

CZECH *DOKUD* AND TELICITY*

MOJMÍR DOČEKAL

Department of Linguistics and Baltic Languages, Masaryk University in Brno, CZ

1 Goals of the article

There is an ongoing research concerning the English *until* and its proper treatment. Karttunen (1974) argues that *until* is ambiguous and that we can explain its behavior if we postulate two separate *until*: one durative and another one punctual negative polarity item. De Swart (1996) claims that there is no ambiguity and that we can predict all the relevant data via different scoping of negation and one lexical entry for *until* (for a careful recapitulation of the debate and additional references see Giannakidou 2002). This paper provides a new empirical support for analyzing *until* as one. The new data come from the Czech conjunction *dokud* which is a counterpart of English *until*. Czech is a helpful data source for *until* debate because it is a language with overt aspectual morphology. And one of the crucial arguments for or against the ambiguity of *until* concerns the interplay of aspectual system and negation. I argue that the non-ambiguous treatment of *dokud* and *until* can be pursued even if we don't accept the stativizing effect of negation. Concretely, I will argue that *dokud* can and should be analyzed as a reversed implication with basically durative meaning, thus supporting the view of *until* as a non-ambiguous expression, but I will do so (instead of proposals like de Swart (1996) and Krifka (1989) where negation is treated as stativizer) sticking to the zero hypothesis, namely that negation doesn't have any aspect shifting properties.

In English, the preposition *until* is grammatical only in atelic sentences (1-a). Using *until* in telic sentences yields ungrammaticality (1-b), unless the telic sentence is negated (1-c). As said above, there is an ongoing disagreement about the proper treatment of the facts. The two existing approaches argue either that the contrast follows from the fact that negation has a stativizing effect (Krifka (1989), de Swart (1996)) and therefore there is only one durative *until*; or that there is no principle explanation and *until* must be treated as semantically ambiguous, namely,

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the meaning of *until* is either durative, or punctual (Karttunen (1974), Giannakidou (2002)). The punctual *until* is claimed to be a negative polarity version of the durative *until*, and as such can be found only in negated sentences. The next section looks at the debate in more detail.

- (1) a. The princess slept until midnight.
 b. *The princess arrived until midnight.
 c. The princess didn't arrive until midnight.

2 The one *until* vs. two *until* approaches

Besides the aspectual sensitivity of *until* illustrated in (1), both approaches try to capture the following basic set of facts. While atelic sentences containing negation and *until* are ambiguous, telic sentences with both expression have just one meaning. Consider the atelic option first, as illustrated in (2). Atelic sentences like (2) have two independent meanings. First meaning can be paraphrased as: John was awake at least until midnight – *until* scopes above negation – schematically as in (2-a). This reading would be falsified by any interval of time before midnight, in which John would have slept. The second meaning where negation has wide scope with respect to *until* – schematically as in (2-b) – is true in a situation where John sleeps before midnight, but not all the way till midnight (e.g. he wakes up at 11:30). Both readings are logically independent as one is true in situations which make the second reading false and vice versa.

- (2) John didn't sleep until midnight.
 a. until midnight > \neg sleep(John)
 b. \neg > until midnight > sleep (John)

As discussed in the previous paragraph, atelic sentences containing negation and *until* are ambiguous and it is natural to capture the ambiguity via different scopes of *until* and negation. Telic sentences like (3) on the other hand aren't ambiguous in the same way. (3) can be interpreted only as reporting that John arrived after midnight but definitely not before. (3) cannot mean that John arrived sooner than at midnight (e.g. at 10:00). So in telic sentences it is impossible for negation to have a wide scope with respect to *until*, schematically as in grammatical (3-a) and ungrammatical (3-b).

- (3) John didn't arrive until midnight.
 a. until midnight > \neg arrive(John)
 b. * \neg > until midnight > arrive(John)

The theoretical solution of this intricate set of data proceeds in two possible approaches as sketched in the previous section. I will discuss both shortly. The proper evaluation of the debate out-scopes the goals of my article, so I will concentrate only on the main ingredients of both approaches.

One *until* approach accounts for the data in the following way. *Until* and negation interact scopally, therefore all the meaning differences in atelic sentences as well as the non-ambiguity of telic sentences can be derived from their different scope possibilities. *Until* is basically durative and can combine only with atelic predicates, so in case of telic predicates' negation it acts as an

aspect shifting operator changing accomplishments and achievements into states. If there is not such a shifter, the ungrammaticality obtains, see (1-b). I will comment on the aspect shifting nature of negation in the next paragraph. Let's note that the one *until* approach correctly prohibits the wide scope reading of negation in telic sentences like (3), because *until* would combine here with telic predicates, which is independently known to lead to ungrammaticality.

