Testing the implicature approach to sequence of tense*

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Abstract In English, past tense stative clauses embedded under a past-marked attitude verb, like *Eric thought that Kalina was sick*, can receive two possible interpretations, differing on whether the state of the complement is understood to hold before, i.e. Kalina's sickness precedes the time of Eric's thinking, or at the matrix evaluation time, Kalina is sick at the time of Eric's thinking. As is well known, the availability of the simultaneous reading – also called 'Sequence of Tense' (SOT) – is subject to cross-linguistic variation. Non-SOT-languages, like for instance Japanese or Polish, only allow for the other, backward-shifted interpretation. This cross-linguistic variation has been analysed in two main ways in the literature: A structural approach, connecting the availability of the simultaneous reading in a language to a syntactic mechanism that allows the embedded past morphology not to be interpreted, and an implicature approach, which links the absence of such reading to the presence of a 'cessation' implicature associated with past tense. We report an experimental study testing the predictions of the two approaches by investigating Polish past-under-past sentences in positive and negative contexts, comparing their potential cessation implicature to the exclusive implicature of disjunction. In our results, we found that the latter was endorsed more often in positive than in negative contexts, as expected, while the cessation implicature was endorsed overall very little, with no difference across contexts. The disanalogy between the disjunction and the temporal cases, and the insensitivity of the latter to monotonicity, is a challenge for the implicature approach, and casts doubts on associating SOT phenomena with implicatures. The results are instead in line with the structural approach, which expects no effect of monotonicity on the (un)availability of simultaneous readings, and no similarity between SOT phenomena and implicatures.

Contents

1 Introduction

In English, past tense stative clauses embedded under a past-marked attitude verb can receive two possible interpretations, differing on whether the state of the complement is understood to hold before, as in (1-a), or at the matrix evaluation time, as in (1-b).

(1) Eric thought that Kalina was sick.   PAST-UNDER-PAST
   a. Eric's thought: "Kalina was sick"   SHIFTED
   b. Eric's thought: "Kalina is sick"   SIMULTANEOUS

As is well known, the availability of the SIMULTANEOUS reading in (1-b) – also called 'Sequence of Tense' (SOT) – is subject to cross-linguistic variation (Ogihara 1989, 1995, 1996, Kusumoto 1999, 2005, Kubota et al. 2009, Ogihara & Sharvit 2012). Non-SOT-languages, like for instance Japanese or Polish, only allow for the backward SHIFTED interpretation (Bošković 2012, Sharvit 2014).

This cross-linguistic variation has been analysed in two main ways in the literature: A structural approach, connecting the availability of the simultaneous reading in a language to a syntactic mechanism that allows the embedded past morphology not to be interpreted (Ogihara 1995, 1996, Kusumoto 1999, 2005), and an implicature approach, which links the absence of such reading to the presence of a 'cessation' implicature associated with past tense (Altshuler 2016, Altshuler & Schwarzschild 2013). We report an experimental study testing the predictions of the two approaches by investigating Polish past-under-past attitude complements in positive and negative contexts, comparing their potential cessation implicature to the exclusive implicature of disjunction. In our results, we found that the latter was endorsed more often in positive than in negative contexts, as expected, while the cessation implicature was endorsed overall very little, with no difference across contexts. The disanalogy between the disjunction and the temporal cases, and the insensitivity of the latter to monotonicity, is a challenge for the implicature approach. The results are instead in line with alternative structural approaches, which expect no similarity between SOT phenomena and implicatures (Ogihara 1995, 1996, Kusumoto 1999, 2005).

The rest of the paper is organised as follows. In Section 2, we discuss the interpretation of past-under-past sentences and its cross-linguistic variation and we briefly outline the background assumptions we make. In Section 3, we discuss the two approaches mentioned above in more detail, together with the predictions they make. In Section 4 we report an experimental study designed to test these predictions. In Section 5, we discuss the results in relation to those predictions, and Section 6 concludes the paper.

2 Background

2.1 Sequence of Tense and cross-linguistic variation

An important theoretical challenge arising from SOT phenomena is how to derive the simultaneous interpretation in sentences such as (1), and the associated cross-linguistic variation i.e. the fact that this interpretation is not available in all languages. A well-studied case of a language lacking the simultaneous interpretations is Japanese (Ogihara 1989, 1995, 1996, Kusumoto 1999, 2005, Kubota et al. 2009, Ogihara & Sharvit 2012). To illustrate, consider the Japanese sentence in (2), which can only receive a backward-shifted interpretation, unlike its English counterpart in (1).

(2)   Past-under-Past in Japanese (SHIFTED interpretation only)

  Taroo-wa [Hanako-ga   byookidat-ta]- to   it-ta.
  Taro-TOP [Hanako-NOM be.sick-PAST] that say-PAST
  'Taro said that Hanako had been sick.'   (Ogihara 1996: 69)

In order to convey that the state expressed in the complement clause coincides with the matrix attitude time (i.e., the SIMULTANEOUS interpretation), embedded present tense must be used in Japanese, as illustrated in (3).

(3)   Taroo-wa [Hanako-ga   byooki-da   ]-to it-ta.
  Taro-TOP [Hanako-NOM be.sick-PRES]that say-PAST
  'Taro said that Hanako was sick (at that time).'   (Ogihara 1996: 69)

Beyond this contrast between English and Japanese, observations have been made for Russian and Hebrew, suggesting additional interesting further variation within non-SOT languages. Both Russian and Hebrew behave like Japanese in that simultaneity is canonically expressed with embedded present, and that past-under-past attitude complements are interpreted as backward-shifted. In contrast to Japanese, however, Russian and Hebrew reportedly also allow for simultaneous interpretations for past-under-past under certain restricted circumstances (Altshuler 2008, Grønn & von Stechow 2010, Ogihara & Sharvit 2012, Sharvit 2018). In Hebrew, for instance, some speakers also accept sentences like (4) without backward-shifting, as reported in Ogihara & Sharvit 2012: 640.[1]

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1 Ogihara & Sharvit (2012) propose an analysis of this variation that derives simultaneous readings of past-under-past in Hebrew by means of a restricted de re mechanism (e.g., res movement, Heim 1994), which allows the embedded past to be interpreted deictically and possibly coincide with the time denoted by the matrix past. The variation between Japanese and Hebrew is then captured by a "tense-copy-parameter" (Ogihara & Sharvit 2012: 662). In Japanese, but not in Hebrew, a res-moved past tense leaves a copy in the complement clause that must be interpreted, thereby excluding these

(4)   Past-under-Past in Hebrew
       (SIMULTANEOUS interpretation marginally available)

       lifney apayim   šana, Yosef xašav   še Miriam ahava   oto
       before two-thousand year Yosef think.PAST that Miriam love.PAST him
       'Two thousand years ago, Yosef thought that Miriam loved him.'

We also find interesting sub-variation between English and other SOT-languages. According to Schlenker (1999) and Sharvit (2003), Modern Greek patterns with English in that past-under-past can obtain simultaneous interpretations, as in (5-a). However, simultaneity of the embedded state with the matrix attitude time can also be expressed with embedded present in Greek (5-b).[2]

(5)   Simultaneous interpretation in Modern Greek (Sharvit 2003: 673)

       a.   To 1963 o   Kostas mas ipe oti i   Maria tan eggios.
             the 1963 the Kostas us   told that the Maria was pregnant
       b.   To 1963 o   Kostas mas ipe oti i   Maria ine eggios.
             the 1963 the Kostas us   told that the Maria is   pregnant
             'In 1963, Kostas told us that Maria was pregnant [at the time].'

In English, by contrast, embedded present is said to only receive so-called 'double-access' interpretations (see, e.g., Abusch 1997) under which the embedded state holds both at the matrix attitude time and at the utterance time. Sharvit (2003: 670) illustrates this restriction with the example in (6-a), which is assumed to be unacceptable since world knowledge tells us that the matrix attitude time (two years ago) and the utterance time cannot both be temporally included in the duration of one pregnancy. In order to induce a purely simultaneous interpretation that does not require the embedded proposition to be true at the utterance time, past-under-past must be used in English, as in (6-b). We will come back to this particular property of English in our discussion of the implicature approach to SOT below.

(6)   a.   #Two years ago, Sally found out that Mary is pregnant.
       b.   Two years ago, Sally found out that Mary was pregnant.

Finally, as discussed in detail in Bochnak et al. (to appear), the SOT/non-SOT distinction cuts across broader typological differences between tense-systems cross-linguistically. For instance, we also find SOT variation in languages where tense marking is grammatically optional. To illustrate, consider first the example from

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accidental simultaneous readings.

2 The existence of 'mixed languages' such as Hebrew and Greek, where both embedded present and past can convey simultaneous readings, presents at least a prima facie challenge for the implicature approach. For discussion we refer the reader to Sharvit (2018).

Medumba (Grassfields Bantu, Cameroon) in (7). In Medumba, just like in Japanese, a past-marked stative complement clause embedded under a past-marked attitude verb can only receive a backward-shifted interpretation.[3]

(7) <u>Past-under-Past in Medumba</u> (SHIFTED interpretation only)

Bú **ná'** cúb [mbə bú **ná'** búut].
they PAST say that they PAST tired
'They said that they had been tired.'

Since Medumba is an optional tense language, the complement clause can occur without any tense marking. If the past tense in the embedded clause is omitted, as in (8), a simultaneous interpretation is available.

(8) Bú **ná'** cúb [mbə bú búut].
they PAST say that they tired
'They said that they were tired.'

In contrast to Medumba, we also find optional tense languages that display the SOT behaviour familiar from English. One language for which this has been observed is Washo (language isolate) (see Bochnak 2016). In Washo, a past-under-past complement clause such as (9) can get a backward-shifted as well as a simultaneous interpretation, as it is in English. Unlike in English, however, the complement clause can also be temporally unmarked, as in (10), to express simultaneity or temporal backward-shifting.

(9) <u>Past-under-Past in Washo</u> (SIMULTANEOUS and SHIFTED interpretation)

[Tim de-gum-díʔyeʔ   M-éʔ-**uŋil**-aʔ] di-hámu-**yuŋil**-i
Tim NMLZ-REFL-name 2-be-PAST-DEP 1-think-PAST-IND
'I thought your name was Tim.'

(10) [Tim de-gum-díʔyeʔ   M-éʔ-aʔ] di-hámu-**yuŋil**-i
Tim NMLZ-REFL-name 2-be-DEP 1-think-PAST-IND
'I thought your name was Tim.'

In sum, and abstracting away from more subtle differences between individual languages, previous research on SOT phenomena has established a contrast between SOT-languages where simultaneous interpretations are freely available in past-under-past attitude complements, and non-SOT languages where these interpretations are excluded or at least highly restricted. An overview of selected languages in each

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3 Medumba is a graded tense language, and the morpheme *ná'* glossed as PAST in the examples is not a general tense marker but actually marks remote past. This does not make a difference for our purposes, however, since the pattern is the same with near past (see Mucha 2017).

class is provided in Bošković (2012), and reproduced in (11).

(11) a. **SOT languages:** English, Dutch, Modern Greek, Spanish, French, German, Italian
      b. **non-SOT languages:** Russian, Polish, Czech, Serbian-Croatian, Romanian, Hebrew, Japanese, Korean, Hindi, Turkish, Malayalam, Bangla, Angika

In this paper we focus on the non-SOT language Polish. As discussed for instance by Sharvit (2014), Polish behaves like Japanese in that past-marked complement clauses embedded under past-marked attitude verbs can only be interpreted as backward-shifted, and embedded present must be used for a simultaneous interpretation.[4]

(12) a. BACKWARD-SHIFTED:
          Eryk uważał,   że   Kalina była   chora.
          Eryk think.3SG.PAST that Kalina be.3SG.PAST sick.1SG.FEM
          'Eryk thought that Kalina had been sick.'
      b. SIMULTANEOUS:
          Eryk uważał,   że   Kalina jest   chora.
          Eric think.3SG.PAST that Kalina be.3SG.PRES sick.3SG.FEM
          'Eryk thought that Kalina was sick (at the time).'

