1}(g(0))|u) = \tau(e)]]] \ \& \ \text{day}_{-1}(g(0)) * t]$

(24c) is bad because $\text{day}_{-1}(g(0)) * t$ is false for any utterance time t . This captures Klein's Present Perfect Puzzle.

Note that this also captures the contrast in (2), repeated below. As discussed above, clauses without overt FAs are analyzed as having pronominal ones. In (25a) the pronominal FA is allowed to freely refer to an interval entirely in the past (the timespan of the party), while in (25b), we must accommodate an interval which overlaps speech time; e.g., the maximal interval.

- (25) a. A: Oh, I saw Mary at the party.
 b. Yeah. I didn't talk to her.
 b'. Yeah. I haven't talked to her.

Many questions remain for this analysis, not the least of which being universal or continuous perfects (Iatridou et al. 2003, Portner 2003); these must be left to future research. The point of this section has been simply to sketch a unifying semantic analysis. We now move directly to the morphosyntactic analysis.

3. Morphosyntax

This section implements morphosyntactically the claim that the past and the perfect are the same in English, in the specific sense that a perfect construction consists of a past tense scoped over by certain functional heads. The analysis is based on two insights relating the syntax and morphology of these constructions that ultimately go back to Hoffman 1966 and Bach 1967. First, the morphological past tense (*-ed*) is the realization of past tense when it is on the highest verb in a finite clause (Hoffman 1966, McCawley 1971, 1988, 208–

- (27) *Feature Transmission (FT)*. Move an inflectional feature ([FIN, TNS:PRES/PAST, INFL:PRT/BARE]) from a head to another head.

This simply defines FT as displacement of features.⁴ The following constraints, which can be considered as part of its definition, give it the properties that allow it to account for the correct distribution of verbal inflectional features in a clause:

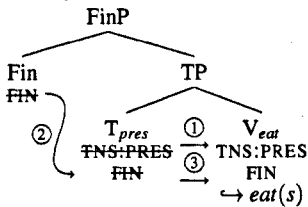
- (28) *Constraints on Feature Transmission*. Given a feature *F* on a head *H* that is transmitted to another head *H'*:
- a. *Locality*: *H'* is the head of the complement of *H*.
 - b. *Feature Conflict*: *H'* is not specified for a feature of the same type as *F*.
 - c. *Cyclicity*: *F* is transmitted as soon as *H* is merged.

Locality ensures that each step of FT is to the next head down the clausal spine. As shown below, this entails that a feature undergoes several FT steps if it is generated more than one head up the spine from a verb. Feature Conflict is at the heart of our analysis: a head cannot transmit a feature to a head that is specified for a feature of the same type. This results in some features being stranded, which triggers the insertion of a [V] feature (realized as *have*) on the head containing the stranded feature. This accounts for the presence of an auxiliary verb in the perfect. As discussed below, Cyclicity derives that some potential feature conflicts are circumvented in the course of the derivation.

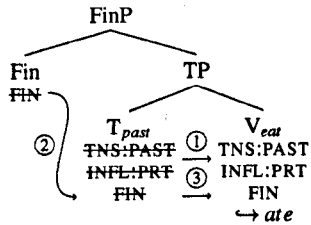
3.3 Simple tenses

Clauses with simple tenses contain a Fin and a single T head, which can be present (26b) or past (26c). They provide a straightforward instantiation of FT in which no Feature Conflict arises:

(29) *Simple present*



(30) *Simple past*



Each arrow indicates an instance of FT, which applies in the derivational order indicated by the number above or to the left of the arrow. After Merge of T, its features are transmitted to V (step ①). Fin is merged next, and its feature [FIN] is transmitted to the verb in two steps

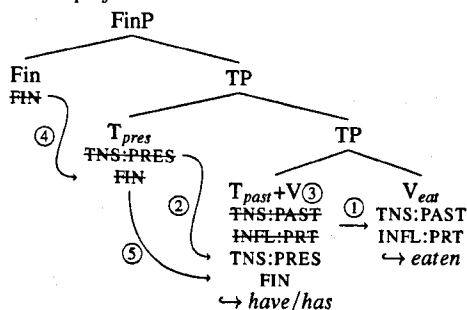
⁴Note that this displacement of features is unlike movement in the Minimalist sense: no copy of the feature is left on the transmitting head.

(by Locality): first to T ②, then to V ③. No Feature Conflict arises, and all inflectional features are licensed on the main verb. In both cases, a single finite verbal form is spelled out.

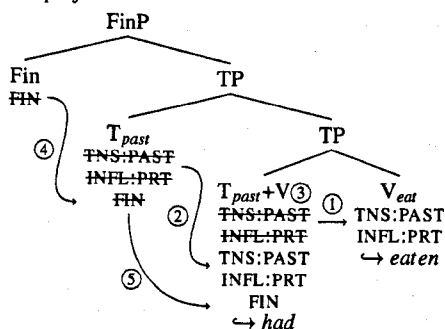
3.4 Perfect morphology

In the present and past perfect, the presence of two T heads results in Feature Conflict, as shown in the following derivations:

(31) Present perfect

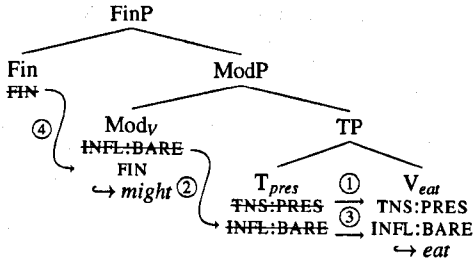
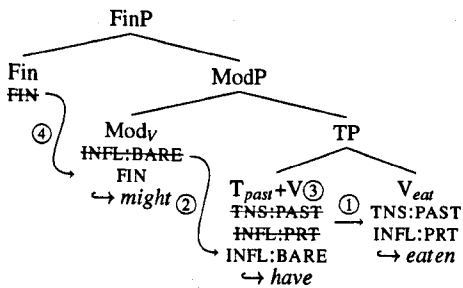


(32) Past perfect



Step ① is as in simple tenses: the lower T is merged, and its features [TNS:PAST, INFL:PRT] transmitted to V. After the higher T is merged, its features are transmitted to the lower T (by Locality, step ②). Although the lower T is merged with features that potentially conflict with the features transmitted by the higher T, no Feature Conflict ensues, due to the previous Transmission of the features of the lower T to V. This *Feature Vacancy Corollary* is an automatic consequence of our definition of FT as downward displacement of features: if a

modal present tense sentences, in the same way as our account of this morphology in the present and past perfect:

(37) *might eat*(38) *might have eaten*

The crucial difference between present T in (37) and past T in (38) is that the latter, but not the former, is specified for [INFL:PRT]. This causes Feature Conflict with Mod's [INFL:BARE] in the past, which, as in the perfect constructions in the previous subsection, triggers the presence of an auxiliary. No Conflict arises in the present, hence no auxiliary is needed.

The derivations proceed as follows. After T transmits its features to V ①, Mod can transmit its feature [INFL:BARE] to T (Feature Vacancy, step ②). This transmitted feature on T can be further transmitted to V in the present (step ③ in (37)), but not in the past, due to Feature Conflict ([INFL:BARE] on T and [INFL:PRT] on V), which triggers insertion of [V] in the latter case only (step ③ in (38)). The final step ④ in both derivations is transmission of [FIN] to Mod. The latter is specified for [V], so [FIN] is licensed in that position. In both cases, the modal is spelled out in finite form. In the present, the main verb surfaces in bare form, and in the past two nonfinite forms follow the modal: a bare auxiliary and the main verb in past participle form.

As is well known, the syntax of English infinitival *to* is very similar to the syntax of modal verbs (see, among many others, McCawley 1988 and Bjorkman 2011). Like (33),

the infinitival clause in *John believes [Fred to be home]* has a nonpast orientation, and, like (34), the infinitival in *John believes [Fred to have been home]* has a past orientation. As in modal sentences, this correlates with the absence of perfect-like morphology in the former and its presence in the latter. Thus, that infinitival *to*, like modals, is specified as [INFL:BARE], which results in Feature Conflict and insertion of *have* in the presence of past T. The only difference between *to* and modals is that, given the absence of FinP in infinitival clauses, *to* doesn't surface specified for [FIN], which we consider an uncontroversial claim.

4. Conclusion

In these concluding remarks, we would like to briefly compare our analysis of the morphosyntax of English tense with others that are similar in some respects. First, Chomsky's (1957) Affix Hopping is similar to FT: they both involve lowering from a functional element to a V. The crucial difference is that Affix Hopping lowers an entire morpheme, but FT only lowers features. Our account most naturally captures Feature Conflict, which is ultimately responsible for insertion of *have*, in terms of conflict within the same node, an option not available in an analysis in which the conflicting features are on separate nodes.

FT is also reminiscent of the use of downward Agree in Bjorkman 2011 in her account of auxiliaries in English and other languages: in both analyses, features originating in functional heads are spelled out on a lower verbal head. One of our main motivations for using FT instead of Agree is that verbal inflectional features (at least in the English constructions discussed here) surface only on the verb, which strongly suggests that the mechanism involved is not Agree-like copying, but literal feature displacement.

In addition, Bjorkman's own analysis of the perfect is not based on a common syntactic and semantic core for the perfect and the past, and can thus not account for the evidence for a unified analysis discussed here and in other works cited above. In our FT-based analysis, this common semantic core is anteriority, encoded in T_{past} . Thus, the distribution of past vs. perfect morphology (*-ed* and *have-en*, respectively) has to do more with the morphosyntax of T and other functional heads than with their semantics.

We would like to note that the unification of the past and the perfect offered here is only a small part of the bigger puzzle of the relation between the syntax, semantics, and morphology of verbal inflection. Our account is so far limited to English, and it remains to be seen whether it can be extended to other languages with similar constructions. In addition, the FT-based analysis of the perfect auxiliary given here is largely inspired by Bach 1967, McCawley 1988 and Bjorkman 2011, but while these works also provide an account of auxiliary *be* in passives and in the progressive, this is a matter that we leave for future work. Another topic into which our analysis naturally intrudes is that of sequence of tense. Schematically, the inflectional features proposed here can be used in implementing the proposal that this phenomenon arises from a transformation by which a present tense embedded under a past tense becomes (morphologically, but not semantically) past tense (e.g. Ladusaw 1977). This would involve copying [INFL:PRT] from the matrix past T to the embedded present T (with no Feature Conflict), which would then be specified as [TNS:PRS, INFL:PRT, FIN] and thus spelled out with past-like morphology (*-ed*). A detailed exploration of this analysis must also be left to future research.

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