Ambiguity of temporal adjuncts and the limits of operator movement

Caroline Heycock, Elise Newman, and Robert Truswell

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Abstract: Temporal adverbial clauses come in two different types. One type has Geis/Larson ambiguities, permits a measure phrase like *exactly* or *two minutes*, and has a purely temporal interpretation. The other lacks Geis/Larson ambiguities, rejects measure phrases, and may denote relations between objects other than times. These two types of adverbial are distinguished syntactically, with the former derived by operator movement and latter without. Using English *when* as a case study, we show that certain temporal adverbials are ambiguous between these two structures.

Keywords: temporal adjunct clauses, relative clauses, operator movement, structural ambiguity

1 Introduction

Geis 1970 and Larson 1987 demonstrated that the syntactic derivation of temporal adverbials introduced by *when*, *before*, and *after* can involve operator movement. The key empirical evidence supporting this conclusion concerns examples like (1).

(1) Grumpy arrived before/after/when I predicted that Sneezy would leave.

(1) is ambiguous, and movement can make sense of the ambiguity. To see this, it can be

helpful to make a series of analogies. *When*, as a *wh*-word, is implicated in ambiguous adjunct *wh*-questions like (2), with the two representations in (3).

(2) When did you predict that Sneezy would leave?

(3) a. [When did you predict ~~when~~ [that Sneezy would leave]]?
b. [When did you predict [~~when~~ that Sneezy would leave ~~when~~]]?

It is therefore reasonable to explain the ambiguity of *when*-adjuncts in the same way, essentially analyzing them as free relatives, as in (4).

(4) a. Grumpy arrived [when I predicted ~~when~~ [that Sneezy would leave]].
b. Grumpy arrived [when I predicted [~~when~~ that Sneezy would leave ~~when~~]].

Geis and Larson extended this analysis to *before* and *after*, claiming that those cases involve Ā-movement of a null temporal operator, as in (5). The null operator binds a time variable that represents the run-time of the adjunct event. Through movement, the operator becomes accessible to *before*/*after*, which relate it to the matrix event time.

(5) a. Grumpy arrived before/after [Op I predicted ~~Op~~ [that Sneezy would leave]].
b. Grumpy arrived before/after [Op I predicted [~~Op~~ that Sneezy would leave ~~Op~~]].

It is important to appreciate the force of this argument. It is an argument that these temporal adverbials *can* be derived using movement (of *when* or of Op). It is not an argument that they *must always* be derived in this way. In this paper, we argue that movement is in fact not always implicated in this way in the derivation of this class of adverbials. That is, there is an extra structural analysis available for our illustrative examples, in which the Ā-movement identified by Larson is missing.

In the case of *before*, it is common to assume an analysis without operator movement; Sharvit (2014, §5) explicitly argues that *before*-clauses are in fact ambiguous between structures with and without movement—an argument we will return to in Section 3.2. This entails that a structure like (6) must exist for *before*, in addition to the structure in (5).

(6) Grumpy arrived before [I predicted [that Sneezy would leave]].

In this paper, we argue that *when*-clauses show the same structural ambiguity, between structures with and without operator movement. We have already discussed the structure with movement. We argue that there is also a movement-free structure, parallel to (6), as in (7). In this structure, we cannot assume that *when* is an Ā-moved *wh*-phrase, because we are arguing precisely that there is a structure for *when*-adverbials without Ā-movement. We propose instead that *when* does double duty as a preposition similar to *before* and *after*, although it evidently differs from them in selecting only for clauses, not for nominals.

(7) Grumpy arrived when [I predicted [that Sneezy would leave]].

The most straightforward empirical difference between (6)/(7), and the structures with Ā-movement, is that in the movement-free structures (6) and (7), there can be no Geis/Larson ambiguities, because the temporal preposition has no direct access to the lower clause within the adverbial. That means that (6) and (7) can only be about the relation between Grumpy's arrival and the speaker's prediction—they cannot be about the relation between Grumpy's arrival and Sneezy's departure. In other words, (6) and (7) do not yield any "low" reading analogous to (4b) or (5b). However, we will demonstrate that for *when*, there is another difference between the representations with and without movement: the representations without movement, in (6) and (7), yield what we will call a *situational* reading, which can be doubly dissociated from the *purely temporal* reading which (4) and (5) derive.[1] The core of our argument for a syntactic ambiguity is that situational readings correlate with the lack of low readings, and purely temporal readings correlate with the availability of low readings, subject to the usual locality constraints on movement. We infer from this that purely temporal readings are derived from a structure with operator movement, like (4), while situational readings are derived from a structure without operator movement, like (7).

In Section 2, we review the evidence for operator movement in temporal adjuncts. In Section 3, we demonstrate that this evidence cannot be replicated for many adjuncts, and review Sharvit's arguments that *before* does not always require operator movement. Section 4 discusses *when*. In that section, we first establish the ambiguity of *when*, before discussing some similar patterns crosslinguistically. Finally, we show that the position of the *when*-clause, on the left or right edge of the host clause, can condition its interpretation.

2 Geis/Larson effects: evidence for movement

Here we discuss more detailed evidence for a treatment of temporal adverbial clauses as derived by Ā-movement. Recall that examples like (8) are ambiguous.

(8) I arrived [when/before/after she said [she would leave]].
   a. Reading 1: I arrived when/before/after she spoke about leaving.
   b. Reading 2: I arrived at/before/after her promised time of departure.

Temporal adverbials do two things in these contexts. Firstly, they introduce an ordering relation between the matrix event time (the time of arrival in (8)) and the time variable introduced by the temporal adverbial clause.[2] Secondly, in many cases, they introduce a presupposition that the eventuality introduced by the temporal adverbial clause actually takes place.[3] Since the temporal adverbial clause in (8) itself contains an embedded clause, there are in principle two event times that the ordering relation could refer to: that of the adverbial matrix event or the embedded event. Accordingly, (8) is ambiguous between an interpretation in which the arrival time is ordered relative to the presupposed saying time or leaving time. We will refer to Reading 1 as the *high* reading and Reading 2 as the *low* reading.

