Sequence of tense and cessation implicatures: evidence from Polish

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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 interpretations, differing on when the state of the complement is understood to hold, i.e. Kalina's sickness precedes the time of Eric's thinking (backward-shifted reading), or Kalina is sick at the time of Eric's thinking (simultaneous reading). 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 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 not to be interpreted; and an implicature approach, which links the absence of such a reading to the presence of a "cessation" implicature associated with past tense. We report a series of experiments on Polish, which is commonly classified as a non-SOT language. First, we investigate the interpretation of complement clauses embedded under past-marked attitude verbs in Polish and English. This investigation revealed a difference between these two languages in the availability of simultaneous interpretations for past-under-past complement clauses, albeit not as large as a binary distinction between SOT and non-SOT languages would lead us to expect. We then address the question of whether the lower acceptability we observe for simultaneous readings in Polish might be due to an embedded cessation implicature. On the way to address this question, we show that in simple matrix clauses, Polish gives rise to the same cessation inference as English. Then we investigate 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, are a challenge for the implicature approach, and cast doubts on associating SOT phenomena with implicatures.

Keywords Embedded tense · Cessation implicatures · Experimental evidence · Polish

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1 Introduction

In English, past tense stative clauses embedded under a past-marked attitude verb (e.g., a doxastic verb like 'think' in (1) or a speech report verb like 'say') can receive two possible interpretations. As illustrated in (1), the state of the complement can be understood to hold before the matrix evaluation time (1a), or at the matrix evaluation time (1b).

(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 (1b)—also called Sequence of tense (SOT)—is subject to cross-linguistic variation. That is, while SOT-languages allow for both the backward-SHIFTED and SIMULTANEOUS interpretation, non-SOT languages only allow for the backward-SHIFTED interpretation in a past-under-past configuration like (1) (see e.g. Ogihara 1989, 1995b, 1996; Kusumoto 1999, 2005; Kubota et al. 2009; Ogihara and Sharvit 2012). This cross-linguistic variation has been analysed in two main ways in the literature: A structural approach, which connects the availability of the simultaneous reading in a language to a syntactic mechanism that allows the embedded past morphology not to be interpreted (Ogihara 1995b, 1996; Kusumoto 1999, 2005), and an implicature approach, which links the absence of such a reading to the presence of a "cessation" implicature associated with past tense (Altshuler 2016; Altshuler and Schwarzschild 2013).

     We contribute to this debate by reporting a series of experiments on Polish, which is commonly classified as a non-SOT language (e.g., Kozlowska-Raś 1987; Arregui and Kusumoto 1998; Sadowska 2012; Bittner 2014; Sharvit 2014). In our first experiment (reported in Sect. 4), we investigated the possible interpretations of past-under-past attitude complement clauses, testing the widely held assumption that Polish is a non-SOT language in contrast to English. Previewing the results, this study shows that simultaneous interpretations of past-under-past complement clauses are available in both languages, but they are more restricted in Polish than in English. We then set out to address the question of whether this restriction in Polish might be due to a cessation implicature triggered by the embedded past tense, in the spirit of the proposals sketched in Altshuler and Schwarzschild (2013) and Altshuler (2016). Our second experiment (reported in Sect. 5) sets the stage for this investigation by showing that in Polish, just like in English, in matrix clauses with stative predicates, past tense gives rise to a cessation inference. That is, a past stative clause such as *Jan był w Wielkiej Brytanii* ('John was in the UK') gives rise to the inference that John is currently not in the UK anymore. Finally, in the third experiment (Sect. 7) we tested past-under-past attitude complement clauses 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 inference which would correspond to the cessation implicature under the implicature approach 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, suggest that no cessation implicature

was computed in these past-under-past sentences by our participants. While this result is in line with structural approaches to SOT variation, which expect no similarity between SOT phenomena and implicatures, the general availability of simultaneous readings in Polish as revealed in Experiment 1 supports a more refined view of temporal interpretation in complement clauses beyond the (un)availability of an SOT deletion rule, as advocated, e.g., in Ogihara and Sharvit (2012) and Sharvit (2018). We provide such an analysis for tense in attitude complements in Polish, adopting the proposals that i) tense is pronominal in Polish and English (Sharvit 2014) and ii) the interpretation of embedded past involves a de re mechanism that can derive simultaneous readings in attitude complements (Ogihara and Sharvit 2012; Sharvit 2018). We also maintain that Polish, in contrast to English, does not have an SOT deletion mechanism in its grammar, which accounts for the observed difference in the availability of simultaneous readings of past-under-past between the two languages. Thus, based on novel experimental evidence, we propose to include Polish in the class of languages that show "mixed" behaviour with respect to SOT in complement clauses.

The rest of the paper is organised as follows. In Sect. 2, we discuss the interpretation of past-under-past complement clauses and its cross-linguistic variation and we briefly outline our background assumptions about the semantics of tense. In Sect. 3, we discuss the two approaches to SOT mentioned above in more detail. In Sect. 4, we present our first experiments investigating possible interpretations of past-under-past and present-under-past complement clauses in Polish and in English. Section 5 presents a further study on cessation inferences in matrix clauses. In Sect. 6, we summarize our results thus far and discuss the predictions of the two approaches to SOT. This lays the ground for Sect. 7, where we report an experimental study designed to test these predictions. In Sect. 8 we propose an analysis to account for the results of our experiments. Section 9 concludes the paper and points out some issues for future research.

