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A lexicalist and word-based approach to the semantic composition of German and English clauses in the perfect

Carsten Breul

Abstract

The paper provides an account of the semantic composition of perfect aspect sentences in German and English based on the assumption that the relevant semantic information is encoded in the lexical entries for past participles and perfect auxiliaries. These lexical entries are conceived of as in word-based theories of morphology and the lexicon. This is a novel approach to the compositional semantics of tense and aspect. The basic ideas concerning the semantic ingredients of tense and aspect are adopted and partially adapted from work by Wolfgang Klein. It is shown that the central facts of the interpretation of perfect sentences in German and English, both interpretive similarities and differences, follow from the denotations proposed for past participles and perfect auxiliaries and their composition by standard semantic operations (functional application, λ-conversion). Moreover, the semantic derivations suggested in connection with an information-structural consideration provide an explanation for what has been referred to as the "present perfect puzzle" (Klein), that is, essentially, the compatibility in German and the incompatibility in English of a definite positional past time adverbial with the finite present perfect.

1 Introduction

Wolfgang Klein's (e.g. 1992, 1994, 2000) theory of tense and aspect, building on Reichenbach (1947: 287ff.), is based on two conceptual components: first, the distinction between situation time (TSit), topic time (TT) and utterance time (TU) and, second, the idea that tense expresses a temporal relation between topic time and utterance time while aspect expresses a temporal relation between topic time and situation time.[1] More specifically, perfect aspect involves the relation 'topic time after situation time' (TSit < TT) – in other words, topic time is in the post-time of situation time.[2] According to Klein & Vater (1998), this post-time meaning of a perfect aspect construction in languages such as German and English is formally expressed by the infinitival component of the combination of the perfect auxiliary and the past participle, tense being expressed by finiteness, that is, finite morphology on the auxiliary. With respect to the post-time meaning, Klein & Vater (1998: 232f.) conclude that

> it is the joint contribution of the auxiliary and the past participle morphology. It is a difficult problem to determine the precise role which these two elements play in this process – is it the auxiliary or is it rather the participle marking which defines the posttime, or do they interact in some way?

This particular question – whether it is the auxiliary, the past participle or both in combination that define the post-time of perfect aspect in German and English – has seldom been explicitly

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[2] For an overview discussion of various approaches to the question whether the perfect should be called an aspect and what its defining characteristics are, see e.g. Ritz (2012). Given that the progressive vs. non-progressive distinction is commonly considered to be an aspectual one and given that Klein's (1994: 9, 108) characterisation of the progressive (imperfective) as 'topic time is included in situation time' (i.e. as another relation between the two times) corresponds to a fairly wide-spread view of the progressive, calling the perfect an aspect is well motivated. Equally well-motivated is Huddleston's (2002: 116) terminological choice of calling the perfect a secondary tense, if we want to conceive of tense as expressing anteriority or posteriority relations between times.

investigated within the framework of Klein's approach. Klein (2000: 372) does address "[t]he contribution of participle marking and auxiliary", as the title of the respective section of this one of his works reads. But there he embraces a much more comprehensive perspective, taking the use of the past participle in predicative, attributive and passive constructions into account, such that the specific point of the question raised in the quotation from Klein & Vater (1998) just mentioned gets lost.[3]

Concentrating on German and English, the present paper undertakes to answer this question by proposing that the semantic representation of post-time as such is expressed solely by the past participle, that the auxiliary plays no role in the definition of post-time. However, a finite perfect aspect auxiliary *is* assigned the role of expressing that topic time is contained in the post-time alongside expressing a temporal (tense) relation to utterance time. Moreover, it is proposed that those parts of the denotation of a past participle that are responsible for its nature as a past participle are the same in German and English (see also Rothstein 2011: 127).

The theoretical framework in which the present approach is couched is lexicalist and word-based, with morphological relations between word forms being represented by correspondences between word schemas. Thus, an additional purpose of the paper is to show what a compositional semantic approach to the perfect may look like that is *not* based on the assumption that there are functional tense and aspect heads in the syntactic structure of a clause that provide the semantic content for tense and aspect semantics (i.e. semantic tense and aspect operators). Rather, one of the premises is that tense and aspect are encoded in the denotation of the word forms of verbs and auxiliaries. This aspect of the approach makes it different in principle from previous formal semantic accounts of tense and aspect in languages like German and English,[4] while being straightforwardly compositional.[5] As the semantic component of lexical entries in approaches that take a word-based grammar architectural perspective has seldom been shown in action in semantic composition, the present paper enlarges the domain of application of such approaches and thus contributes to demonstrations of their feasibility. A discussion of the advantages and disadvantages of a word-based lexicalist approach in comparison to its rivals is not intended. I take it for granted that this approach has enough to speak for it to be legitimate in principle.

The paper discusses the semantic derivation of German and English present and preterit perfect sentences and of sentences and clauses that involve non-tensed perfect auxiliaries. It shows how essential differences between German and English, including those that are responsible for the "present perfect puzzle" (Klein 1992), follow from the semantic composition (by the standard means of functional application and λ-conversion) of the denotations proposed for German and English perfect auxiliaries and past participles, partly in combination with information-structural considerations. A comprehensive discussion of the German and

[3] Wegner (2019) contains an answer to the question in terms of syntax and syntactic-semantic features, which remains semantically abstract, though, in that it lacks analyses with respect to how the meaning of the perfect is compositionally derived.

[4] Cf. Grønn & von Stechow (2016: 313) for a statement representative of previous formal semantic approaches: "Tense is typically marked by verbal morphology, normally an affix on the matrix verb or on an auxiliary verb, but the semantic tense operator is not interpreted at the verb. The operator can be located quite distant from the verb at the level of logical form". Musan (2002) is the most comprehensive analysis of the German perfect (with many references to English as well) within a compositional framework that is not word-based.

[5] 'Compositionality' refers to the conviction of many linguists "that the meaning of a sentence is determined by the composition of the sentence from its parts: the meaning of the words in it and the way they are ordered into phrases" (Kearns 2000/2011: 57). The present work is straightforwardly compositional in that what is composed is nothing but what is contained as components of meaning in the denotations of words, and thus of phrases built from words.

English perfect is not intended. The originality of the paper lies in the word-based lexicalist approach, the particulars of the denotations proposed – which provide an answer to Klein & Vater's (1998) question mentioned above – and the discussion of the interplay between semantics and information structure that lead to a proposal for the solution of the present perfect puzzle. A claim to the effect that the approach taken in the present work is superior to other approaches is not intended. Rather, it is claimed that the present approach is as viable as others and potentially attractive to those who take a word-based lexicalist stance in general. The present work adopts ideas from previous analyses of the perfect in German and English in the wake of Reichenbach (1947: 287ff.), but it differs significantly from every single one in approach and details of analysis.

The following section 2 introduces the notions of situation, situation time, post-time and topic time, and proposes denotations for German and English past participles and perfect auxiliaries, in which these notions play key roles. In section 3 a number of German and English finite and non-finite perfect aspect clauses are semantically derived (composed) on the basis of the denotations proposed. Similarities and especially differences between such clauses in the two languages are discussed; the derivations and discussion in the second subsection of section 3 are specifically geared to motivating the denotations for the past participles and the perfect auxiliaries proposed in section 2. Section 4 is devoted to the well-known observation that definite positional past time adverbials are generally acceptable in German present perfect clauses, but not in English ones. The paper concludes with a summary and an outlook on a direction in which the approach taken may be expanded.

2 Denotations for infinitives, past participles of (main) verbs and for perfect auxiliaries

2.1 Situation, situation time, post-time, topic time

I consider the denotation of a predicate and of a syntactic projection of a predicate to be a set of situations. (Note that I use the term *denotation* for both the logico-semantic expression that defines, or describes, a set of situations and for the set itself.) The denotation of a projection P^n of a predicate P is contained in the denotation of a projection P^{n-1} or, if P^n is the immediate projection P^1 of P, in the denotation of P itself. In other words, the higher the projection of a predicate, the more restricted the set of situations denoted. For example, ignoring grammatical categories such as tense, aspect, person and number, and following, just for the sake of concreteness, the syntactic assumptions of Haider (2013: 46ff.), if *send* is P, then *send a letter* would be P^1, *send Mary a letter* would be P^2 and *Jim send Mary a letter* would be P^3; the set of situations denoted by P^3 (sending-situations with someone called Jim as agent, someone called Mary as recipient and a letter as theme) is contained in and thus more restricted than the set of situations denoted by P^2 (sending-situations with someone called Mary as recipient and a letter as theme), which is contained in and thus more restricted than the set of situations denoted by P^1 (sending-situations with a letter as theme) and so on. For example, the sentence *Alex slept* denotes a set of sleeping-situations, where someone called Alex is involved as sleeper and which obtain in a certain interval of time whose characteristics are determined by the fact that the predicate occurs in the preterit form.[6]

[6] Since copular clauses raise semantic and syntactic issues that are independent of the topic of the present paper, the following discussion is restricted to predicates that are main verbs (henceforth to be called *verbs* as opposed to *auxiliaries*) and their projections.

Conceptually, situations have an extension in time and can be said to hold for a certain time.[7] Adopting and adapting Klein's (1992, 1994, 2000) notion of situation time – "the time at which some sit[ua]tion obtains" (Klein 2000: 364) – I define:

(1) situation time (T_{sit}): some interval at which a situation obtains

Since utterance producers cannot be expected always to know what *the* interval is "at which a situation obtains", I opt for saying that the relevant notion ought to be defined by using an indefinite determiner, so as to express that situation time is some interval within what has commonly been called the running time τ of an eventuality or situation (see also footnote 7).

(2) An interval is a T_{sit} of a situation s iff
$T_{sit}(s) \subseteq \tau(s)$
with $\tau(s)$ the running time of s.

Topic time, for Klein, is "the time for which a particular utterance makes an assertion" (1994: 37). He also states, "[i]n English as in other Indo-European languages, the carrier of TT is FIN – the finite component of the verb" (1994: 144). Klein apparently understands *assertion* in the sense of an assertion operator that is the semantic counterpart of finiteness, not in the speech act theoretical sense or in a more general pragmatic sense where it is opposed to presupposition. My slightly adapted definition of topic time is as given in (3) and goes along with Klein's use of the notion of assertion.

(3) topic time (T_{top}): the interval for which a situation is asserted to obtain

Note, however, that while the presence of topic time in the semantic representation of a lexical item (verb or auxiliary form) entails its finiteness, the presence of finiteness in the semantic representation of a lexical item need not necessarily entail the presence of topic time. The latter is the case with some English modals, such as *must*, for instance.

In a discussion of the semantics of the perfect it is necessary to define a specific kind of situation time as well, namely what Klein calls post-time, "the time after TSit" (1994: 109). I provide a definition in terms of intervals:

(4) post-time: the right-unbounded interval that follows situation time: **(**T_{sit}, $+\infty$**)** (for this notation see shortly below)

I consider post-time to be a kind of situation time since it is the interval at which the post-state (Klein 1994: 9, *pass.*; Musan 2002: 34, *pass.*) of a given situation obtains. A post-state is a state and thus a situation itself.

The notion of interval underlying these definitions is one which, in principle, allows for intervals whose left and right included boundary points are identical (a point in time), for closed, open and half-open, bounded and half-bounded as well as unbounded intervals.[8] In order to

[7] "Events and states must be associated with time, and in particular must have temporal locations" (Higginbotham 2000: 52). Thus, my assumptions are the same as those of Landman & Rothstein (2010: 235), who use the term *eventuality* instead of *situation*, though: "We assume an event semantics based on a domain of eventualities, where eventualities are states or events. Eventualities have running times: the running time of eventuality e, τ(e), is the time interval at which e goes on. We interpret verbs, verb phrases, and sentences as **event types**, sets of events; the event type corresponding to a verb phrase like *eat an apple* is the set of apple eating events" (emphasis in the original).

[8] A half-open interval is one whose left or right boundary is not contained in it. An open interval is one both of whose boundaries are not contained in it. A half-bounded interval has no left or right boundary. An unbounded interval lacks both boundaries. Usually, boundaries of time intervals are conceived of as points in time, the boundary points of an interval. I allow for intervals to be conceived of as boundaries of intervals as well, accord-

facilitate the representation of relations between intervals, I make use of the following definitions and notational conventions (involving the use of bold-printed brackets for intervals):

(5) Let *L* and *R* be intervals. Then:
(*L*, *R***)**: an interval whose left excluded boundary point is the right excluded boundary point of *L* and whose right excluded boundary point is the left excluded boundary point of *R*; i.e. *L* is a left excluded boundary interval of **(***L*, *R***)**, and *R* is a right excluded boundary interval of **(***L*, *R***)**.
[*L*, *R***)**: an interval whose left included boundary point is the left included boundary point of *L* and whose right excluded boundary point is the left excluded boundary point of *R*; i.e. *L* is a left included boundary interval of **[***L*, *R***)**, and *R* is a right excluded boundary interval of **[***L*, *R***)**.
(-∞, *R***)**: a left-unbounded interval with *R* as a right excluded boundary interval.
(*L*, +∞**)**: a right-unbounded interval with *L* as a left excluded boundary interval.

Both situation time and post-time play a role in the denotations for past participles. Topic time, post-time as well as utterance time play a role in the denotations for perfect auxiliaries.