Of course, pragmatic and semantic factors can (dis)favor—or in some cases block entirely—either a high or a low reading. Perhaps most obviously, there are constraints on the tense in the clauses expressing the events that are being related. While we cannot

go into all the details of these here, note that if the tense in the matrix is past, the tense in a monoclausal temporal adverbial cannot be present (or future):

(9) I came in when she {left/*leaves/*will leave}.

As we would expect, the example in (10), where both of the tenses in the biclausal temporal adverbial are present, is also unacceptable:

(10) *I came in when she claims she leaves.

However, if the tense in the lower clause within the temporal adverbial is changed to make it consistent with the matrix, a minimally different variant of (10) becomes acceptable—but it only has the low reading, since the present/future tense in the higher clause within the adverbial (*claims*) blocks the high reading:

(11) I came in when she {claims/will claim} she left.

In the discussion that follows, we will occasionally make use of the disambiguating effect of tense to make the (im)possibility of a low reading clearer in the relevant cases.

Following Geis 1970; Larson 1983; Larson 1987, the high/low ambiguity can be derived through movement. On this analysis, temporal adverbial clauses have a structure and derivation similar to that of a relative clause. In other words, (8) and (12) are presumed to have the same syntactic source for their ambiguity.

(12) I arrived [before/after the time [at which she said [she would leave]]].

This approach is attractive because it directly accounts for the ambiguous interpretation of both (8) and (12). The time variable that is bound by the relative operator in (12) can in principle originate in either the upstairs or downstairs clause inside the temporal adjunct, Ā-movement then takes place to the edge of the higher clause. The ambiguous

base position of the variable tracks the ambiguous interpretation in (8) and (12).

(13) [$_{PP}$ before/after [$_{CP}$ *Op* C she said [$_{CP}$ ~~*Op*~~ C she would leave ~~*Op*~~]]]

It is slightly less clear that this approach works for *when*, which cannot be pronounced in contexts like (14).

(14) *I arrived [when the time [at which she said [she would leave]]].

This does not preclude a movement analysis of *when*-clauses, however. Since *when* is a *wh*-word, it may be analyzed as the relative operator itself, in complementary distribution with other operators. We thus treat *when*-clauses as free relatives, as in (15).

(15) [$_{CP}$ when C she said [$_{CP}$ ~~when~~ C she would leave ~~when~~]]

This establishes movement as a possible way of analyzing the ambiguity of temporal adverbial clauses. However, this ambiguity is not sufficient to diagnose movement because nonlocal binding could similarly account for the long-distance reading. What crucially motivates a movement analysis is sensitivity to islands. As Geis demonstrated, putting an island boundary between the two clauses inside the adjunct blocks the low readings, as in (16).

(16) I arrived [when/before/after she made [the claim [that she would leave]]].
   a. High reading: I arrived when/before/after she spoke about leaving.
   b. *Low reading: I arrived at/before/after her promised time of departure.

Consistent with this, if only the tense in the lower clause within the adjunct is consistent with the tense in the matrix, an example like (17a)—where there is no island—is grammatical but unambiguous, with only the low reading. (17b), on the other hand, is unacceptable: the high reading is made unavailable by the tense clash, and the low reading is blocked by the island:

(17) a. I arrived when/before/after she will claim that she left.
b. *I arrived when/before/after she will make the claim that she left.

Taken together, this is compelling evidence that Ā-movement is a strategy for deriving temporal adverbial clauses, accounting for long-distance readings, ambiguity, and island-sensitivity.[4]

We therefore have good evidence that the movement strategy is able to derive adjunct clauses of various kinds. That said, we will now discuss adjuncts for which the movement analysis is untenable.

3 Some temporal adjuncts lack operator movement

So far, we have seen evidence that temporal adverbial clauses *can* be formed by operator movement, but the evidence does not tell us that they *must* be so formed in every context. In fact, most adverbial clauses, whether temporal or not, don't show the Geis/Larson ambiguities: none of the examples in (18) are ambiguous.[5]

(18) a. Liz left while I predicted that she would be leaving.
b. We were eating lunch as they told us she would leave.
c. Liz left once everyone said she would come.
d. She left because I predicted she would meet a hippo.
e. She left (just) in case I predicted she would meet a hippo.

In these cases, there is no reason to blame the lack of ambiguity on an island effect, so the natural conclusion is that these classes of adjuncts do not involve operator movement in the first place. In fact, our impression is that the prepositions showing the Geis/Larson ambiguities are actually a minority, raising questions about what distinguishes them from the more common pattern illustrated in (18).

In the following subsections, we first briefly motivate an analysis of *because*-clauses without operator movement, and then summarize the argument from Sharvit (2014) that *before*-clauses are ambiguous between structures with and without operator movement. Then we return to our central case study of *when*-clauses, demonstrating that they show

a similar structural ambiguity to *before*-clauses.

3.1 Adjuncts without A′-movement: *Because*

Although *because*-clauses, as non-temporal adjuncts, are strictly out of scope for this paper, we include a brief discussion here to illustrate an important point: the meanings of some adjuncts are not plausibly derived using operator movement, regardless of whether the operator originates in the upstairs or downstairs clause.

We make this argument by showing that the only plausible paraphrase of *because*-clauses involving operator movement is truth-conditionally inaccurate. The meaning of *because* is not easily paraphrased by any overt relative operator. If we were to paraphrase (19a), the closest we can imagine is (19b). However, (19a) and (19b) do not have the same truth conditions.

(19) a. Sue left because Mary left.
b. Sue left for the reason that Mary left.

In (19a), the meaning is something like: *Mary's leaving* characterizes Sue's reason for leaving. In (19b), the meaning is: Mary's reason for leaving is the same as Sue's reason for leaving. For example, suppose that Sue and Mary are both at a party and we know that they both have an aversion to the YMCA song. When the YMCA song comes on, we observe that they both leave. In this context, (19b) is a justifiable claim while (19a) is not.