As stated above, the literature provides different proposals to account for SOT variation. In the next Section, we introduce the two main approaches to SOT — the structural and the implicature approach — and their predictions, which we then tested in our experimental study. Before however we dive into discussing both approaches, let us first briefly outline some background assumptions we make about the semantics of tense and about implicatures in simple and complex sentences; assumptions which are compatible with both approaches and which will allow us to outline and compare their predictions more concretely.

2.2 The semantics of tense

We assume a quantificational analysis of tense (Ogihara 1989, 1995, 1996, Kusumoto 1999, 2005, Altshuler & Schwarzschild 2013, Thomas 2012, among others). In

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4 In the literature on Sequence of Tense it is usually assumed that the SOT/non-SOT property holds across complements of different types of attitude verbs, in particular for communication verbs such as 'say', as well as for verbs of mental attitude such as 'think' or 'believe'. Since, however, SOT variation is quite consistently discussed with reference to complements of 'say'-verbs, and since our study presents data on complements of mental attitude predicates, it is worth emphasizing that the non-SOT property is indeed observed in these contexts in Polish as well.

particular, we assume that past tense is associated with a quantificational operator with the semantics in (13) (ignoring for the time being the domain of quantification of the existential quantifier, to which we go back below).

(13) $[\![\text{PAST}]\!]^c = \lambda p \lambda t \exists t'[t' < t \wedge p(t')]$

In turn, a past-marked sentence like *Kalina was sick* is associated with the truth-conditions in (14) (where time(c) refers to the utterance time in the context): there is a time t before the utterance time and Kalina is sick at that time t.

(14) $[\![\text{Kalina was sick}]\!]^c = \exists t[t < \text{time}(c) \wedge \text{sick}(\text{k},t)]$

We assume that the present tense is also quantificational, with the semantics in (15). For the present tense sentence *Kalina is sick*, it gives rise to the truth-conditions in (16): there is a time t which corresponds to the utterance time and Kalina is sick at that time t.

(15) $[\![\text{PRES}]\!]^c = \lambda p \lambda t \exists t'[t' = t \wedge p(t')]$

(16) $[\![\text{Kalina is sick}]\!]^c = \exists t[t = \text{time}(c) \wedge \text{sick}(\text{k},t)]$

Finally, we assume that a past-under-past sentence like (1) above, repeated below in (17), can have the LF in (18), giving rise to the backward shifted truth-conditions in (19), where bel(eric, w,t) represents the set of world-time pairs compatible with Eric's beliefs in world w at time t. (19) expresses the backward shifted reading conveying Kalina's sickness precedes Eric's thinking time.

(17)   Eric thought that Kalina was sick.

(18)   [PAST Eric think that [PAST Kalina be sick]]

(19) $[\![\text{Eric thought that Kalina was sick}]\!]^c =$
$\exists t[t < \text{time}(c) \wedge \forall w'[w' \in \text{bel}(\text{eric},w,t) \rightarrow \exists t'[t' < t \wedge \text{sick}(\text{k},w',t')]]]$

As we discuss below, both the structural and the implicature approach to SOT agree that (19) is a possible reading of (17). They diverge, however, in how they derive the simultaneous reading of (17) and whether they consider it a genuine reading at all. The structural approach argues that (17) can also be associated to a different LF, which gives rise to truth-conditions associated with the simultaneous reading. The implicature-approach, on the other hand, only posits (18) and (19) as the possible representation and truth-conditions of (17), respectively. In fact, this approach argues that the simultaneous reading is not a genuine reading of the sentence, but that its appearance arises due to the absence of an implicature, in a sense to be clarified below. Before turning to discussing both approaches, we spell out some assumptions about implicatures in simple and complex sentences.

2.3 The implicatures of simple and complex sentences

Implicatures, and scalar implicatures in particular, are one of the most studied inferences we draw from sentences. The main idea, going back to Grice's seminal work, is that rational interactions in communication are guided by general principles of co-operation (Grice 1975). In particular, the assumption is that upon hearing an utterance, the hearer will reason about what the speaker might have said instead, with a variety of assumptions about why the speaker said what she said rather than something else she could have said instead. Among these assumptions, the one that is relevant here is the assumption that the speaker is being as informative as is required. The fact that the speaker chose to assert what they did and not something else (among a set of restricted relevant competitors) leads the hearer to conclude that the competitors that are stronger than the assertion must be false.

In the gricean conception, scalar implicatures sit squarely within the pragmatic side of the semantic-pragmatic interface. Recent proposals have argued that we should consider scalar implicatures to be part of the compositional make up of meaning and argued that they arise from the presence of an operator in the syntax, sometimes referred to as EXH, the semantics of which 'mimics' the Gricean reasoning above (Chierchia 2004, Fox 2007, Chierchia 2013, Magri 2010, Bar-lev 2018, Meyer 2013 among many others). We adopt a version of this approach for concreteness, but nothing hinges on that, and any theory of scalar implicature which can derive the implicatures below will do for our purposes.

Informally, what EXH does is combining with a sentence and comparing it to some alternative sentences. It then outputs the conjunction of the meaning of that sentence with the negation of its 'excludable' alternatives. The definition of EXH is in (20) and that of the excludable alternatives in (21): essentially EXH negates all alternatives that are logically stronger than the assertion.[5]

(20) $\quad \llbracket \text{EXH} \rrbracket^{c,w} = \lambda p [p(w) \wedge \forall q \in Excl(p)[\neg q(w)]]$

(21) $\quad Excl(p, Alt(p)) = \{q : q \in Alt(p) \wedge q \subset p\}$

To illustrate how EXH works with an example, consider the disjunctive sentence in (22-a), which is well-known to give rise to the scalar implicature in (22-b).

(22)   a.   Kalina or Alex are sick.
         b.   ⇝ *Kalina and Alex are not both sick*

The way this implicature is derived is by assuming that (22-a) has the corresponding conjunctive alternative among its alternatives. That is, the relevant alternatives for

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5 This is a simplification but it will be enough for our purposes; see Fox 2007 among others for discussion.

EXH are those in (23).[6]

(23)   *Alt*((22-a)) = {Kalina or Alex are sick, Kalina and Alex are sick}

In addition, (22-a) is assumed to be parsed with an EXH, giving rise to the truth-conditions in (24): either Kalina or Alex are sick, but not both of them are.

(24) $⟦EXH[Kalina\ or\ Alex\ are\ sick]⟧^c =$
         $\exists t[t = \mathsf{time}(c) \wedge (\mathsf{sick}(k,t) \vee \mathsf{sick}(a,t))] \wedge$
         $\neg\exists t[t = \mathsf{time}(c) \wedge (\mathsf{sick}(k,t) \wedge \mathsf{sick}(a,t))]$

One characteristic property of scalar implicatures, which any theory has to capture, is their sensitivity to monotonicity. That is while (22-a) conveys (22-b), (25) simply conveys that neither Kalina nor Alex are sick, with no implicature.

(25)   It's not true that Kalina or Alex are sick.

This is captured by the approach above for two reasons. First, the alternatives of (25) are those in (26), both containing negation. And given that negation reverses entailment relations, the conjunctive alternative is not stronger than the disjunctive one anymore (in fact, the opposite holds). Therefore applying EXH as in (27) is simply vacuous and the meaning predicted is the desired one that neither Kalina nor Alex are sick.

(26)   *Alt*((22-a)) = {it's not true that Kalina or Alex are sick, it's not true that Kalina and Alex are sick}

(27) $⟦EXH[not[Kalina\ or\ Alex\ are\ sick]]⟧^c =$
         $\neg\exists t[t = \mathsf{time}(c) \wedge (\mathsf{sick}(k,t) \vee \mathsf{sick}(a,t))]$

In addition, this approach has to explain why EXH is generally not merged below negation, giving rise to the weaker meaning in (28), which we could paraphrase as either neither Kalina or Alex are sick or both of them are.[7]

(28) $⟦not[EXH[Kalina\ or\ Alex\ are\ sick]]⟧^c =$
         $\neg\exists t[t = \mathsf{time}(c) \wedge ((\mathsf{sick}(k,t) \vee \mathsf{sick}(a,t)) \wedge \neg(\mathsf{sick}(k,t) \wedge \mathsf{sick}(a,t))]$

The way this is generally accounted for is by restricting the distribution of EXH with

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6 Generally also the single disjuncts are included, we omit them here for simplicity; Sauerland 2004, Katzir 2007 for discussion.

7 Note that this meaning is possible as a marked option if forced by a continuation like in (i) and stress on the scalar term, but it is definitely not the default reading of the sentence.

(i)   It's not true that Kalina OR Alex are sick, they both are!

a constraint, which prevents it to apply in the scope of negation (Chierchia 2004, Chierchia et al. 2012, Fox & Spector 2018, Enguehard & Chemla 2019). A version of this constraint is the non-weakening constraint in (29).

(29)   **Non-weakening constraint**: A parse is banned if it contains an occurrence of EXH that is weakening the overall meaning of the sentence, (i.e. removing EXH would give rise to a stronger meaning).

Finally, a lot of discussion in the literature has focused on the possible scalar implicatures of more complex sentences like (30), where a scalar term is embedded in the scope of an attitude predicate (Chierchia 2004, Geurts & Pouscoulous 2009, Geurts 2010, Russell 2006, Sauerland 2004, Chemla & Spector 2011, among many others).

(30)   Eric thinks that Kalina or Alex are sick.

    In particular, sentences like (30) have been discussed in relation to the issue as to whether there are embedded scalar implicatures; that is, implicatures that arise at an embedded level, from parts of a larger sentence. In the case of (30), this issue translates into the question as to whether (30) has two possible implicatures: A weak implicature conveying that Eric thinks that Kalina or Alex are sick and it's not true that he thinks that they both are (either he doesn't know whether both are or he thinks both are not) and a stronger one conveying that Eric thinks that either Kalina or Alex are sick and that he thinks that not both of them are. The difference between the two readings correspond to the strength of Eric's belief about the truth of the negation of the conjunctive alternative.

    Whether there really are two scalar implicatures for a sentence like (30) is controversial and far from settled. What is important for us is that everyone agrees that there are these two possible readings, with different approaches disagreeing on how to derive the stronger one (either as a genuine implicature or as another type of inference arising on top of the weak implicature in (29)). To illustrate how these two inferences can be derived as scalar implicatures in the EXH-based approach above, consider the alternatives in (31) and note that now there are at least two sites where EXH can be adjoined: globally or in the scope of the attitude predicate. The two options give rise to different truth conditions, as indicated in (32) and (33). The former corresponds to the weak reading that Eric thinks that Kalina and Alex are sick and is compatible with him not knowing as to whether both of them are sick. The latter, instead, entails the strong reading conveying that according to Eric, Kalina or Alex are sick but they are not both sick.

(31)   *Alt* = {Eric thinks that Kalina or Alex are sick,
            Eric thinks that Kalina and Alex are sick}

(32) $[\![\text{EXH}[\text{Eric thinks that Kalina or Alex are sick}]\!]^{c,w} =$
$\exists t[t = \text{time}(c) \wedge \forall w'[w' \in \text{bel}(\text{eric},w,t) \rightarrow (\text{sick}(k,w,t) \vee \text{sick}(a,w,t))]] \wedge$
$\neg \exists t[t = \text{time}(c) \wedge \forall w'[w' \in \text{bel}(\text{eric},w,t) \rightarrow (\text{sick}(k,w,t) \wedge \text{sick}(a,w,t))]]$

(33) $[\![\text{Eric thinks EXH}[\text{that Kalina or Alex are sick}]\!]^{c,w} =$
$\exists t[t = \text{time}(c) \wedge \forall w'[w' \in \text{bel}(\text{eric},w,t) \rightarrow (\text{sick}(k,w,t) \vee \text{sick}(a,w,t)) \wedge$
$\neg(\text{sick}(k,w,t) \wedge \text{sick}(a,w,t))]]$

This concludes our making explicit the minimal set of background assumptions we need to illustrate the two approaches to SOT phenomena and their relevant predictions. We turn to each of them in the following Section.