2 Background

2.1 Sequence of tense and cross-linguistic variation

Languages vary in the availability of simultaneous readings for past-under-past complement clauses. A well-studied case of a language lacking the simultaneous interpretation, and thus being classified as a non-SOT language, is Japanese (Ogihara 1989, 1995b, 1996; Kusumoto 1999, 2005; Kubota et al. 2009; Ogihara and Sharvit 2012). To illustrate, consider the Japanese sentence in (2), which has been reported to only allow 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 that suggest interesting further variation between 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 also marginally allow for simultaneous interpretations for past-under-past (Khomitsevich 2007; Altshuler 2008; Ogihara and Sharvit 2012; Sharvit 2018). In Hebrew, for instance, some speakers also accept sentences like (4) without backward-shifting, as reported in Ogihara and Sharvit (2012: 640).

(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.'

There is also 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 (5a). However, simultaneity of the embedded state with the matrix attitude time can also be expressed with embedded present, as in (5b).

(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 has been claimed to only receive so-called "double access" interpretations under which the embedded state holds both at the matrix attitude time and at the utterance time (see, e.g., Ogihara 1995a; Abusch 1997; Sharvit 2003, but also Altshuler 2016, ch.4, where potential counterexamples from corpora are discussed). Sharvit (2003: 670) illustrates this restriction with the example in (6a), 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 (6b).

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

To conclude this overview on cross-linguistic variation, we point out that the SOT/non-SOT distinction cuts across broader typological differences between tense-systems, as discussed in Bochnak et al. (2019). For instance, we also find SOT variation in languages where tense marking is grammatically optional. To illustrate, consider first the example from Medumba (Grassfields Bantu) 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.[1]

(7)   Past-under-Past in Medumba (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, there are also 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 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)   Past-under-Past in Washo (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 for the moment, 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 restricted. An overview of selected languages in each class is provided in Bošković (2012) and reproduced in (11).

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[1]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).

(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

2.2 Polish as a non-SOT language

In this paper we focus on Polish. While, to the best of our knowledge, SOT phenomena in Polish have never been subject to systematic empirical scrutiny, both the descriptive literature on Polish and the theoretical literature on SOT variation consistently classify Polish as a non-SOT language (see, e.g., Kozlowska-Raś 1987; Vater 1995; Arregui and Kusumoto 1998; Kusumoto 1999; Sadowska 2012; Bittner 2014; Sharvit 2014). For instance, Sharvit (2014: 264) argues that Polish behaves like Japanese in that past-marked complement clauses embedded under past-marked attitude verbs can only be interpreted as backward-shifted, as in (12a), and embedded present must be used for a simultaneous interpretation, as in (12b).[2]

(12)   a. BACKWARD-SHIFTED
           Eryk uważał,   że Kalina była   chora.
           Eryk think.3SG.PAST that Kalina be.3SG.PAST sick
           '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
           'Eryk thought that Kalina was sick (at the time).'

In descriptive works this is sometimes phrased in the style of Jespersen's (1924) original remarks on "tense shifting" in English (e.g. in Sadowska 2012: 460: "The tense of reported speech in Polish stays the same as in the original sentence, unlike in English, where the reported speech involves tense changes"), or as the absence of "tense agreement" ("Polish has neither sequence of tense nor tense agreement rules," Kozlowska-Raś 1987: 176). Formal semantic works that explicitly classify Polish as a non-SOT language include Arregui and Kusumoto (1998: 6) ("Polish, as Japanese, is a non-SOT-language"), Bittner (2014: 230) ("In indirect speech and attitude reports with tensed complements, Polish has no sequence of tense") and, as stated above, Sharvit (2014: 264) ("...past-under-past in [English] can be understood as 'null,' giving rise to the so-called 'simultaneous' reading; ...in Polish and Japanese the 'simultaneous' reading must be expressed with an embedded present"). It is also explicitly stated in the literature that present tense in Polish is relative, in contrast

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[2]Polish shows a perfective-imperfective distinction, i.e. an aspectual contrast. This contrast can be encoded on Slavic verbs by prefixes, secondary imperfectives, and habitual suffixes (Łazorczyk 2010). There is a vast discussion in the literature on the syntax and semantics of aspect in Slavic languages, and Polish in particular (for details, see for example Schuyt 1990; Rozwadowska 2003; Łazorczyk 2010; among many others). In all the reported experiments we controlled for the aspectual interpretation of the embedding and embedded verbs, the details are provided in the materials-section of each experiment. However, an exact analysis of perfective and imperfective interpretation is beyond the scope of this paper.

to the English present tense (see e.g. Bittner 2014: 97). This is particularly relevant since Altshuler and Schwarzschild (2013) and Altshuler (2016, Chap. 5) hypothesize that in languages with a relative present tense, past tense on stative predicates gives rise to cessation implicatures in embedded clauses, providing evidence from Hebrew and Russian.

Thus, available descriptions of embedded tense in Polish lead us to expect that Polish displays the properties typical of non-SOT languages in complement clauses, i.e. that past-under-past stative attitude complements can only be interpreted as backward-shifted and that present-under-past is used to express simultaneity. The ideas advanced by Altshuler and Schwarzschild (2013: 54) suggest that in languages with these properties, the lack of simultaneous interpretations for past-under-past sentences might be due to a cessation implicature. In the empirical parts of this paper, we expose both the non-SOT classification of Polish and the proposal of embedded cessation implicatures to empirical scrutiny. The results indicate that simultaneous readings are in fact available for past-under-past attitude constructions in Polish, but more restricted than in English (Sect. 4). Moreover, the results suggest that while cessation inferences arise in past-marked matrix clauses in Polish and English alike (Sect. 5), a cessation implicature as proposed by Altshuler and Schwarzschild (2013) could not be detected in embedded clauses (Sect. 7). Thus it might not be the source of the restriction on embedded simultaneous readings in Polish. Before we report on our experiments however, let us first briefly outline some relevant background assumptions about the semantics of tense and formal approaches to SOT phenomena.