The key ingredient of one *until* approach is the aspectual shifting nature of negation. A recent defender of this approach, de Swart (1996), postulates the following semantics for aspectual shifting negation – see (4), her examples (31) and (32) on page 235. Negation of telic predicates in her framework describes a state which corresponds to a negative state of affairs. De Swart (1996) follows Krifka's (1989) proposal to interpret negative eventualities as a 'fusion' of all eventualities at a given time t which are not of the type denoted by the predicate P . For (3) it would mean that the sentence denotes such state s where the sum of all events of John not arriving appeared. The aspectual shifting negation is defined in (4-b) – it is a function from predicates P into state s , such that it denotes only the state where not a single event of type P occurred. The crucial MAX operator from (4-a) which is responsible for the supremum ('fusion') of all events of type P is defined in (4-b).

- (4) a. $\lambda P \lambda s [\text{MAX}(s) \wedge \neg \exists e [P(e) \wedge e \subseteq s]]$
 b. $\forall e [\text{MAX}(e) \leftrightarrow \exists t [e = \sup_e (\lambda e' \exists t' (\text{AT}(e', t') \wedge t' \subseteq t))]]$

The two *until* approaches stem from Karttunen, a recent representative is Giannakidou (2002). According to Karttunen (1974) *until* in negated sentences is different from the durative *until* appearing in non-negated atelic sentences. The first *until* is a negative polarity item and as such it must be interpreted in the scope of negation. Karttunen argues that NPI *until* is punctual and its semantics is equivalent to *before* under negation. The ambiguity of atelic sentences like (2) is explained in this framework differently than in the scope treatment – schematically as in (5-a) corresponding to (2-a) vs. (5-b) corresponding to (2-b). The interpretation of (5-a) is the same as in the one *until* approach. But according to Karttunen and Giannakidou (5-b) has an inchoative meaning. The inchoative meaning illustrated for example (3) can be paraphrased as: John fell asleep after midnight but not before. In two *until* approach the NPI *until* guarantees entailment of the positive state of affairs after the time expressed by *until* NP. This actualization is argued to be the main reason for populating lexicon with two homophonous *until*.

- (5) a. durative *until* midnight > \neg sleep(John)
 b. \neg > NPI *until* midnight > sleep(John)

The reason for non-ambiguity of telic sentences like (3) in the two *until* approach is the following: the punctual *until* is NPI, the sentence like (3) can have two readings schematized as (6-a) and (6-b). The punctual *until* is not aspectually sensitive, it can occur both with telic as well as with atelic predicates, but it must be in the scope of negation. The first reading is probably filtered out in this approach because negation isn't aspectual shifter for Karttunen and Giannakidou, so there is a prima facie incompatibility between the durative *until* and the telic predicate in (6-a). The remaining reading (6-b) entails actualization of John's arrival after midnight. And this prediction is considered to be the cornerstone of the argumentation for two *until* by Karttunen and Giannakidou.

- (6) a. durative *until* midnight > \neg arrive(John)
 b. \neg > NPI *until* midnight > arrive(John)

3 Dokud

In the previous section I discussed the *until* debate. Now I will focus on *dokud*, its relation to *until* and how can the proper treatment of *dokud* help us understand the one vs. two *until* frameworks.

As it has been shown already in the previous sections, *until* requires a particular aspect. The Czech conjunction *dokud* is similar in this respect. The basic empirical observation concerning *dokud* is, that it occurs embedded in sentences containing atelic aspect (7-a), but it becomes ungrammatical when its sentence is telic (7-b). But negation seems to reverse the pattern again, as we see in (8). Sentences (7-b) and (8) form a minimal pair distinguished only by negation. What we see is the common property of *until* and *dokud*: both expressions are sensitive to the telicity of their sentences, they appear in atelic sentences only, but telic negated sentences are grammatical for both – see example (1) repeated here as (9). Czech and English differ in the way the telicity is coded – in Czech perfective aspect on verb like *probudit* ('wake up') enforces the telicity of the sentence, in English the lexical semantics of achievements like *arrive* causes the whole sentence to be telic but if we put aside this difference, *dokud* and *until* exhibit the distribution.