3 Two approaches to sequence of tense

3.1 The structural approach

The structural approach adds to the assumptions outlined in the previous subsections an optional tense deletion rule at LF. Essentially, this rule allows a tense operator to be deleted at LF if c-commanded by a tense of the same kind. We will assume the formulation of the rule in (34), from Ogihara 1995:[8]

(34) **Tense deletion rule**: A tense operator α may be deleted if and only if α is locally c-commanded by another tense operator β and α and β are occurrences of the same tense.

On the basis of (34), the structural approach can generate an additional LF for (1), repeated below in (35), namely (36), where the most embedded PAST operator is deleted and hence not interpreted. Interpreting (36), gives rise to the truth-conditions in (37), conveying that the time of Kalina's sickness overlaps with Eric's thinking time.

(35) Eric thought that Kalina was sick.

(36) [PAST Eric think that [~~PAST~~ Kalina be sick]]

(37) $[\![\text{Eric thought that Kalina was sick}]\!]^{c} =$
$\exists t[t < \text{time}(c) \wedge \forall w'[w' \in \text{bel}(\text{eric},w,t) \rightarrow \text{sick}(k,w',t)]]$

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8 We restrict our discussion to Ogihara's implementation for ease of exposition. There exist, of course, other SOT analyses that would qualify as "structural" in that they assume distinct LF structures for deriving backward-shifted and simultaneous readings (e.g., Kratzer 1998, Kusumoto 1999, 2005, von Stechow 2009), as well as an alternative approach that derives simultaneous readings directly from the semantics of past tense (Kauf & Zeijlstra 2017). As far as we can see, our relevant predictions converge for all analyses that do not rely on implicatures to derive SOT variation.

In other words, the structural approach, in languages like English, generates two possible LFs for (35) differing only in the presence of the embedded PAST operator, which can be optionally deleted. These two LFs are, in turn, associated with two different readings: the simultaneous reading in (37) and the shifted reading in (19).

This approach deals with the cross-linguistic variation associated with the availability of the simultaneous reading by assuming that the grammar of languages like Polish simply lacks this rule and therefore the corresponding sentence of (35) in Polish in (12-b) can only express the backward shifted reading.

3.2   The implicature approach

Under the implicature approach, sentences like (35), regardless of the language considered, are only associated with the backward shifted truth-conditions. In languages like English, however, an (apparent) simultaneous reading would arise from the absence of the implicature that is incompatible with it (and that arises in other languages).

To illustrate this approach, let us start from the implicature of simple past sentences. We will use the implementation in Altshuler & Schwarzschild (2013), which has been extended to account for SOT phenomena.

Consider the observation that a simple sentence like (38) gives rise to the cessation inference that Kalina is not sick anymore. In other words, it conveys that the corresponding present tense sentence is false: there is no time which corresponds to the utterance time in which Kalina is sick. That is, Kalina is not sick anymore.

(38) $[\![\text{Kalina was sick}]\!]^c = \exists t[t < \text{time}(c) \wedge \text{sick}(\mathsf{k}, t)]$

(39) $[\![\text{Kalina is sick}]\!]^c = \exists t[t = \text{time}(c) \wedge \text{sick}(\mathsf{k}, t)]$

Altshuler & Schwarzschild (2013) argue that this inference should be derived as an implicature. An obstacle to this comes from the fact that the literal meanings of (38) and (39) are logically independent. However, Altshuler & Schwarzschild (2013) argue that the latter actually entails the former once (40) is assumed. Essentially, if a stative predicate is true at some interval t, then one can always find a superinterval t' containing t in which that predicate is true.

(40)   **Temporal profiles of statives:** If a tenseless stative clause ϕ is true at moment m, then there is a moment m' preceding or following m at which that ϕ is true.

And indeed, it is easy to see that if we assume (40), then it follows that (39) is stronger than (38): this is because if there is a time which includes the utterance time at which Kalina is sick, then on the basis of (40), there must be a moment prior to

that time (and henceforth prior to the utterance time), in which Kalina is sick. This automatically makes (38) true.

Altshuler & Schwarzschild (2013) argue that this reasoning extends to embedded tense for languages like Polish. That is, a sentence like (12-b), repeated in (41), competes with its corresponding present tense counterpart (12-a), repeated in (42). In addition, given (40), the latter is stronger than the former.

(41) a. Eryk uważał, że Kalina była chora.
         'Eryk thought that Kalina was sick.'
      b. ⟦Eryk thought that Kalina was sick⟧^{c,w} =
         $\exists t[t < \text{time}(c) \wedge \forall w'[w' \in \text{bel}(\text{eric}, w, t) \rightarrow \exists t'[t' < t \wedge \text{sick}(\text{k}, w', t')]]]$

(42) a. Eryk uważał, że Kalina jest chora.
         'Eryk thought that Kalina is sick.'
      b. ⟦Eryk thought that Kalina is sick⟧^{c,w} =
         $\exists t[t < \text{time}(c) \wedge \forall w'[w' \in \text{bel}(\text{eric}, w, t) \rightarrow \exists t'[t' = t \wedge \text{sick}(\text{k}, w', t')]]]$

When we consider the possible implicatures of (41), we have again two possible sites where EXH can be adjoined: globally or in the scope of the attitude predicate. The two options give rise to different truth conditions, as indicated in (43) and (44). The former conveys that Eric thought that Kalina was sick before the time of thinking and it is not true that Eric thought that Kalina was sick at the time of thinking. The latter, instead, entails that according to Eric, Kalina was sick before the time of thinking and she is not sick anymore at the time of thinking.

(43) ⟦EXH[Eric thought that Kalina was sick]⟧^{c,w} =
      $\exists t[t < \text{time}(c) \wedge \forall w'[w' \in \text{bel}(\text{eric}, w, t) \rightarrow \exists t'[t' < t \wedge \text{sick}(\text{k}, w', t')]]] \wedge \neg \exists t[t < \text{time}(c) \wedge \forall w'[w' \in \text{bel}(\text{eric}, w, t) \rightarrow \exists t'[t' = t \wedge \text{sick}(\text{k}, w', t')]]]$

(44) ⟦Eric thought EXH[that Kalina was sick]⟧^{c,w} =
      $\exists t[t < \text{time}(c) \wedge \forall w'[w' \in \text{bel}(\text{eric}, w, t) \rightarrow \exists t'[t' < t \wedge \text{sick}(\text{k}, w', t')] \wedge \neg \exists t''[t'' = t \wedge \text{sick}(\text{k}, w', t'')]]]]$

This approach deals with the cross-linguistic variation associated with the availability of the simultaneous reading by assuming that the present tense in languages like English is not a suitable competitor for implicature computation. This is because, as mentioned above, a sentence with an embedded present under past in English gives rise to a so-called DOUBLE-ACCESS reading. This reading entails that the reference time of the embedded clause actually overlaps with both the attitude time and the time of utterance. In contexts where the reference time does not include the utterance time, the English correspondent of (42-b) in (45) is just false, which in turn ensures that is not a suitable competitor for (41-b). Therefore, in English, the only possible truth conditions of the sentence are those corresponding to the backward shifted

meaning in (19), which are compatible with a situation in which Kalina's sickness overlaps with Eric's thinking time.

(45)   Eric thought that Kalina is sick.

It is in this sense that, under this approach, the lack of the implicature is what can give the impression of a simultaneous reading and what would differentiate languages like English from those like Polish. In other words, the cross-linguistic variation under the implicature view has to do with whether present-under-past can serve as a genuine competitor for the corresponding past-under-past sentence. In languages like Polish it can serve that role, thereby giving rise to a cessation implicature. In languages like English, on the other hand, the embedded present tense sentence has a double access reading and therefore cannot be a competitor for past-under-past sentences. This, in turn, means that a past-under-past sentence remains compatible with a situation in which the attitude time and that of the embedded complement overlap, and this would be the reason why it can give rise to the appearance of a simultaneous reading.

3.3   Predictions

The two approaches outlined above defend two very different pictures of the cross-linguistic variation of SOT phenomena. In the structural approach, the variation is about the availability of a syntactic deletion rule, which renders the simultaneous reading possible. In the implicature approach, on the other hand, the locus of variation is the lexicon. In particular, it is in the meaning of embedded present tense, which determines whether it can serve as a competitor for the embedded past tense in order to derive the cessation implicature, which is, in turn, responsible for the lack of (the appearance of a) simultaneous reading. Despite these differences, the two approaches are similarly successful in capturing the basic pattern of variation and related more complex data. Here we focus on the divergent predictions the two accounts make for past-under-past sentences in non-SOT languages across positive and negative contexts.

To illustrate, consider a positive sentence like (46) first, repeated from above. Under the structural approach, (46) is associated only with the shifted meaning in (41-b), repeated in (47): there is a time before the utterance time at which Eric's thinking entails that there was a time before that, at which Kalina was sick. This meaning is compatible with a 'simultaneous' context, in which Eric thought Kalina was sick at the time of thinking, in that it doesn't say anything about Eric's beliefs about Kalina's sickness at the thinking time.

(46)   Eryk uważał, że Kalina była chora.

'Eric thought that Kalina was sick.'

(47) $\exists t[t < \mathsf{time}(c) \land \forall w'[w' \in \mathsf{bel}(\mathsf{eric}, w, t) \rightarrow \exists t'[t' < t \land \mathsf{sick}(\mathsf{k}, w', t')]]]$

Similarly, when we move to the negative counterpart of (46) in (48), the predicted reading is simply the negation of the shifted reading in (49). This meaning conveys that it's not true that Eric thought that Kalina was sick before the thinking time and, as before, it does not say anything about Eric's beliefs about her being sick at the time of thinking and it is therefore compatible with a situation in which Eric thought Kalina was sick at the time of thinking.

(48) Eryk nie uważał, że Kalina była chora.
'Eric didn't think that Kalina was sick.'

(49) $\neg\exists t[t < \mathsf{time}(c) \land \forall w'[w' \in \mathsf{bel}(\mathsf{eric}, w, t) \rightarrow \exists t'[t' < t \land \mathsf{sick}(\mathsf{k}, w', t')]]]$

In sum, the meaning under the structural approach is compatible with a simultaneous context, across positive and negative cases: it simply doesn't say anything about Eric's beliefs about Kalina's sickness at the time of thinking.

The implicature approach, on the other hand, predicts stronger meanings in both cases. First, the meaning of the positive case is strengthened with the cessation implicature either as in (50) or as in (51), respectively. The former conveys that it's not true that according to Eric Kalina was sick at the time of thinking, while the latter entails that according to Eric, Kalina wasn't sick anymore at that time. In either case, the the resulting meaning is *incompatible* with Eric thinking that Kalina was sick at the time of thinking.

(50) $\exists t[t < \mathsf{time}(c) \land \forall w'[w' \in \mathsf{bel}(\mathsf{eric}, w, t) \rightarrow \exists t'[t' < t \land \mathsf{sick}(\mathsf{k}, w', t')]]] \land$
$\neg\exists t[t < \mathsf{time}(c) \land \forall w'[w' \in \mathsf{bel}(\mathsf{eric}, w, t) \rightarrow \exists t'[t' = t \land \mathsf{sick}(\mathsf{k}, w', t')]]]$

(51) $\exists t[t < \mathsf{time}(c) \land \forall w'[w' \in \mathsf{bel}(\mathsf{eric}, w, t) \rightarrow \exists t'[t' < t \land \mathsf{sick}(\mathsf{k}, w', t')] \land$
$\neg\exists t''[t'' = t \land \mathsf{sick}(\mathsf{k}, w', t'')]]]]$

In the negative case in (48), no cessation implicature is computed given the non-weakening principle, and the predicted truth-conditions are the same as those of the structural approach in (49). The implicature approach, however, also adopts the temporal profile of statives above in (40). As a consequence, (49) ends up entailing the negation of the present alternative in (52): it's not true that Eric thought that Kalina was sick at the time of thinking. That is, (49) together with (40) is again incompatible with a simultaneous context in which Eric thought that Kalina was sick at the time of thinking.[9]

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9 If the cessation implicature is forced in the scope of negation, despite the non-weakening principle, the resulting meaning in this case would be the weaker one in (i), which is true if Eric thought that

(52) $\neg \exists t[t < \text{time}(c) \land \forall w'[w' \in \text{bel}(\text{eric}, w, t) \rightarrow \exists t'[t' = t \land \text{sick}(\text{k}, w', t')]]]$

To sum up, the structural approach only predicts the shifted reading which doesn't say anything about Eric's beliefs about Kalina's sickness at the time of thinking, across positive and negative cases. Under the implicature approach, on the other hand, both the positive and the negative cases are incompatible with such simultaneous context. That is, both conveys that it's not true that according to Eric, Kalina was sick at the time of thinking; in the positive case, via a cessation implicature and as an entailment in the negative case.