This difference between (19a) and (19b) can illuminate the lack of Geis ambiguities in *because*-clauses. Example (20a) is unambiguous: Sue's reason for leaving is that Mary made a certain claim, not that John left. Trying to make the adjunct tenses force a low reading results in ungrammaticality, as in (20b). This ungrammaticality contrasts sharply with what we saw for a comparable temporal adjunct in (11) above.

(20) a. Sue left because Mary said that John left.
b. *Sue left because Mary will say that John left.

It is tempting to describe *because*-clauses as having only a high reading, since the meaning of the *because*-clause clearly depends on properties of the adjunct matrix predicate. However, as Sabine Iatridou, p.c., points out to us, it is actually misleading to say that *because* has a high reading at all: there is no relative operator that captures the meaning of *because* in the first place, as we saw in (19). Trying to posit a *reason*-like operator in either the higher or lower clause in (20a) would predict a meaning that is generally unavailable for a *because*-clause. The high and low readings should be paraphrased as in (21), neither of which is a good paraphrase of a *because*-clause.

(21) Sue left for the reason that Mary will say that John left.
High: Sue's reason for leaving is Mary's reason for saying that John left.
Low: Sue's reason for leaving is John's reason for leaving, according to Mary's future proclamation.

It therefore seems that an operator-movement analysis of *because*-clauses is a non-starter, and the meaning of *because*-clauses is distinct from any "low" or "high" reading of a clause with operator movement. We need a different way to understand *because*'s meaning, one that does not appeal to operator movement. Rather, it seems that *because* relates two propositions more directly. The complement of *because* is a proposition, and the *because*-clause modifies a proposition, introducing a relation between them without involving a null operator, and indeed the interpretation of *because*-clauses is truth-conditionally distinct from from the most obvious paraphrase with an overt operator.

This is relevant to the analysis of *when*-clauses because we will argue below that *when*-clauses also have an interpretation which is distinct from those derived with operator movement. However, *when*-clauses, unlike *because*, can also take complements *with* operator movement. That is, they are structurally ambiguous, unlike *because*-clauses. In the next subsection, we will review arguments from Sharvit 2014 for a parallel structural ambiguity in *before*-clauses, again to lend plausibility to our claims about *when*-clauses.

3.2 Adjuncts with ambiguous structure: *Before*

Sharvit (2014, §5) describes the following pattern with *before*: *before*-clauses in general license NPIs, as in (22).

(22) John watered the plant before it ever got sick. (Sharvit 2014, p. 266)

Before-clauses also show Geis/Larson ambiguities, as illustrated above—see for example (5). However, low readings of *before*-clauses do not license NPIs (p. 294).

(23) a. John watered the plant before Sally ever said it bloomed.(no low reading)
b. John watered the plant before Sally said it ever bloomed. (no low reading)[6]

Sharvit's strategy in accounting for this pattern is to propose two denotations for *before*: one which licenses NPIs but doesn't generate low readings, and one which generates low readings but doesn't license NPIs.

More specifically, Sharvit gives two denotations for *before*. The focus of her paper is what she calls *before*$^{\text{B\&C}}$,[7] which takes a proposition p and a time t as arguments, and is true iff t precedes the earliest time at which p holds. *Before*$^{\text{B\&C}}$ is downward-entailing, but does not induce operator movement in its complement: loosely speaking, operator movement derives a set of times from a proposition, and as such it is incompatible with *before*$^{\text{B\&C}}$, which takes a proposition directly as its argument, not a set of times. Accordingly, *before*$^{\text{B\&C}}$ licenses NPIs but lacks low readings.

The second denotation is *before*$^{\text{F}}$, which takes two times as arguments and is true iff the second precedes the first. Syntactically, the first argument of *before*$^{\text{F}}$ is a DP, which sometimes transparently denotes a time (*before that time*, for instance); sometimes a noun like *time* is modified by a relative clause (*before the time at which it bloomed*)—in such cases, the operator movement is crucial in yielding a CP that denotes a set of times. In other cases, Sharvit argues, *the time at which* is unpronounced but still syntactically present. Accordingly, a sentence like (24) is ambiguous between two structures: one

with *before*$^{B\&C}$ taking a CP complement and one with *before*^{F} taking a DP complement with unpronounced *the time at which*.

(24) John watered the plant before it bloomed.

Because the *before*^{F}-structure for examples with covert *the time at which* involves operator movement, Sharvit derives the existence of Geis/Larson ambiguities in these cases. As for NPI-licensing, Sharvit argues that *the*, whether overt or covert, blocks NPI-licensing, citing examples like (25). Accordingly, the *before*^{F}-structure licenses low readings but does not license NPIs.

(25) a. John likes no woman he ever dated.
b. *John doesn't like the woman he ever dated. (p. 295)

In Section 4, we will argue that *when* shows an ambiguity very similar to Sharvit's distinction between *before*^{F} and *before*$^{B\&C}$. However, as we develop our argument, one difference between *when* and *before* will become apparent. Both varieties of *before* yield temporal readings, and as a result Sharvit talks about the interpretation of movement-free *before*$^{B\&C}$-clauses as the 'high' reading. In the case of *when*, we will see that this is inappropriate: *when*-clauses with operator movement describe temporal relations, but *when*-clauses without operator movement describe relations between other semantic objects. Like *because*, the movement-free readings of *when*-clauses are semantically distinct from any of the readings generated with operator movement.

4 Back to *when*

4.1 Temporal and situational interpretations of *when*

In this section, we demonstrate that, like *before*, *when*-clauses have a second, movement-free structure. In this respect, this structure is like the structure with *before*$^{B\&C}$ described previously, and like *before*$^{B\&C}$ it does not generate Geis/Larson ambiguities.

However, the two *when*s are more semantically distinct, as we shall see presently. Just as *because*-clauses are truth-conditionally distinct from *for*-clauses with operator movement, we argue that the non-movement structure for *when*-clauses yields truth conditions not derivable from a *time* operator.

There certainly are *when*-clauses without Geis/Larson ambiguities. A clear example of this arises when the clausal complement of *when* is non-finite, as in (26b).