- (7) a. Petr četl knížku, dokud Marie spala.
 Petr read.Imperf book DOKUD Marie sleep.Imperf
 'Petr was reading a book while Mary was sleeping' \surd *dokud*+atelic
 b. *Petr četl knížku, dokud se Marie probudila.
 Petr read.Imperf book DOKUD Marie sleep.Perf
 'Petr was reading a book while Mary woke up' **dokud*+telic
- (8) Petr četl knížku, dokud se Marie neprobudila.
 Petr read.Imperf book DOKUD Marie woke_up.Perf.Neg
 'Petr was reading a book while Mary didn't wake up' \surd *dokud*+NEG+telic
- (9) a. The princess slept until midnight. (=1)
 b. *The princess arrived until midnight.
 c. The princess didn't arrive until midnight.

Even if *until* and *dokud* act similarly with respect to their aspectual sensitivity, they are at least on surface semantically very different. The first difference, let's name it **property 1**, is a basic semantic difference: *until* (without negation) denotes succession of two events (see 10-a) but *dokud* (without negation) denotes subinterval relation of two events (see 10-b). For a bit more insightful understanding of the differences, I formalize this distinction by the temporal trace function τ (following Krifka 1989). This function maps an event to its temporal trace, or 'run time'. For English *until* in (10-a) it means that the event of stirring with a metal spoon precedes the event of dissolving the sugar. Formally the function τ mapping the event of the main clause denotes some interval preceding the time interval of the result state following the moment when the sugar has dissolved. But for Czech *dokud*, the intuitive meaning of (10-b) is that the event denoted by the main clause is contained in the bigger event denoted by the

embedded clause. Let's model this intuition with the subset relation and say that the run time of the embedded event is a superinterval of the run time of the main event – see (10-b). But surprisingly with negated telic verbs in both sentences, as in (11-a), Czech *dokud* intuitively denotes the succession as well. (11-a) means that the event of Petr's finishing reading the book follows the event of Mary's return. A similar English sentence with both telic sentences and only the main negated verb is in (11-b), where also the intuitive meaning is: the event of the embedded clause must precede the event of the main clause. Let's hypothesize that the inclusion relation is basic meaning of *dokud* and that the consecution is the basic meaning for *until*. The consecutive interpretation of *until* is particularly well visible in sentences like (1) where *until* acts as a preposition (see Giannakidou 2002:ex. 6 for the formal treatment of this durative *until*). My basic assumption concerning the meaning relation between *until* and *dokud* follows the data in (10) and (11). *Dokud* denotes inclusion (10-b), but in negated sentences it denotes consecution (11-a). Thus *until* is a mirror image of *dokud* – its basic meaning is the consecution (10-a). The distinction simply follows from the negation incorporated into *until* which can be emulated with sentential negation for *dokud* (11-a). Otherwise both conjunctions are alike but reversed by negation.

(10) a. Stir with a metal spoon until the sugar has dissolved.

$\tau(\text{stir}') < \tau(\text{dissolve}')$

b. Petr četl knížku, dokud Marie plavala.

'Petr was reading a book, while Marie was swimming.'

$\tau(\text{read}') \subset \tau(\text{swim}')$

(11) a. Petr nepřečetl tu knížku, dokud se Marie nevrátila.

'Petr hadn't finished reading the book until Mary returned'

$\tau(\text{return}') < \tau(\text{read}')$

b. The EC will not lift its sanctions until that country makes political changes.

Let's look at another property which is especially important with respect to *dokud*. I will call it **property 2**. Slavic languages belong to strict negative concord languages (for a recent linguistic treatment of this phenomena see e.g. Zeijlstra 2004), so any negative indefinite requires its main verb to be negated, otherwise the ungrammaticality obtains. Czech is a fine example of this Slavic pattern, as you can see in (12): (12-a) containing three negative indefinites is grammatical because its main verb is negated. Nevertheless (12-b) with non-negated main verb is ungrammatical. Surprisingly, negative concord is disrupted in sentences with *dokud* and telic embedded verb, as witnessed in (13-c). (13-a) and (13-b) show that the decisive factor for ungrammaticality of (13-c) is really negative concord – (13-a) with the proper name *Karel* and (13-b) with the indefinite *někdo* are grammatical. (13-c) is ungrammatical, even if the whole embedded sentence *Nikdo neumřel* would be perfectly acceptable if it stood alone. But the pattern is even more interesting because the ungrammaticality of negative concord with *dokud* obtains only if the embedded sentence is telic, as in (13-c), whereas an atelic sentence as in (14) leads to full acceptability of *dokud* + negative concord. A tentative empirical hypothesis concerning negative concord and *dokud* is in (15).