We investigated the divergent predictions above from a slightly different angle: we focused on the endorsement of the potential cessation implicature of past-under-past sentences across positive and negative contexts and we compared the behaviour of this inference across positive and negative contexts against the baseline of a prototypical scalar implicature in the same contexts. That is, we compared the endorsement of the cessation inference with the exclusivity implicature of disjunction, one of the most studied scalar implicatures.

To illustrate, consider the positive case again in (53-a) together with its potential cessation inference in (53-b).[10] As discussed, only the implicature approach predicts (53-b) as an inference of (53-a) and therefore only under the implicature approach do we expect endorsement of this inference.

(53)   a.   Eryk uważał, że Kalina była chora.
               'Eric thought that Kalina was sick.'
     b.   *According to Eric, Kalina was not sick anymore*

Consider next the negative case in (54-a) and the candidate inference in (54-b). Under the implicature approach, (54-a) contradicts the inference in (54-b) (it entails its negation, see (52)), so low inference endorsement is expected in this case.[11] Under the structural approach, (54-b) is merely compatible with (54-a) and therefore similarly low inference endorsement is expected under this approach as well.

Kalina was still sick at the time of thinking and is therefore compatible with the simultaneous context. This is, however, predicted to be a marked/disprefered option at best in a theory of implicatures.

(i) $\neg[\exists t[t < \text{time}(c) \land \forall w'[w' \in \text{bel}(\text{eric}, w, t) \exists t'[t' < t \land \text{sick}(\text{k}, w', t')]]] \land \neg \exists t[t < \text{time}(c) \land \forall w'[w' \in \text{bel}(\text{eric}, w, t) \rightarrow \exists t'[t' = t \land \text{sick}(\text{k}, w', t')]]]]$

10 Note that in both the temporal and the disjunction cases, we focused on the stronger version of the candidate inference, as they were more natural to word than the weaker ones. We come back to the strength of the inference in the discussion section.

11 If an implicature is computed under negation, contra the non-weakening principle, the resulting meaning is compatible with (i-a) (see fn. XX above). Given that the meaning is just compatible with the candidate inference, still low inference endorsement is expected.

(54) a. Eryk nie uważał, że Kalina była chora.
          'Eric didn't think that Kalina was sick. '
      b. *According to Eric, Kalina was still sick*

In sum, the structural approach predicts low endorsement of the candidate inference across the positive and negative cases above, while the implicature approach predicts endorsement in the positive case but not in the negative case. That is, only the implicature approach predicts a difference between positive and negative cases.

We compared the cases above to the sentences below in (55-a) and (56-a) containing a disjunction embedded under an attitude predicate. As discussed in Section 2, (55-a) gives rise to the scalar implicature that according to Eric, Kalina or Alexander are sick but not both of them are sick, which arise in positive contexts like (55), but not in negative ones like (56).[12] More precisely, the predictions are as follows: we expect endorsement of the inference in (55-b) from (55-a) and very low endorsement for the inference in (56-b) from (56-a).[13]

(55) a. Eryk uważa, że Kalina lub Alex są chorzy.
          'Eryk thinks that Kalina or Alek are sick.'
      b. *According to Eric, Kalina and Alex are not both sick*

(56) a. Eryk nie uważa, że Kalina lub Alek są chorzy.
          'Eryk doesn't think that Kalina or Alek are sick.'
      b. *According to Eric, Kalina and Alex are both sick*

In sum, under the implicature approach, the temporal cases should exhibit an effect of monotonicity, with more endorsement of the inference in the positive than in the negative case, in parallel to the corresponding disjunction case. That is, under this approach the candidate inferences in (53-b) and (55-b) should be endorsed more than those in (54-b) and (56-b).[14] The structural approach, on the other hand, predicts, in the temporal case, low inference endorsement uniformly across positive and negative cases, as those candidate inferences are merely compatible with the corresponding sentences. More in general, given that it does not involve implicatures, this approach is compatible with a different pattern of behaviour between the temporal and the

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12 This holds regardless of whether we consider the weak inference conveying that it's not true that Eric thought that Kalina and Alex are both sick or the stronger one that according to him, Kalina and Alex are not both sick, see Section 2 for discussion.

13 If an implicature is forced under negation, despite the non-weakening principle, the inference becomes merely compatible. Either way, low inference endorsement is expected. The same is true for the temporal case.

14 Note that the expected parallelism between the temporal and the disjunction cases is compatible with cessation and exclusivity implicatures differing overall in strength, as it has been found for scalar items in general (van Tiel et al. 2016 among others). The prediction is of a uniform pattern across positive and negative contexts (i.e. not an interaction).

	SENTENCES	POSITIVE	NEGATIVE
STRUCTURAL APPROACH	past-under-past	×	×
IMPLICATURE APPROACH	past-under-past	✓	×
BOTH APPROACHES	disjunction	✓	×

Table 1   Predictions of the two approaches on inference endorsement across positive and negative contexts and temporal and disjunction cases, with ✓ corresponding to inference endorsement and × to non-endorsement.

disjunction cases. Or said it differently, only the structural approach is compatible with an interaction between monotonicity and type of inference. These predictions are summarised in Table 2. We turn now to describe the details of the experiment testing these predictions.

4   The experiment

4.1   Methods

4.1.1   Participants

We tested 52 native speakers of Polish (12 females, 40 male, mean age: 26, age range: 19–41) living in Poland. 51 of those participants have a high-school degree or higher; 1 participant didn't answer this question. 15 participants were excluded from the analysis due to not answering correctly at least 75% (21/28) of the control-trials, leaving 37 participants for data analysis. The participants were recruited via the online platform Prolific and they were compensated £6 for their participation.

4.1.2   Procedure

Participants were asked to imagine they were meeting with a friend, Anna, who would tell them news about their common friends. Participants received pairs of Anna's statement together with a candidate inference. Their task was to judge to which extent one can deduce the latter from the former on a scale from 1 ('one cannot deduce at all') – 7 ('with whole certainty one can deduce'). The experiment was run online using the free software platform OnExp (GNU General Public License) hosted at the Universität Tübingen (http://www.lingexp.uni-tuebingen.de/OnExp2/). The task took about 20 minutes to complete.

Kontekst: *Spotykasz swoją przyjaciółkę Anię i pytasz się jej, czy nie ma jakichś nowinek o Waszych wspólnych znajomych. W odpowiedzi, Ania opowiada Tobie, kogo ostatnio spotkała i jakich ploteczek się dowiedziała.*

Rozmawiałam ostatnio z Erykiem. Nie uważał, że Kalina była chora.

W jakim stopniu z wypowiedzi Ani można wywnioskować, że:

Według Eryka, Kalina była wtedy nadal chora.

(w ogóle nie można wywnioskować) 1 2 3 4 5 6 7 (z całkowitą pewnością można wywnioskować)

Dalej

Figure 1   An example of a target item as seen by the participants in the experiment.

4.1.3   Materials

In the experiment, we manipulated two factors: *type-of-inference* (past-under-past vs. disjunction) and *monotonicity* (positive vs. negative). Each participant received in total 24 target items and 36 fillers (including 28 controls). All the items had unique lexicalizations which were distributed over 4 lists in a Latin square design. A full list of items is provided in Appendix A.

In the target items, Anna's statements were either PAST-UNDER-PAST sentences, accompanied by their potential cessation inferences, or DISJUNCTIVE sentences, together with their potential exclusivity inferences. Both types of sentences appeared in positive and negative contexts.

More specifically, in the past-under-past condition, in positive contexts Anna's statements were accompanied by the inference corresponding to the cessation inference that according to Eric, Kalina was not sick anymore, as exemplified in (57). In negative contexts, Anna's statement was followed by the inference that according to Eric, Kalina was still sick, as in (58).

(57)   PAST-UNDER-PAST — POSITIVE:

Rozmawiałam   ostatnio z   Erykiem. Uważał,   że Kalina
talk.1SG.FEM.PAST recently with Eryk.INST think.3SG.PAST that Kalina

była   chora.
be.3SG.PAST sick.3SG.FEM
'I talked to Eryk recently. He thought that Kalina was sick.'

INFERENCE:

Według   Eryka,   Kalina nie była   już   wtedy
according.to Eryk.GEN Kalina NEG be.3SG.PAST already then
chora.
sick.3SG.FEM
'*According to Eryk then, Kalina was not sick anymore.*'

(58)   PAST-UNDER-PAST — NEGATIVE:

Rozmawiałam   ostatnio z   Erykiem. Nie uważał,   że
talk.1SG.FEM.PAST recently with Eryk.INST NEG think.3SG.PAST that
Kalina była   chora.
Kalina be.3SG.PAST sick
'I talked to Eryk recently. He didn't think that Kalina was sick.'

INFERENCE:

Według   Eryka,   Kalina była   wtedy nadal chora.
according.to Eryk.GEN Kalina be.3SG.PAST then   still sick.3SG.FEM
'*According to Eryk then, Kalina was still sick.*'

If participants interpreted past-under-past in positive contexts as predicted by the implicature approach i.e. as implying that *according to Eryk, Kalina was not sick anymore*, they were expected to endorse such inference more often than in negative contexts, where the corresponding candidate inference is merely compatible with its associated sentence. By contrast, if participants' interpretation reflected the predictions of the structural approach, low endorsement across positive and negative contexts with no effect of monotonicity is expected, as in both cases the predicted reading is merely compatible with the provided inferences.

    In the same ways as in the past-under-past condition, in the disjunction positive condition Anna's statement was followed by the exclusivity inference that according to Eric, it's not true that both Alex and Kalina are sick, as in (59). In the disjunction negative condition, again in the same way as above, the inference that according to Eric, both Kalina and Alex are sick, illustrated in (60), is either incompatible with Anna's statement or merely compatible with it if an implicature is forced under negation. Either way, low inference endorsement is expected.

(59)   DISJUNCTION — POSITIVE:

Rozmawiałam ostatnio z Erykiem. Uważa, że Kalina
talk.1SG.FEM.PAST recently with Eryk.INST think.3SG.PRES that Kalina

lub Alek są chorzy.
or Alek be.3PL.PRES sick.3PL
'I talked to Eryk recently. He thinks that Kalina or Alek are sick.'

INFERENCE:

Według Eryka, to nieprawda, że Kalina i Alek
according.to Eryk.GEN this not.true that Kalina and Alek

są obydwoje chorzy.
be.3PL.PRES both sick.3PL
According to Eryk, it's not the case that both Kalina and Alek are sick.

(60) DISJUNCTION — NEGATIVE:

Rozmawiałam ostatnio z Erykiem. Nie uważa, że
talk.1SG.FEM.PAST recently with Eryk.INST NEG think.3SG.PRES that

Kalina lub Alek są chorzy.
Kalina or Alek be.3PL.PRES sick.3PL
'I talked to Eryk recently. He doesn't think that Kalina or Alek are sick.'

INFERENCE:

Według Eryka, Kalina i Alek są obydwoje chorzy.
according.to Eryk.GEN Kalina and Alek be.3PL.PRES both sick.3PL
According to Eryk, both Kalina and Alek are sick.