(26) a. She was in Edinburgh when she claimed that she was in Paris. (ambiguous)
b. She was in Edinburgh when claiming that she was in Paris.(unambiguous)

In these cases, the movement derivation may be unavailable because the *-ing* clause does not have an available landing site for a moved operator. But since they are grammatical, and feature *when*, here at least *when* must have some other status.

In this article, however, we focus on finite adverbial clauses where a movement analysis could in principle have been available, but in fact is not. In the rest of this section, we will argue that in these clauses, the movement/non-movement distinction correlates with a semantic distinction between *when* as denoting a relation between times, versus a relation between situations.[8]

As an initial illustration of this semantic distinction, consider the relative clauses headed by *time* in (27). The preposition *at* is optional in (27), but its inclusion has consequences for interpretation (see also Rothstein 1995; Hall & Caponigro 2010). We refer to the interpretation associated with (27a) as the *purely temporal* reading, and the interpretation associated with (27b) as the *situational* reading.

(27) a. Sue was there at the time I came home. (purely temporal)
b. Sue was there the time I came home. (situational)

To illustrate the difference, imagine the following context: Sue visited my parents for a week last month, but I was out of town for most of it. I came home to visit my parents on Thursday during that week when she was visiting, but she was out shopping

at the precise time that I arrived, and we only saw each other later that evening. In this context, we judge (27a) to be infelicitous, but (27b) to be perfectly good. We can infer from the infelicity of (27a) in this context that *at* requires overlap between the time intervals introduced by the matrix and adjunct clauses. In contrast, for (27b) to be felicitous in this context, it appears that a bare temporal adjunct is compatible with no actual overlap between the times of each event, so long as they are both related to the same situation.[9]

Inspecting the availability of each of these readings, we observe that the purely temporal reading is compatible with low interpretations in Geis/Larson contexts. In (28), an example adapted from one in Hall & Caponigro 2010, we find a temporal adjunct with an embedded clause, whose context supports a purely temporal reading. The preposition is therefore required on the preferred reading, and the low reading is possible (the high temporal reading is ruled out by a tense clash).

(28) The rare cactus bloomed #(at) the time the experts had predicted it would bloom.
   a. Purely temporal, low, reading (preferred): the expected bloom time interval coincided with the actual bloom time.
   b. Situational reading (dispreferred): the unique situation in which the experts had made a prediction about the blooming of the cactus is related to the blooming of the cactus.

In contrast, (29)—also based on an example from Hall & Caponigro 2010—strongly supports a situational reading. Adding an embedded clause to the adjunct in this context does not support a low reading.

(29) a. I lost my keys in the water (#at) the time I went swimming in the bay.
   Situational reading (preferred): the unique swimming-in-the-bay situation is related to me losing my keys.
   Purely temporal reading (dispreferred): there is a salient time interval during which I was swimming in the bay, which coincided with my losing my keys.
   b. I lost my keys in the water the time I said I went swimming in the bay.
   Unnatural situational reading (available): the unique saying-I-went-swimming situation is related to me losing my keys.

Natural low reading (unavailable): I said that there is a unique swimming event, which characterizes when I lost my keys.

The lack of a low reading in "bare" (not contained in a PP) temporal clauses introduced by *time* was noted already in Rothstein (1995). That paper focused on quantified cases like (30a,b) (Rothstein's (1a,48)):

(30) a. I met a friend every time I went to the bakery.
b. Every time I see a horror movie, I have nightmares.

Although Rothstein's paper is not principally concerned with the internal structure of such clauses, she notes that although these adjuncts appear to involve relative clauses, and such clauses "normally contain a trace subjacent to and bound by an operator" (p. 19), here there is no evidence for A′ movement of an operator because "in [(31)] *every* unambiguously quantifies over the events introduced by the matrix verb, events of telling and of thinking, and [(32)] asserts that the announcements were announcements of deciding to move, and not of movings:" (p. 20).

(31) a. Every time John tells me that he fixed the car ...
b. Every time I think John's fixed the car ...
c. Every time I am told John fixes the car ...

(32) They announced it every time they decided to move house.

Rothstein contrasts this with the ambiguity of (33) (her (65c)) which has one reading—the most salient one in fact—where *every* can quantify over ways of fixing the car:

(33) Every way John suggested you fixed the car ...

As we we would predict, given that the low reading is excluded in these *time*-adjuncts, the tense of the highest clause within the adjunct is constrained in the way we have already observed:

(34) a. Mary paid the bill every time Jo told me/#Jo tells me that they got the car fixed.

b. There was a terrible mess every time I thought/#I think Jo fixed the car.

And again, this contrasts with manner adverbials:

(35) I adjusted the engine of my car every way John claims that he adjusted his.

Hall & Caponigro (2010) demonstrated that both the purely temporal reading and the situational reading that we have seen with *(at) the time that* are available for *when*-clauses as well. In their examples (36), we see the same contexts as in (28) and (29), each of which supports a different reading, and *when* is compatible with them both.[10]

(36) a. The rare cactus bloomed when we all expected it would bloom.
(purely temporal)
b. I lost my keys in the water when I went swimming in the bay.
(situational)

We conclude with them that *when*-clauses are ambiguous between these two readings. However, while Hall & Caponigro took this ambiguity to be purely lexical, we argue that it is structural. That is, just as we have seen for the examples with *time*, only the purely temporal reading of *when*-clauses involves A′-movement, and hence allows low readings.

Although the interpretive distinction that we are proposing is perhaps a subtle one, one further diagnostic can be found in a certain type of modification. Under a purely temporal reading, words like *approximately* or *exactly* tell us how precisely the times of the two events in question overlap. This is illustrated in (37).

(37) The rare cactus bloomed at (approximately/exactly) the time we all expected it would bloom.

However, the situational reading does not relate times, and so do not have any measure of coincidence for *approximately* or *exactly* to regulate. Accordingly, *approximately/exactly the time*, without *at*, is bizarre.

(38) #I lost my keys in the water approximately/exactly the time I went swimming in

the bay.