2.2 Denotations for infinitives and past participles of (main) verbs

In (6) below, I modify the common semantic representation of the denotation of the lexical content of a verb as a λ-function by conjoining the predicate term with a term involving the property variable T_{sit} (this is an abbreviating notation which I will spell out immediately after having presented (6)). T_{sit} here expresses the property of being equipped with situation time as defined in (1) and (2) above that pertains to every member of the set of situations denoted by the predicate term. T_{sit} is a variable in that, according to (1), it denotes "*some* interval at which a situation obtains" (emphasis added). T_{sit} is related to another variable *t* for a time interval bound by λ such that T_{sit} has to be included in or equal to the interval instantiating *t*, i.e. $T_{sit} \subseteq t$. This term thus has the role of constraining T_{sit} depending on the value assigned to *t* pragmatically or by some time adverbial. I also indicate the potential presence of a highest-ranking non-primary argument position in the sense of Breul & Wegner (2017) by a superscript ^{n}.[9] For example:

(6) a. ‖rain‖ = λt [rain' & $T_{sit} \subseteq$ t]
a'. ‖regnen‖ = λt [regnen' & $T_{sit} \subseteq$ t]
b. ‖work‖ = λx [λt [work' (x^n) & $T_{sit} \subseteq$ t]]
b'. ‖arbeiten‖ = λx [λt [arbeiten' (x^n) & $T_{sit} \subseteq$ t]]
c. ‖arrive‖ = λx [λt [arrive' (x) & $T_{sit} \subseteq$ t]]
c'. ‖ankommen‖ = λx [λt [ankommen' (x) & $T_{sit} \subseteq$ t]]
d. ‖find‖ = λx [λy [λt [(find' (x)) (y^n) & $T_{sit} \subseteq$ t]]]
d'. ‖finden‖ = λx [λy [λt [(finden' (x)) (y^n) & $T_{sit} \subseteq$ t]]]

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ing to the definition in terms of boundary points provided in (5) in the main text. See e.g. Lohnstein (1996/2011: 259ff.) for basic definitions in interval semantics.

[9] Breul & Wegner (2017) argue that the past participle of a German and English verb is one and the same, whether it projects a perfect aspect or a passive voice verb phrase. They go some way in showing how this assumption can be made to work syntactically and semantically. In order to capture the argument-structural difference between a clause in the perfect and in the passive, they employ a distinction between primary and non-primary argument positions. In the examples in (6), this distinction corresponds to the common one between the only argument position of 'unergative' *work*/*arbeiten* (a non-primary argument position) vs. the only argument position of 'unaccusative' *arrive*/*ankommen* (a primary argument position) and the argument position for the subject of transitive *find*/*finden* (a non-primary argument position) vs. that for its object (a primary argument position).

These definitions of denotations are systematically abbreviative in two respects. First, since predicate terms such as *rain'*, *arbeiten'* etc. have been said above to denote sets of situations, they cannot, strictly speaking, be logically conjoined with anything. What these predicate terms abbreviate is a formula to the effect that the respective set of situations is a subset of the set of situations that have existed, exist or will exist in the world. If we call this set *W*, the spelt-out version of notations such as *rain'*, *arbeiten' (x^n)* etc., then, is *rain' ∈ W*, *arbeiten' (x^n) ∈ W* etc. Second, the spelt-out version of the notation T_{sit} indicates what set of situations T_{sit} is a situation time of, for example T_{sit}*(rain')*, T_{sit}*(arbeiten')* etc. The abbreviation can be used as long it is clear what predicate term a given T_{sit} is associated with. I will make use of these two abbreviations in the definitions of denotations for past participles and semantic derivations of sentences to come. Since the derivation of only sentences that do not contain more than one past participle will be exemplified, the second abbreviation will not lead to confusion.

The general pattern derivable from the paradigm in (6) can be represented in the following way:[10]

(7) $\|V\| = (\lambda x,\ldots)\ \lambda t\ [V'\ (x^{(n)},\ldots)\ \&\ T_{sit} \subseteq t]$

The notation *(x$^{(n)}$,...)* attached to the placeholder for the verb in combination with *(λx,...)* is an informal abbreviation for the potentially present arguments of the verb bound by λ, one or two of which may be non-primary. T_{sit} as such is a variable, thus a pro-term, whose value the utterance producer may leave unspecified or may specify to different degrees by providing a time adverbial, for example of the durational or positional type, whose denotation supplies a value for *t*,[11] as in (8).

(8) a. She plans to *work from 9 to 12 am*. (T_{sit} = ‖*from 9 to 12 am*‖ (duration))
b. She plans to *work on Saturday*. (probably intended: $T_{sit} \subset$ ‖*on Saturday*‖ (position on time axis))
c. Sie plant noch zu *arbeiten, wenn sie 80 wird*.
she plans still to work when she 80 becomes
'She plans to be still working when she turns 80.'
(T_{sit} = ‖*wenn sie 80 wird*‖ (position on time axis))[12]
d. Sie plant noch zu *arbeiten, nachdem sie 80 geworden ist.*
she plans still to work after she 80 become is
'She plans to be still working after she has turned 80.'
(probably intended: $T_{sit} \subset$ ‖*nachdem sie 80 geworden ist*‖ (position on time axis))
e. She plans to *work tomorrow morning*. (intended: $T_{sit} \subset$ ‖*tomorrow morning*‖ or T_{sit} = ‖*tomorrow morning*‖ (position on time axis))

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[10] It has been pointed out several times in the literature that only one positional time adverbial per clause is possible (see e.g. Rothstein 2007: 100 and the literature mentioned there). I take this for granted, assuming that the reasons are independent from the points to be made in the present paper. However, since more than one time adverbial *of different types* per clause is clearly possible (*It rained for 8 hours yesterday*), I nevertheless actually assume that the denotations allow for iteration in the following sense: (6)a would be ‖*rain*‖ = *λt* [rain' & ($T_{sit} \subseteq$ t)*]* with the effect that the application of this function to a time adverbial *a* yields *λt* [rain' & ($T_{sit} \subseteq$ a) & ($T_{sit} \subseteq$ t)*]*, which, in turn can be applied to another time adverbial *b*, and so forth. Assuming there is no time adverbial in addition to *a*, the formula can be simplified to *rain' & $T_{sit} \subseteq a$*; else one gets *rain' & $T_{sit} \subseteq a$ & $T_{sit} \subseteq b$* or *rain' & $T_{sit} \subseteq a$ & $T_{sit} \subseteq b$ & $T_{sit} \subseteq c$* and so forth. I do not discuss iterated time adverbials in the present paper, though. I do assume that some instances of *apparent* iterated time adverbials, such as *morgen um 12 Uhr* are actually cases of a complex single adverbial (see also Rothstein 2007: 105, note 9).

[11] "Adverb modification may apply to both TT and TSit" (Klein 1994: 6) – although, as pointed out in the preceding footnote, not in the same clause. "The boundaries of TSit are not indicated by the lexical content; but if there is need, they can be specified, for example by the adverbial *from six to seven*" (Klein 1994: 84).

[12] Recall that situation time is *a* time at which the situation obtains, i.e. that T_{sit} = ‖*wenn sie 80 wird*‖ does not entail anything about whether the situation also obtains before or after the time denoted by *wenn sie 80 wird*.

f. She plans to *work tomorrow morning from 9 to 12*. (T_{sit} = ‖*tomorrow morning from 9 to 12*‖ (duration and position on time axis))

As can be seen, a specification of situation time is, if present at all, often vague. It is typically the case that, if a value for *t* is supplied, it does not specify the temporal characteristics of situation time exhaustively nor any of them precisely. If there is no adverbial that supplies a value for *t*, as in an utterance of *She plans to work*, then any specification of the temporal characteristics of situation time is left implicit by the utterance producer, and the addressee has to infer one pragmatically in order to interpret the utterance. Note, however, that with non-durative situations, such as the leaving-situation in *She plans to leave at 10 (sharp)*, situation time cannot be interpreted in any other way than T_{sit} = ‖*at 10 (sharp)*‖. This is because both ‖*at 10 (sharp)*‖ and the leaving-situation are conceptualised as non-durational, punctual, such that ‖*at 10 (sharp)*‖ cannot properly contain T_{sit}.[13] From similar considerations it follows that the leaving-situation time of *She plans to leave tomorrow*, for instance, can only be interpreted as $T_{sit} \subset$ ‖*tomorrow*‖ and the be-at-home-situation time of *She plans to be at home when the film begins* as T_{sit} = ‖*when the film begins*‖. This last example illustrates that the relevant notion of situation time is not to be confused with the running time of the situation, here specifically the time during which she is at home in the possible worlds that correspond to her plans. The relation between ‖*when the film begins*‖ and running time (which may be represented as ‖*when the film begins*‖ $\subset \tau$) is irrelevant for the semantics of the perfect.

I assume that denotations such as provided in (6) above, which have been introduced as those of the "lexical content of a verb", are identical to those of one of the inflectional forms of the respective verb lexeme, namely the infinitive. Thus, the pattern for the denotational part of a word schema for the infinitive of a (main) verb is (9).

(9) $\|V_{inf}\| = (\lambda x,\ldots)\ \lambda t\ [V'\ (x^{(n)},\ldots)\ \&\ T_{sit} \subseteq t]$

By "pattern for the denotational part of a word schema" I mean that which corresponds to the semantic part of a word schema as conceived of in word-based models of morphology (for a concise introduction see Haspelmath & Sims 2002/2010: 46ff.; for more elaborated presentations see Matthews 1974/1991; Bochner 1993; Booij 2010). Such word schemas are commonly notated in a way similar to (10), where the first line within the large brackets contains the representation of a pattern for phonological information, the second a representation of a pattern for syntactic information and the third the representation of a pattern for semantic information. (The brackets /…/, <…> and ‖…‖ are redundantly added here to distinguish the contents of the three lines.) Such patterns usually contain or consist of variables (X and V here) that subsume corresponding values (phonological, syntactic, semantic) from lexical entries that match a given word schema.

(10) $\begin{pmatrix} /X/ \\ <X> \\ \|(\lambda x,\ldots)\ \lambda t\ [V'\ (x^{(n)},\ldots)\ \&\ T_{sit} \subseteq t]\| \end{pmatrix}$

A lexical entry in a word-based lexicon that matches such a word schema would be represented as in (11), where <infinitive> is shorthand for an explicit representation of the syntactic properties of an infinitive.

(11) $\begin{pmatrix} /ə'ɹaɪv/ \\ <\text{infinitive}> \\ \|\lambda x\ [\lambda t\ [\text{arrive}'\ (x)\ \&\ T_{sit} \subseteq t]]\| \end{pmatrix}$

[13] I would argue that both *at 10* and *at 10 sharp* are equally non-durational, punctual, and that the presence of *sharp* expresses a tighter restriction on the range of situations that are *pragmatically* allowed to be described by the clause in which these expressions specify situation time.

For the purposes of the present paper only the denotational (i.e. semantic) component is relevant.

As pointed out above, in the Kleinian framework the perfect is conceived of as making reference to the post-time and the post-state of a situation. In the present paper's approach, this has to be built into the denotation of past participles. Let us assume that the denotation of a present or past participle expresses an aspect of stativeness associated with the situations that are members of the set denoted by the corresponding infinitive. For the past participle this is implied by the relevance of the notion of post-state in Kleinian approaches to the perfect; for the present participle stativeness has been argued to be a key aspect as well (see Ramchand 2018: 54: "The progressive functions like a state in its temporal semantics (Vlach 1981, Parsons 1990, Hallman 2009a)"). I propose to define another temporal property variable, state time (T_{sta}), as follows:

(12) state time (T_{sta}): the interval during which the state associated with a present or past participle obtains

In the denotation of past participles, state time is specified as (identified with) post-time: $T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$. (In the denotation of present participles, state time is specified differently, but this is a topic for another paper.) This specification is built into the denotation for past participles by logically conjoining it with the conjunction in the denotation of the corresponding infinitives. Assuming in addition that the 'formation' of a past participle from the 'morphological base of the verb' involves the 'deletion'[14] of the "argument position for the highest-ranking non-primary argument […] unless case is assigned lexically to it" (Breul & Wegner 2017: 38), we set up the following denotations for English and German past participles corresponding to the examples in (6):

(13) a. $\|\text{rain}_{\text{pastpcp}}\| = \lambda t\,[\text{rain}' \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]$
a'. $\|\text{regnen}_{\text{pastpcp}}\| = \lambda t\,[\text{regnen}' \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]$
b. $\|\text{work}_{\text{pastpcp}}\| = \lambda t\,[\text{work}' \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]$
b'. $\|\text{arbeiten}_{\text{pastpcp}}\| = \lambda t\,[\text{arbeiten}' \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]$
c. $\|\text{arrive}_{\text{pastpcp}}\| = \lambda x\,[\lambda t\,[\text{arrive}'\,(x) \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]]$
c'. $\|\text{ankommen}_{\text{pastpcp}}\| = \lambda x\,[\lambda t\,[\text{ankommen}'\,(x) \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]]$
d. $\|\text{find}_{\text{pastpcp}}\| = \lambda x\,[\lambda t\,[\text{find}'\,(x) \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]]$
d'. $\|\text{finden}_{\text{pastpcp}}\| = \lambda x\,[\lambda t\,[\text{finden}'\,(x) \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]]$

The general pattern of the morphological relation between infinitive and corresponding past participle can be represented as in (14), where superscript $^{(-n)}$ is supposed to signal the potentially present difference in argument structure between a past participle and other forms of a verb lexeme due to the 'deletion' of a non-primary argument position in the 'formation' of a past participle.

(14) $\|V_{\text{pastpcp}}\| = (\lambda x,\ldots)\,\lambda t\,[V'\,(x^{(-n)},\ldots) \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]$

That is, the following correspondence between two word schemas – left for the infinitive, right for the past participle – is potentially an entry in the lexicon for German as well as English.

(15) /X/ <infinitive> $\|(\lambda x,\ldots)\,\lambda t\,[V'\,(x^{(n)},\ldots) \,\&\, T_{sit} \subseteq t]\|$ ⟷ /Y/ <past participle> $\|(\lambda x,\ldots)\,\lambda t\,[V'\,(x^{(-n)},\ldots) \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]\|$

[14] The scare quotes here are supposed to express that these expressions are somewhat inappropriate in a word-based model of morphology.