Again, if the participants access the implicature of (59), interpreting it as *it's not the case that Kalina and Alek are both sick*, then they should be able to endorse the inference of (59) in positive contexts and to lesser degree the inference that both Kalina and Alek are sick in negative context, which again is only compatible (not an actual inference) with the literal meaning without implicatures or with computing the scalar implicature of *lub* 'or' in the scope of negation. All in all then, the implicature approach to temporal inferences predicts the same pattern of differences between positive and negative contexts across the inference types. By contrast, the structural approach, unlike the implicature one, is compatible with an interaction between the two conditions.

Besides the targets trials, the participants also saw 36 filler trials, 28 of which constituted the control trials as they were designed to clearly elicit the upper values of the scale , 4–7, ('good' controls) or the lower ones, 1–4, ('bad controls'). 14 of the control trials included negation. An example of the good control trial is given in (61) and of the bad control trial in (62).

(61)   GOOD CONTROL:

Rozmawiałam   ostatnio z   Hanią.   Utrzymywała,
talk.1SG.FEM.PAST recently with Hania.INST maintain.3SG.FEM.PAST
że Karol i   Sandra są   lekarzami.
that Karol and Sandra be.3PL.PRES doctor.INST.3PL
'I talked to Hania recently. She maintained that Karol and Sandra are doctors.'

INFERENCE:

Według   Hani,   Karol jest   lekarzem.
according.to Hania.GEN Karol be.3SG doctor.INST.3SG
'According to Hania, Karol is a doctor.'

(62)   BAD CONTROL:

Wpadłam   ostatnio na Pawła. Utrzymywał,   że Michał i
bump.1SG.PAST recently at Paweł claim.3SG.PAST that Michał and
Łukasz zostaną ojcami.
Łukasz become father.INST.PL
'I bumped into Paweł recently. He claimed that Michał and Łukasz will become fathers.'

INFERENCE:

Według   Pawła,   to nieprawda, że Michał zostanie
according.to Paweł.GEN it not.true   that Michał become.3SG
ojcem.
father.INST.3SG
'According to Paweł, it's not true that Michał will become a father.'

In addition to the good and bad controls, the participants saw 8 filler items that included the negative verb 'didn't say' and were designed to elicit judgments around the middle values of the scale:

(63)   FILLER:

Rozmawiałam ostatnio z   Sonią.   Nie powiedziała,   że
talk1SG.PAST recently with Sonia.INST NEG say.3SG.FEM.PAST that
Maciej i   Miłosz byli   milionerami.
Maciej and Miłosc be.3PL.PAST millionaire.PL
'I talked to Sonia recently. She didn't say that Maciej and Miłosz were millionaires.'

INFERENCE:

Według   Soni, Maciej i   Miłosz nie   byli
according.to Sonia Macieh and Miłosc NEG be.3PL.PAST
milionerami.
millionaire.3PL.INST
'*According to Sonia, Maciej and Miłosz weren't millionaires.*'

Summing up, each participant received 3 training items, followed by 24 target trials (12 in the past-under-past condition and 12 in the disjunction condition) as well as 36 filler trials (14 controls trials that were supposed to elicit the judgments from the lower part of the scale and 14 from the upper part of the scale as well as 8 filler trials that were designed to elicit the middle values). The targets and the fillers were presented in randomised order.

4.2 Results

Figure 2 shows the proportion of each response across the *type-of-inference* (disjunction vs. past-under-past) and *monotonicity* (negative vs. positive). The mean inference endorsement in the target conditions is displayed in Figure 3. We conducted an ordinal mixed logistic regression analysis using the statistics software R with the ordinal package. We fitted the model to the target trials with *type-of-inference* (baseline: Disjunction) and *monotonicity* (baseline: Positive) and their interaction as fixed effects, and by-participant intercepts and by-participant slopes as random effects. The model revealed a significant effect of *type-of-inference* ($\beta = -0.47$, $z = -3.19$, $p < .01$), *monotonicity* ($\beta = -1.1$, $z = -7.28$, $p < .001$), and a significant interaction between the *type-of-inference* and *monotonicity* ($\beta = 1.76$, $z = 5.87$, $p < .001$). Overall, participants computed the implicature of disjunction more than the cessation inference and only the former exhibited sensitivity to monotonicity.

5 Discussion

5.1 The challenge for the implicature approach

We tested the predictions of different approaches to SOT, by investigating PAST-UNDER-PAST Polish sentences in positive and negative contexts. Our results do not show any effect of monotonicity on the unavailability of SOT interpretations: we did not find any more cessation inference in positive versus negative contexts, unlike what we found for the disjunction case, as revealed by the interaction between *type-of-inference* and *monotonicity* in our results. These results are therefore challenging for the implicature approach and cast doubts on the idea of treating SOT phenomena in this way.
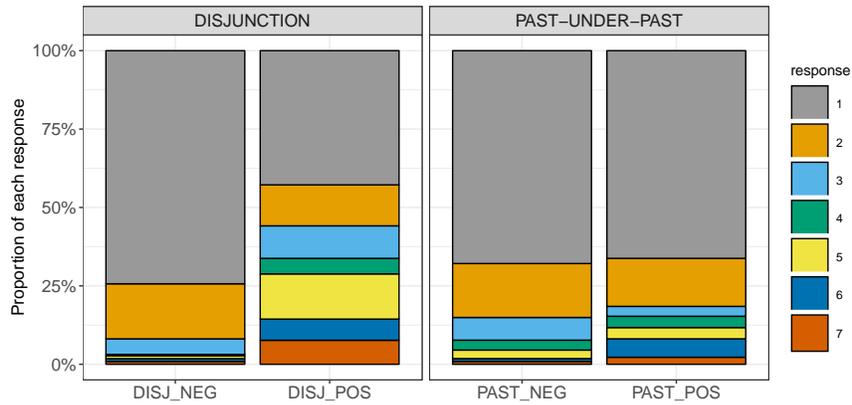
Figure 2 Proportion of each response type across conditions, with 1 representing low endorsement ('one cannot deduce at all') and 7 high endorsement ('one can fully deduce').
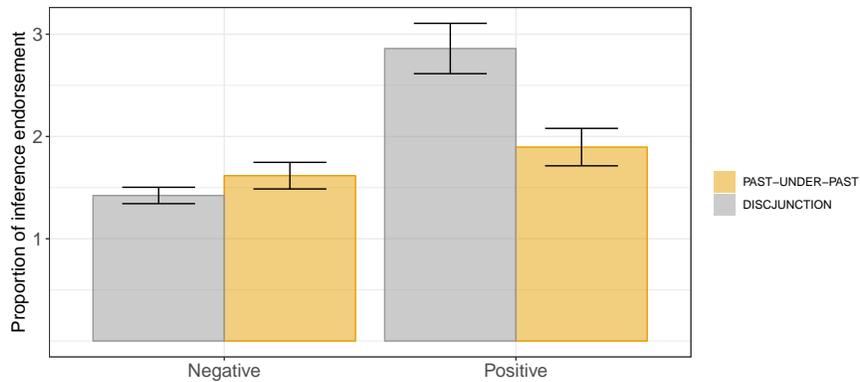

Figure 3 Inference endorsement across conditions.

The results are, instead, in line with the structural approach, which expects no effect of monotonicity on the (un)availability of simultaneous readings and is compatible with the interaction we find. In addition, this approach only predicts the shifted reading which is simply compatible with the inference both in positive and negative cases, and therefore expects very little inference endorsement across positive and negative contexts, as reflected in our results.

Before looking at future directions and concluding, we want to briefly address two potential issues associated with our results: the issue of domain restriction and the role it plays in the implicature approach and the strength of the cessation inference.

5.2 Domain restriction

To illustrate the domain restriction issue, let us go back to simple past sentences and the meaning we associated them with in (64).

(64) $[\![\text{Kalina was sick}]\!]^c = \exists t[t < \text{time}(c) \wedge \text{sick}(\text{k}, t)]$

One thing that we had not discussed explicitly in relation to sentences like (64) is the domain of quantification of the existential quantifier. That is, more precisely, (64) is standardly analysed as in (65), where D represents the quantificational domain, the set of salient time intervals.

(65) $[\![\text{Kalina was sick}]\!]^c = \exists t[t \in D \wedge t < \text{time}(c) \wedge \text{sick}(\text{k}, t)]$

Being precise about the domain of quantification is important for cases like (66), which fix that domain explicitly (i.e. D is the set of intervals belonging to last week).

(66) Last week, Kalina was sick.

This, in turn, correctly predicts that (66) does not give rise to any cessation implicature about the utterance time - it doesn't suggest that Kalina is not sick anymore. This is because the present alternative (66) is compared to is (67), (where D remains constant by assumption). Given that D does not contain the utterance time, (67) is necessarily false just in virtue of the first conjunct and nothing about Kalina being sick at the utterance time can be concluded by the falsity of that.

(67) $[\![\text{Last week, Kalina is sick}]\!]^c = \exists t[t \in D \wedge t = \text{time}(c) \wedge \text{sick}(\text{k}, t)]$

The same can be replicated at the embedded level for cases like (68) in Polish, where the domain of the matrix existential is fixed to yesterday (*wczoraj*) and that of the embedded one to last week (*w zeszłym tygodniu*).

(68) ⟦Wczoraj, Eryk uważał, że Kalina była chora w zeszłym tygodniu⟧^{c} =
$\exists t[t \in D \wedge t < \text{time}(c) \wedge \forall w'[w' \in \text{bel}(e,w,t) \rightarrow \exists t'[t' \in D' \wedge t' < t \wedge \text{sick}(\text{k},t')]]]$

The implicature approach predicts no cessation inference for (68) because its alternative with embedded present in (69) is again necessarily false in virtue of the first conjunct of the embedded existential quantification (i.e. t' cannot be part of D' (= last week) if it's equal to t, which is in turn part of D (=yesterday)).

(69) ⟦Wczoraj, Eryk uważał, że Kalina jest chora w zeszłym tygodniu⟧^{c} =
$\exists t[t \in D \wedge t < \text{time}(c) \wedge \forall w'[w' \in \text{bel}(e,w,t) \rightarrow \exists t'[t' \in D' \wedge t' = t \wedge \text{sick}(\text{k},t')]]]$

In sum, the implicature approach predicts no cessation implicature if the domain of quantification is restricted to be in the past of the utterance time (or the matrix time in the embedded case). In addition, the domain of quantification can also be fixed to a salient set of intervals in the context and need not be made linguistically explicit as in the examples above. For instance, in (70), D will be easily fixed to last week, given its saliency in the context.

(70) Context: we have been talking about last week.
⟦Kalina was sick⟧^{c} = $\exists t[t \in D \wedge t < \text{time}(c) \wedge \text{sick}(\text{k},t)]$

Conversely and crucially for us, however, if there is no salient set of intervals, it is hard to fix the domain not to include the utterance time or matrix time. In our study, the experimental materials were designed not to encourage fixing the domain of quantification in the way above, as we undertook the following steps: we had minimal contexts introducing a vague set of intervals for when the matrix time should be understood to hold (i.e. 'I talked to Eric recently') but no set of intervals was made salient for the embedded quantification, neither linguistically nor in the context. We think therefore that it is pretty unlikely that any systematic domain restriction of the embedded existential quantifier was possible in our stimuli.

5.3   The strength of the inference

As discussed in detail in Section 3, the implicature approach in combination with most theories of scalar implicatures predicts two cessation inferences for sentences like (71): a strong one entailing that according to Eric, Kalina was not sick anymore at the time of thinking and a weaker one merely conveying that it's not true that, according to Eric, Kalina was sick at the time of thinking.

(71) Eryk uważał, że Kalina była chora.
'Eryk thought that Kailna had been sick.'

In our study we focused on the stronger of the two inferences, because it was easier and more natural to word. Importantly, we did the same for the disjunction case in (72). (72) also has two possible inferences, as discussed above: a strong one conveying that according to Eric, Alex and Kalina are not both sick and a weaker one merely entailing that it is not true that, according to Eric, Kalina and Alex are both sick.