Modifiers like *approximately* and *exactly* therefore disambiguate in favor of the purely temporal reading, independently of Geis/Larson effects.

As expected, it is possible to modify *when* with *approximately* or *exactly* on the purely temporal interpretation:

(39) The rare cactus bloomed approximately/exactly when we all expected it would bloom. (purely temporal)

And as we predict, this modification is also compatible with the low reading; this is the most natural reading for (37), as also evident through the possibility of having an appropriate tense only in the lower clause within the adjunct:

(40) She's quite right: the cactus bloomed approximately/exactly when she says it bloomed.

However, adding *approximately* or *exactly* to a *when*-clause that favors a situational reading is odd: common sense favors the situational reading, but these modifiers disambiguate in favor of the dispreferred purely temporal reading.

(41) I lost my keys in the water approximately/exactly when I went swimming in the bay. (purely temporal, incongruous)

It is worth dwelling on the nature of this effect. In which body of water did the speaker lose their keys? The most natural answer would be the water in the bay, the only water mentioned in the discourse context. We might expect to be able to enrich this purely temporal reading so that the speaker's swimming caused them to lose their keys—the preferred situational reading of (36b). However, (41) resists this reading: to the extent that (41) has an interpretation like (36b) at all, it gives an impression of the speaker puzzling things out, perhaps attempting to piece together an answer to a question under discussion like *What the hell have I done with my keys*, as in (42).

(42) I know I lost my keys in the water approximately/exactly when I went swim-

ming in the bay, so maybe I absentmindedly took them with me swimming and lost them then.

But such a continuation, in the absence of *approximately* or *exactly*, is bizarre, because the continuation is as good as entailed by the first part of the sentence.

(43) #I know I lost my keys in the water when I went swimming in the bay, so maybe I absentmindedly took them with me swimming and lost them then.

It therefore appears that we have two distinct structures for *when*-clauses. One corresponds to the purely temporal reading and allows long-distance readings, suggesting that this reading is derived by movement. The second structure corresponds to the situational reading and blocks long-distance readings, suggesting that this reading is not derived by movement.

We will assume that purely temporal *when* has a denotation specified in terms of the models of temporal semantics developed in Geis 1970; Larson 1990; Romero & von Stechow 2008; Iatridou 2014; von Fintel & Iatridou 2019; Newman 2021, etc. That is, we assume that purely temporal *when* encodes a temporal relation between the two time intervals picked out by the adjunct clause and its host. For instance, Romero & von Stechow (2008) claim that temporal *when* means the same as *at*, an idea that Newman (2021, p. 22) exploits to predict available tenses in *when*-clauses with purely temporal readings.

The crucial point is that an analysis of *when* in terms of *at*, or temporal coincidence, cannot extend to the situational readings of *when*, because we have seen that situational *when* does not encode any such strictly temporal constraint. Accordingly, here, we want to explore the nature of situational readings a little further.

Our description of these readings is consonant with a line of work on *when*-clauses that argues that their meaning is "not primarily temporal at all" (Moens & Steedman 1988, p. 16). Rather, as is argued in Lascarides & Oberlander 1993, the interpretation of *when*-clauses, at least on their situational reading, and their contribution to the meaning

of the whole, is determined by generally active processes assigning discourse coherence relations between text segments, and temporal–causal relations between the situations they describe.[11]

When the situations described in both the *when*-clause and the matrix clause are punctual, a common relation to posit is Result, as in (44).[12]

(44) a. (When the car backfired,) I jumped (when the car backfired).
b. (When she said that,) I laughed (when she said that).
c. (When they built the new railway,) enrolment in the Melrose schools went up (when they built the new railway).

Result is not the only observed relation, though: (45) shows that the event described in the *when*-clause can even follow the event in the matrix clause, so long as some coherence relation holds between these event descriptions.

(45) When they built the 39th Street Bridge, a local architect drew up the plans.
(Moens & Steedman 1988, p. 23)

The situational reading therefore doesn't uniquely point to a single coherence relation. Rather, the situational interpretation of *when*-clauses can support Result, Cause, and other kinds of relations as well (Moens & Steedman 1988 refer to a general overarching notion of "contingency").

4.2 Other syntactic diagnostics: Extraction and coordination

Returning to the syntactic correlates of the two interpretations under discussion, we have seen that temporal adverbials introduced by *before* and *when* are often ambiguous between one relative-like structure with Ā-movement, and one simpler structure with no movement. This leads to a prediction: extraction from temporal adverbials should only be possible when the movement-free structure is available. If independent factors force the relative-like structure, then extraction from the adjunct should be ruled out as a violation of Relativized Minimality (Rizzi 1990), as in (46).[13]

(46) a. [Wh . . . [$_{PP}$ before/when [. . . ~~Wh~~]]]
b. *[Wh . . . [$_{CP}$ Op before [. . . ~~Wh Op~~]]]
c. *[Wh . . . [$_{CP}$ when C [. . . ~~Wh when~~]]]

This prediction is borne out by contrasts like (47) (Branan & Truswell 2024).

(47) Snakes like this, you need to be careful [(*precisely) when you touch ~~snakes like this~~].

Adding a temporal measure phrase like *precisely* makes these examples noticeably less acceptable. It is unlikely that this reflects a direct effect of the measure phrase on the Ā-dependency—after all, Ā-extraction of an argument is normally insensitive to an adjunct intervening along the movement path. Instead, we conclude that this is an indirect consequence of the inclusion of the measure phrase: the measure phrase forces a strictly temporal interpretation of the adverbial clause, the strictly temporal interpretation requires operator movement, and this operator intervenes in Ā-movement of *snakes like this*. In this way, the ambiguity of temporal adverbials helps us to make sense of the otherwise puzzling interaction in (47).[14]

Coordination can also diagnose this structural ambiguity. As pointed out to us by Kai von Fintel (p.c.), *when* can be coordinated with gapless complementizers. When it is coordinated in this way, it loses the low reading associated with operator movement.

As a starting point, consider that complementizers like *if*, *whether*, and *because* are gapless. As such, they lack the low readings that Geis and Larson proposed must be derived by operator movement.