2.3 The semantics of tense

In the semantic literature on temporal reference, there are two main approaches to the formal implementation of tense, the quantificational approach and the pronominal approach. In this background section, we sketch variants of both these approaches, for the following reason: one empirical goal of our study is to investigate whether evidence can be obtained for embedded cessation implicatures in Polish past-under-past attitude complement clauses. This is inspired by the particular proposal put forward by Altshuler and Schwarzschild (2013) and Altshuler (2016), which works with a quantificational approach to tense. Moreover, the existential interpretation that is built into the semantics of (past) tense under this approach is a crucial component to the derivation of the relevant implicature. Given that our experimental investigation yielded no evidence for such an embedded implicature in Polish (see Sect. 7), we ultimately adopt a pronominal analysis of embedded tense (see Sect. 8).

Let us consider the quantificational approach first, in a version that draws on Ogihara (1989, 1995b, 1996), Kusumoto (1999, 2005), von Stechow (2009); among others. Under this type of analysis, past tense is associated with an existential 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) $[\![\text{PAST}]\!]^{g,c} = \lambda p.\lambda t.\lambda w. \exists t'[t' \prec t \wedge p(t', w)]$

In turn, a past-marked sentence like *Kalina was sick* is associated with the truth-conditions in (14) (where t_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) $[\![\text{Kalina was sick}]\!]^{g,c} = \lambda w.\exists t[t \prec t_c \wedge \text{sick}(\text{kalina}, t, w)]$

Following, for instance, Altshuler and Schwarzschild (2013), the present tense can also be viewed as quantificational, with the semantics in (15). For the present tense sentence *Kalina is sick*, this 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) $[\![\text{PRES}]\!]^{g,c} = \lambda p.\lambda t.\lambda w.\exists t'[t' = t \wedge p(t', w)]$

(16) $[\![\text{Kalina is sick}]\!]^{g,c} = \lambda w.\exists t[t = t_c \wedge \text{sick}(\text{kalina}, t, w)]$

Under this approach, a past-under-past sentence like (1) above, repeated below in (17), can have the LF in (18). With the semantics of doxastic attitude verbs given in (19), we thus derive the truth-conditions in (20), where bel(eric, w, t) represents the set of world-time pairs compatible with Eric's beliefs in world w at time t. (20) expresses the backward shifted reading conveying that 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) $[\![\text{believe/think}]\!]^{g,c} = \lambda p_{\langle i, \langle s, t \rangle \rangle}.\lambda x_e.\lambda t_i.\lambda w_s.\forall \langle w', t' \rangle \in \text{bel}(x, w, t), p(w', t')$
      (with BEL(x,w, t) the set of world-time-pairs compatible with what x believes in w at t)

(20) $[\![\text{Eric thought that Kalina was sick}]\!]^{g,c} =$
      $\lambda w.\exists t[t \prec t_c \wedge \forall \langle w', t' \rangle \in \text{bel}(\text{eric}, w, t), \exists t''[t'' \prec t' \wedge \text{sick}(\text{kalina}, w', t'')]]$

As noted above, the quantificational analysis represents just one of two popular approaches to tense semantics. Under an alternative account based on the works of Partee (1973), Heim (1994), Kratzer (1998), Matthewson (2006) and others, tense has a "pronominal" semantics. More precisely, tense denotes an indexed pronoun corresponding to the reference time (in the sense of Reichenbach 1947), and the reference of this pronoun is restricted by a presupposition. For illustration, the semantics of a pronominal past tense is given in (21).

(21) $[\![\text{PAST}_i]\!]^{g,c}$ is defined only if g(i) < t_c, if defined,
      $[\![\text{PAST}_i]\!]^{g,c} = $ g(i)

While according to traditional wisdom, quantificational and pronominal approaches account equally well for the core observations on tense in English given certain auxiliary assumptions, some works argue that languages vary in whether they have quantificational or pronominal tenses, or even both (see e.g. Ogihara and Sharvit 2012; Sharvit 2014; Mucha 2015, 2017; Chen et al. 2021). For the purposes of this paper the most relevant questions are i) whether tense in Polish should be considered pronominal or quantificational and ii) what implications a pronominal analysis would have regarding the analysis of SOT in complement clauses. As for ii), much recent literature assumes that the issue of quantificational vs. pronominal tense is in principle orthogonal to the issue of SOT variation (e.g. Sharvit 2018; Bochnak et al. 2019). For instance, while SOT deletion as a structural mechanism to derive simultaneous read-

ings was famously proposed by Ogihara (1995b, 1996) in a quantificational framework, subsequent works such as Sharvit (2014) and Bochnak (2016) refer to the same SOT deletion mechanism to account for simultaneous readings under a pronominal analysis.

Moreover, Sharvit (2014) provides one of the few formally explicit analyses of tense in Polish that we are aware of. In her proposal, Polish patterns with English in that it has pronominal tenses, in contrast to Japanese, where tense is argued to be quantificational.[3] At the same time, Polish is assumed to pattern with Japanese in that it does not allow simultaneous readings of past-under-past in complement clauses and thus does not have an SOT deletion rule in its grammar, in contrast to English. Thus, Sharvit (2014) agrees with much previous literature (e.g. Kozlowska-Raś 1987; Vater 1995; Arregui and Kusumoto 1998; Sadowska 2012; Bittner 2014; see Sect. 2.2) that Polish differs from English in that it is a non-SOT language, but this difference is independent of the variation between pronominal and quantificational tense, since in her analysis both English and Polish have pronominal tenses. In this paper, we do not aim to offer any new arguments pertaining to the choice between a pronominal or quantificational tense analysis as such. We note that the vast majority of accounts of cross-linguistic variation in SOT phenomena work on the assumption of a uniform (quantificational or pronominal) semantics of past tense, apparently presuming either that one approach is preferable to the other, or that possible variation in this respect will not affect SOT contrasts. This includes pertinent accounts of SOT variation such as Arregui and Kusumoto (1998) and Kusumoto (1999), which consider Polish at least in passing as an example of a non-SOT language and assume a unified quantificational semantics for past tense. Crucially, it also includes the analyses proposed in Altshuler (2016) and Altshuler and Schwarzschild (2013), which do not discuss Polish in particular, but sketch an implicature approach to SOT variation based on a quantificational analysis of tense.