Apart from spelling out the phonological and syntactic information, it would be the task of a morphological analysis to determine if this specific correspondence is actually part of the lexicon of German or English. For it is possible in principle that both the word schemas for infinitives and past participles participate in correspondences with the word schemas for other forms of verb lexemes, but not with each other.[15]

Contrary to what an anonymous reviewer suggests, T_{sit} in representations of denotations like those in (6) and (13) above are not to be bound by an existential quantifier. Existence of a T_{sit} is entailed by the premise that the corresponding predicate denotes sets of situations. Moreover, T_{sit} is indeed conceived of as an indexical variable (which the reviewer appears to consider an unwanted consequence of not existentially binding situation time), restricted by the value assigned to the variable *t* and itself indexically restricting post-time. Thus, as far as situation time is concerned, I do not conceive of (16)B as expressing that there is at least one situation time, but that the (temporal frame for the) situation time intended by the speaker has to be pragmatically inferred and thus identified by the addressee.[16]

(16) A: Are you hungry.
B: No. I have had breakfast.

This conception does not prevent quantification over situation times, as we will see at the end of section 3.4 below.

2.3 Denotations for perfect auxiliaries

One aspect of the denotation of a tensed English or German perfect auxiliary is that it expresses that topic time is a (proper or improper) subinterval of post-time, i.e. $T_{top} \subseteq (T_{sit}, +\infty)$. In addition, as pointed out in section 1 above, tense involves relations between topic time and utterance time (T_u). The tense relation expressed by the English present perfect auxiliary (i.e. a present form of *have*) is that topic time is identified with utterance time, i.e. $T_{top} = T_u$.[17] The tense relation expressed by a first variety of a German present perfect auxiliary (i.e. a present form of *haben* 'have' or *sein* 'be') is that topic time is some subinterval of $(-\infty, T_u)$, i.e. $T_{top} \subseteq (-\infty, T_u)$, thus excluding utterance time. This latter point, which places T_{top} anterior to T_u, makes the present analysis different from all (as far as I can see) previous ones where denotations and semantic derivations are provided. It ultimately accounts for both the virtual interpretive identity of the present perfect and the preterit in some cases and the differences between German and English present perfects. Note that assigning a *present* perfect auxiliary a denotation in which topic time precedes utterance time does not mean that the analysis is non-

[15] As pointed out by Blevins (2016: 173) with respect to word (and paradigm) based models of implicational morphological relations in terms of conditional entropy, "one morphological element – whether a [paradigmatic] cell or form or some other unit of analysis – is informative about a second element to the extent that knowledge of the first element reduces the amount of uncertainty about the second element measured by its entropy". For example, it may be that English past participles are actually morphologically more strongly related to their corresponding preterit forms, rather than their infinitives.

[16] Here I follow Recanati (2018: 126), who maintains that "*to reach assertoric content we need to appeal to speaker's reference, thus injecting a dose of speaker's meaning into the semantic machinery*. There is no alternative way to assign contextual values to demonstratives – no 'brute fact of the context' (Kaplan 1989b: 588) can do the job. This applies not only to the assignment of contextual values to demonstratives, but also to the assignment of contextual values to so-called 'contextual expressions' (Clark 1992), and more generally to all free variables in logical form" (emphasis in the original).

[17] It may ultimately be preferable to substitute Huddleston's (2002: 125ff.) notion of "deictic time" for utterance time, with deictic time being either the time of encoding (= utterance time) or of decoding. Decoding time rather than utterance time is relevant for the interpretation of tense in cases such as Huddleston's example of the written notice *You are now leaving West Berlin*. But this is a minor point for the purposes of the present paper.

compositional. Just calling a certain set of lexical items *present* perfect auxiliaries (for traditional or historical reasons) does not entail that one is committed in principle to assigning them a denotation that is identical to, or contains parts that are identical to, the denotation of other verbs that one calls *present* tense verbs. (How much preteritness or pastness is contained in the English so-called preterit, or past tense, modal auxiliary *might*?) Thus, assigning so-called present perfect auxiliaries a denotation which specifies that topic time precedes utterance time while not doing so for so-called present tense main verbs does not *per se* constitute a breach of compositionality. What counts for compositionality is that the denotations do the job they are supposed to do, i.e. to result in a meaning for a complex natural language expression that it actually has.

There is a second, homonymous but denotationally different variety of the German present perfect auxiliary which will be discussed in section 3.5 below; this is the variety that appears in present perfect clauses that make reference to future time or to present time, as in *Ich habe es dir morgen um 12 zurückgegeben* (lit. '*I have given it back to you by tomorrow at 12') or *Alex ist jetzt angekommen* ('Alex has now arrived'). The tense relation expressed by German or English preterit perfect auxiliaries (i.e. preterit forms of *have*, *haben* or *sein*) is $T_{top} \subseteq (-\infty, T_u) \cap i$ (where $\cap$ symbolises intersection); *i* is a variable for an interval whose value is either explicitly provided by a positional time adverbial or remains implicit, i.e. has to be pragmatically inferred by the interpreter.[18] The relations between post-time and topic time as well as topic time and utterance time are to be integrated as constraints into the denotations for present and preterit perfect auxiliaries respectively, specifically as logical conjuncts. In contrast to a main verb, the denotation of a perfect auxiliary does not introduce T_{sit} since an auxiliary does not denote a situation. Another key difference between a main verb and a perfect auxiliary is that the denotation of the latter takes the denotation of a phrase projected by a past participle as its argument, i.e. the argument corresponding to the variable *s* in (17) below, which thus ranges over situations. Following Breul & Wegner (2017), I assume that the perfect auxiliaries *haben* and *have* introduce an argument position, i.e. the position occupied by the variable *x* in (17) below. Deviating from Breul & Wegner (2017) for reasons that are irrelevant in the present context, I do not assume that the perfect auxiliary *sein* introduces an argument position as well. (As we will see, whether or not this assumption is made makes no semantic difference.) Ignoring number and gender distinctions, the denotations for the tensed English perfect auxiliaries and the first variety of tensed German perfect auxiliaries are proposed to be as given in (17).[19]

(17) a. $\|have_{pres}\| = \lambda s\, [\lambda x\, [s\ (x)\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} = T_u]]$[20]

b. $\|haben_{pres}\| = \lambda s\, [\lambda x\, [s\ (x)\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq (-\infty, T_u)]]$

c. $\|sein_{pres}\| = \lambda s\, [s\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq (-\infty, T_u)]$

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[18] This corresponds to the well-known observation that a preterit perfect "requires that the time of reference be specified either by an adverb of time or contextually" (Rathert 2012: 252).

[19] The denotations provided contradict Breul & Wegner's (2017: 49, 53, 58) conclusion that German and English perfect and passive auxiliaries apart from German *werden* introduce no lexical semantic content beyond their argument-structural and, if finite, tense-related contributions. While the second conjuncts involving T_{top}, where T_{top} is related to T_u, express the tense-related contribution in the word-based framework, the conjunct $T_{top} \subseteq T_{sta}$ expresses an additional semantic contribution by these finite perfect auxiliaries.

[20] This denotation is actually a slight simplification. The unsimplified version has $T_{top} = T_u \cap i$ instead of $T_{top} = T_u$, *i* being an interval variable. The only possible values for *i*, those that do not cause the intersection $T_u \cap i$ to be the empty set, are intervals that overlap T_u or are identical with T_u. I think the only class of English adverbials that may denote such intervals are those projected by *now* which deictically refer to T_u. If there is no such adverbial explicitly present, *i* gets converted into an implicit pro-adverbial which needs to be assigned a value that is identical to the denotation of such an adverbial. This effectively means that the need for *i* becomes apparent only in the cases where there is a time adverbial like *now* or *right now* to be semantically processed (*Alex has now arrived*; *Right now, Alex and Kim have arrived*).

d. $\llbracket have_{past} \rrbracket = \lambda s\ [\lambda x\ [\lambda i\ [s\ (x)\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq \mathbf{(}\text{-}\infty, T_u\mathbf{)} \cap i]]]$

e. $\llbracket haben_{past} \rrbracket = \lambda s\ [\lambda x\ [\lambda i\ [s\ (x)\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq \mathbf{(}\text{-}\infty, T_u\mathbf{)} \cap i]]]$

f. $\llbracket sein_{past} \rrbracket = \lambda s\ [\lambda i\ [s\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq \mathbf{(}\text{-}\infty, T_u\mathbf{)} \cap i]]$

The details of these denotations that do not immediately follow from Klein's (e.g. 1992, 1994, 2000) theory, especially the relation between topic time and utterance time for *haben*$_{pres}$ and *sein*$_{pres}$ in German and its difference to English, will be motivated in section 3.2 below.

According to Breul & Wegner (2017), in German, if deletion of the argument position for a non-primary argument position has operated, then *haben* is the auxiliary that selects for the phrase headed by the past participle; if deletion of the argument position for a non-primary argument position has not operated, then *sein* is the auxiliary. In English, *have* is the auxiliary in any case. The argument position introduced by *haben* must be satisfied by a non-raised ('externally merged') argument that inherits the semantic role from the deleted argument position. If deletion of a non-primary argument position has taken place, then the argument position introduced by *have* must be satisfied by a non-raised argument that inherits the semantic role from the deleted argument position, otherwise it must be satisfied by raising an argument into it.

The denotations for the English and German past participles as well as the English and German perfect auxiliaries in (13)-(17) above are constructed in such a way that the argument variables *x*, *y*, *z* have to be λ-converted prior to the time variables *t* and *i*. As far as German is concerned, this ensures that the order of functional application conforms to the syntactic conclusion reached by Pittner (2004: 271) that "temporal adverbials c-command the base position of the highest argument". As far as English is concerned, the situation is less straightforward. I follow Ernst (2002: 446), who comes to the conclusion that location (positional) and duration time adverbials "do in fact occur fairly easily anywhere from clause-initial position down to PredP", but not lower than PredP, as his schematic overview on p. 448 shows. Since adverbials are adjoined in Ernst's approach and since the base position of subjects is the specifier of PredP, Ernst's result amounts to the same as Pittner's (2004) for German: time adverbials are merged after all arguments of the verbs. I take this as a syntactic premise with the semantic effect that the time variables *t* and *i* cannot be λ-converted before all of the argument variables have been converted.[21]

As far as denotations for non-tensed perfect auxiliaries are concerned, I restrict the discussion in the present paper to English (section 3.4 below) and to occurrences of perfects in participle clauses as exemplified in (18).

(18) Having arrived yesterday, Alex set to work immediately.

I propose that the denotation of *having* differs from its tensed counterpart by lacking the logical conjuncts that express the relations between post-time, topic time and utterance time. Thus, simply:

(19) $\llbracket have_{nonfin} \rrbracket = \lambda s\ [\lambda x\ [s\ (x)]]$

The discussion in this section may have revealed implicitly one advantage of the word-based lexicalist approach taken in the present paper over the wide-spread alternative approach in which tense and aspect are syntactic heads and semantic operators separated from individual

[21] Von Stechow (2009: 138), though, asks: "Which argument of the verb (or other predicates) is the time argument? Is it the first or is it the last? I know of no convincing evidence to decide this question. In this article, I will assume that the time argument is the first argument of the predicate".

word forms: it is more flexible in that a specific denotation for a present or preterit perfect auxiliary can be assumed to exist that is independent in principle from semantic characteristics of present and past tense in connection with finite main verbs. In other words, it is not necessary in this approach to assume that present or past tense in present or preterit perfect clauses is the same as present or past tense in non-perfect clauses (as is assumed in Musan 2002, for instance). Of course, it would unlikely be correct to assume that the denotation for a present or preterit main verb on the one hand and, respectively, that of a present or preterit perfect auxiliary on the other hand are diachronically independent from one another. But it is not unreasonable to assume that presentness or preteritness has (developed) more or less different semantic properties on auxiliaries than on main verbs. The diachronic development of modal auxiliaries in English is a well-known paradigm example of semantic shifts pertaining to what is associated with the present vs. preterit opposition. However, it ought to be pointed out as well that this advantage of the word-based lexical approach is irrelevant and cannot be made use of in analyses that insist on the premise that the semantic components which make the present tense are equally there in the present perfect.

3 Semantic derivations for perfect aspect clauses

3.1 Preliminaries

As for the interplay between syntactic merger and semantic composition, I assume that syntax operates on lexical items drawn from the lexicon, that the denotations of these lexical items are semantically composed at the point where they are merged syntactically. Very probably, it is also necessary to assume some version(s) of the concept of movement, which may partly be syntax- or phonology-induced. These movements do not affect semantic composition.

The only semantic operation that is made use of here is functional application followed by λ-conversion. Of two expressions that are merged syntactically, one is semantically a function and the other an argument. A function applied to a time argument has the form illustrated in (20).

(20) a. $\lambda t\,[\ldots T_{sit} \subseteq t \ldots]\,(a)$
b. $\lambda i\,[\ldots T_{top} \subseteq \ldots \cap i \ldots]\,(a)$

Syntactically, a semantic time argument is an optional adverbial (an adjunct). Since such an adverbial is optional, it may or may not be present at the stage of syntactic merger that corresponds to an instance of functional application as schematised in (20). If one is present, i.e. if one is merged, λ-conversion makes (21) out of (20).

(21) a. $\ldots T_{sit} \subseteq a \ldots$
b. $\ldots T_{top} = \ldots \cap a \ldots$

If no time adverbial is merged, *t* and *i* are converted into *pro-t* or *pro-i*, respectively. *Pro-t* and *pro-i* are phonologically empty variables for time intervals whose value has to be inferred pragmatically by the interpreter. (In the following semantic derivations, conversion into pro-forms is always written in an abbreviated manner, i.e. in one step, without first notating the application of the function to the pro-form.)

A derivation that results in T_{top} being empty (∅) is one that crashes. That is, such a derivation is not valid, does not yield a valid interpretation. This follows from the definition of T_{top}. It also means that intervals that are operated on, especially by intersection, may have to satisfy

requirements in order to yield a non-empty result for T_{top}. For example, if a derivation results in the expression in (22) for T_{top}

(22) $T_{top} = \mathbf{(}T_{sit}, +\infty\mathbf{)} \cap \mathbf{(}-\infty, T_u\mathbf{)}$

then, for T_{top} to be non-empty, it must be that T_{sit} precedes T_u. Otherwise the intersection is empty.