(72)   Eryk uważa, że Kalina lub Alex są chorzy.
         'Eryk thinks that Kalina or Alex are sick.'

As this choice of focusing on the strong inference was kept constant across the temporal and the disjunction conditions, we are confident that it cannot account for the interaction in our results. It could, however, be responsible for an overall low endorsement rate across the two conditions. Ideally, follow up studies would compare the weak and the strong inferences side by side, across conditions.

6   Conclusions and future directions

In English, past tense stative clauses embedded under a past-marked attitude verb, like *Eric thought that Kalina was sick*, can receive two possible interpretations, differing on whether the state of the complement is understood to hold before, i.e. Kalina's sickness precedes the time of Eric's thinking, or at the matrix evaluation time, Kalina is sick at the time of Eric's thinking. As is well known, the availability of the simultaneous reading in sentences like the above – also called 'Sequence of Tense' (SOT) – is subject to cross-linguistic variation. Non-SOT-languages, like for instance Japanese or Polish, only allow for the backward-shifted interpretation. This cross-linguistic variation has been analysed in two main ways in the literature: A structural approach, connecting the availability of the simultaneous reading in a language to a syntactic mechanism that allows the embedded past morphology not to be interpreted, and an implicature approach, which links the absence of such reading to the presence of a 'cessation' implicature associated with past tense. In this paper, we reported an experimental study testing the predictions of the two approaches by investigating Polish past-under-past sentences in positive and negative contexts, comparing their potential cessation implicature to the exclusive implicature of disjunction. In our results, we found that the latter was endorsed more often in positive than in negative contexts, as expected, while the cessation implicature was endorsed overall very little, with no difference across contexts. The disanalogy between the disjunction and the temporal cases, and the insensitivity of the latter to monotonicity, is a challenge for the implicature approach, and casts doubts on associating SOT phenomena with implicatures. The results are instead in line with the structural approach, which expects no effect of monotonicity on the

(un)availability of simultaneous readings, and no similarity between SOT phenomena and implicatures.

One might ask what an extension of our study would expect to find in a SOT language like English. The implicature approach would make a different prediction for English than for Polish. Since this approach assumes that no cessation inference arises in past-under-past attitudes in SOT languages, no effect of monotonicity is expected in the temporal case. What would the structural approach predict? In Section 4, we established that in the case of Polish, the potential temporal inferences we presented were not actually inferences, but merely logically compatible with our target sentences, therefore predicting low endorsement. For SOT languages like English, the structural approach derives two distinct LFs. The LF that derives the backward-shifted reading is the one we also find in Polish, leading to the same predictions. The alternative LF derived by the SOT deletion rule generates truth conditions that are *not* compatible with the target inferences, both in the positive and in the negative case. Since this would also lead us to predict overall low endorsement of the presented temporal inferences, a parallel study on English would not allow us to discriminate between the two approaches.

Beyond the the SOT/non-SOT contrast, the literature has also identified more fine-grained differences in the temporal interpretation of attitude complement clauses in non-SOT languages (see Section 2). It has been observed that while simultaneous readings are generally excluded in some non-SOT languages (e.g., Japanese), they are marginally available in others (e.g., Hebrew). We are not aware of any systematic investigation of this question with respect to Polish and, in future research, we aim to include Polish in a more fine-grained semantic typology of embedded tense, and, conversely, to extend experimental studies along the line of what we presented here to other non-SOT languages.

All in all, experimental work can help us refine our theoretical accounts of SOT phenomena, and shed light on the observed crosslinguistic variation.

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A Target trials

(73) a. Rozmawiałam ostatnio z Erykiem. Uważa, że Kalina lub Aleksander są chorzy.
'I talked to Eryk recently. He thinks that Kalina or Aleksander are sick.'
⤳ *'Według Eryka, to nieprawda, że Kalina i Aleksander obydwoje są chorzy.*
'According to Eryk, it's not the case that both Kalina and Aleksander are sick.'

   b. Rozmawiałam ostatnio z Erykiem. Nie uważa, że Kalina lub Aleksander są chorzy.
I talked to Eryk recently. She doesn't think that Kalina or Aleksander are sick.
⤳ *Według Eryka, Kalina i Aleksander obydwoje są chorzy.*
'According to Kalina, both Eryk and Aleksander are sick.'

   c. Rozmawiałam ostatnio z Erykiem. Uważał, że Kalina była chora.
'I talked to Eryk recently. She thought that Kalina was sick.'
⤳ *Według Eryka, Kalina nie była już wtedy chora.*
'According to Kalina then, Eryk was not sick anymore.'

   d. Rozmawiałam ostatnio z Erykiem. Nie uważał, że Kalina była chora.
'I talked to Eryk recently. He didn't think that Kalina was sick.'
⤳ *Według Eryka, Kalina była wtedy nadal chora.*
'According to Eryk then, Kalina was still sick. '

(74) a. Widziałam ostatnio Joannę. Sądzi, że Piotr lub Julia są w Londynie.
'I saw Joanna recently. She thinks that Potr or Julia are in London.'
⤳*Według Joanny, to nieprawda, że Piotr i Julia obydwoje są w Londynie.*
'According to Joanna, it's not the case that both Piotr and Julia are in London.'

   b. Widziałam ostatnio Joannę. Nie sądzi, że Piotr lub Julia są w Londynie.

'I saw Joanna recently. She doesn't think that Piotr or Julia are in London.'
↝*Według Joanny, Piotr i Julia obydwoje są w Londynie.*
'According to Joanna, both Piotr and Julia are in London.'

    c.   Widziałam ostatnio Joannę. Sądziła, że Piotr był w Londynie.
'I saw Joanna recently. She thought that Piotr was in London.'
↝*Według Joanny, Piotr nie byłjuż wtedy w Londynie.*
'According to Joanna then, Piotr was not in London anymore.'

    d.   Widziałam ostatnio Joannę. Nie sądziła, że Piotr był w Londynie.
'I saw Piotr recently. He didn't think that Joanna was in London.'
↝*Wedug Joanny, Piotr byłwtedy nadal w Londynie.*
'According to Joanna then, Piotr was still in London.'

(75)   a.   Spotkałam ostatnio Małgorzatę. Twierdzi, że Leon lub Jan są żonaci.
'I met Małgorzata recently. She claims that Leon or Jan are married.'
↝*Według Małgorzaty, to nieprawda, że Leon i Jan obydwoje są żonaci.*
'According to Małgorzata, it's not the case that both Pawel and Jan are married.'

    b.   Spotkałam ostatnio Małgorzatę. Nie twierdzi, że Leon lub Jan są żonaci.
'I met Małgorzata recently. She doesn't claim that Leon or Jan are married.'
↝*Według Małgorzaty, Leon i Jan obydwoje są żonaci.*
'According to Małgorzata, both Leon and Jan are married.'

    c.   Spotkałam ostatnio Małgorzatę. Twierdziła, że Jan był żonaty.
'I met Małgorzata recently. She claims that Jan was married.'
↝*Według Małgorzaty, Jan nie był już wtedy żonaty.*
'According to Małgorzata then, Jan was not married anymore.'

    d.   Spotkałam ostatnio Małgorzatę. Nie twierdziła, że Jan był żonaty.
'I met Małgorzata recently. She didn't claim that Jan was married.'
↝*Według Małgorzaty, Jan był wtedy nadal żonaty.*
'According to Małgorzata then, Jan was still married.'

(76)   a.   Wpadłam ostatnio na Polę. Uważa, że Marek lub Ola są bogaci.
'I bumped into Pola recently. She thinks that Marek or Ola are rich.'
↝*Według Poli, to nieprawda, że Marek i Ola obydwoje są bogaci.*
'According to Pola, it's not the case that both Marek and Ola are rich.'

    b.   Wpadłam ostatnio na Polę. Nie uważa, że Marek lub Ola są bogaci.
'I bumped into Pola recently. She didn't think that Marek or Ola are rich.'
↝*Według Poli, Marek i Ola obydwoje są bogaci.*

‘According to Pola, both Marek and Ola are rich.’

    c.   .Wpadłam ostatnio na Polę. Uważała, że Marek był bogaty.
‘I bumped into Pola recently. She thought that Marek was rich.’
↝*Według Poli, Marek nie był już wtedy bogaty.*
‘According to Pola then, Marek wasn't rich anymore.’

    d.   .Wpadłam ostatnio na Polę. Nie uważała, że Marek był bogaty.
‘I bumped into Pola recently. She didn't think that Marek was rich.’
↝*Według Poli, Marek był wtedy nadal bogaty.*
‘According to Pola then, Marek was still rich.’

(77)   a.   Rozmawiałam ostatnio z Barbarą. Sądzi, że Filip lub Milena są zawodowymi lekkoatletami.
‘I talked to Barbara recently. She thinks that Filip or are professional athletes.’
↝*Według Barbary, to nieprawda, że Filip i Milena są obydwoje zawodowymi lekkoatletami.*
‘According to Barbara, it's not the case that both Filip and Milena are professional athletes.’

    b.   Rozmawiałam ostatnio z Barbarą. Nie sądzi, że Filip lub Milena są zawodowymi lekkoatletami.
‘I talked to Barbara recently. He doesn't think that Filip or Milena are professional athletes.’
↝*Według Barbary, Filip i Milena obydwoje są zawodowymi lekkoatletami.*
‘According to Barbara, both Filip and Milena are professional athletes.’

    c.   Rozmawiałam ostatnio z Barbarą. Sądziła, że Milena była zawodową lekkoatletką.
‘I talked to Filip recently. He thought that Milena was a professional athlete.’
↝*Według Barbary, Milena nie była już wtedy zawodową lekkoatletką.*
‘According to Barbara then, Milena was not a professional athlete anymore.’

    d.   Rozmawiałam ostatnio z Barbarą. Nie sądziła, że Milena była zawodową lekkoatletką.
‘I talked to Filip recently. He didn't think that Milena was a professional athlete.’
↝*Według Barbary, Milena była wtedy nadal zawodową lekkoatletką.*
‘According to Barbara then, Milena was still a professional athlete.’

(78)   a.   Widziałam ostatnio Dawida. Twierdzi, że Monika lub Sebastian są w szpitalu.

'I saw Dawid recently. He claims that Monika lub Sebastian are in the hospital.'

⤳*Według Dawida, to nieprawda, że Monika i Sebastian obydwoje są w szpitalu.*

'According to Dawid, it's not the case that both Monika and Sebastian are in the hospital.'

b. Widziałam ostatnio Dawida. Nie twierdzi, że Monika lub Sebastian są w szpitalu.

'I saw Dawid recently. He doesn't claim that Monika or Sebastian are in the hospital.'

⤳*Według Dawida, Monika i Sebastian obydwoje są w szpitalu.*

'According to Dawid, both Monika and Sebastian are in the hospital.'

c. Widziałam ostatnio Dawida. Twierdził, że Sebastian był w szpitalu.

'I saw Dawid recently. He claimed that Sebastian was in the hospital.'

⤳*Według Dawida, Sebastian nie był już wtedy w szpitalu.*

'According to Dawid then, Sebastian was not in the hospital anymore.'

d. Widziałam ostatnio Dawida. Nie twierdził, że Sebastian był w spitalu.

'I saw Dawid recently. He didn't claim that Sebastian was in the hospital.'

⤳*Według Dawida, Sebastian był wtedy nadal w szpitalu.*

'According to Dawid then, Sebastian was still in the hospital.'

(79) a. Spotkałam ostatnio Weronikę. Uważa, że jej mama lub jej tata są źli na nią.

'I met Weronika recently. She thinks that her mother or her father are angry with her.'

⤳*Według Weroniki, to nieprawda, że jej mama i jej tata obydwoje są źli na nią.*

'According to Weronika, it's not the case that both her mother and her father are angry with her.'

b. Spotkałam ostatnio Weronikę. Nie uważa, że jej mama lub jej tata są źli na nią.

'I met Weronika recently. She doesn't think that her mother or her father are angry with her.'