This being said, we ultimately follow Sharvit (2014) in assuming a pronominal semantics for tense in Polish and English, and propose an analysis in this framework that accounts for the results of our experiments (see Sect. 8). In our final remarks (Sect. 9), we briefly resume the issue of whether and how the pronominal/quantificational meaning of tense in a language might correlate with its (non-)SOT properties.

In the next section, we briefly summarise the main assumptions of the structural and the implicature approach to SOT. Here we refer to the concrete implementations in Ogihara (1995b, 1996) and Altshuler and Schwarzschild (2013), respectively, both of which work with a quantificational analysis of tense.

3 Two approaches to Sequence of tense

3.1 The structural approach

Two important theoretical challenges in analysing SOT phenomena are the issues of how to derive the simultaneous interpretation of past-under-past complement clauses

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[3]The argument for cross-linguistic variation in pronominal vs. quantificational tense semantics is based on the observation that past tense is acceptable in *before*-clauses in English and Polish, but not in Japanese. We refer the reader to Sharvit (2014) for details.

and the associated cross-linguistic variation, i.e. the fact that this interpretation is not equally available in all languages. The structural approach attributes simultaneous readings of past-under-past complement clauses to an optional tense deletion rule.

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 (22), from Ogihara (1995b):[4]

(22)   **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 (22), the structural approach can generate an additional LF for (1) (repeated below in (23)), namely (24), where the embedded PAST operator is deleted and hence not interpreted. Interpreting (24) gives rise to the truth-conditions in (25), conveying that the time of Kalina's sickness overlaps with Eric's thinking time.

(23)   Eric thought that Kalina was sick.

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

(25) $[\![$Eric thought that Kalina was sick$]\!]^c =$
        $\lambda w.\exists t[t \prec t_c \wedge \forall \langle w', t' \rangle \in \mathsf{bel}(\mathsf{eric}, w, t), \mathsf{sick}(\mathsf{kalina}, w', t')]$

In other words, in languages like English, the structural approach generates two possible LFs for (23) 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 (25) and the shifted reading in (20).

This approach deals with the cross-linguistic variation associated with the availability of the simultaneous reading by assuming that the grammar of non-SOT languages simply lacks this rule. Assuming that Polish is a non-SOT language (see Sect. 2.2), the sentence corresponding to (23) in Polish, (12a), can only express the backward-shifted reading.

3.2 The implicature approach

Under the implicature approach, sentences like (23) are only associated with the backward-shifted truth conditions. An (apparent) simultaneous reading in English would arise from the absence of a temporal implicature that is incompatible with this reading (and that arises in other languages).[5]

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[4]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 and 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.

[5]In Altshuler and Schwarzschild (2013: 54) and Altshuler (2016: 137), this is formulated somewhat more cautiously in the "simultaneity conjecture" reproduced in (i), which is accompanied by the statement that, in light of their observations about the distribution of cessation implicatures, the authors have begun to wonder whether there truly is a simultaneous reading.

Before moving to sketch this approach, let us briefly introduce the notion of implicatures in general. The main idea, going back to Grice's (1975) seminal work, is that rational interactions in communication are guided by general principles of cooperation. In particular, the premise 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. 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 she 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 scalar implicatures should be considered to be part of the compositional make up of meaning and 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, 2013; Fox 2007; Magri 2010; Meyer 2013; Bar-lev 2018; 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 (26) and that of the excludable alternatives in (27): essentially EXH negates all alternatives that are logically stronger than the assertion.[6]

(26) $[\![\text{EXH}]\!]^{c,w} = \lambda p[p(w) \wedge \forall q \in Excl(p)[\neg q(w)]]$

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

To illustrate how EXH works with an example, consider the disjunctive sentence in (28a), which is well-known to give rise to the scalar implicature in (28b).

(28)   a.   Kalina or Alex are sick.
         b.   ⤳ *Kalina and Alex are not both sick*

The way this implicature is derived is by assuming that (28a) has the corresponding conjunctive alternative among its alternatives. That is, the relevant alternatives for EXH are those in (29).[7]

(29) $Alt((28a)) = \{$Kalina or Alex are sick, Kalina and Alex are sick$\}$

(i)   Simultaneity conjecture
        It is the perception of the absence of a cessation implicature that is reported as "simultaneity" for
        PAST statives embedded under attitude predicates.

[6]This is a simplification but it will be enough for our purposes; see Fox (2007) among others for discussion.

[7]Generally also the single disjuncts are included, we omit them here for simplicity; see Sauerland (2004), Katzir (2007) for discussion.

In addition, (28a) is assumed to be parsed with an EXH, giving rise to the truth-conditions in (30): either Kalina or Alex are sick, but not both of them are.

(30) $[\![\text{EXH}[\text{Kalina or Alex are sick}]\!]^c =$
      $\lambda w.\exists t[t = t_c \wedge (\text{sick}(\text{kalina}, w, t) \vee \text{sick}(\text{alex}, w, t))]\wedge$
      $\neg\exists t[t = t_c \wedge (\text{sick}(\text{kalina}, w, t) \wedge \text{sick}(\text{alex}, w, t))]$

To illustrate the implicature approach to (non-)SOT, let us start from the cessation implicature of simple past matrix sentences. We will use the implementation in Altshuler and Schwarzschild (2013) and Altshuler (2016), which has been extended to account for SOT phenomena.

