

## On the Semantics of Temporal *When*-Clauses

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**Introduction.** Temporal *when*-clauses are non-interrogative embedded clauses introduced by the wh-word *when*, as exemplified by the bracketed clause in (1). (In this paper, we do not deal with the atemporal/conditional *when*-clauses discussed in Farkas and Sugioka 1983.)

1) You called me [when she left for London].

Syntactic analyses have treated them as free relatives with the wh-word *when* licensing a gap (or silent pronoun) since at least the 1970s (Grimshaw 1977, Bresnan and Grimshaw 1978, a.o.). The few available semantic proposals, instead, have analyzed *when* as a two-place relation that takes the two events associated with the main clause and the embedded clause and returns the value true if a certain temporal relation holds between those two events, much like the temporal connectives *before* and *after* (Bonomi 1997, Vikner 2004, a.o.).

In this paper, we reconcile the syntactic nature and the semantic properties of temporal *when*-clauses by proposing a semantic analysis that crucially relies on treating them as free relatives. Also, we show that our analysis is superior in (i) dealing with the ambiguity that temporal *when*-clauses exhibit between a time point/interval reading and an occasion reading and (ii) handling the complex semantic interaction between the aspectual properties of the matrix and the embedded clause.

**Proposal.** Developing insights from Jacobson's (1995) semantic analysis of free relatives introduced by *who* or *what*, we argue that temporal *when*-clauses are referential and denote a maximal individual. We assume a structure for free relatives (and bring new syntactic evidence supporting it) and a logical translation like those in (2). The wh-word *when* moves, leaving a trace that translates into a variable. Standard lambda-abstraction over the variable applies first; then the resulting set is restricted to the subset of time points/intervals or occasions by the semantic contribution of the wh-word ( $\text{TIME}(x) \vee \text{OCCASION}(x)$ ; see further discussion below); finally, the subset is type-shifted to its maximal individual by the  $\iota$  operator (along the line of Partee's 1987  $\iota$  type-shifting for NPs).

2) [ $\text{when}_m$  she left [ $[_p e]$   $t_m$ ]]]  $\rightsquigarrow \iota x[\text{TIME}(x) \vee \text{OCCASION}(x) \wedge \text{leave}(\text{AT}(x))(she) \wedge \text{PAST}(x)]$

Following Caponigro and Pearl (2008), we assume that the variable (and its wh-word) is an NP that combines with the predicate by means of a silent preposition AT. Another silent preposition takes the whole *when*-clause as its complement and allows it to combine with the matrix clause (3).

3) You called me [ $[_{pp} [_p e]$  [ $\text{when}_m$  she left [ $[_p e]$   $t_m$ ]]].

As independent support, the very same pattern is observed with temporal adverbial nominals like *the time*, *the day*, *the moment*, *yesterday*: they look like NPs but syntactically and semantically behave like PPs/adverbials (4) (McCawley 1988, Caponigro and Pearl 2009 a.o.).

4) You called me [the moment/the day she left].

Our analysis can also shed light on two further properties that temporal *when*-clauses exhibit.

**(i) Ambiguity.** The ability to paraphrase *when*-clauses with nominals highlights two distinct readings: one anchored to a time interval, the other anchored to an occasion. For instance, the calling in (1) can happen at the time of the physical leaving event, in a situation where you are calling me as she is walking out the door. In this case, the *when*-clause is anchored to a time interval (5). However, the calling event can also happen sometime after the physical leaving event, in a situation where she is

gone and you called me the next day, while she is gone. In this case the *when*-clause is anchored to an occasion (6).

5) You called me [at the time she left for London].

6) You called me [the time she left for London].

It is also possible to have both kinds of *when*-clauses occurring within the same matrix clause. In (7), the left-most *when*-clause is interpreted as denoting the occasion in which they went hiking together, whereas the other *when*-clause is interpreted as denoting a time point/interval at which the sun rose.

7) [When they went hiking together], she got up [when the sun was still down].

Our analysis handles the ambiguity of the *when*-clause in (1) or the different interpretations of the two *when*-clauses in (7) by assuming that the wh-word *when* allows the variable it licenses to range over both occasions and time intervals, with instants being an extreme case of an interval (Bonomi 1997 makes a similar point, though his analysis is radically different). Variety in the range of the variable is attested in other free relatives as well. For instance, free relatives introduced by *what* can range at least over inanimate concrete/abstract atomic/non-atomic individuals, including propositions as in (8). Also, the temporal pronominal *then* appears to range over both occasions and time intervals as illustrated in (9) where *then* refers to an occasion and (10) where *then* refers to a time interval.

8) I don't like [what you cooked/said/thought/imagined/felt].

9) Remember that time we went camping? I had so much fun then.

10) I leave work at 5:30. Will you be free then?

**(ii) Aspectual properties.** The temporal alignment of the matrix clause and the *when*-clause appears to be sensitive to the aspectual properties of the two clauses. The same pattern is also observed with temporal adverbials that are headed relatives that do not contain *when*. This is seen in (11-13).

11) I wrote that book [when you lived in Colombia].

12) I wrote that book [the year you lived in Colombia].

13) I wrote that book [during the year you lived in Colombia].

In these examples, the matrix event is contained within the *when* state. Since it is the same in all three cases, even when *when* is not present, the temporal alignment appears to be due to factors other than the meaning of *when*. Our analysis reduces the temporal alignment to general aspectual restrictions and general semantic properties of the silent/overt preposition that takes either *when*-clauses or adverbial NPs as its complement. On the other hand, the previous semantic analyses have problems handling these facts. Since they put the burden of the temporal relation between the two clauses on the meaning of the wh-word *when* as a two-place relation, whenever there's a variation in the temporal relation, it should be due to a change of the meaning of *when*. But a multiple ambiguity of *when* is not only stipulative, but also needs to be linked to the aspectual properties of the predicates of both clauses, which is not straightforward at all. Also, the previous analyses fail to capture the differences between the behavior of temporal clauses introduced by *when* and those introduced by *before* or *after*.

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