When I use the notation ‖...‖ for denotations in semantic derivations, the order of the lexical items within the ‖-brackets is independent of the order prescribed by syntax. Rather, I write the item or combination of items that corresponds to the denotational function on the left and the item or combination of items that corresponds to the denotational argument on the right of the binary structure.

3.2 Motivating the denotational difference between German and English tensed perfect auxiliaries

In section 2.3 above, the following denotations for the English and German present perfect auxiliaries are distinguished:

(23) a. $\|have_{pres}\| = \lambda s\, [\lambda x\, [s\,(x) \,\&\, T_{top} \subseteq T_{sta} \,\&\, T_{top} = T_u]]$
b. $\|haben_{pres}\| = \lambda s\, [\lambda x\, [s\,(x) \,\&\, T_{top} \subseteq T_{sta} \,\&\, T_{top} \subseteq \mathbf{(}-\infty, T_u\mathbf{)}]]$
b. $\|sein_{pres}\| = \lambda s\, [s \,\&\, T_{top} \subseteq T_{sta} \,\&\, T_{top} \subseteq \mathbf{(}-\infty, T_u\mathbf{)}]$

The difference is that topic time in the denotation for the English present perfect auxiliary is identified with utterance time whereas topic time precedes utterance time in the case of German. As argued in section 4 below, this difference is one of two factors responsible for the most prominent difference between the two languages, namely the incompatibility of definite positional past time adverbials with the present perfect in English and the lack of such an incompatibility in German.[22] The second factor is an information-structural one which, as far as I can see, has not yet been considered in discussions of the German and English present perfect. What follows in the present subsection is a discussion of other (though related) differences between German and English present perfects, partly based on well-known observations and explanatory ideas that motivate the denotational difference just pointed out.

The first piece of motivation concerns the difference exemplified in (24), an example that has been mentioned several times in the literature (e.g. Klein 2000: 359; Mittwoch 2014: 226; Schaden 2009: 118; (24)a originates with Chomsky 1969: 34). (24) has to be imagined as being uttered, for example, at the time of reading the present text.

(24) a. #Einstein has visited Princeton.
b. Einstein hat Princeton besucht. ('Einstein visited Princeton.')
Einstein has Princeton visited

The semantic derivation for (24)a with the denotations for the past participle and the perfect auxiliary as suggested above is provided in (25).

(25) $\|visit_{pastpcp}$ Princeton‖
$= \lambda x\, [\lambda t\, [visit'\,(x) \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]]\,(Princeton')$
$= \lambda t\, [visit'\,(Princeton') \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]$

[22] By *definite positional past time adverbials* I refer to what Heny (1982: 151) (among many others) calls time adverbials that are used with "a specific referential significance, which picks out some definite time in the past". As is well known, there are time adverbials that may be so used in some contexts or on some occasions, but differently in other contexts or on other occasions.

= visit' (Princeton') & $T_{sit} \subseteq$ pro-t & T_{sta} = **(**T_{sit}, $+\infty$**)**
$\|have_{pres}\ (visit_{pastpcp}$ Princeton$)\|$
= λs [λx [s (x) & $T_{top} \subseteq T_{sta}$ & $T_{top} = T_u$]] (visit' (Princeton') & $T_{sit} \subseteq$ pro-t & T_{sta} = **(**T_{sit}, $+\infty$**)**)
= λx [(visit' (Princeton')) (x) & $T_{sit} \subseteq$ pro-t & T_{sta} = **(**T_{sit}, $+\infty$**)** & $T_{top} \subseteq T_{sta}$ & $T_{top} = T_u$]
$\|(have_{pres}\ (visit_{pastpcp}$ Princeton$))$ Einstein$\|$
= λx [(visit' (Princeton')) (x) & $T_{sit} \subseteq$ pro-t & T_{sta} = **(**T_{sit}, $+\infty$**)** & $T_{top} \subseteq T_{sta}$ & $T_{top} = T_u$] (Einstein')
= (visit' (Princeton')) (Einstein') & $T_{sit} \subseteq$ pro-t & T_{sta} = **(**T_{sit}, $+\infty$**)** & $T_{top} \subseteq T_{sta}$ & $T_{top} = T_u$
= (visit' (Princeton')) (Einstein') & $T_{sit} \subseteq$ pro-t & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** & $T_{top} = T_u$

For this denotation to be consistent, T_{sit} has to precede $T_{top} = T_u$. The sentence then denotes the set of post-states obtaining at utterance time of visiting-situations involving Princeton as visitee and Einstein as visitor.

Assume now that sentence (24)a is uttered at the time of reading this with the main sentence accent on *Princeton*. Information-structurally, a clause initial referential subject in English tends to be interpreted as a topic expression if it is not intonationally marked as a focus expression (see Lambrecht 1994). From this in connection with the assumption that a topic expression needs to have a referent (see Meyer-Viol & Jones 2011: 228), or be pragmatically real, in the world that the utterance makes reference to at topic time,[23] the oddness of the present perfect in the English sentence (24)a follows immediately: its topic time is identified with utterance time, but the referent of the topic expression, the famous physicist, does not live anymore at utterance time (see also Klein 2008: 292). In this context it is interesting to refer to an observation that has also been made several times in the literature and seems to go back to McCawley (1971: 106). In the version provided by Huddleston (2002: 144, fn. 37): "*Nixon has been impeached*, for example, can still be acceptable even though Nixon has since died, given a context where the issue is the occurrence within the time-span of situations of the kind 'impeachment of a president'". In terms of information structure, Huddleston seems to think of a context here where *Nixon* is an identificational focus expression, not a topic expression. That is, it is the phrase that carries the main sentence accent and provides a value for the variable in the open presupposition 'x has been impeached' that is active at the given point of the discourse (see Lambrecht 1994: 277ff.). In contrast to a topic expression, an identificational focus expression is *not* subject to the requirement that it have a referent, or be pragmatically real, in the world that the utterance makes reference to at topic time (see Breul 2004: 89f).

If we assumed that the present perfect auxiliary in the German sentence (24)b were the same as its English counterpart, its semantic derivation would obviously result in (26), requiring that T_{sit} precede T_{top}.

(26) (besuchen' (Princeton')) (Einstein') & $T_{sit} \subseteq$ pro-t & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** & $T_{top} = T_u$

Since a sentence initial referential subject not marked as a focus expression tends to be interpreted as a topic expression in German as well, the explanation of the oddness of (24)a would equally apply to the denotation in (26). However, the sentence in (24)b is not odd. The reason is that the correct denotation for it is not the one provided in (26), but the one in (27).

[23] As for the "pragmatic reality" of topic expressions, see the discussion in Lambrecht (1994: 157). As already pointed out by McCawley (1971: 106f.), the existence or pragmatic reality of a referent of a topic expression such as *Einstein* or *Frege* is not necessarily restricted to the existence of the famous personalities bearing these names as living human beings. There may be other entities referred to by using these names that may be relevant referents of topic expressions, such as their writings, for example.

(27) = (besuchen' (Princeton')) (Einstein') & $T_{sit} \subseteq$ pro-t & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** & $T_{top} \subseteq$ **(**$-\infty$, T_u**)**
= (besuchen' (Princeton')) (Einstein') & $T_{sit} \subseteq$ pro-t & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** $\cap$ **(**$-\infty$, T_u**)**
For there to be a T_{top}, T_{sit} has to precede T_u. Then:
= (besuchen' (Princeton')) (Einstein') & $T_{sit} \subseteq$ pro-t & $T_{top} \subseteq$ **(**T_{sit}, T_u**)**

The exclusion of T_u from any interval that may serve as topic time makes the fact that the subject Einstein has no referent at utterance time a non-issue. And there certainly was a time after Einstein's visit to Princeton but before utterance time when the expression *Einstein* did have a suitable referent.[24]

The second piece of motivation for assuming the difference between the denotations for the English and German present perfect auxiliaries derives from the contrast exemplified in (28).

(28) a. Alex is my neighbour. She has lived here since 1980.
b. Alex ist meine Nachbarin. #Sie hat seit 1980 hier gewohnt.[25]

The first sentence in each sequence implies that Alex still lives at the place denoted by *hier* / *here* at utterance time. This meaning is not excluded by the denotation for the English version of the second clause in the sequence, the present perfect clause:[26]

(29) live-here' (⟦she⟧) & $T_{sit} \subseteq$ ⟦since 1980⟧ & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** & $T_{top} = T_u$

If the situation is such that Alex has lived here since some time in 1980 and still does so at utterance time, then there are infinitely many intervals within the interval that spans her time of living here which may serve as a suitable situation time.[27] The only condition is that such a situation time is anterior to T_{top} identified with utterance time, i.e. that T_{top} is included within **(**T_{sit}, $+\infty$**)**. Thus the set of post-states of situations denoted by (29) is *compatible* with the fact that Alex still lives here at utterance time, i.e. with what is implied by the first sentence in (28)a. Note that the denotation for the sentence does by no means *entail* that Alex still lives here at utterance time. In other words, while the denotation is compatible with both a continuative (universal) and a non-continuative (existential) reading of the sentence,[28] the continuative reading is called for in the context of the first sentence in the sequence. (I will come back to universal vs. existential readings in connection with *since*-adverbials in the final section of this paper.)

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[24] Schaden (2009) argues against this kind of explanation. Since his argument involves preterit perfects, I will discuss it in section 3.3, which is devoted to preterit perfects.

[25] I conducted searches with the following search patterns in the *Deutsches Referenzkorpus* (archive *W-öffentlich*) (last time on 5 Jan 2018):
(i) &haben hier seit /+w4:2 (gelebt oder gewohnt)
(ii) &haben seit /+w4:2 hier (gelebt oder gewohnt)
(iii) (&leben oder &wohnen) seit /+w4:2 hier
(iv) (&leben oder &wohnen) hier seit
In terms of lexemes and word forms, (i) corresponds to the sequence *HABEN hier seit x (y) (z) {gelebt / gewohnt}*, (ii) corresponds to *HABEN seit x (y) (z) hier {gelebt / gewohnt}*; (iii) to *{LEBEN / WOHNEN} seit x (y) (z) hier*, (iv) to *{LEBEN / WOHNEN} hier seit*. Searches (i) and (ii), the perfect versions, result in literally a handful of relevant present perfect hits for which it may perhaps be assumed that the referent of the subject still lives at the place referred to by *hier*. Searches (iii) and (iv), the present tense versions, result in several hundreds of examples with this interpretation.

[26] The denotations provided in the present paper are sometimes simplified, here by ignoring the denotation and compositional integration of the place adverbial *here* and by leaving the denotation for *since 1980* implicit. The simplifications are assumed not to impinge on the relevant points to be made.

[27] This is because a living-situation is homogeneous, that is, it has the subinterval property; see e.g. Ogihara (2007: 399).

[28] For an overview of this well-known distinction see e.g. Portner (2012: 1219ff.).

The corresponding denotation for the German present perfect clause in (28)b under the assumptions about the denotations for the past participles and perfect auxiliaries made above is as given in (30).

(30) hier-wohnen' (⟦sie⟧) & $T_{sit} \subseteq$ ⟦seit 1980⟧ & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** & $T_{top} \subseteq$ **(**$-\infty$, T_u**)**
= hier-wohnen' (⟦sie⟧) & $T_{sit} \subseteq$ ⟦seit 1980⟧ & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** $\cap$ **(**$-\infty$, T_u**)**
For there to be a T_{top}, T_{sit} has to precede T_u. Then:
= hier-wohnen' (⟦sie⟧) & $T_{sit} \subseteq$ ⟦seit 1980⟧ & $T_{top} \subseteq$ **(**T_{sit}, T_u**)**

Here, topic time precedes utterance time, i.e. topic time may not be utterance time. Given that the first sentence in the sequence implies that Alex still lives at the place denoted by *hier* at utterance time and given that the corresponding German sentence in the present tense (*Sie wohnt seit 1980 hier*) can be used to express that she has lived here since 1980 and continues to do so at utterance time, the reference to a topic time that precedes utterance time makes the present perfect sentence pragmatically odd. This is not to say that there is anything semantically wrong with the sentence. It is semantically impeccable and its utterance would be so pragmatically as well in a context that does *not* imply that Alex still lives here.[29] The fact that the sentence *is* odd in a context that suggests that Alex still lives at the place denoted by *hier* at utterance time is problematic for accounts that constrain topic time in such a way that it may not precede utterance time, thus allowing for $T_{top} = T_u$ or $T_{top} > T_u$ (e.g. Musan 2002 among others).[30]

The third piece of motivation for assuming the denotational difference between German and English present perfect auxiliaries displayed by (23)a and b above arises from the type of contrast exemplified by (31):

(31) a. A: *What have you done for a living before you became a politician?
B: #I have been a teacher.
b. A: Was haben Sie beruflich gemacht bevor Sie Politikerin wurden?
what have you professionally done before you politician became
B: Ich bin Lehrerin gewesen.
I am teacher been

In a German present perfect clause it is impeccable to make reference to a situation time that is anterior to an implicit past time (implicit at the clause level), as shown by (31)bB: The time at which the referent of *ich* was a teacher is anterior to the time when she became a politician. The latter time can be assumed to be the implicit topic time for (31)bB. Hence, topic time in German present perfects cannot be identified with utterance time and needs to allow for a topic time that precedes utterance time. This is again problematic for the accounts that posit 'T_{top}

[29] The following example of a contrast from Pancheva & von Stechow (2004: 476) does not make the same point as my example discussed above in the main text:
(i) a. I have always lived here … *until recently.
b. Ich habe hier immer gewohnt … bis vor kurzem.
It does show that "*I live here* needs to be true at speech time" (p. 475) in English, but not in German. It does not show that a German present perfect is odd if the situation described continues to obtain at utterance time.