Consider the observation that a simple sentence like (31) 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.

(31) $[\![\text{Kalina was sick}]\!]^c = \lambda w.\exists t[t \prec t_c \wedge \text{sick}(\text{kalina}, w, t)]$

(32) $[\![\text{Kalina is sick}]\!]^c = \lambda w.\exists t[t = t_c \wedge \text{sick}(\text{kalina}, w, t)]$

Altshuler and 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 (31) and (32) are logically independent. However, Altshuler and Schwarzschild (2013) argue that the latter actually entails the former once (33) 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.

(33) **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 (33), then it follows that (32) is stronger than (31): this is because if Kalina is sick at the utterance time, then on the basis of (33), there must be a moment prior to that time at which Kalina is sick. This automatically makes (31) true.

Altshuler and Schwarzschild (2013) and Altshuler (2016) hypothesize that this reasoning extends to embedded tense in languages with a relative present tense, such as Hebrew or Russian. Following the previous literature cited in Sect. 2, we start from the assumption that Polish also belongs to the class of languages (i.e. non-SOT languages) for which this hypothesis is relevant.

Thus in Polish, a sentence like (12a), repeated in (34), would compete with its corresponding present tense counterpart (12b), repeated in (35). In addition, given (33), the latter is stronger than the former.

(34) a. Eryk uważał, że Kalina była chora.
          'Eryk thought that Kalina was sick.'
      b. $[\![\text{Eryk thought that Kalina was sick}]\!]^c =$
          $\lambda w.\exists t[t \prec t_c \wedge \forall \langle w', t' \rangle \in \text{bel}(\text{eric}, w, t),$
          $\exists t''[t'' \prec t' \wedge \text{sick}(\text{kalina}, w', t'')]]$

(35) a. Eryk uważał, że Kalina jest chora.
'Eryk thought that Kalina is sick.'

b. ⟦Eryk thought that Kalina is sick⟧^{c} =
$\lambda w.\exists t[t \prec t_c \wedge \forall\langle w', t'\rangle \in \mathsf{bel}(\mathsf{eric}, w, t),$
$\exists t''[t'' = t' \wedge \mathsf{sick}(\mathsf{kalina}, w', t'')]]$

When we consider the implicatures of (34), the resulting meaning is indicated in (36): 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.

(36) ⟦EXH[Eric thought that Kalina was sick]⟧^{c} =
$\lambda w.\exists t[t \prec t_c \wedge \forall\langle w', t'\rangle \in \mathsf{bel}(\mathsf{eric}, w, t), \exists t''[t'' \prec t' \wedge \mathsf{sick}(\mathsf{kalina}, w', t'')]] \wedge$
$\neg\exists t[t \prec t_c \wedge \forall\langle w', t'\rangle \in \mathsf{bel}(\mathsf{eric}, w, t), \exists t''[t'' = t' \wedge \mathsf{sick}(\mathsf{kalina}, w', t'')]]$

This approach deals with the cross-linguistic variation associated with the availability of the simultaneous reading by assuming that the present tense in 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. Under this reading, 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 (35b) in (37) is false, which in turn ensures that is not a suitable competitor for (34b). Therefore, in English, the only possible truth conditions of the sentence are those corresponding to the backward shifted meaning in (20), which are compatible with a situation in which Kalina's sickness overlaps with Eric's thinking time.

(37) Eric thought that Kalina is sick.

In this sense, the lack of the implicature is what gives the impression of a simultaneous reading and what differentiates SOT languages from non-SOT languages. In other words, the cross-linguistic variation under the implicature view lies in the question of whether present-under-past can serve as a genuine competitor for the corresponding past-under-past sentence or not. In non-SOT languages it can serve that role and thereby a cessation implicature arises. In 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. For that, the cessation implicature does not arise. 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.[8] This concludes our introduction of the structural approach and the implicature approach to simultaneous interpretations of past-under-past complement clauses. In the next section, as a first step in our investigation of past-under-past sen-

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[8]We reproduce here the general reasoning of the implicature approach to SOT variation and in doing so simplify the discussion of present tense in English. We refer the reader to Altshuler (2016, Chap. 4) for details of the analysis as well as a lexical entry for the English present that captures double access under a quantificational approach to tense.

tences in Polish, we present an experiment testing to what extent these interpretations are available in Polish, in comparison to English.

4 Experiment 1: Sequence of tense in complement clauses

We ran an accuracy judgment task to test whether Polish differs from English with respect to the availability of the simultaneous interpretation of past-under-past complement clauses. In particular, we tested (i) whether past-under-past complement clauses receive a simultaneous interpretation in Polish at all, and (ii) whether such interpretation is available less often than in English. In order to do this, we asked Polish native speakers and English native speakers to rate past-under-past sentences in their respective languages in different contexts. In particular, we asked them to rate past-under-past sentences like (38) or (39), in contexts which forced a simultaneous interpretation.

(38)   Emma said that Milo was sick.

(39)   Kalina powiedziała, że   Eryk był   chory.
         Kalina say.3SG.PAST that Eryk be.3SG.PAST sick
         'Kalina said that Eryk was sick.'

If Polish is a non-SOT language, as claimed in the literature, we expect the ratings of Polish speakers in this condition to be quite low and much lower than the English speakers in the corresponding condition. More precisely, the main questions we are investigating in this experiment are: (i) whether past-under-past complement clauses in Polish receive a simultaneous interpretation less often than in English, and (ii) whether such interpretation of those sentences in Polish is available at all.