(12) a. Nikdo nikoho nikde neviděl.

Nobody nobody.Acc nowhere saw.Neg

'Nobody saw anybody anywhere.'

- b. *Nikdo nikoho nikde viděl.
 Nobody nobody.Acc nowhere saw
 ‘Nobody saw anybody anywhere.’
- (13) a. Petr čekal, dokud Karel neumřel.
 ‘Petr waited until Karel died’
 b. Petr čekal, dokud někdo neumřel.
 ‘Petr waited until somebody died’
 c. *Petr čekal, dokud nikdo neumřel.
 ‘Petr waited until nobody died’ *NC+dokud+telic
- (14) Petr kouřil dýmku, dokud v hospodě nikdo nebyl.
 ‘Petr was smoking a pipe while there was nobody in the pub’ $\sqrt{\text{NC+dokud+atelic}}$
- (15) If *dokud* appears in a in telic sentence, it may combine only with expletive negation. However, if *dokud* appears in an atelic sentence, negative concord may take place.

To summarize the current section, let’s recall the empirical generalizations we need to account for. First property 0 which connects *until* and *dokud* – both conjunctions are aspectual sensitive and there’s some interplay with negation concerning that. Second, even if both expressions are acting similarly w.r.t. aspect and negation, their semantics seems to be very different, property 1 but this difference is most probably just reflex of negation incorporated into *until* but missing in the meaning of *dokud*. And finally if we look at negative concord and *dokud*, it seems that negation and aspect interacts again in an interesting way.

1. Property 0: both *dokud* and *until* basically atelic conjunctions sensitive to negation
2. Property 1: a meaning difference between *dokud* and *until*: subinterval vs. succession
3. Property 2: a syntactic observation: *dokud* allows negative concord only in atelic sentences

The next section shows how the behavior of *dokud* can be explained in the non-ambiguity framework. My plan is to show how the peculiar behavior of *dokud* can shed light on the *until* debate, particularly I will argue for a variant of scope treatment of *dokud*.

4 Proposal

As was claimed in the previous section, there are two apparent semantics of *dokud*: subinterval and succession, illustrated in (16-a) and (16-b) respectively. The subinterval semantics occurs basically in atelic environments, the succession in the telic environments with negated verbs of both conjoined sentences. The section 4.1 begins with the subinterval *dokud* and section 4.2 shows how the apparent succession variant of *dokud* can be derived from its basic meaning.

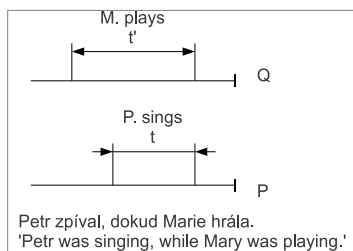
- (16) a. Petr zpíval, dokud Marie hrála.
 ‘Petr was singing while Mary was playing’
 $\tau(\text{sing}') \subset \tau(\text{play}')$
- b. Petr nedopsal tu knihu, dokud Marie neodjela do Londýna.
 ‘Petr hadn’t written the book until Mary left for London’
 $\tau(\text{leave}') < \tau(\text{write}')$

4.1 *Dokud* in embedded atelic sentences

My main claim concerning Czech *dokud* is that there is only one *dokud*, its basic semantics is formalized in (17). The formalization based on von Stechow (2002) and his discussion of various types of German *seit*. In core the lexical entry for *dokud* conjoins two predicates (P and Q), P and Q have their respective running times t and t' . The running time of Q (the embedded clause) is a subset of the running time of P (the main clause) and both events' end at some dummy variable (time t''), this time t'' is the right boundary (RB in (14)) of both events. The illustration of the meaning for (15) is the figure (16), the lexical entry for *dokud* basically aligns two events such that one is the subset of the other and both are ending in the same time.