(48) a. I'll leave if you say you'll go. (conditional on saying, not going)
b. I wonder whether you said you'd go. (wondering about saying, not going)

Gapless complementizers are thus semantically and syntactically different than those that induce operator movement, and are thus expected not to be able to coordinate with them. This explains the ungrammaticality of (49): *you should go* would have to simultaneously have no gap (for *whether*) and a gap (for *where*).

(49) *I wonder whether and where you should go.

However, complementizers like *if* or *whether* can be coordinated with *when*. When this happens, the *when*-clause takes on the properties of clauses headed by a gapless complementizer: the low reading is blocked.

(50) I'll leave if and when you say/*said you'll go.

When can also be coordinated with *where*. In this case, the clause contains operator movement, and is therefore compatible with the low reading.

(51) I'll go where and when you said I should go. (low reading available)

In sum, our proposed structural ambiguity for *when*-clauses helps us understand *when*'s double life—its ability to coordinate with both gapless *if* and gappy *where*.

4.3 Some crosslinguistic comparisons

Although our focus in this paper is on English, we note that several other languages show a distinction parallel to the one we have identified for English, between a structure for temporal adverbials involving operator movement, and a structure with no low readings or evidence for operator movement. We have not investigated whether the other interpretive effects discussed in the previous subsection track this distinction, but this crosslinguistic evidence nevertheless strengthens our proposal, because it introduces complementary evidence for the core structural distinction that we have introduced. We discuss Hungarian, Norwegian, and Japanese in turn.

4.3.1 Hungarian

Lipták (2005) and Ürögdi (2009) argue that there are two series of temporal clause-introducing expressions. They analyze one, illustrated in (52), as having the syntax of

a typical relative. This structure allows high/low ambiguities.

(52) Add-**ig** maradok, a-medd-**ig** mondod, hogy maradjak.
DEM-until I.stay DEM-WH-until you.say COMP I.stay.SUB
High: 'I will stay as long as you keep saying I should stay.'

Low: 'You tell me I should stay until time t. I'll stay until time t.'

The other structure is in (53). This structure does not have typical relative syntax, and concomitantly does not allow low readings.

(53) Az-**után** indulok, mi-**után** mondod, hogy Péter elindul.
DEM-after I.leave WH-after you.say COMP Peter leaves
High: 'I'll leave after the time of you saying that Peter's leaving.'

*Low: 'You tell me Peter's leaving at time t. I'll leave after t.'

(both examples from Ürögdi 2009, p. 137)

4.3.2 Norwegian

Stephens (2006) demonstrates that Norwegian (Bokmål) has a similar ambiguity to English and Hungarian. *Når* 'when,' in (54a), has the Geis/Larson ambiguity, indicating the presence of operator movement, while *da* 'when/then,' in (54b), does not.

(54) Napoleon var faktisk på Korsika
Napoleon was actually in Corsica
'Napoleon was actually in Corsica . . . '

a. [**når** du påstår at han ledet hæren i Italia]
when you claim that he led army.DEF in Italy
'at the time when you claim that he led the army into Italy.' (ambiguous)

b. [**da** du påstår at han ledet hæren i Italia]
then you claim that he led army.DEF in Italy
'*at the time when you claim that he led the army into Italy.' (high only)

However, the lack of a low reading for (54b) contrasts with what happens when *da* appears in a headed relative, as in (55):

(55) Napoleon var faktisk på Korsika
Napoleon was actually on Corsica

‘Napoleon was actually in Corsica . . . ’

på den tiden [**da** du påstår at han ledet hæren i Italia]
at the time.DEF then you claim that he led army.DEF in Italy
‘at the time that you claim that he led the army into Italy.’ (ambiguous)

Stephens concludes that *da* is ambiguous: it can be a simple adverb, it can introduce a relative clause, or it can combine with a gapless adverbial clause, as in (54b). We have argued that *when* shares the last two of these functions.

4.3.3 Japanese

Oda & Tatsumi (2017) and Sharvit (2014) demonstrate that Japanese *-mae* ‘before’ clauses generally don’t allow low readings.

(56) [[Mary-ga [John-ga Nihon-ni kur-u to] shutyoo-sur-u]
Mary-NOM John-NOM Japan-LOC come-PRES C claim-do-PRES
mae] -ni Taro-wa Nihon-ni tsui-ta.
before -LOC Taro-TOP Japan-LOC arrive-PAST
‘Taro arrived in Japan before Mary claimed that John would come to Japan.’
‘Taro arrived in Japan before Mary made a claim that John would come to Japan.’ (high)
‘*Taro arrived in Japan before John’s coming to Japan, according to Mary.’ (low)

On the other hand, an actual relative clause shows Geis/Larson ambiguities ((57) is example (5) from Oda & Tatsumi 2017).

(57) [[Mary-ga [John-ga Nihon-ni kur-u to] shutyoo-si-ta] jikan
Mary-NOM John-NOM Japan-LOC come-PRES C claim-do-PAST time
] -o osie-te kudasai
-ACC teach-INF please
‘Please tell me the time when Mary claimed that John would come to Japan.’
‘Please tell me the time when Mary made a claim that John would come to Japan.’ (high)
‘Please tell me the time of John’s coming to Japan, according to Mary.’ (low)

Strikingly, however, if a measure phrase is added, low readings become available even in *-mae*-clauses. In (58) (their (6)), the only difference to (56) is the addition of *mikka* ‘three days’:

(58) [[Mary-ga [John-ga Nihon-ni kur-u to] shutyoo-sur-u]
Mary-NOM John-NOM Japan-LOC come-PRES C claim-do-PRES
mikka mae] -ni Taro-wa Nihon-ni tsui-ta.
three day before -LOC Taro-TOP Japan-LOC arrive-PAST
'Taro arrived in Japan three days before Mary claimed that John would come to Japan.'
'Taro arrived in Japan three days before Mary made a claim that John would come to Japan.' (high)
'Taro arrived in Japan three days before John's coming to Japan, according to Mary.' (low)