[30] Rothstein (2011: 135f.) makes the following interesting observation: all Germanic languages that are like English in that they do not allow for a definite positional past time adverbial modifying a present perfect verb phrase, require, again like English, the present perfect in clauses whose verb phrase is modified by a temporal *since*-adverbial and where the denoted situation is supposed to still obtain at utterance time; conversely, all Germanic languages that are like German in that they do allow for a definite positional past time adverbial modifying a present perfect verb phrase, require the present tense in clauses whose verb phrase is modified by a temporal *since*-adverbial and where the denoted situation is supposed to still obtain at utterance time. (Thanks to an anonymous reviewer for providing this reference.) This suggests that temporal *since*-adverbials in present perfects are indeed an important tool for motivating cross-linguistic assumptions about the denotations of perfect auxiliaries.

≥ T_u' (e.g. Musan 2002 among others). By contrast, the oddness of the English (31)aB results precisely from the fact that its situation time would equally have to be interpreted to be anterior to an implicit past topic time (the time she became a politician). This – so the reasoning goes – is not provided for by the denotation of the present perfect auxiliary, which, arguably, requires topic time to be identified with utterance time. (The ungrammaticality of (31)aA will be explained in section 4 below.)

3.3 Derivations for preterit perfect sentences

(32) below provides pairs of examples of corresponding German and English preterit perfect sentences. There is no truth-conditional difference between utterances of the members of each pair.

(32) a. Alex war gestern um 12 angekommen. / Gestern um 12 war Alex angekommen.
b. Alex had arrived yesterday at 12. / Yesterday at 12 Alex had arrived.

Recall the denotations for the English and German perfect auxiliaries in the past tense, here repeated in (33).

(33) a. $\llbracket have_{past} \rrbracket = \lambda s\, [\lambda x\, [\lambda i\, [s\,(x)\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq \mathbf{(}{-\infty}, T_u\mathbf{)} \cap i]]]$
b. $\llbracket haben_{past} \rrbracket = \lambda s\, [\lambda x\, [\lambda i\, [s\,(x)\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq \mathbf{(}{-\infty}, T_u\mathbf{)} \cap i]]]$
c. $\llbracket sein_{past} \rrbracket = \lambda s\, [\lambda i\, [s\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq \mathbf{(}{-\infty}, T_u\mathbf{)} \cap i]]$

Since the time adverbials *gestern um 12* / *yesterday at 12* may be taken to specify either situation time or topic time, i.e. to provide a denotation for either the variable *t* or the variable *i*, there are two possible derivations for the German and for the English pair. Recall from footnote 10 above that, for some reason not investigated in the present paper, specification of both situation time and topic time in the same clause by an adverbial is assumed to be impossible. I go through the derivations for the German sentences:

(34) $\llbracket ankommen_{pastpcp}\ Alex \rrbracket$
$= \lambda x\, [\lambda t\, [ankommen'\,(x)\ \&\ T_{sit} \subseteq t\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]]\,(Alex')$
$= \lambda t\, [ankommen'\,(Alex')\ \&\ T_{sit} \subseteq t\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]$
$\llbracket (ankommen_{pastpcp}\ Alex)\ gestern\ um\ 12 \rrbracket$
$= \lambda t\, [ankommen'\,(Alex')\ \&\ T_{sit} \subseteq t\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]\,(\llbracket gestern\ um\ 12 \rrbracket)$
$= ankommen'\,(Alex')\ \&\ T_{sit} \subseteq \llbracket gestern\ um\ 12 \rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$
$\llbracket sein_{past}\ ((ankommen_{pastpcp}\ Alex)\ gestern\ um\ 12) \rrbracket$
$= \lambda s\, [\lambda i\, [s\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq \mathbf{(}{-\infty}, T_u\mathbf{)} \cap i]]\,(ankommen'\,(Alex')\ \&\ T_{sit} \subseteq \llbracket gestern\ um\ 12 \rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)})$
$= \lambda i\, [ankommen'\,(Alex')\ \&\ T_{sit} \subseteq \llbracket gestern\ um\ 12 \rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq \mathbf{(}{-\infty}, T_u\mathbf{)} \cap i]$
$= ankommen'\,(Alex')\ \&\ T_{sit} \subseteq \llbracket gestern\ um\ 12 \rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq \mathbf{(}{-\infty}, T_u\mathbf{)} \cap pro\text{-}i$
$= ankommen'\,(Alex')\ \&\ T_{sit} \subseteq \llbracket gestern\ um\ 12 \rrbracket\ \&\ T_{top} \subseteq \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} \subseteq \mathbf{(}{-\infty}, T_u\mathbf{)} \cap pro\text{-}i$
$= ankommen'\,(Alex')\ \&\ T_{sit} \subseteq \llbracket gestern\ um\ 12 \rrbracket\ \&\ T_{top} \subseteq \mathbf{(}T_{sit}, +\infty\mathbf{)} \cap \mathbf{(}{-\infty}, T_u\mathbf{)} \cap pro\text{-}i$
For there to be a T_{top}, T_{sit} must precede T_u. Then:
$= ankommen'\,(Alex')\ \&\ T_{sit} \subseteq \llbracket gestern\ um\ 12 \rrbracket\ \&\ T_{top} \subseteq \mathbf{(}T_{sit}, T_u\mathbf{)} \cap pro\text{-}i$

This is the derivation for the reading where the *ankommen*-situation takes place yesterday at 12. (Since an *ankommen*-situation is non-durative, $T_{sit} \subseteq \llbracket gestern\ um\ 12 \rrbracket$ must be interpreted to mean, more specifically, $T_{sit} = \llbracket gestern\ um\ 12 \rrbracket$.) Under this interpretation, the preterit perfect is appropriate if the producer thinks of a topic time that is located between situation time

and utterance time. This semantic aspect is covered by the fact that there has to be a pragmatically supplied value for pro-i that is intersected with $\mathbf{(}T_{sit}, T_u\mathbf{)}$. Obviously, the result of the corresponding derivation for the English sentences is (35) with the same interpretation.

(35) arrive' (Alex') & $T_{sit} \subseteq$ ‖yesterday at 12‖ & $T_{top} \subseteq \mathbf{(}T_{sit}, T_u\mathbf{)} \cap$ pro-i

The following is the derivation for the German sentences with the time adverbial specifying topic time:

(36) ‖ankommen$_{pastpcp}$ Alex‖
= λx [λt [ankommen' (x) & $T_{sit} \subseteq$ t (‖Alex‖) & $T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$]]
= λt [ankommen' (Alex') & $T_{sit} \subseteq$ t & $T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$]
= ankommen' (Alex') & $T_{sit} \subseteq$ pro-t & $T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$
‖sein (ankommen$_{pastpcp}$ Alex)‖
= λs [λi [s & $T_{top} \subseteq T_{sta}$ & $T_{top} \subseteq \mathbf{(}-\infty, T_u\mathbf{)} \cap$ i]] (ankommen' (Alex') & $T_{sit} \subseteq$ pro-t & $T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$)
= λi [ankommen' (Alex') & $T_{sit} \subseteq$ pro-t & $T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$ & $T_{top} \subseteq T_{sta}$ & $T_{top} \subseteq \mathbf{(}-\infty, T_u\mathbf{)} \cap$ i]
‖(sein (ankommen$_{pastpcp}$ Alex)) gestern um 12‖
= λi [ankommen' (Alex') & $T_{sit} \subseteq$ pro-t & $T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$ & $T_{top} \subseteq T_{sta}$ & $T_{top} \subseteq \mathbf{(}-\infty, T_u\mathbf{)} \cap$ i] (‖gestern um 12‖)
= ankommen' (Alex') & $T_{sit} \subseteq$ pro-t & $T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$ & $T_{top} \subseteq T_{sta}$ & $T_{top} \subseteq \mathbf{(}-\infty, T_u\mathbf{)} \cap$ ‖gestern um 12‖
= ankommen' (Alex') & $T_{sit} \subseteq$ pro-t & $T_{top} \subseteq \mathbf{(}T_{sit}, +\infty\mathbf{)}$ & $T_{top} \subseteq \mathbf{(}-\infty, T_u\mathbf{)} \cap$ ‖gestern um 12‖
= ankommen' (Alex') & $T_{sit} \subseteq$ pro-t & $T_{top} = \mathbf{(}T_{sit}, +\infty\mathbf{)} \cap \mathbf{(}-\infty, T_u\mathbf{)} \cap$ ‖gestern um 12‖
For there to be a T_{top}, T_{sit} must precede T_u. Then:
= ankommen' (Alex') & $T_{sit} \subseteq$ pro-t & $T_{top} = \mathbf{(}T_{sit}, T_u\mathbf{)} \cap$ ‖gestern um 12‖

Thus, ‖*gestern um 12*‖ must be contained in $\mathbf{(}T_{sit}, T_u\mathbf{)}$. This derivation corresponds to the reading where the time of the *ankommen*-situation precedes the time denoted by *gestern um 12*, which is topic time. The result of the corresponding derivation for the English sentences is, of course, (37):

(37) arrive' (Alex') & $T_{sit} \subseteq$ pro-t & $T_{top} = \mathbf{(}T_{sit}, T_u\mathbf{)} \cap$ ‖yesterday at 12‖

The same comment as above applies, resulting in the same interpretation as in the corresponding German sentence.

This is the appropriate place to elaborate that Schaden's (2009: 119) argument against previous explanations of the difference between English and German concerning *#Einstein has visited Princeton* and *Einstein hat Princeton besucht* does not apply to the analysis proposed above. Schaden gives the example

(38) In 1942, Hitler attacked Russia. Napoleon had tried before him, but without success.

and argues that "life-time effects" should also arise in preterit perfects, but do not; for although Napoleon had long been dead in 1942, the example is still felicitous. Just to simplify without damaging Schaden's argument, let us understand the phrase *before him* in his example in such a way that it can be replaced by *before 1942*. Then the relevant denotation for *Napoleon had tried before 1942* on the basis of the denotations provided above is either (39)a or b:

(39) a. try' (Napoleon') & $T_{sit} \subseteq$ ‖before 1942‖ & $T_{top} \subseteq \mathbf{(}T_{sit}, T_u\mathbf{)} \cap$ pro-i
b. try' (Napoleon') & $T_{sit} \subseteq$ pro-t & $T_{top} \subseteq \mathbf{(}T_{sit}, T_u\mathbf{)} \cap$ ‖before 1942‖

(39)a denotes the set of post-states obtaining at topic time of situations where Napoleon tries to subjugate Russia at a time before 1942, which is situation time. If *pro-i* is conceived of as a time at which Napoleon was alive, then T_{top} is a time at which Napoleon was alive as well so that no lifetime effect ought to arise, which is correct. (39)b denotes the set of post-states obtaining at topic time of situations where Napoleon tries to subjugate Russia at some time before 1942 (situation time), which itself precedes some other time before 1942 (topic time). There certainly are such topic time intervals during which Napoleon was alive, so that, again, no lifetime effect ought to arise, which is correct. Finally in this context, I may point out that lifetime effects do occur with the preterit perfect under appropriate circumstances (see also Klein 2008: 292):

(40) a. Carlsen won the chess world championship in 2013. By that time Anand had won or defended it already five times. [At the time of writing this, Anand is alive and consequently was alive in 2013.]
b. Carlsen won the chess world championship in 2013. #By that time Botvinnik had won or defended it already five times. [Botvinnik died in 1995. Note that the oddness arises on the basis of the knowledge that Botvinnik was long dead in 2013.]

Finally in this section I illustrate how sentences in the present perfect with quantificational temporal adverbials (such as *sometimes*, *never*, *always*) are composed in the present framework. These adverbials are not of the type that instantiates the variable *t*. Rather, they are functions that take expressions which denote sets of situations as arguments. Specifically, their denotations are as given in (41), where *z* is a variable that ranges over intervals.

(41) a. $\llbracket\text{sometimes}\rrbracket = \lambda s\,[\exists z\,(T_{sit} = z\ \&\ s)]$
b. $\llbracket\text{never}\rrbracket = \lambda s\,[\sim\exists z\,(T_{sit} = z\ \&\ s)]$
c. $\llbracket\text{always}\rrbracket = \lambda s\,[\forall z\,(T_{sit} = z \rightarrow s)]$

Let us go through the derivation of the sentence in (42)a, assuming that the step where the denotation of *never* is semantically composed is the last one of the derivation.

(42) a. Alex has never worked since she left school.
b. $\llbracket\text{work}_{pastpcp}$ (since she left school)$\rrbracket$
$= \lambda t\,[\text{work}' \ \&\ T_{sit} \subseteq t\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]$ ($\llbracket$since she left school$\rrbracket$)
$= \text{work}' \ \&\ T_{sit} \subseteq \llbracket$since she left school$\rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$
$\llbracket\text{have}_{pres}\ (\text{work}_{pastpcp}$ (since she left school))$\rrbracket$
$= \lambda s\,[\lambda x\,[s\,(x)\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} = T_u]]\ (\text{work}' \ \&\ T_{sit} \subseteq \llbracket\text{since ...}\rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)})$
$= \lambda x\,[\text{work}'\,(x)\ \&\ T_{sit} \subseteq \llbracket\text{since ...}\rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} = T_u]$
$\llbracket(\text{have}_{pres}\ (\text{work}_{pastpcp}$ (since she left school))) Alex$\rrbracket$
$= \lambda x\,[\text{work}'\,(x)\ \&\ T_{sit} \subseteq \llbracket\text{since ...}\rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} = T_u]$ (Alex')
$= \text{work}'\,(\text{Alex}')\ \&\ T_{sit} \subseteq \llbracket\text{since ...}\rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} = T_u$
$= \text{work}'\,(\text{Alex}')\ \&\ T_{sit} \subseteq \llbracket\text{since she left school}\rrbracket\ \&\ T_{top} \subseteq \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} = T_u$
$\llbracket\text{never}\ ((\text{have}_{pres}\ (\text{work}_{pastpcp}$ (since she left school))) Alex)$\rrbracket$
$\lambda s\,[\sim\exists z\,(T_{sit} = z\ \&\ s)]\ (\text{work}'\,(\text{Alex}')\ \&\ T_{sit} \subseteq \llbracket\text{since ...}\rrbracket\ \&\ T_{top} \subseteq \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} = T_u)$
$\sim\exists z\,(T_{sit} = z\ \&\ \text{work}'\,(\text{Alex}')\ \&\ T_{sit} \subseteq \llbracket\text{since ...}\rrbracket\ \&\ T_{top} \subseteq \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} = T_u)$

As before, for the formula to be consistent, T_{sit} must precede T_u identified with T_{top}. The formula says that there is no interval identical to a T_{sit} that satisfies the conjoined subformulas involving T_{sit}. More specifically, topic time identified with utterance time is in the post-time

of not a single interval since the time of Alex's leaving school that is the situation time of a working-situation involving Alex as agent. This is what the sentence means. Note that the denotation of the sentence *Alex has never worked* would have *pro-t* instead of ⟦*since she left school*⟧ allowing for the same vagueness concerning the temporal location of situation time and thus post-time that the sentence actually has (Never ever? Never since she lost her first/second/third job?). The derivations involving *sometimes* and *always* instead of *never* in (42)a work analogously to (42)b, of course, resulting in (43)b-c respectively.