(17) $\llbracket \text{dokud} \rrbracket = \lambda Q \lambda P \exists t \exists t' \exists t'' [P(t) \wedge Q(t') \wedge \tau(P) \subseteq \tau(Q) \wedge \text{RB}(t, t'') \wedge \text{RB}(t', t'')]$, Q is homogeneous

(18) Petr zpíval, dokud Marie hrála.
'Petr was singing while Mary was playing'



(19)

If we look at *dokud* in terms of propositional logic, then the conjunction denotes a reversed implication (the main clause implicates the embedded clause), normal implication goes in the opposite direction: the embedded clause implicates the main clause. This observation isn't very surprising, as implication is the propositional logic counterpart of the subset relation which is the core of the semantics of *dokud*. Nevertheless I think it is very helpful to think about *dokud* as about reversed implication as we will see shortly. So the sentence like (20-a) – normal implication – claims that there are three scenarios where the whole sentence is right: Peter is singing and Mary is playing, Peter isn't singing and Mary is playing, and finally: Peter isn't singing and Mary isn't playing. (20-b) – reversed implication – on the other hand claims that there are three possible scenarios for the whole sentence to be true: Peter is singing and Mary is playing, Peter is singing and Mary isn't playing and finally: Peter isn't singing and Mary isn't playing. The truth conditions for *dokud* are summarized in the table (21).

(20) a. If Peter was singing, then Mary was playing. $p \supset q$
b. Dokud Petr zpíval, Marie hrála. $q \supset p$

(21)

p	q	<i>dokud</i>	<i>if</i>
1	1	1	1
1	0	1	0
0	1	0	1
0	0	1	1

The main conclusion of this section is demonstrated on the example (22-a): its propositional meaning is simply the implication going from the main clause to the embedded clause – (22-c). The more detailed meaning following from the lexical entry for *dokud* is in (22-b). (22-b) can be read as: there is an event of Petr’s sleeping and an event of Mary’s singing, both happening at times t and t' respectively, t is a subinterval of t' and both events end at the point t'' , the right boundary of both events. This gets the truth conditions of (22-a) illustrated in the figure (19) right and the whole process is totally compositional. The core meaning of *dokud* is quite simple but the complications with its distribution arise because it is aspect sensitive and moreover the negation can reverse the intervals, so we come to apparently different meanings. More about this in the next section.

(22) a. Petr spal, dokud Marie zpívala.

‘Petr was sleeping while Mary was singing’

b. $\exists t \exists t' \exists t'' [\text{sleep}'(\text{Petr}', t) \wedge \text{sing}'(\text{Marie}', t') \wedge \tau(\text{sleep}') \subseteq \tau(\text{sing}') \wedge \text{RB}(t, t'') \wedge \text{RB}(t', t'')]$,
sing' is homogeneous

c. $\text{sleep}' \supseteq \text{sing}'$

As for the aspectual sensitivity, the lexical entry for *dokud* constraints the predicate of the embedded clause to homogeneous predicates. This is the way how I code the atelicity constraint, observed with *dokud*. I assume, following at least Dowty 1979 a.o., that homogeneity is the way how to formalize the atelicity of verbal predicates. Predicate P is homogeneous if it has the subinterval property: $P(t): \forall t' [t' \subset t \rightarrow P(t')]$, so e.g. the predicate *zpívat* from (23-a) is atelic because it is homogeneous – if it is true that Petr was singing from 14:00 to 15:00, then it is true that he was singing in every subinterval of the given time. The verb *dohrát* (‘finish playing’) from (23-b) is telic on the other hand because it is not true that any subinterval of time where the predicate holds has the subinterval property, the only interval where the predicate holds is the maximal interval – from the beginning of the event till its end. *Dokud* is sensitive only w.r.t. to the telicity of the embedded clause, as witnessed by (23-b) where the telicity of the main clause doesn’t cause any ungrammaticality.

(23) a. *Petr zpíval, dokud Marie dohrála.

‘Petr was singing while Mary finished playing’

b. Petr napsal tu knihu, dokud byl Karel děkanem.

‘Peter wrote the book while Karel was a dean’

4.2 *Dokud* in embedded telic sentences

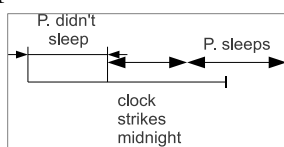
The second meaning of *dokud*, the consecutive one, intuitively denotes succession of two events as in (24-b). (24-b) can be paraphrased as: if Honza kills the dragon, then the princess will marry him, but not sooner. For English *until* the same meaning appears when *until* occurs in a sentence without negation in the embedded clause – see (11-b) repeated here as (24-a). The distinction between *until* and *dokud* is that the consecutive meaning is possible for *dokud* only if it occurs with two negated telic predicates, while *until* can have this meaning if it occurs in a non-negated embedded sentence as in (24-a). The distinction is probably a reflex of the different derivational make-up of both items as was suggested above: while *dokud* is composed of directional preposition and wh-element, *until* (at least diachronically) contains negation and conjunction.