Even a "vague" measure phrase like *sukosi* 'a little' does the same trick:

(59) [[Mary-ga [John-ga Nihon-ni kur-u to] shutyoo-sur-u]
Mary-NOM John-NOM Japan-LOC come-PRES C claim-do-PRES
sukosi mae] -ni Taro-wa Nihon-ni tsui-ta.
a little before -LOC Taro-TOP Japan-LOC arrive-PAST
'Taro arrived in Japan a little before the time when Mary claimed that John would come to Japan.' (ambiguous)

In these respects, the effects of measure phrases in Japanese are remarkably similar to those described for English in Section 4. However, Oda & Tatsumi's own analysis of the Japanese facts is that there is a relative clause (with Ā-movement of a silent operator) only when more structure is forced by the presence of a modifier. It is not clear that this analysis can be straightforwardly transplanted to English, where we have argued that the distinction between situational and purely temporal readings is not simply a matter of presence vs. absence of operator movement.

4.4 The effects of clause position

Moens & Steedman (1988) made an additional observation about *when*-clauses in initial position, namely that examples like (60) are odd.

(60) #When my car broke down, the sun set.

To explain the oddness of (60), they argue that the sentence is bizarre because no co-

herence relation between the two situation descriptions is well supported, which is a requirement of the situational reading of *when*.

A puzzle arises: why is the purely temporal reading, which does not impose such a requirement for coherence relations, not readily available here? This is especially puzzling because, at the same time, these authors note that other temporal clauses do express "purely temporal coincidence."

(61) a. Just after my car broke down, the sun set.
b. At approximately the same time as my car broke down, the sun set.

Observe that in (61), the temporal adverbial clauses are modified with expressions like *just* and *approximately*, which were previously shown to disambiguate between the temporal and situational readings. Surprisingly, adding such a modifier can even make the purely temporal interpretation of the *when*-clause available, as in (62).

(62) Exactly when my car broke down, the sun set.

What we think is happening is that there is an effect of surface position on the kinds of readings that are most readily available to a temporal adverbial clause: in initial position, the situational reading is strongly preferred, rendering the temporal reading all but impossible to access unless cued by a phrase like *exactly*.

This is corroborated by a striking contrast in the availability of long-distance readings for *when*-clauses when the *when*-clause is in clause-initial position (Sabine Iatridou, p.c.). Thus while (63) permits a downstairs reading (the high temporal reading and situational reading being ruled out by a tense clash), (64) is degraded: the tense clash is still there, but the low temporal reading is now also unavailable.

(63) He will leave when I said he should go.

(64) */??When I said he should go, he will leave.
a. *Tense clash:*
He will leave at time *t* such that I said at *t* that he should go.
b. *Unavailable/hard to access low reading*:

He will leave at time *t* such that I said [that he should go at *t*]

Given that we have established that *when*-clauses with situational readings do not allow long-distance readings, we conclude that the structure with operator movement is unavailable in (64), so the initial *when*-clause in (64) is for some reason unambiguously situational.

In contrast, note that low readings are available for other adjuncts in clause-initial position. For instance, as we saw in (74), free relatives introduced by *where* can be used as locative adjuncts. As illustrated in (65), such locatives can have a low reading even in initial position: both (65a) and (65b) can easily be interpreted as meaning that the speaker saw an otter in a place associated with the seeing of seals.

(65) a. I'm sure I will see an otter where I expected to see an otter.
b. Where I expected to see an otter, I'm sure I will see an otter.

The same observation is also supported by the fact that a temporal adjunct containing a headed relative clause also permits the low reading:

(66) At the time that I predicted they would go home, they did.

In fact, adding a measure phrase modifier to a clause-initial *when*-clause, as in (62), also restores the possibility of a low reading. Thus, while (64) has only the high reading, its minimally different counterpart (67) is ambiguous:

(67) Roughly/exactly when I said he should go, he will leave, I'm sure.

This striking effect supports our hypothesized explanation in terms of the association of long-distance readings exclusively with purely temporal rather than situational *when*-clauses. This is because we see again the correlation between modifiers like *exactly*, purely temporal interpretations, and the availability of low readings.

To sum up, in clause-initial position, temporal adjunct clauses by default receive a

situational interpretation, which is, as we have argued, associated with a structure that does not involve Ā-movement and hence blocks any low reading. When a modifier like *exactly* is included, the otherwise strongly preferred situational reading is suppressed, allowing the temporal reading—and with it the potential ambiguity arising from its derivation via Ā-movement—to surface.

We do not as yet have a theory of why it should be that the structural position of the *when*-clause affects its preferred interpretation in the way that it does. However, it may be revealing to link this to observations that have been made about the effect of structural position on the the different interpretations given to *then*.

The interpretation of *then* depends in part on its structural position. Glasbey 1992 points out that clause-final *then* can get a simultaneous-time interpretation when there are two successive eventive clauses in the simple past, and she interprets this as involving anaphoric reference to a previously mentioned time interval:

(68) a. Daniel climbed Ben Nevis in July.
b. Gareth climbed Snowdon then.
=he climbed Snowdon in July

Note that the explicit previous mention is necessary:[15]

(69) a. Daniel climbed Ben Nevis.
b. #Gareth climbed Snowdon then.

Clause-initial *then*, on the other hand, *can't* get a simultaneous-time intepretation, it can only get an "update" interpretation:

(70) a. Daniel climbed Ben Nevis in July.
b. Then Gareth climbed Snowdon.
= he climbed Snowdon after Daniel climbed Ben Nevis
$\neq$ he climbed Snowdon in July

Glasbey's interpretation involves *then* in initial position translating as a relation between two *eventualities*—not directly between time-intervals—such that the second eventuality is not part of the first, and temporally follows it.

This supports the idea that there is a strong dispreference for a purely temporal reading for a clause-initial temporal expression if there is an event-related reading available, although of course it still leaves us with the question of *why* this is the case.

Strikingly, if we modify *then*, we now can get the simultaneous-time interpretation *even in initial position*, exactly as with our temporal clauses:

(71) a. Daniel climbed Ben Nevis in July.
b. Exactly/roughly then, Gareth climbed Snowdon.