4.1 Methods

4.1.1 Participants

We tested 33 native speakers of Polish (10 female, 23 male, mean age: 23, age range: 18–45) living in Poland and 33 native speakers of British English living in the UK (26 female, 7 male, mean age: 33, age range: 18–64), a total of 66 participants. 58 of those participants have a high-school degree or higher (30 Polish native speakers and 28 English native speakers); 1 Polish native speaker participant didn't answer this question. All Polish participants reported that they can speak English and 10 of them reported further knowledge of at least one more foreign language (Italian, German, French, Dutch, Spanish, Japanese or Russian). As for English native speaker participants, 7 of them reported knowledge of at least one foreign language (German, Italian, Spanish, Gujarati, Hindi or Panjabi). 3 participants were excluded from the analysis due to not answering correctly at least 75% (27/36) of the control-trials, leaving 63 participants for data analysis. All the participants were recruited via the online platform Prolific and they were compensated £4 for their participation.

Fig. 1 An example of a target item as seen by the participants in the English version of the experiment

4.1.2 Procedure

The participants were asked to imagine they are talking over the phone to their friend Ben, who is telling them gossip about their common friends. They were presented then with two sentences. The first sentence shows what their common friends said to Ben and the second sentence shows what Ben told the participants over the phone. The participants' task was to judge the accuracy of Ben's report on a scale from 1 to 7: 7 means that his report is fully accurate and 1 means that his report is totally inaccurate. An example of a target item as seen by the participants is presented in Fig. 1. 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 15 minutes to complete.

4.1.3 Materials

We manipulated three factors in the experiment: *tense* (present vs. past), *context* (shifted vs. simultaneous), and *language* (English vs. Polish). *Tense* refers to the tense form used in the indirect speech/attitude report in the target sentence. *Context*, on the other hand, refers to the tense used in the direct speech presented in the context, with past intended to trigger a shifted reading and present a simultaneous one.[9] Manipulating these factors gives rise to the following four types of target items across the two languages:

(40)   SHIFT PAST:
        Last week, Emma said to Ben: 'Milo was sick.'
        BEN'S REPORT:
        Emma said that Milo was sick.

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[9]This design, simple as it is, reflects how SOT variation in complement clauses is commonly described in the literature, i.e. variation in whether or not a past-under-past complement clause can be used to report a simultaneous attitude or speech report, as in (42).

(41)   SHIFT PRESENT:
       Last week, Emma said to Ben: 'Milo was sick.'
       BEN'S REPORT:
       'Emma said that Milo is sick.'

(42)   SIMULTANEOUS PAST:
       Last week, Emma said to Ben: 'Milo is sick.'
       BEN'S REPORT:
       'Emma said that Milo was sick.'

(43)   SIMULTANEOUS PRESENT
       Last week, Emma said to Ben: 'Milo is sick.'
       BEN'S REPORT:
       'Emma said that Milo is sick.'

Polish version:

(44)   SHIFT PAST:
       W zeszłym tygodniu Kalina powiedziała: 'Eryk był   chory.'
       in last   week   Kalina say.3SG.PAST Eryk be.3SG.PAST sick
       Last week Kalina said: 'Eryk was sick.'

       BEN'S REPORT:

       Kalina powiedziała, że   Eryk był   chory.
       Kalina say.3SG.PAST that Eryk be.3SG.PAST sick
       'Kalina said that Eryk was sick.'

(45)   SHIFT PRESENT:
       W zeszłym tygodniu Kalina powiedziała: 'Eryk był chory.'
       in last week Kalina say.3SG.PAST Eryk be.3SG.PAST sick
       Last week Kalina said: 'Eryk was sick.'

       BEN'S REPORT:

       Kalina powiedziała, że   Eryk jest   chory.
       Kalina say.3SG.PAST that Eryk be.3SG.PRES sick
       'Kalina said that Eryk is sick.'

(46)   SIMULTANEOUS PAST:
       W zeszłym tygodniu Kalina powiedziała: 'Eryk jest   chory.'
       in last   week   Kalina say.3SG.PAST Eryk be.3SG.PRES sick
       Last week Kalina said: 'Eryk is sick.'

       BEN'S REPORT:

       Kalina powiedziała, że   Eryk był   chory.
       Kalina say.3SG.PAST that Eryk be.3SG.PAST sick
       'Kalina said that Eryk was sick.'

(47)   SIMULTANEOUS PRESENT
       W zeszłym tygodniu Kalina powiedziała: 'Eryk jest   chory.'
       in last   week   Kalina say.3SG.PAST Eryk be.3SG.PRES sick
       Last week Kalina said: 'Eryk is sick.'

BEN'S REPORT:

Kalina powiedziała, że Eryk jest chory.
Kalina say.3SG.PAST that Eryk be.3SG.PRES sick
'Kalina said that Eryk is sick.'

Two types of embedding verbs were used in the Polish target sentences (Ben's reports): *powiedział/a* 'tell' and *stwierdził/a* 'claim' (in half of the items each) which were marked for perfective aspect. As for the embedded verbs, in all three experiments, these are stative predicates. Therefore they are all in the imperfective form, as the perfective form either does not exist or it induces a change in meaning (e.g. inchoative, see e.g., Rozwadowska 2003 on the interpretation of stative predicates in Polish.)

Along with the 24 target items, the participants also received 36 filler items, 18 of which were designed to elicit clearly accurate reports (eliciting the responses from the upper part of the scale, i.e., 4–7) and 18 clearly non-accurate reports (eliciting the responses from the lower part of the scale, i.e., 1–3). The filler items also served as controls to exclude from the analysis any participants that did not pay enough attention to the task.