(43) a. $\exists z\ (T_{sit} = z\ \&\ \text{work'}\ (\text{Alex'})\ \&\ T_{sit} \subseteq \llbracket \text{since ...} \rrbracket\ \&\ T_{top} \subseteq \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} = T_u)$

b. $\forall z\ (T_{sit} = z \rightarrow (\text{work'}\ (\text{Alex'})\ \&\ T_{sit} \subseteq \llbracket \text{since ...} \rrbracket\ \&\ T_{top} \subseteq \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} = T_u))$

The semantic representation of the German sentence in (44)a, then, is (44)b.

(44) a. Alex hat Sam immer geliebt.
Alex has Sam always loved

b. $\forall z\ (T_{sit} = z \rightarrow ((\text{love'}\ (\text{Sam'}))\ (\text{Alex'})\ \&\ T_{sit} \subseteq \text{pro-t}\ \&\ T_{top} \subseteq \mathbf{(}T_{sit}, T_u\mathbf{)})$

This means, correctly, that any arbitrary interval that is located before T_{top} is a situation time of loving-situations involving the two referents mentioned. Such a situation obtaining at utterance time is not excluded by the denotation of the sentence; but it is also not entailed. This is compatible with the observation that an utterance of (44)a may appropriately be followed by an utterance of *Aber jetzt ist es vorbei* ('But now it's over'). An utterance of the sentence *Alex hat Sam schon immer geliebt*, which differs from (44)a by the presence of the particle *schon*, has the same denotation as (44)a but comes with the additional implication, triggered by the particle, that the loving-situation obtains at utterance time too.[31]

3.4 Clauses involving non-tensed perfect auxiliaries

As mentioned before, I illustrate the idea of the semantic composition of phrases headed by non-tensed perfect auxiliaries with the help of the example in (45).

(45) Having arrived yesterday, Alex set to work immediately.

Recall from section 2.3 above that the denotation for non-tensed *have* is assumed to be as given in (46).

(46) $\llbracket \text{have}_{nonfin} \rrbracket = \lambda s\ [\lambda x\ [s\ (x)]]$

For the semantic derivation of the present participle clause *having arrived yesterday* I assume that the argument variable *x* is λ-converted into a pro-form *pro-x*, which is a variable that is assigned a value pragmatically. The derivation thus runs as follows:

(47) $\llbracket \text{arrive}_{pastpcp}\ (\text{pro-x}) \rrbracket$
$= \lambda x\ [\lambda t\ [\text{arrive'}\ (x)\ \&\ T_{sit} \subseteq t\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]]\ (\text{pro-x})$
$= \lambda t\ [\text{arrive'}\ (\text{pro-x})\ \&\ T_{sit} \subseteq t\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]$
$\llbracket (\text{arrive}_{pastpcp}\ (\text{pro-x}))\ (\text{yesterday}) \rrbracket$
$= \lambda t\ [\text{arrive'}\ (\text{pro-x})\ \&\ T_{sit} \subseteq t\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]\ (\llbracket \text{yesterday} \rrbracket)$
$= \text{arrive'}\ (\text{pro-x})\ \&\ T_{sit} \subseteq \llbracket \text{yesterday} \rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$
$\llbracket \text{have}_{nonfin}\ ((\text{arrive}_{pastpc}\ (\text{pro-x}))\ (\text{yesterday})) \rrbracket$
$= \lambda s\ [\lambda x\ [s\ (x)]]\ (\text{arrive'}\ (\text{pro-x})\ \&\ T_{sit} \subseteq \llbracket \text{yesterday} \rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)})$

[31] Thus, as suggested by an anonymous reviewer, according to the present approach a German present perfect is never 'universal', if this notion requires that the obtaining of the situation at topic time be semantically entailed. 'Universal' readings can be pragmatically implicated.

= λx [(arrive' (pro-x)) (x) & $T_{sit} \subseteq$ ‖yesterday‖ & T_{sta} = **(**T_{sit}, +∞**)**]
= arrive' (pro-x) & $T_{sit} \subseteq$ ‖yesterday‖ & T_{sta} = **(**T_{sit}, +∞**)**[32]

The formula correctly denotes the set of post-states of arriving-situations that occurred yesterday. The post-time introduced by such present participle clauses usually serves as a frame for the topic time in their past or present tense matrix clauses. The lack of an issue concerning definite positional past time adverbials correlates with the absence of a semantic role for topic time in non-tensed perfect clauses.

(47) reveals that the non-finite perfect auxiliary is semantically vacuous in a past participle clause headed by a participle such as *arrived*: the second line after ‖*(arrive$_{pastpcp}$ (pro-x)) (yesterday)*‖ is identical to the last line of the derivation. This corresponds to the fact that the only function of a non-finite perfect auxiliary is the argument-structural one of introducing an argument position. With past participles like *arrived*, to which deletion of a non-primary argument position (Breul & Wegner 2017) has *not* applied, it is the primary argument that gets raised into the argument position introduced by the perfect auxiliary, thus satisfying it. But since the making available of an additional argument position is actually not necessary for past participles such as *arrived*, the presence of a perfect auxiliary is optional, as evidenced by attested examples such as those in (48) from the *Corpus of Contemporary American English*.[33]

(48) a. Having arrived at the course just after 8 a.m., I teed off at 11:15.
b. Arrived in New York as a counterintelligence agent in 1964, he needed a place to live and wanted to make a call about an apartment.

3.5 Present perfect clauses with present time and future time reference in German

As briefly mentioned above, there is a second denotation associated with the forms of German present perfect auxiliaries. This is a denotation that accounts for the grammaticality of German present perfect sentences that have future time reference, as in (49).[34]

(49) Ich habe es dir morgen um 12 zurückgegeben.
I have it to-you tomorrow at 12 given-back
'I will have given it back to you by 12 tomorrow.'

I suggest that the denotation is as given in (50).

(50) a. ‖haben$_{pres}$'‖ = λs [λx [λi [s (x) & $T_{top} \subseteq T_{sta}$ & $T_{top} \subseteq$ **[**T_u, +∞**)** ∩ i]]]
b. ‖sein$_{pres}$'‖ = λs [λi [s & $T_{top} \subseteq T_{sta}$ & $T_{top} \subseteq$ **[**T_u, +∞**)** ∩ i]]

I assume that there is a requirement for the use of this denotation to the effect that the variable *i* has to be overtly instantiated (see also Musan 2002: 54f.). In order for T_{top} to be non-empty, then, *i* must be instantiated by a positional future time adverbial such as *morgen* ('tomorrow'), *nächstes Jahr* ('next year'), *im Jahre 2200* ('in the year 2200'), *bald* ('soon') etc., or by a present time adverbial like *jetzt* ('now'). This accounts for the observation that a present perfect

[32] This step in the derivation, where *λx* and *(x)* from the previous step seem to have simply disappeared, is the semantic equivalent of the syntactic operation of raising the only argument of *arrive'* into the argument position introduced by the auxiliary. That is, the argument variable *x* is λ-converted into the inner argument *pro-x* here, making the inner argument position predicate-logically void.
[33] In non-finite constructions with a past participle such as *arrived* other than past participle clauses, the perfect auxiliary may not be optional. In *She wanted to have arrived earlier* (cf. **She wanted to arrived earlier*), for instance, the need for the auxiliary is due to the fact that the clause has to be headed by an infinitive.
[34] The example involves a 3-place verb this time in order to show that the mechanism of semantic composition to be gone through below does not differ in principle from the examples with 1- and 2-place verbs used so far.

clause that does not contain a future time adverbial, such as *Ich habe es dir zurückgegeben* ('I have given it back to you'), does not license a future time interpretation (see also Musan 2002: 36f.). Note that the requirement of an overt instantiation of *i* in connection with the assumption that more than one positional time adverbial in one clause is not possible (recall footnote 10 above) excludes the possibility that the single time adverbial *morgen um 12* in *Ich habe es dir morgen um 12 zurückgegeben* may specify situation time with some future time *pro-i* providing the value for *i*. Thus, an interpretation to the effect that the *zurückgeben*-situation obtains tomorrow at 12 and that topic time is some implicit time posterior to tomorrow at 12 is excluded, which is correct.[35]

The existence of the denotation in (50) means that there are two homonymous pairs of German present perfect auxiliaries, *haben*$_{pres}$ and *sein*$_{pres}$ on the one hand and *haben*$_{pres}$' and *sein*$_{pres}$' on the other hand.[36] The semantic derivation of the sentence in (49) with *haben*$_{pres}$' proceeds as shown in (51), assuming that the surface constituent order we find in that sentence is not the one that reflects the order of semantic composition but results from semantically irrelevant movement operations.

(51) $\llbracket$zurückgeben$_{pastpcp}$ es$\rrbracket$
$= \lambda x\,[\lambda y\,[\lambda t\,[(\text{zurückgeben}'(x))(y) \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]]](\llbracket es \rrbracket)$
$= \lambda y\,[\lambda t\,[(\text{zurückgeben}'(\llbracket es \rrbracket))(y) \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]]$
$\llbracket$(zurückgeben$_{pastpcp}$ es) dir$\rrbracket$
$= \lambda y\,[\lambda t\,[(\text{zurückgeben}'(\llbracket es \rrbracket))(y) \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]](\llbracket dir \rrbracket)$
$= \lambda t\,[(\text{zurückgeben}'(\llbracket es \rrbracket))(\llbracket dir \rrbracket) \,\&\, T_{sit} \subseteq t \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]$
$= (\text{zurückgeben}'(\llbracket es \rrbracket))(\llbracket dir \rrbracket) \,\&\, T_{sit} \subseteq \text{pro-t} \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$
$\llbracket$haben$_{pres}$' ((zurückgeben$_{pastpcp}$ es) dir)$\rrbracket$
$= \lambda s\,[\lambda x\,[\lambda i\,[s(x) \,\&\, T_{top} \subseteq T_{sta} \,\&\, T_{top} \subseteq \mathbf{[}T_u, +\infty\mathbf{)} \cap i]]](\text{zurückgeben}'(\llbracket es \rrbracket))(\llbracket dir \rrbracket) \,\&\, T_{sit} \subseteq \text{pro-t} \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)})$
$= \lambda x\,[\lambda i\,[((\text{zurückgeben}'(\llbracket es \rrbracket))(\llbracket dir \rrbracket))(x) \,\&\, T_{sit} \subseteq \text{pro-t} \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)} \,\&\, T_{top} \subseteq T_{sta} \,\&\, T_{top} \subseteq \mathbf{[}T_u, +\infty\mathbf{)} \cap i]]$
$\llbracket$(haben$_{pres}$' ((zurückgeben$_{pastpcp}$ es) dir)) ich$\rrbracket$
$= \lambda x\,[\lambda i\,[((\text{zurückgeben}'(\llbracket es \rrbracket))(\llbracket dir \rrbracket))(x) \,\&\, T_{sit} \subseteq \text{pro-t} \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)} \,\&\, T_{top} \subseteq T_{sta} \,\&\, T_{top} \subseteq \mathbf{[}T_u, +\infty\mathbf{)} \cap i]](\llbracket ich \rrbracket)$
$= \lambda i\,[((\text{zurückgeben}'(\llbracket es \rrbracket))(\llbracket dir \rrbracket))(\llbracket ich \rrbracket) \,\&\, T_{sit} \subseteq \text{pro-t} \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)} \,\&\, T_{top} \subseteq T_{sta} \,\&\, T_{top} \subseteq \mathbf{[}T_u, +\infty\mathbf{)} \cap i]$
$\llbracket$((haben$_{pres}$' ((zurückgeben$_{pastpcp}$ es) dir)) ich) morgen um 12$\rrbracket$
$= \lambda i\,[((\text{zurückgeben}'(\llbracket es \rrbracket))(\llbracket dir \rrbracket))(\llbracket ich \rrbracket) \,\&\, T_{sit} \subseteq \text{pro-t} \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)} \,\&\, T_{top} \subseteq T_{sta} \,\&\, T_{top} \subseteq \mathbf{[}T_u, +\infty\mathbf{)} \cap i](\llbracket \text{morgen um 12} \rrbracket)$
$= ((\text{zurückgeben}'(\llbracket es \rrbracket))(\llbracket dir \rrbracket))(\llbracket ich \rrbracket) \,\&\, T_{sit} \subseteq \text{pro-t} \,\&\, T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)} \,\&\, T_{top} \subseteq T_{sta} \,\&\, T_{top} \subseteq \mathbf{[}T_u, +\infty\mathbf{)} \cap \llbracket \text{morgen um 12} \rrbracket$

[35] This corresponds to Musan's (2002: 36f.) observation that the sentence *Hans ist morgen um zehn weggegangen* (lit. '*Hans has left tomorrow at ten') does not have a denotation where the adverbial specifies situation time. See also Thieroff (1992: 189), pointing out that this use of the German present perfect is equivalent to the future perfect ("Futur II"). A specification of situation time would be equivalent to *Futur I*.