This looks like a related fact to the contrast we saw earlier, when low readings in clause-initial time-adverbial clauses are generally extremely hard to access but are facilitated by measure-phrase modification:

(72) When I said she would arrive, she showed up. (unambiguous)
a. She showed up at time t such that I said at time t that she would arrive.
b. *Unavailable/hard to access low reading*:
She showed up at time t st I said [she would arrive at time t]

(73) Exactly/roughly when I said she would arrive, she showed up. (ambiguous)

5 Summary

This paper has made two related arguments. The first is that the well-known Geis/Larson argument for operator movement in temporal adjuncts, although empirically well-supported, in fact only applies to a small subset of the full class of temporal adjunct clauses. Most temporal adjunct clauses do not show Geis/Larson ambiguities, and therefore should not be analyzed as including operator movement, because a key motivation for operator movement is to permit an analysis of the ambiguity in terms of ambiguous position of the operator trace. To be clear, this argument does not threaten any of Geis' or Larson's syntactic claims; it merely suggests that temporal adjunct clauses do not uniformly require an analysis in terms of operator movement.

The second argument is that the presence or absence of operator movement can cor-

relate with a semantic difference. In the case of *when*, structures with operator movement, as diagnosed by Geis/Larson ambiguities, are purely temporal, in the sense that they permit modification by *exactly* or *roughly* that measure the degree of precision of temporal coincidence, and resist interpretations which are not strictly compatible with the basic temporal semantics (such as Moens & Steedman's 'bridge' example (45)). This reveals a double dissociation: on the one hand, Geis/Larson ambiguities and availability of modifiers like *exactly*; on the other hand, availability of situational readings. We have analyzed this as a distinction between a purely temporal reading, relating temporal variables, and a situational reading, relating variables over situations.

Although our analysis has focused on *when*, it is consonant with Sharvit's (2014) analysis of *before*-clauses as similarly structurally ambiguous, and with the range of similar phenomena described for other languages in Section 4.3. It therefore seems likely that such alternations between structures with and without operator movement are widespread.

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Notes

[1]Hall & Caponigro (2010) distinguish between "event" and "time interval" interpretations of *when*-clauses. We have chosen new terms because there are reasons to think that the situational reading relates semantic objects which can be larger than the usual linguistic conception of events. We are also not sure whether we are describing exactly the same distinction that Hall & Caponigro indicated.

[2]Here, we are treating *before/after/when* as *eventuality-level*-modifiers, using the terms of Iatridou, Anagnostopoulou & Izvorski 2001. They show that *before/after/when* commonly modify the matrix event time (and in some cases, other times introduced by the matrix clause). We will put aside readings derived from higher attachment sites for simplicity.

[3]We temporarily put aside the exceptional behavior of *before* in this respect: *Schubert died before he completed the 8th symphony* does not presuppose that Schubert finished the symphony posthumously. See Sharvit 2014 and references therein.

[4]Incidentally, this strategy is not limited to temporal adjuncts, but can also be used with locative adjuncts, as in the *where*-clauses in (74).

(74) a. I planted the clematis where you told me it would flourish. (ambiguous)
b. I planted the clematis where you made the announcement that it would flourish. (high only)

[5]Geis 1970 in fact noted that *while* did not generate the relevant ambiguities. He nevertheless pursued a relative clause analysis of *while*, claiming that movement of *while* is clause-bound, unlike regular operator movement. We are not persuaded by this claim, because Geis's evidence for a relative clause analysis is quite weak, coming mainly from the diachronic origin of *while*, and because we do not see any way to derive the claim that *while*-movement is more local than movement of other operators.

[6]This is Sharvit's judgment. One of the authors of this paper finds the sentence ungrammatical on any interpretation, but we believe that Sharvit's analysis could be amended to capture this ungrammaticality if needed.

[7]The name reflects the fact that Beaver & Condoravdi (2003) proposed a similar denotation for *before*. We omit many details irrelevant to the present discussion.

[8]It would be interesting to pursue the question of whether the non-finite cases are limited to what we refer to as the situational reading; however this is an issue that we have to leave for subsequent investigation.

[9]There is an additional difference in meaning between the variants with and without the preposition. If *at* is absent, the event referred to in the temporal clauses is presupposed to be "globally" unique, rather than unique to some contextually-defined situation. Thus (75a) is perfectly natural, but (75b) implies that the speaker coming home was a unique event, conflicting with our normal expectations.

(75) It was another long day at the office . . .

a. The children were in bed at/by the time I got home.

b. #The children were in bed the time I got home.

Similarly, (76b) is anomalous because there is a conflict between the use of *always* in the matrix and the presupposition of global uniqueness associated with the prepositionless use of *the time*:

(76) a. The children were always in bed at the time their mother got home.

b. #The children were always in bed the time their mother got home.

We have no explanation at present for this fact concerning the interpretation of *the time* as a bare adverbial.

[10]A reviewer queries whether the reading in (36b) is in fact a relation between situations. It can be difficult to address this concern directly because of disparities in how the term 'situation' is used in different research contexts. However, it is not essential for our argument that (36b) involves a relation between situations. All that really matters is that the relation isn't between times.

[11]It is also interesting to compare Rothstein's comments about the nature of the relation between the events in the quantified cases of *the time* adverbials that she discusses (Rothstein 1995, pp. 23ff).

[12]We will return in Section 4.4 to a comparison of *when*-clauses in initial and final position.

[13]This assumes that extraction from adjuncts is sometimes possible, contrary to Cattell 1976; Huang 1982, but we assume that this is now widely accepted (see also Postal 1998; Truswell 2011, etc.).

[14]Branan & Truswell approach the contrast in (47) from a different perspective, focusing on constraints on the interpretation of the Ā-dependency rather than the intervention effect described here. There is no obvious incompatibility between these two approaches, but we have nothing to suggest concerning a reconciliation between them.

[15]This is not true if the second sentence is in the progressive: see Glasbey 1992 for discussion and analysis.