(48) GOOD CONTROL:
At this very moment, Evelyn is saying to Ben: 'Maya is a doctor.'
BEN'S REPORT:
'Evelyn says that Maya is a doctor.'

(49) BAD CONTROL:
At this very moment, Archie is saying to Ben: 'Ada is at work.'
BEN'S REPORT:
Archie claims that Ada is not at work anymore.

Polish version:

(50) GOOD CONTROL:
Hania właśnie mówi: 'Karol jest lekarzem'.
Hania just say.3SG.PRES Karol be.3SG.PRES doctor
'Hania is just saying that Karol is a doctor.'

BEN'S REPORT:

Hania mówi, że Karol jest lekarzem.
Hania say.3SG.PRES that Karol be.3SG.PRES doctor
'Hania says that Karol is a doctor.'

(51) BAD CONTROL:
Franciszek właśnie mówi: 'Jagoda jest w pracy'.
Franciszek just say.3SG.PRES Jagoda be.3SG.PRES at work
'Franciszek is just saying that Jagoda is at work.'

BEN'S REPORT:

Franciszek twierdzi,   że nie ma   już   Jagody w
Franciszek claim.3SG.PRES that NEG have.3SG.PRES already jagoda at
pracy.
work
'Franciszek claims that Jagoda is not at work anymore.'

As in the target items, also in the filler items two types of embedding verbs were used in the target sentences in half of the items: *mówi* 'say' and *twierdzi* 'claim.'[10]

Summing up, each participant received in total 24 target items and 36 fillers (18 good and 18 bad). All the items had unique lexicalizations which were distributed over 4 lists in a Latin square design in randomised order. A list of items is provided in Appendix A.

4.2 Results

Figure 2 below shows the proportion of each response across the conditions and languages. The mean acceptability rate in the target conditions is displayed in Fig. 3. Participants across the two languages appear to accept the simultaneous reading of past tense, though they do so less in Polish than in English.

To analyse this statistically, we compared the SIM PAST and SIM PRES conditions across the two languages. In particular, we fitted an ordinal mixed effects model using the ordinal package in R, with Condition (SIM PAST vs. SIM PRES) and Language as fixed effects, and random by-participant and by-item intercepts, as well as by-participant random slopes for Condition. We then used χ^2 statistics with one degree of freedom to compare models with and without the fixed effects, which revealed a significant effect of Condition ($\chi^2(1) = 16.45$, $p < .001$), a marginally significant effect of language ($\chi^2(1) = 4.09$, $p = .07$), and, most importantly, a significant interaction between Condition and Language ($\chi^2(1) = 6.91$, $p < .01$). In addition, restricting the comparison to the SIM PAST reading across the two languages with an ordinal model with Language as fixed effect and by-participant and by-item random intercepts, reveals a significant effect of Language ($\beta = -1.46$, $z = -3.67$, $p < .001$), confirming the difference in availability of this reading across English and Polish.

On the other hand, the two languages do not differ on the corresponding comparison with the SIM PRES reading ($\beta = 0.2$, $z = 0.3$, $p = .7$).[11] Overall, these results suggest that participants allowed simultaneous interpretations of past-under-past complement clauses in both languages, but more so in English than in Polish.[12]

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[10]Note that while in the target items all embedding verbs are in past tense and perfective aspect in Polish, in the control items, all embedding verbs are in present and in imperfective aspect, which causes the differences in the form.

[11]This does not necessarily mean that embedded present behaves the same in the two languages. Recall that, according to many previous works, present-under-past in English gives rise to double access rather than purely simultaneous readings. However, our experiment was not designed to distinguish between these; see Sect. 8 for further discussion.

[12]Finally, for completeness, we also compared the SHIFT conditions across languages with an ordinal model fitted to the data restricted to those two conditions, with the same fixed effects and ran-
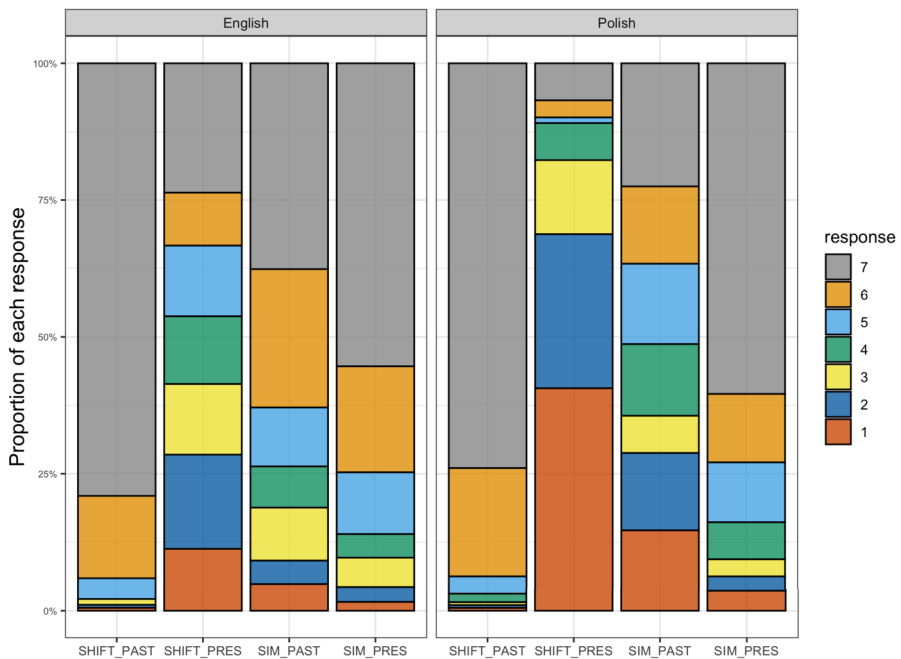
Fig. 2 Proportion of each response type across conditions, with 1 representing low acceptability and 7 high acceptability

4.3 Discussion

We investigated the possible interpretations of past-under-past complement clauses in Polish, and compared them to their English counterparts. The two main questions we wanted to address in particular were whether Polish allowed a simultaneous interpretation of such sentences less than English, and whether it allowed it at all. In our results we did find, as claimed in the literature, that when speakers of Polish are forced to interpret past-under-past sentences with a simultaneous interpretation, they rate them lower than English speakers rate the corresponding English sentences. We also found, however, that a simultaneous interpretation is available in Polish as well, albeit less.