The straight translation of (24-a) into Czech using *dokud* would be (24-c) where both the main clause and the embedded clause are negated contrary to the English source.

- (24) a. The EC will not lift its sanctions until that country makes political changes.
 b. Princezna si Honzu nevezme, dokud Honza nezabije draka.
 ‘The princess will not marry Honza until he kills the dragon’
 c. Evropská unie **ne**-zruší své sankce, dokud tato země **ne**-provede politické změny.

The consecutive meaning for *dokud* can be illustrated on Czech sentences like (25). (25) can be depicted as in (26): the event of the embedded clause precedes the event of the main clause – for that we must intuitively de-negate the predicates. Even if the sentence’s truth conditions strictly speaking refer to two negative states of affairs, its interpretation is different. It is notoriously difficult to state whether the actualization inference is some sort of presupposition or real entailment. Nevertheless I will try to describe the actualization in the semantics instead of pragmatics. More about this in the next paragraph.

- (25) Princezna neusnula, dokud neodbila půlnoc.
 ‘The princess didn’t fall asleep until the clock stroke midnight’



(26)

If we want to stick to the assumption that there is only one *dokud*, then the lexical entry in (17) should deliver the right truth conditions in any context. Let’s apply the lexical entry to the example (27-a). We obtain straightforwardly (27-b). Its core meaning says that the negation of the event of the princess’ marrying Honza is a subinterval of the negation of the event of Honza’s killing the dragon. In other words, when the proposition ‘Honza killed the dragon’ starts to be true, then it would also be possible for the proposition ‘Princess maries Honza’ to be true. So my hypothesis is that the lexical entry in (17) delivers the truth conditions right, but it’s a bit hard to comprehend them. More on this bellow but let’s note for now that the semantics of *dokud* predicts right that the negated telic predicate is grammatical with *dokud*, while the un-negated telic predicate isn’t – see (28). This is so because the negation of an accomplishment like *kill* has the subinterval property, although the accomplishment pure doesn’t have the subinterval property at all. This is so, because negation reverses the entailments: the trade mark of downward entailing (DE) contexts is the reasoning from sets to subsets. The same holds for time intervals also: telic predicates in DE contexts are homogeneous and there’s no need for stativizing theory of negation. Regardless to the fact that it would be possible to describe the data with the stativizing negation, which we could do that with null hypothesis (negation doesn’t have any special aspectual properties), let’s do the work without the aspectual shifting theory. The only ingredients needed are the following: *dokud* (as well as *until*) can combine only with homogeneous predicates, because negation of telic predicates is homogenous, *dokud* can combine with such predicates.¹

¹ In fact I think that Czech conforms to the hypothesis that negation has stativizing effect. One powerful indicator of that is the following. Even if it is possible to negate imperfective imperatives: *čti!* ‘read!’ *ne-čti!* ‘do not read!’, the

(27) a. Princezna si Honzu nevezala, dokud nezabil draka.

‘The princess hadn’t married Honza until he killed the dragon.’

b. $\exists t \exists t' \exists t'' [\neg \text{marry}'(\text{princess}', \text{Honza}', t) \wedge \neg \text{kill}'(\text{Honza}', \text{dragon}', t') \wedge \tau(\neg \text{marry}') \subseteq \tau(\neg \text{kill}') \wedge \text{RB}(t, t'') \wedge \text{RB}(t', t'')]$, $\neg \text{kill}'$ is homogeneous

(28) *Princezna si Honzu vzala, dokud zabil draka.

As I implied in the previous paragraph, I consider the lexical entry (17) sufficient to describe truth conditions of *dokud* in any context. But I assume that it is hard for native speakers to process such meanings. As clear from the previous paragraph, implication of two negated sentences is quite hard to comprehend, so I assume that hearers use the inferential rule of transposition of implication as stated in (29-a). They use the rule to process the meaning of negated telic sentences with *dokud* more easily. The transposition of implication belongs to the tautologies of propositional logic and when applied to natural language, it claims the equality of an implication with the reversed negation of its antecedent and consequent. Schematically the sentence like (27-a) is then interpreted as the right part of the equation in (29-b): instead of implication of two negations, the sentence is interpreted as an implication going from the embedded clause to the main clause. In that respect negation reverses the implication of *dokud* (recall that *dokud* in non-negated contexts implies from the main clause to the embedded clause), so it behaves in this respect as ordinary *if*.