[36] Adopting a word-based lexicalist framework does not entail a lack of concern for constraints on the formation of lexical items (homonymous or otherwise) in the lexicon (see Bochner 1993 among others). But neither does this framework subscribe to the methodological principle that the assumption of the existence of homonymic lexical items is to be avoided at all costs. English auxiliaries provide a good example for the point that it would be unreasonable to reject the claim of the existence of *haben*$_{pres}$' alongside *haben*$_{pres}$ and *sein*$_{pres}$' alongside *sein*$_{pres}$ on the grounds of such a principle. Who would try to provide a semantic analysis of the modal and the non-modal (past tense) interpretation of a sentence like *She could not do it* on the basis of the assumption that *could* is not ambiguous here, i.e. that it is not the case that there are two homonymous lexical entries associated with *could*?

= ((zurückgeben' (‖es‖)) (‖dir‖)) (‖ich‖) & $T_{sit} \subseteq$ pro-t & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** & $T_{top} \subseteq$ **[**T_u, $+\infty$**)** $\cap$ ‖morgen um 12‖
= ((zurückgeben' (‖es‖)) (‖dir‖)) (‖ich‖) & $T_{sit} \subseteq$ pro-t & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** & $T_{top} \subseteq$ ‖morgen um 12‖
= ((zurückgeben' (‖es‖)) (‖dir‖)) (‖ich‖) & $T_{sit} \subseteq$ pro-t & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** $\cap$ ‖morgen um 12‖

For there to be a T_{top}, ‖*morgen um 12*‖ has to be contained in ***(***T_{sit}, $+\infty$***)***, which entails that T_{sit} has to precede ‖*morgen um 12*‖. This correctly denotes post-states of *zurückgeben*-situations involving the referents of *es*, *dir* and *ich* supplied with the appropriate semantic roles according to their syntactic functions where situation time precedes tomorrow at 12. This includes situations where situation time is before utterance time, which is correct. An utterance producer who knows that Alex will have arrived by tomorrow at 12, but does not know whether Alex has already arrived or not, may very well utter *Alex ist morgen um 12 angekommen* (lit. '*Alex is tomorrow arrived'), allowing for the situation that Alex has already arrived.

Let us consider a modified version of the example *Morgen hat er sein Werk vollendet* ('Tomorrow he will have completed his work.') given in *Duden Grammatik* (2005: 514).

(52) Nächsten Monat hat er sein Werk vollendet.
next month has he his work completed
'Next month he will have completed his work.'

This version makes it clear that the completion of his work may happen during next month or earlier. (The latter reading for the version with *morgen* instead of *nächsten Monat* is pragmatically more difficult to accept since before tomorrow is today or before today, and there are more informative ways of expressing this than uttering *Morgen hat er sein Werk vollendet*). The denotation for (52) is (53).

(53) (vollendet' (‖sein Werk‖)) (‖er‖) & $T_{sit} \subseteq$ pro-t & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** $\cap$ ‖nächsten Monat‖

For there to be a T_{top}, T_{sit} has to precede T_{top}. T_{top} may be included in next month so that T_{sit} may precede T_{top} and still be within next month or may be earlier. If T_{top} is conceived of to be equal to next month, T_{sit} cannot be but earlier than next month. Thus, the denotation covers the potential readings.

Let us consider what happens when a positional future time adverbial is used in combination with the denotation suggested for German present perfect auxiliaries in (17), i.e. the one underlying the derivations in the preceding sections. The derivation with this denotation of the sentence

(54) Alex ist morgen angekommen. ('Alex will have arrived by tomorrow.')
Alex is tomorrow arrived

goes as follows:

(55) ‖(ankommen$_{pastpcp}$ Alex) morgen‖
= λt [ankommen' (Alex') & $T_{sit} \subseteq$ t & T_{sta} = **(**T_{sit}, $+\infty$**)**] (‖morgen‖)
= ankommen' (Alex') & $T_{sit} \subseteq$ ‖morgen‖ & T_{sta} = **(**T_{sit}, $+\infty$**)**
‖sein$_{pres}$ ((ankommen$_{pastpcp}$ Alex) morgen)‖
= λs [s & $T_{top} \subseteq T_{sta}$ & $T_{top} \subseteq$ **(**$-\infty$, T_u**)**] (ankommen' (Alex') & $T_{sit} \subseteq$ ‖morgen‖ & T_{sta} = **(**T_{sit}, $+\infty$**)**)
= ankommen' (Alex') & $T_{sit} \subseteq$ ‖morgen‖ & T_{sta} = **(**T_{sit}, $+\infty$**)** & $T_{top} \subseteq T_{sta}$ & $T_{top} \subseteq$ **(**$-\infty$, T_u**)**

= ankommen' (Alex') & $T_{sit} \subseteq$ ‖morgen‖ & $T_{top} \subseteq$ **(**T_{sit}, +∞**)** & $T_{top} \subseteq$ **(**-∞, T_u**)**
= ankommen' (Alex') & $T_{sit} \subseteq$ ‖morgen‖ & $T_{top} \subseteq$ **(**T_{sit}, +∞**)** ∩ **(**-∞, T_u**)**

Since situation time is later than utterance time, ***(****T_{sit}, +∞**)** ∩ **(**-∞, T_u***)*** is empty and thus there cannot be a T_{top}. The derivation crashes. This shows that a positional future time adverbial in combination with the denotation for present perfect auxiliaries in (17) does not lead to an interpretable result. This supports the claim that we need both denotations for the German present perfect auxiliaries, those in (17) and in (50).

To round up the discussion in this section, it ought to be pointed out that what has been said about future time reference in German present perfects also holds for present time reference by a time adverbial such as *jetzt* ('now'), which refers deictically to utterance time. It is well known that sentences like those in (56) are fully acceptable in German.

(56) a. Alex ist jetzt angekommen.
b. Hans hat jetzt den Brief geschrieben. (from Musan 2002: 23) ('Hans has now written the letter')

These are prime examples proving the necessity for a distinction between situation time and topic time. For *jetzt* clearly does not specify the time of arrival or the time of writing the letter. These situations are located in the past. What *jetzt* specifies is topic time.[37] Let us concentrate on (56)a. If the present perfect auxiliary is the one with the denotation from (17), we get (57)a for the denotation of the sentence, and we get (57)b, if the present perfect auxiliary is the one with the denotation from (50).

(57) a. ankommen' (Alex') & $T_{sit} \subseteq$ ‖jetzt‖ & $T_{top} \subseteq$ **(**T_{sit}, +∞**)** ∩ **(**-∞, T_u**)**
b. ankommen' (Alex') & $T_{sit} \subseteq$ pro-t & $T_{top} \subseteq$ **(**T_{sit}, +∞**)** ∩ ‖jetzt‖

The first derivation, where *jetzt* would specify situation time, crashes, for both T_{sit} and T_u are identical to ‖*jetzt*‖ ('now') – T_{sit} by virtue of $T_{sit} \subseteq$ ‖*jetzt*‖ and T_u by virtue of its definition – such that the intersection ***(****T_{sit}, +∞**)** ∩ **(**-∞, T_u***)*** is empty (recall that T_{sit} and T_u are completely excluded from these intervals); thus there can be no T_{top}. By contrast, the derivation in (57)b, where *jetzt* specifies topic time, is fine. In order for the intersection ***(****T_{sit}, +∞**)** ∩ ‖*jetzt*‖ not to be empty, it requires T_{sit} to precede ‖*jetzt*‖, which is exactly what the sentence expresses.

4 Definite positional past time adverbials in present perfect sentences

As is well known, German present perfects are generally compatible with a definite positional past time adverbial, whereas English ones are not. This, in combination with the fact that English non-tensed perfects are compatible with such adverbials (see section 3.4 above), is the core datum of the present perfect puzzle (Klein 1992):[38]

[37] The same holds for English *now*. Recall footnote 20.

[38] The acceptability of definite positional past time adverbials in English non-tensed and auxiliariless past participle clauses constitutes evidence that it is not the past participle as such that is responsible for the present perfect puzzle. This provides a partial answer to an anonymous reviewer's question – "why are these differences [i.e. those between English and German present perfects discussed in the present paper] due to the auxiliary, why not to the whole construction?". That is, if one takes a word-based lexicalist and compositional perspective, the present perfect puzzle points to the semantics of the English and German perfect auxiliaries in the present tense where one ought to search for the source of the differences. Insofar as the auxiliary interacts semantically with the past participle in present perfects, a difference between the respective auxiliaries projects to the construction as a whole. In that sense the reviewer's dichotomy 'auxiliary' vs. 'whole construction' does not constitute an exclusive alternative. If 'construction' in the sense of construction grammar is intended, though, the present paper indeed does not have anything to offer that speaks in favour of taking the word-based lexicalist and composition-

(58) a. Alex ist gestern angekommen. ('Alex arrived yesterday.')
b. *Alex has arrived yesterday.

There is some doubt and discussion concerning the nature of the constraint in English. For example, according to Declerck (2006: 598), definite positional past time adverbials "are only compatible with the past tense, not with the present perfect (not even when there is a clear idea of present relevance or resultativeness)". Quirk et al. (1985: 195, note a) mention that some examples that violate the constraint can be explained as performance errors, but add that "[s]uch explanations may not, however, be so readily available in other cases, such as *They asked me about something I've said years ago*". Corpus-based work by Hundt & Smith (2009), as well as work referred to by them, suggests that present perfects with definite positional past time adverbials do occur, but are very rare in general. Ritz (2010) observes frequent occurrences of such cases in Australian police media releases but characterises such occurrences as non-standard. Portner (2012: 1224) refers to examples presented by Schaden (2009) and comments: "the attested examples which he provides are all representative of very formal contexts. A correct account will need [to] allow for such sentences in a particular dialect or register, but also to explain their ungrammaticality elsewhere". Huddleston (2002: 144) gives the following example and comments on it as follows:

(59) We've already discussed it yesterday.

> In [(59)] the *already* indicates that I'm concerned with the occurrence of the situation of our discussing it within a time-span up to now and cancels the normally excluding effect of *yesterday* evident in [*We discussed it yesterday*].

Here it appears to be the presence of the adverbial *already* which licenses the definite positional past time adverbial in the present perfect clause. Quirk et al. (1985: 195) explicitly mention *already* as one of those past time adverbials that are compatible with both the simple preterit and the present perfect.

(60) provides the derivation for the German sentence in (58)a.

(60) $\llbracket(\text{ankommen}_{\text{pastpcp}}\ \text{Alex})\ \text{gestern}\rrbracket$
$= \lambda t\ [\text{ankommen'}\ (\text{Alex'})\ \&\ T_{sit} \subseteq t\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}]\ (\llbracket\text{gestern}\rrbracket)$
$= \text{ankommen'}\ (\text{Alex'})\ \&\ T_{sit} \subseteq \llbracket\text{gestern}\rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}$
$\llbracket\text{sein}_{\text{pres}}\ ((\text{ankommen}_{\text{pastpcp}}\ \text{Alex})\ \text{gestern})\rrbracket$
$= \lambda s\ [s\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq \mathbf{(}-\infty, T_u\mathbf{)}]\ (\text{ankommen'}\ (\text{Alex'})\ \&\ T_{sit} \subseteq \llbracket\text{gestern}\rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)})$
$= \text{ankommen'}\ (\text{Alex'})\ \&\ T_{sit} \subseteq \llbracket\text{gestern}\rrbracket\ \&\ T_{sta} = \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq \mathbf{(}-\infty, T_u\mathbf{)}]$
$= \text{ankommen'}\ (\text{Alex'})\ \&\ T_{sit} \subseteq \llbracket\text{gestern}\rrbracket\ \&\ T_{top} \subseteq \mathbf{(}T_{sit}, +\infty\mathbf{)}\ \&\ T_{top} \subseteq \mathbf{(}-\infty, T_u\mathbf{)}$
$= \text{ankommen'}\ (\text{Alex'})\ \&\ T_{sit} \subseteq \llbracket\text{gestern}\rrbracket\ \&\ T_{top} \subseteq \mathbf{(}T_{sit}, +\infty\mathbf{)} \cap \mathbf{(}-\infty, T_u\mathbf{)}$
For there to be a T_{top}, T_{sit} must precede T_u. Then:
$= \text{ankommen'}\ (\text{Alex'})\ \&\ T_{sit} \subseteq \llbracket\text{gestern}\rrbracket\ \&\ T_{top} \subseteq \mathbf{(}T_{sit}, T_u\mathbf{)}$

The formula correctly denotes post-states of *ankommen*-situations obtaining some time yesterday, with topic time following situation time but preceding utterance time. Note that in German present perfect sentences a definite positional past time adverbial can only specify situation time, not topic time, for there is no variable in the denotation of these sentences that constrains topic time and could take up the value of such an adverbial. This gives us another correct result, for if topic time could be so specified, we would get denotations of present per-

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al perspective rather than a construction grammar perspective, I think. But speaking in favour of the former perspective rather than the latter is not my intention here.

fect sentences that are the same as those of preterit perfect sentences where topic time is specified by such a past time adverbial. But this would predict interpretations that such sentences do not have. A German sentence like *Alex ist gestern angekommen* never gets an interpretation where the *ankommen*-situation is located anterior to the interval denoted by *gestern*. The problem, however, is that the derivation for the English sentence (58)b results in a well-formed and non-contradictory denotation, just as (60) does for (58)a. The obvious result is given in (61).

(61) arrive' (Alex') & $T_{sit} \subseteq$ ‖yesterday‖ & $T_{top} \subseteq$ **(**T_{sit}, +∞**)** & $T_{top} = T_u$

There is no logico-semantic problem with (61). Thus, on the basis of the denotations and semantic operations assumed, an interpretation corresponding to denotation (61) for the sentence (58)b ought to be possible.

My explanation of why sentences like (58)b are unacceptable runs as follows: Such sentences are logico-semantically flawless indeed. Their communicative use, though, usually violates an information structural requirement. The reason why this requirement affects English, but not German, is that the denotations of the respective English sentences involve the semantic constraint $T_{top} = T_u$ (see (61)) while the denotations of the corresponding German sentences involve the constraint $T_{top} \subseteq$ **(**T_{sit}, T_u**)** (see the final line of (60)).