⤳*Według Weroniki, jej mama i jej tata obydwoje są źli na nią.*

'According to Weronika, both her mother and her father are angry with her.'

c. Spotkałam ostatnio Weronikę. Uważała, że jej mama była zła na nią.

'I met Weronika recently. She thought that her mother was angry with her.'

⤳*Według Weroniki, jej mama nie była już wtedy zła na nią.*
'According to Weronika then, her mother was not angry with her anymore.'

    d.   Spotkałam ostatnio Weronikę. Nie uważała, że jej mama była zła na nią.
'I met Weronika recently. She didn't think that her mother was angry with her.'
⤳*Według Weroniki, jej mama była wtedy nadal zła na nią.*
'According to Weronika then, her mother was still angry with her.'

(80)   a.   Wpadłam ostatnio na Szymona. Sądzi, że Anna lub Tomasz są palaczami.
'I bumped into Szymon recently. He thinks that Anna or Thomas are smokers.'
⤳*Według Szymona, to nieprawda, że Anna i Tomasz obydwoje są palaczami.*
'According to Szymon, it's not the case that both Anna and Thomas are smokers.'

    b.   Wpadłam ostatnio na Szymona. Nie sądzi, że Anna lub Tomasz są palaczami.
'I bumped into Szymon recently. He doesn't think that Anna or Thomas are smokers.'
⤳*Według Szymona, Anna i Tomasz obydwoje są palaczami.*
'According to Szymon, both Anna and Thomas are smokers.'

    c.   Wpadłam ostatnio na Szymona. Sądził, że Tomasz był palaczem.
'I bumped into Szymon recently. He thought that Tomasz was a smoker.'
⤳*Według Szymona, Tomasz nie był już wtedy palaczem.*
'According to Szymon then, Tomasz was not a smoker anymore.'

    d.   Wpadłam ostatnio na Szymona. Nie sądził, że Tomasz był palaczem.
'I bumped into Szymon recently. He didn't think that Tomasz was a smoker.'
⤳*Według Szymona, Tomasz był wtedy nadal palaczem.*
'According to Szymon then, Tomasz was still a smoker.'

(81)   a.   Rozmawiałam ostatnio z Eweliną. Twierdzi, że Paweł lub Magda są nerwowi.
'I talked to Ewelina recently. She claims that Paweł or Magda are nervous.'
⤳*Według Eweliny, to nieprawda, że Paweł i Magda obydwoje są nerwowi.*
'According to Ewelina, it's not the case that both Paweł and Magda

are nervous.'

b. Rozmawiałam ostatnio z Eweliną. Nie twierdzi, że Paweł lub Magda są nerwowi.
'I talked to Ewelina recently. She doesn't claim that Paweł or Magda are nervous.'
↝*Według Eweliny, Paweł i Magda obydwoje są nerwowi.*
'According to Ewelina, both Paweł and Magda are nervous.'

c. Rozmawiałam ostatnio z Eweliną. Twierdziła, że Magda była nerwowa.
'I talked to Ewelina recently. She claimedd that Magda was nervous.'
↝*Według Eweliny, Magda nie była już wtedy nerwowa.*
'According to Ewelina then, Magda was not nervous anymore.'

d. Rozmawiałam ostatnio z Eweliną. Nie twierdziła, że Magda była nerwowa.
'I talked to Ewelina recently. She didn't claim that Magda was nervous.'
↝*Według Eweliny, Magda była wtedy nadal nerwowa.*
'According to Ewelina then, Magda was still nervous.'

(82) a. Widziałam ostatnio Dariusza. Uważa, że Ewa lub Robert są w nim zakochani.
'I saw Dariusz recently. He thinks that Ewa or Robert are in love with her.'
↝*Według Dariusza, to nieprawda, że Ewa i Robert obydwoje są w nim zakochani.*
'According to Dariusz, it's not the case that both Ewa and Robert were in love with her.'

b. Widziałam ostatnio Dariusza. Nie uważa, że Ewa lub Robert są w nim zakochani.
'I saw Dariusz recently. He doesn't think that Ewa or Robert are in love with her.'
↝*Według Dariusza, Ewa i Robert obydwoje są w nim zakochani.*
'According to Dariusz, both Ewa and Robert were in love with her.'

c. Widziałam ostatnio Dariusza. Uważał, że Ewa była w nim zakochana.
'I saw Dariusz recently. He thought that Ewa was in love with him.'
↝*Według Dariusza, Ewa nie była już wtedy w nim zakochana.*
'According to Dariusz then, Ewa was not in love with him anymore.'

d. Widziałam ostatnio Dariusza. Nie uważał, że Ewa była w nim zakochana.
'I saw Dariusz recently. He didn't think that Ewa was in love with

him.'

↝Według Dariusza, Ewa była wtedy nadal w nim zakochana.
'According to Dariusz then, Ewa was still in love with her.'

(83)   a.   Spotkałam ostatnio Agnieszkę. Sądzi, że Artur lub Klaudia są na wakacjach.
'I met Agnieszka recently. She thinks that Artur or Klaudia are on vacation.'
↝Według Agnieszki, to nieprawda, że Artur i Klaudia obydwoje są na wakacjach.
'According to Agnieszka, it's not the case that both Artur and Klaudia are on vacation.'

       b.   Spotkałam ostatnio Agnieszkę. Nie sądzi, że Artur lub Klaudia są na wakacjach.
'I met Agnieszka recently. She doesn't think that Artur or Klaudia are on vacation.'
↝Według Agnieszki, Artur i Klaudia obydwoje są na wakacjach.
'According to Agnieszka, both Artur and Klaudia are on vacation.'

       c.   Spotkałam ostatnio Agnieszkę. Sądziła, że Artur był na wakacjach.
'I met Agnieszka recently. She thought that Artur was on vacation.'
↝Według Agnieszki, Artura nie był o już wtedy na wakacjach.
'According to Agnieszka then, Artur was not on vacation anymore.'

       d.   Spotkałam ostatnio Agnieszkę. Nie sądziła, że Artur był na wakacjach.
'I met Agnieszka recently. She didn't think that Artur was on vacation.'
↝Według Agnieszki, Artur był wtedy nadal na wakacjach.
'According to Agnieszka then, Artur was still on vacation.'

(84)   a.   Wpadłam ostatnio na Nikolę. Twierdzi, że Kasia lub Oskar są z kimś związani.
'I bumped into Nikola recently. She claims that Kasia or Oskar are in a relationship with sb.'
↝Według Nikoli, to nieprawda, że Kasia i Oskar obydwoje są z kimś związani.
'According to Nikola, it's not the case that both Kasia and Oskar are in a relationship with sb.'

       b.   Wpadłam ostatnio na Nikolę. Nie twierdzi, że Kasia lub Oskar są z kimś związani.
'I bumped into Nikola recently. She doesn't claim that Kasia or Oskar are in a relationship with sb.'
↝Według Nikoli, Kasia i Oskar obydwoje są z kimś związani.
'According to Nikola, both Kasia and Oskar are in a relationship with

somebody.'

    c.   Wpadłam ostatnio na Nikolę. Twierdziła, że Kasia była z kimś związana.
'I bumped into Nikola recently. She claimed that Kasia was in a relationship with somebody.'
⤳Według Nikoli, Kasia nie była już wtedy z nikim związana.
'According to Nikola then, Kasia was not in a relationship with somebody anymore.'

    d.   Wpadłam ostatnio na Nikolę. Nie twierdziła, że Kasia była z kimś związana.
'I bumped into Nikola recently. She didn't claim that Kasia was in a relationship with somebody.'
⤳Według Nikoli, Kasia była wtedy nadal z kimś związana.
'According to Nikola then, Kasia was still in a relationship with somebody.'

(85)   a.   Rozmawiałam ostatnio z Jackiem. Uważa, że Krystian lub Alina są samotni.
'I talked to Jacek recently. He thinks that Krystian or Alina are lonely.'
⤳Według Jacka, to nieprawda, że Krystian i Alina obydwoje są samotni.
'According to Jacek, it's not the case that both Krystian and Alina are lonely.'

    b.   Rozmawiałam ostatnio z Jackiem. Nie uważa, że Krystian lub Alina są samotni.
'I talked to Jacek recently. He doesn't thinks that Krystian or Alina are lonely.'
⤳Według Jacka, Krystian i Alina obydwoje są samotni.
'According to Jacek, both Krystian and Alina are lonely.'

    c.   Rozmawiałam ostatnio z Jackiem. Uważał, że Krystian był samotny.
'I talked to Jacek recently. He thought that Krystian was lonely.'
⤳Według Jacka, Krystian nie był już wtedy samotny.
'According to Jacek then, Krystian was not lonely anymore.'

    d.   Rozmawiałam ostatnio z Jackiem. Nie uważał, że Krystian był samotny.
'I talked to Jacek recently. He didn't think that Krystian was lonely.'
⤳Według Jacka, Krystian był wtedy nadal samotny.
'According to Jacek then, Krystian was still lonely.'

(86)   a.   Widziałam ostatnio Agatę. Sądzi, że Iwona lub Jakub są znudzeni życiem.
'I saw Agata recently. She thinks that Iwona or Jakub are bored with life.'
⤳Według Agaty, to nieprawda, że Iwona i Jakub obydwoje są znudzeni

życiem.

'According to Agata, it's not the case that both Iwona and Jakub are bored with life.'

b. Widziałam ostatnio Agatę. Nie sądzi, że Iwona lub Jakub są znudzeni życiem.

'I saw Agata recently. She doesn't think that Iwona or Jakub are bored with life.'

⤳*Według Agaty, Iwona i Jakub obydwoje są znudzeni życiem.*

'According to Agata, both Iwona and Jakub are bored with life.'

c. Widziałam ostatnio Agatę. Sądziła, że Iwona była znudzona życiem.

'I saw Agata recently. She thought that Iwona was bored with life.'

⤳*Według Agaty, Iwona nie była już wtedy znudzona życiem.*

'According to Agata then, Iwona was not bored with life anymore.'

d. Widziałam ostatnio Agatę. Nie sądziła, że Iwona była znudzona życiem.

'I saw Agata recently. She didn't think that Iwona was bored with life.'

⤳*Według Agaty, Iwona była wtedy nadal znudzona życiem.*

'According to Agata then, Iwona was still bored with life.'

(87) a. Spotkałam ostatnio Wandę. Twierdzi, że jej brat lub jej siostra są w AA.

'I met Wanda recently. She claims that her brother or her sister are in AA.'

⤳*Według Wandy, to nieprawda, że jej brat i jej siostra obydwoje są w AA.*

'According to Wanda, it's not the case that both her brother and her sister are in AA.'

b. Spotkałam ostatnio Wandę. Nie twierdzi, że jej brat lub jej siostra są w AA.

'I met Wanda recently. She doesn't claim that her brother or her sister are in AA.'

⤳*Według Wandy, jej brat i jej siostra obydwoje są w AA.*

'According to Wanda, both her brother and her sister are in AA.'

c. Spotkałam ostatnio Wandę. Twierdziła, że jej brat był w AA.

'I met Wanda recently. She claimed that her brother was in AA.'

⤳*Według Wandy, jej brat nie był już wtedy w AA.*

'According to Wanda then, her brother was not in AA anymore.'

d. Spotkałam ostatnio Wandę. Nie twierdziła, że jej brat był w AA.

'I met Wanda recently. She didn't claim that her brother was in AA.'

⤳*Według Wandy, jej brat był wtedy nadal w AA .*

'According to Wanda then, her brother was still in AA.'

(88)   a.   Wpadłam ostatnio na Edwarda. Uważa, że Pan Nowak lub Pani Kowal-ska są nauczycielami.

'I bumped into Edward recently. He thinks that Mr. Nowak or Mrs. Kowalski are teachers.'

⤳*Według Edwarda, to nieprawda, że Pan Nowak i Pani Kowalska obydwoje są nauczycielami.*

'According to Edward, it's not the case that both Mr. Nowak and Mrs. Kowalska are teachers.'

    b.   Wpadłam ostatnio na Edwarda. Nie uważa, że Pan Nowak lub Pani Kowalska są nauczycielami.