(29) a. $(\neg Q \supset \neg P) \leftrightarrow (P \supset Q)$

b. $\neg \text{marry}' \supset \text{kill}' \leftrightarrow \text{kill}' \supset \text{marry}'$

However the reversed implication in (29-b) of itself doesn’t explain why we should obtain the consecutive interpretation for the embedded and the main clause. Of course we can rely on some sort of Gricean reasoning which would explain why with usual implications we obtain the time alignment of the embedded clause before the main clause. But I suppose the alignment for *dokud* follows from the interplay of aspect and negation and not from such pragmatic reasoning. What the truth-conditions of (27-b) say is that the main clause cannot be true sooner than the embedded clause turns out to be true as well. And when are accomplishments like *kill dragon* false? Simply at all the time points before the culmination point of the accomplishment, and then they start to be true. If we follow this line of reasoning, then the telos part of accomplishments in the embedded clause sets the earliest time of the validity of the main clause. In the framework of von Stechow (2009) following Beaver & Condoravdi (2003) we can formalize this as in (30). The definition of the operator the earliest time is in (31). (30) can be paraphrased as: there is an event of princess marrying Honza and an event of Honza killing the dragon, the first event must

negation of perfective imperatives is highly constrained if possible at all. E.g. second person imperative *??ne-pře-čti ten článek!* ‘do not read the article!’ is either ungrammatical or acceptable only with a deontic modality interpretation. I assume this follows straightforwardly from the independently known fact that imperatives are incompatible with states and if Czech negation stativizes the verb, the prediction that only Czech imperfective verbs (they denote activities) are admissible candidates for imperative mood is borne out. But because proper investigations of the stativizing or non-stativizing nature of Czech negation would lead me beyond the scope of the present article, I stick to the minimal hypothesis: negation is just the truth reversing operation we know from propositional logic and it doesn’t have any other special properties.

not start earlier than the second one turns out to be true. This is exactly the meaning of (27-a) and corresponds quite naturally to the intuitions of native speakers.

(30) $\exists t \exists t' \exists t''$ [marry'(princess', Honza', t) \wedge kill (Honza , dragon , t'') \wedge τ (kill') < the earliest τ (marry')] (LF of (27-a))

(31) EARLIEST $\parallel = \lambda P_{it}$.the earliest time such that P(t) = the t, such that P(t) \wedge ($\forall t'$)[P(t') \supset t < t']
von Stechow (2009) and Beaver & Condoravdi (2003)

Interim summary: I presented a way how to derive consecutive meaning of *dokud* from its basic subinterval version. The derivation describes the consecutive meaning as arising as a by-product of the aspectual system combining with sentential negation. There is a similarity between *dokud* and *until* in this respect: both seem to be ambiguous but the ambiguity can be treated scopally or by independently justified systems of natural language.

4.3 *Dokud* and negative concord

In the previous section I have shown how to explain the property 0 and property 1 of *dokud* – its aspectual sensitivity and its basic meaning from which the consecutive meaning can be derived. In the present subsection I will deal with the last property discussed in the section 3: the lack of negative concord in *dokud* headed telic sentences. As we saw, there is a correlation between the scope of negation and telicity of the embedded sentence – in telic sentences the negation cannot license negative concord. I assume that this follows from the syntactic nature of negative concord. The verbal negation which licenses the negative indefinites must be locally enough for the negative agreement to take place. Consequently the negation in telic sentences with disrupted negative concord must be in a position inaccessible to negative concord. In this respect I follow Abels (2005), who claims that when negation (in Russian and also other Slavic languages) rises to CP, it cannot license negative concord anymore. Czech sentence demonstrating this hypothesis is (32) – the semantics of the verb *bát se* ('be afraid') conjoined with the subjunctive forces the negation of the embedded predicate to scope above its usual position. And as the negation ends in the CP periphery, it cannot license negative concord from there.

(32) Petr se bál, aby *nikdo/Karel nepřišel.
'Petr was afraid of somebody/Karel coming.'

Let's assume that the lack of negative concord in the embedded telic sentences with *dokud* is caused by the same process: negation taking scope too high for the negative concord to take place. On the other hand, it's not true that negation has scope over the conjunction itself: propositional logical rendering of such scope: $\neg(p \supset q)$ in sentences like (33) it would be true only in a situation where the princess would marry Honza, even though he hasn't killed the dragon. In any other situation it would be false – a fatally incorrect prediction – see (33-a) and (33-b). So the negation in telic sentences is for sure located somewhere under *dokud*, but it is higher than in atelic sentences. This shows also that the ambiguity approach is untenable at least for Czech *dokud* because it scopes above negation all the time. Consequently its behavior cannot be explained via postulating its NPI nature.