What is the relevant information structural requirement? Recall Huddleston's explanation that a speaker of (59) has to be "concerned with the occurrence of the situation of our discussing it within a time-span up to now". This in connection with the consideration that topic time constitutes a component of a general kind of cross-linguistic information-structural aboutness topicality (see e.g. Lambrecht 1994) that is inherent to any clause in which it is semantically represented suggests an aboutness requirement for topic time:[39]

(62) *Aboutness requirement for topic time*
What is asserted in a tensed clause is asserted about topic time. In order to be information-structurally coherent, what is expressed or entailed by the denotation with respect to the temporal location of the situation must be predicatable about topic time.

The idea is that topic time does not only play a role in the semantic composition of the denotations of expressions but also in the domain of pragmatics where information structural concerns are addressed. In this domain, what is expressed or entailed about the temporal location of the situation must provide predicational information about topic time, independently of and in addition to its semantic relation to situation time, for the utterance to be information-structurally appropriate.

By including the notion that not only what is expressed, but also what is entailed, is relevant for the aboutness requirement for topic time, I aim to account for Portner's (2012: 1224) observation that unacceptability also ensues "when past time reference is implied by an argument, as in [(63)a] and non-temporal adverbials, as in [(63)b], when they entail the same kind of time restriction as a temporal adverbial would".

(63) a. *I've enjoyed yesterday's party. (from Portner 2012: 1224)
b. *Mary has arrived on yesterday's flight. (*ditto*)

The predicatability about topic time of what is expressed or entailed by the denotation with respect to the temporal location of the situation is given if the interval denoted by a time ad-

[39] Cf. Erteschik-Shir's (2007: 16ff.) discussion of time (and space) as dimensions that provide permanently available "stage topics".

verbial, or equivalently entailed, as in (63)a-b, contains topic time.[40] For example, *Alex has arrived {today, this week}* fulfil this requirement since the intervals denoted by the adverbials contain topic time, which is identified with utterance time. For **Alex has arrived {yesterday*, *last week*, *two days ago}* the requirement is not fulfilled since the intervals denoted by the adverbials do not contain topic time identified with utterance time. The denotation of a German present perfect clause such as (58)a does not involve the logical conjunct $T_{top} = T_u$ as the corresponding English clause does. Rather, the corresponding logico-semantic constraint for the German clause is $T_{top} \subseteq (T_{sit}, T_u)$. Thus, topic time can never be identified with utterance time, but may be any interval between situation time and utterance time. Consequently, topic time can always be so chosen that it falls into the interval denoted by such adverbials as *gestern* ('yesterday'), *letzte Woche* ('last week'), *vor zwei Tagen* ('two days ago') etc. This is because there are always infinitely many intervals that can be squeezed between the right boundary of situation time and the right boundary of the interval denoted by the adverbial.

There is a complication, though. English present perfect clauses are compatible with time adverbials such as *just* and *recently* as well as *in the past*, or *before (now)*, whose denotation does not appear to include, but to abut, utterance time.[41] At least if utterance time is conceived of as a point in time, i.e. as an interval whose left and right included boundary points are identical, this can be captured by saying that the predicatability about topic time of what is expressed or entailed by the denotation with respect to the temporal location of the situation is given if topic time is contained in the right closure of the interval denoted by a time adverbial, or equivalently entailed, as in (63)a-b.[42] The right closures of the intervals denoted by adverbials such as *just*, *recently*, *in the past*, *before (now)* do contain utterance time (conceived of as a point in time) and thus topic time in English present perfect clauses modified by these adverbials; utterance time is their right-closing boundary point. Since every interval that is contained in the interval *I* that is denoted by a time adverbial is also contained in the right closure of *I*, the cases involving adverbials like *today* and *this week* mentioned in the previous paragraph are also captured if the notion of predicatability about topic time is based on the right closure of *I* rather than *I* itself. In sum, the proposal is that in German and English present perfect clauses modified by a time adverbial, the aboutness requirement for topic time is fulfilled if it is possible that topic time is contained in the right closure of the interval denoted by the adverbial; the same holds if the temporal modification is entailed rather than expressed.[43]

In section 3.2 above, I postponed the explanation for why (31)aA, here repeated as (64), is ungrammatical.

(64) *What have you done for a living before you became a politician?

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[40] 'Predicatability' is to be understood in the same sense as when we say that a predicate *P* is truly predicated of an argument *a* if what is denoted by *a* is contained, as an element, in the set denoted by *P*.

[41] Cf. Higginbotham's (2008: 185) observation concerning the acceptability of sentences such as *I have visited that museum in the past/before (now)*, which he uses to argue against Pancheva & von Stechow (2004), who suggest, in Higginbotham's (2008: 184) words, "that, in English, the temporal adverbial must apply only to intervals that include the speech time".

[42] The 'closure of an interval *I*' is the smallest closed interval that contains *I*; see e.g. McShane (1983: 4). By the 'right closure of an interval *I*' I mean the smallest right-closed interval that contains *I*.

[43] It is, of course, an open question why it should be the right closure of an interval *I* rather than *I* itself which plays the relevant role here. Maybe it is in some sense 'pragmatically natural' to extend the role of a denoted interval *I* whose right boundary abuts utterance time to the smallest interval that contains *I* and utterance time as these two intervals are 'practically the same'. It should also be pointed out that the notion 'closure (of an interval)' will have to be technically modified if we want to think of utterance time not as an interval whose left and right included boundary points are identical (a point in time), but as a larger interval.

Concentrating on the parts of the denotation of the sentence that are relevant for the present purposes, we get:

(65) ⟦what have you done for a living⟧ & $T_{sit} \subseteq$ ⟦before you became a politician⟧ & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** & $T_{top} = T_u$

This denotation violates the aboutness requirement for topic time since the right closure of ⟦*before you became a politician*⟧ does not contain topic time identified with utterance time.

How can the acceptability of Huddleston's example (59) *We've already discussed it yesterday* be explained? As pointed out above, the key to this example is the time adverbial *already*, which does comply with the aboutness requirement for topic time, in contrast to *yesterday*. It appears as if the fact that *yesterday* on its own violates the requirement loses its relevance in the presence of *already*; the presence of *already* pre-empts a violation of the requirement by *yesterday*.[44] An investigation of such cases, where more than one time adverbial is involved, has to be left to future research.

5 Summary and outlook

The present paper argues that, in a word-based lexicalist framework, the aspects of the denotations of German and English past participles that are relevant for the semantics of the perfect are subsumed by the schema in (66) below. A denotation according to (66) is assumed to reflect the semantic and argument-structural (and thus syntactically relevant) properties that are informally argued in Breul & Wegner (2017) to constitute a uniform past participle, i.e. one which functions in both perfect and passive constructions. The relevant aspects of the denotations of the tensed English and German perfect auxiliaries as well as of the non-finite, and thus non-tensed, English one are those in (67), where (67)c and e are homonymous with (67)b and d and occur in present perfect sentences that make reference to present or future times. The perfect auxiliaries are semantic functions that take the denotation of a phrase *P* projected by a past participle as its semantic argument, by λ-converting the variable *s* into the denotation of *P*.

(66) $\llbracket V_{pastpcp} \rrbracket = (\lambda x,\ldots)\ \lambda t\ [V'\ (x^{(-n)},\ldots)\ \&\ T_{sit} \subseteq t\ \&\ T_{sta} =$ **(**T_{sit}, $+\infty$**)**$]$

(67) a. $\llbracket have_{pres} \rrbracket = \lambda s\ [\lambda x\ [s\ (x)\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} = T_u]]$ (but recall footnote 20)
b. $\llbracket haben_{pres} \rrbracket = \lambda s\ [\lambda x\ [s\ (x)\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq$ **(**$-\infty$, T_u**)**$]]$
c. $\llbracket haben_{pres}' \rrbracket = \lambda s\ [\lambda x\ [\lambda i\ [s\ (x)\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq$ **[**T_u, $+\infty$**)** $\cap$ i$]]]$
d. $\llbracket sein_{pres} \rrbracket = \lambda s\ [s\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq$ **(**$-\infty$, T_u**)**$]$
e. $\llbracket sein_{pres}' \rrbracket = \lambda s\ [\lambda i\ [s\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq$ **[**T_u, $+\infty$**)** $\cap$ i$]]$
f. $\llbracket have_{past} \rrbracket = \lambda s\ [\lambda x\ [\lambda i\ [s\ (x)\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq$ **(**$-\infty$, T_u**)** $\cap$ i$]]]$
g. $\llbracket haben_{past} \rrbracket = \lambda s\ [\lambda x\ [\lambda i\ [s\ (x)\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq$ **(**$-\infty$, T_u**)** $\cap$ i$]]]$
h. $\llbracket sein_{past} \rrbracket = \lambda s\ [\lambda i\ [s\ \&\ T_{top} \subseteq T_{sta}\ \&\ T_{top} \subseteq$ **(**$-\infty$, T_u**)** $\cap$ i$]]$
i. $\llbracket have_{nonfin} \rrbracket = \lambda s\ [\lambda x\ [s\ (x)]]$

The denotations in (66) and (67) provide a clear answer to Klein & Vater's (1998) question (quoted at the beginning of the present paper) about the precise roles of the past participle and the perfect auxiliary in perfect aspect sentences. It is argued that semantic derivations of German and English perfect aspect clauses based on (66) and (67) result in denotations for these

[44] The same effect is triggered by *so far* in relation to *on Tuesday* in McCoard's (1978) example *Has he been playing much golf lately? Well, so far he has played on Tuesday*. See Pancheva & von Stechow (2004: 480f.) for an explanation within their approach.

clauses that correspond to their interpretations and account for related interpretive and distributional differences between German and English, especially those associated with the notion "present perfect puzzle" (Klein 1992).[45]

The fact that definite positional past time adverbials are generally acceptable in German present perfect clauses but not in English ones is explained on the basis of the respective denotations according to (66) and (67) in connection with an information-structural requirement:

(68) *Aboutness requirement for topic time*
What is asserted in a tensed clause is asserted about topic time. In order to be information-structurally coherent, what is expressed or entailed by the denotation with respect to the temporal location of the situation must be predicatable about topic time.

A definite positional past time adverbial in an English present perfect clause violates (68), but not so in German. The reason is that T_{top} is constrained differently in such clauses in the two languages.

The approach to the perfect taken in the preceding sections places it firmly in the tradition of those works that deny a necessity to assume more than one semantic representation for different readings – most commonly: continuative vs. experiential vs. resultative vs. recent past readings; universal vs. existential readings, with existential readings sometimes taken to subsume experiential, resultative, and recent past readings, sometimes equated with experiential readings.[46] No distinctions between denotations for past participles or perfect auxiliaries have been suggested in the present paper that would go with any of the common distinctions between readings. Thus, discussing how the different readings associated with the perfect can be explained on the basis of the denotations provided, possibly in connection with the aboutness requirement for topic time, would be a natural way to extend the approach. This is something the greatest part of which I must leave to future research. But I would like to comment on just one argument leveled against the view that the perfect in English is semantically uniform.

Mittwoch (1988) argues that the universal and the existential readings are semantically distinct. One of her arguments is the observation that with the existential reading of (69) below, "Tuesday is excluded from the range of possible intervals of Sam's being in Boston that are covered by the sentence. […] In the universal reading of [(69)] Tuesday, or at least part of it, is included" (Mittwoch 1988: 207).

(69) Sam has been in Boston since Tuesday.

In Portner's (2012: 1220) words: "the continuative reading of [(69)] entails that Sam was in Boston on Tuesday, while its existential reading is false if he was there only on Tuesday". My explanation makes crucial use of Mittwoch's (1988) observation that *since* is ambiguous between a durational and a temporal frame meaning. With its durational denotation, *since Tuesday* in (69) means, informally, 'at all times during an interval whose left boundary is some

[45] An anonymous reviewer asks about Swedish, which, according to Rothstein (2008: 27ff.), is like English in that it shows lifetime effects and the present perfect puzzle (except for cases that Rothstein analyses as a modal and covertly infinitival construction; see ib.: ch. 4) while it is like German, and unlike English, in that it allows for present perfects with future time reference. These data are fully compatible with the hypothesis that the Swedish present perfect auxiliary *har* comes in two varieties: one having the same denotation as $have_{pres}$ in (67)a, the other having the same denotation as $haben_{pres}$' in (67)c and functioning syntactically like $have_{pres}$. It would be interesting to see whether this hypothesis can be falsified.

[46] Some places in the literature where such distinctions are mentioned: Huddleston (2002: 141, 143); Iatridou, Anagnostopoulou & Izvorski (2001: 191ff.); McCawley (1971: 104); Portner (2003: 459ff.); Rothstein (2008: 111ff.). See Michaelis (1994: 126) and Pancheva (2003: 280f.) for lists of works that argue in favour of a unified semantic representation of the perfect in opposition to those that argue in favour of several distinct representations.

time on Tuesday and whose right boundary is topic time'; with its frame meaning it means 'at some time or times within an interval whose left boundary abuts the end of Tuesday and whose right boundary is topic time' (see Mittwoch 1988: 207, 219).

The denotation for (69) is:

(70) (in' (Boston')) (Sam') & $T_{sit} \subseteq$ ‖since Tuesday‖ & $T_{top} \subseteq$ **(**T_{sit}, $+\infty$**)** & $T_{top} = T_u$

Topic time, which is identified with utterance time, must be posterior to situation time. If *since Tuesday* is durational, the situation has to obtain at all times during the interval that the adverbial specifies, i.e. from some time on Tuesday up to topic time. This is the universal reading. If *since Tuesday* is a frame adverbial, the situation has to obtain at some time or times within the interval that the adverbial specifies, i.e. just after the end of Tuesday up to topic time. This is the existential reading. Thus, the difference between the universal and existential readings of (69) follows from the difference between the durational (universal) and frame (existential) denotations of *since* and the phrase headed by it, all other things being equal. There is no need to assume distinct denotations for the components that make up a perfect, i.e. the perfect auxiliary and the past participle.

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