'I bumped into Edward recently. He doesn't thinks that Mr. Nowak or Mrs. Kowalska are teachers.'

⤳*Według Edwarda, Pan Nowak i Pani Kowalska obydwoje są nauczy-cielami.*

'According to Edward, both Mr. Nowak and Mrs. Kowalska are teachers.'

    c.   Wpadłam ostatnio na Edwarda. Uważał, że Pan Nowak był nauczy-cielem.

'I bumped into Edward recently. He thought that Mr. Nowak was a teacher.'

⤳*Według Edwarda, Pan Nowak nie był już wtedy nauczycielem.*

'According to Edward then, Mr. Nowak was not a teacher anymore.'

    d.   Wpadłam ostatnio na Edwarda. Nie uważał, że Pan Nowak był nauczy-cielem.

'I bumped into Edward recently. He didn't think that Mr. Nowak was a teacher.'

⤳*Według Edwarda, Pan Nowak był wtedy nadal nauczycielem.*

'According to Edward then, Mr. Nowak was still a teacher.'

(89)   a.   Rozmawiałam ostatnio z Henrykiem. Sądzi, że Natasza lub Jacek mają depresję.

'I talked to Henryk recently. He thinks that Natasza or Jacek are depressed.'

⤳*Według Henryka, to nieprawda, że Natasza i Jacek obydwoje mają depresję.*

'According to Henryk, it's not the case that both Natasza and Jacek are depressed.'

    b.   Rozmawiałam ostatnio z Henrykiem. Nie sądzi, że Natasza lub Jacek mają depresję.

'I talked to Henryk recently. He doesn't think that Natasza or Jacek

are depressed.'
↝*Według Henryka, Natasza i Jacek obydwoje mają depresję.*
'According to Henryk, both Natasza and Jacek are depressed.'

    c.   Rozmawiałam ostatnio z Henrykiem. Sądził, że Natasza miała depresję.
'I talked to Henryk recently. He thought that Natasza was depressed.'
↝*Według Henryka, Natasza nie miała już wtedy depresji.*
'According to Henryk then, Natasza was not depressed anymore.'

    d.   Rozmawiałam ostatnio z Henrykiem. Nie sądził, że Natasza miała depresję.
'I talked to Henryk recently. He didn't think that Natasza was depressed.'
↝*Według Henryka, Natasza miała wtedy nadal depresję.*
'According to Henryk then, Natasza was still depressed.'

(90)   a.   Widziałam ostatnio Dorotę. Twierdzi, że Kacper lub Mila są bezrobotni.
'I saw Dorota recently. She claim that Kacper or Mila are unemployed.'
↝*Według Doroty, to nieprawda, że Kacper i Mila obydwoje są bezrobotni.*
'According to Dorota, it's not the case that both Kacper and Mila are unemployed.'

    b.   Widziałam ostatnio Dorotę. Nie twierdzi, że Kacper lub Mila są bezrobotni.
'I saw Dorota recently. She doesn't claim that Kacper or Mila are unemployed.'
↝*Według Doroty, Kacper i Mila obydwoje są bezrobotni.*
'According to Dorota, both Kacper and Mila are unemployed.'

    c.   Widziałam ostatnio Dorotę. Twierdziła, że Kacper był bezrobotny.
'I saw Dorota recently. She claimed that Kacper was unemployed.'
↝*Według Doroty, Kacper nie był już wtedy bezrobotny.*
'According to Dorota then, Kacper was not unemployed anymore.'

    d.   Widziałam ostatnio Dorotę. Nie twierdziła, że Kacper był bezrobotny.
'I saw Dorota recently. She didn't claim that Kacper was unemployed.'
↝*Według Doroty, Kacper był wtedy nadal bezrobotny.*
'According to Dorota then, Kacper was still unemployed.'

(91)   a.   Spotkałam ostatnio Maję. Uważa, że Adrian lub Karola są w więzieniu.
'I met Majka recently. She believes that Adrian or Karola are in prison.'
↝*Według Mai, to nieprawda, że Adrian i Karola obydwoje są w więzieniu.*
'According to Majka, it's not the case that both Adrian and Karola are

in prison.'

b. Spotkałam ostatnio Maję. Nie uważa, że Adrian lub Karola są w więzieniu.
'I met Majka recently. She doesn't believe that Adrian or Karola are in prison.'
↝*Według Mai, Adrian i Karola obydwoje są w więzieniu.*
'According to Majka, both Adrian and Karola are in prison.'

c. Spotkałam ostatnio Maję. Uważała, że Karola była w więzieniu.
'I met Majka recently. She believed that Karola was in prison.'
↝*Według Mai, Karola nie była już wtedy w więzieniu.*
'According to Majka then, Karola was not in prison anymore.'

d. Spotkałam ostatnio Maję. Nie uważała, że Karola była w więzieniu.
'I met Majka recently. She didn't believe that Karola was in prison.'
↝*Według Mai, Karola była wtedy nadal w więzieniu.*
'According to Majka then, Karola was still in prison.'

(92) a. Wpadłam ostatnio na Matyldę. Sądzi, że Kamil lub Zuzanna są ranni.
'I bumped into Matylda recently. She thinks that Kamil or Zuzanna are injured.'
↝*Według Matyldy, to nieprawda, że Kamil i Zuzanna obydwoje są ranni.*
'According to Matylda, it's not the case that both Kamil and Zuzanna are injured.'

b. Wpadłam ostatnio na Matyldę. Nie sądzi, że Kamil lub Zuzanna są ranni.
'I bumped into Matylda recently. She doesn't think that Kamil or Zuzanna are injured.'
↝*Według Matyldy, Kamil i Zuzanna obydwoje są ranni.*
'According to Matylda, both Kamil and Zuzanna are injured.'

c. Wpadłam ostatnio na Matyldę. Sądziła, że Kamil był ranny.
'I bumped into Matylda recently. She thought that Kamil was injured.'
↝*Według Matyldy, Kamil nie był już wtedy ranny.*
'According to Matylda then, Kamil was not injured anymore.'

d. Wpadłam ostatnio na Matyldę. Nie sądziła, że Kamil był ranny.
'I bumped into Matylda recently. She didn't think that Kamil was injured.'
↝*Według Matyldy, Kamil był wtedy nadal ranny.*
'According to Matylda then, Kamil was still injured.'

(93) a. Rozmawiałam ostatnio z Jerzym. Twierdzi, że Tadeusz lub Jadwiga są uzależnieni od kawy.

'I talked to Jerzy recently. He claims that Tadeusz or Jadwiga are coffee-addicts.'

⤳*Według Jerzego, to nieprawda, że Tadeusz i Jadwiga obydwoje są uzależnieni od kawy.*

'According to Jerzy, it's not the case that both Tadeusz and Jadwiga are coffee-addicts.'

b. Rozmawiałam ostatnio z Jerzym. Nie twierdzi, że Tadeusz lub Jadwiga są uzależnieni od kawy.

'I talked to Jerzy recently. He doesn't claim that Tadeusz or Jadwiga are coffee-addicts.'

⤳*Według Jerzego, Tadeusz i Jadwiga obydwoje są uzależnieni od kawy.*

'According to Jerzy, both Tadeusz and Jadwiga are coffee-addicts.'

c. Rozmawiałam ostatnio z Jerzym. Twierdził, że Jadwiga była uzależniona od kawy.

'I talked to Jerzy recently. He claimed that Jadwiga was a coffee-addict.'

⤳*Według Jerzego, Jadwiga nie była już wtedy uzależniona od kawy.*

'According to Jerzy then, Jadwiga was not a coffee-addict anymore.'

d. Rozmawiałam ostatnio z Jerzym. Nie twierdził, że Jadwiga była uzależniona od kawy.

'I talked to Jerzy recently. He didn't claim that Jadwiga was a coffee-addict.'

⤳*Według Jerzego, Jadwiga była wtedy nadal uzależniona od kawy.*

'According to Jerzy then, Jadwiga was still a coffee-addict.'

(94) a. Widziałam ostatnio Antoninę. Uważa, że Krystyna lub Józef są otyli.

'I saw Antonina recently. He thinks that Krystyna or Józef are too fat.'

⤳*Według Antoniny, to nieprawda, że Krystyna i Józef obydwoje są otyli.*

'According to Antonina, it's not the case that both Krystyna and Józef are too fat.'

b. Widziałam ostatnio Antoninę. Nie uważa, że Krystyna lub Józef są otyli.

'I saw Antonina recently. He doesn't think that Krystyna or Józef are too fat.'

⤳*Według Antoniny, Krystyna i Józef obydwoje są otyli.*

'According to Antonina, both his Krystyna and Józef are too fat.'

c. Widziałam ostatnio Antoninę. Uważała, że Józef był otyły.

'I saw Antonina recently. He thought that Józef was too fat.'

⤳*Według Antoniny, Józef nie był już wtedy otyły.*

'According to Antonina then, Józef was not too fat anymore.'

    d.   Widziałam ostatnio Antoninę. Nie uważała, że Józef był otyły.
'I saw Antonina recently. He didn't think that Józef was too fat.'
⤳*Według Antoniny, Józef był wtedy nadal otyły.*
'According to Antonina then, Józef was still too fat.'

(95)   a.   Spotkałam ostatnio Daniela. Sądzi, że Anka lub Borys są pogrążeni w bólu.
'I met Daniel recently. He thinks that Anka or Borys are mourning (in grief).'
⤳*Według Daniela, to nieprawda, że Anka i Borys obydwoje są pogrążeni w bólu.*
'According to Daniel, it's not the case that both Anka and Borys are mourning.'

    b.   Spotkałam ostatnio Daniela. Nie sądzi, że Anka lub Borys są pogrążeni w bólu.
'I met Daniel recently. He doesn't think that Anka or Borys are mourning.'
⤳*Według Daniela, Anka i Borys obydwoje są pogrążeni w bólu.*
'According to Daniel, both Anka and Borys are mourning.'

    c.   Spotkałam ostatnio Daniela. Sądził, że Anka była pogrążona w bólu.
'I met Daniel recently. He thought that Anka was mourning.'
⤳*Według Daniela, Anka nie była już wtedy pogrążona w bólu.*
'According to Daniel then, Anka was not mourning anymore.'

    d.   Spotkałam ostatnio Daniela. Nie sądził, że Anka była pogrążona w bólu.
'I met Daniel recently. He didn't think that Anka was mourning.'
⤳*Według Daniela, Anka była wtedy nadal pogrążona w bólu.*
'According to Daniel then, Anka was still mourning.'

(96)   a.   Wpadłam ostatnio na Romana. Twierdzi, że Martyna lub Klemens są na urlopie wychowawczym.
'I bumped into Roman recently. He claims that Martyna or Klemens are on parental leave.'
⤳*Według Romana, to nieprawda, że Martyna i Klemens obydwoje są na urlopie wychowawczym.*
'According to Roman, it's not the case that both Martyna and Klemens are on parental leave.'

    b.   Wpadłam ostatnio na Romana. Nie twierdzi, że Martyna lub Klemens są na urlopie wychowawczym.
'I bumped into Roman recently. He doesn't claim that Martyna or

Klemens are on parental leave.'

↝*Według Romana, Martyna i Klemens obydwoje są na urlopie wychowawczym.*
'According to Roman, both Martyna and Klemens are on parental leave.'

c.   Wpadłam ostatnio na Romana. Twierdził, że Martyna była na urlopie wychowawczym.
'I bumped into Roman recently. He claimed that Martyna was on parental leave.'

↝*Według Romana, Martyna nie była już wtedy na urlopie wychowawczym.*
'According to Roman then, Martyna was not on parental leave anymore.'

d.   Wpadłam ostatnio na Romana. Nie twierdził, że Martyna była na urlopie wychowawczym.
'I bumped into Roman recently. He didn't claim that Martyna was on parental leave.'

↝*Według Romana, Martyna była wtedy nadal na urlopie wychowawczym.*
'According to Roman then, Martyna was still on parental leave.'