(33) Princezna si Honzu nevzala, dokud nezabil draka. (= (27-a))

- a. $(\neg p \supset \neg q) \leftrightarrow (q \supset p)$ b.* $\neg(p \supset q)$

If we assume that the scope of negation in embedded telic clauses headed by *dokud* is too high to license negative concord, the natural question to ask is why it should be so. Even if we follow von Stechow (2009) in the assumption that negation usually takes wide scope with respect to the time of the sentence (e.g. *John didn't sleep today* is true when negation outscopes past time, otherwise the truth conditions for this sentence would be too weak), it still doesn't follow why telic and atelic sentences should behave differently with respect to the scope of negation. I think that the most probable explanation follows from the homogeneity restriction of *dokud*. As *dokud* requires the embedded clause to be homogeneous, the negation must scope higher than any other element in the clause (recall that telicity of the sentence is the compositional phenomenon, all arguments of verb and of course the verb itself compose in the computation of telicity – see Krifka 1989 a.o.), otherwise the sentence would be semantically anomalous.

(34) a. *Karel čekal, dokud nikdo neumřel.

'Karel waited until nobody died'

*NC+dokud+telic

b. Karel kouřil dýmku, dokud v hospodě nikdo nebyl.

'Karel was smoking a pipe while there was nobody in the pub.'

√NC+dokud+atelic

We can detect the same pattern as with the negative concord with positive polarity items. As we saw in the previous section, negation in telic sentences has higher scope than in atelic sentences. So high that even positive polarity items like *někdo* can have narrow scope w.r.t. negation. Look at (35) with the usual behavior of PPI: sentence (35) can only have the logical form in (35-a), the logical form (35-b) is ungrammatical for the sentence, because the negation would scope over the existential quantifier representing the semantic contribution of the PPI *někdo*. On the other hand, (36) with the same PPI *někdo* allows the scope of negation to be wider than the PPI: the sentence is interpreted as: the event of Peter's smoking the pipe was a subinterval of the time during which nobody entered the pub. The interpretation makes it clear that the PPI is interpreted as a non-specific indefinite in the scope of negation. It doesn't require any specific individual to be the one who stops Peter's smoking the pipe: (36) is true if Petr stops smoking his pipe when anyone enters the pub. I assume again that this follows from the higher scope of negation in telic sentences – *dokud* requires its embedded sentence to be homogeneous, negation outscopes all the elements in its sentence, so even PPI like *někdo* can be interpreted in its scope.

(35) Někdo nepřišel.

'Somebody didn't come'

- a. $\exists x[\text{person}'(x) \wedge \neg \text{came}'(x)]$ b.* $\neg \exists x[\text{person}'(x) \wedge \text{came}'(x)]$

(36) Petr kouřil dýmku, dokud do hospody někdo nevstoupil.

'Petr was smoking a pipe until somebody entered the pub'

nonspecific: Petr was smoking a pipe $\neg \exists x[\text{person}'(x) \wedge \text{enter}'(x)]$

5 Conclusion

I argued for the unified semantics of Czech *dokud*. *Dokud* is a reversed implication: its core meaning is an implication taking as its antecedent the main clause and as its consequent the embedded clause. With respect to the time traces of the events denoted by the main clause and the embedded clause, this translates as the subinterval relation between the running time of the main clause and the running time of the embedded clause. There are two apparent interpretations of *dokud* – ‘durative’ which occurs in the atelic sentences (the subinterval interpretation) and ‘punctual’ which occurs in telic sentences (the consecutive interpretation). But the second interpretation is derived from the basic implicational core of *dokud* and the interplay of aspectual and negation system. The conclusion which follows from the *until* debate is the following. To the extent that *dokud* and *until* can be compared (and they behave similarly w.r.t. aspect and negation, moreover they seem to be just mirror images of each other – *until* containing negation which *dokud* lacks), non-ambiguity treatment of *dokud* supports the one *until* theory. And because negation always scopes below *dokud*, the NPI nature of *dokud* is out of the question. This shows that the Karttunen/Giannakidou style of theory is falsified at least in its cross linguistic predictions.

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