So far we have been working against the background of a general distinction between SOT and non-SOT languages, with Polish belonging to the non-SOT class. The experimental results show however that simultaneous interpretations seem to be

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dom effects structure as above. Model comparison as before revealed significant effects of Condition ($\chi^2(1) = 132.68$, $p < .001$) and Language ($\chi^2(1) = 15.37$, $p < .001$), and a significant interaction between Condition and Language ($\chi^2(1) = 8.23$, $p < .001$). SHIFT PAST was at the same rate across the two languages ($\beta = -0.5$, $z = -0.9$, $p = .3$), while, surprisingly, the SHIFT PRES reading was more acceptable in English than in Polish ($\beta = -2.38$, $z = -5.3$, $p < .001$). It is not entirely clear to us why this increased acceptability of the latter reading in English, but we briefly discuss a possible explanation in Sect. 8.
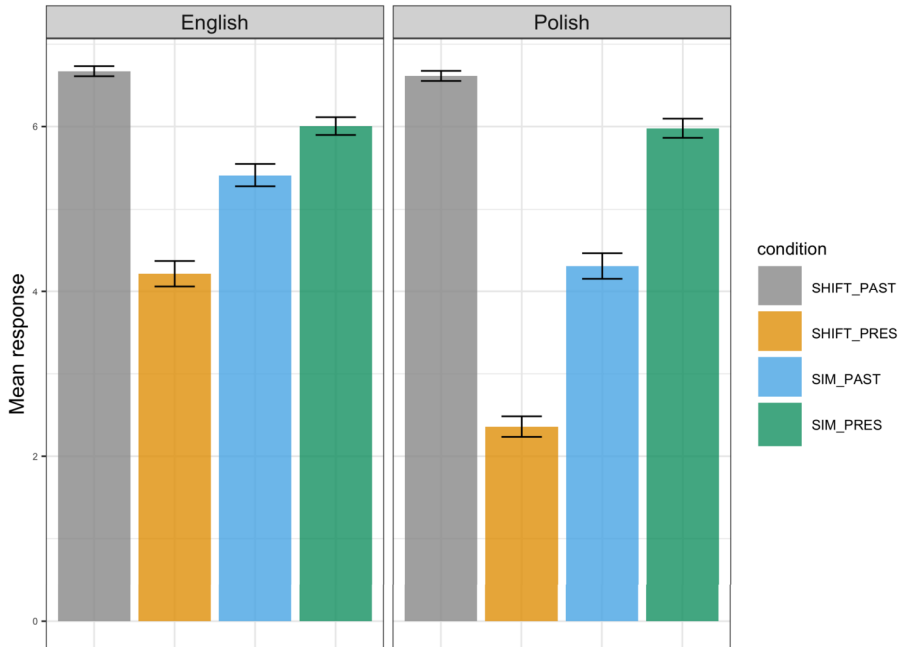
Fig. 3 Mean response across conditions

available in Polish, albeit more restricted than in English.[13] While available descriptions of temporal interpretation of Polish attitude complement clauses consistently classify Polish as a non-SOT language with regard to these constructions, previous works on SOT variation have established that the binary SOT/non-SOT distinction turns out to be too simplistic to capture the actual range of cross-linguistic variation. As stated in our introductory sections, the contrast between SOT and non-SOT languages has commonly been described by example of English (SOT) and Japanese (non-SOT). For our purposes, the central empirical difference between these two languages is that only English allows simultaneous interpretations for past-under-past attitude complements. It has been noted however that some languages do not neatly fit into this dichotomy as they display somewhat inconsistent or "mixed" behaviour. According to Ogihara and Sharvit (2012), Hebrew, for instance, patterns with Japanese in that simultaneous interpretations in attitude complements are canonically expressed with present-under-past. Unlike Japanese, however, simultaneous interpretations are also marginally available for past-under-past sentences for some Hebrew speakers. Ogihara and Sharvit (2012) propose an analysis of this variation that derives simultaneous readings of past-under-past in Hebrew by means of a restricted de

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[13]We would like to acknowledge that it was an anonymous reviewer who first made the observation that simultaneous interpretations seem to be available in Polish, and prompted us to investigate this systematically.

re mechanism (i.e. res movement, Heim 1994),[14] which allows the embedded past to be interpreted deictically and possibly coincide with the time denoted by the matrix past.

Similar proposals have been made with regard to Russian. Khomitsevich (2007: 90) argues that "simultaneous past in Russian is not as ubiquitous as it is in English, but it is not impossible" and in her analysis she proposes that "in Russian, only a de re simultaneous past is present, while in English, an additional mechanism seems to be at work" (2007: 90). Khomitsevich also notes that the interpretation of past-under-past complement clauses in Russian depends on the embedding verb, with perception verbs as well as factive verbs allowing for simultaneous readings more easily than belief or speech report verbs. Grønn and von Stechow (2010) suggest that this variation is expected to a certain extent, since the semantics of these verbs facilitate or even require a de re construal of the embedded tense.

Similar to Khomitsevich (2007), Grønn and von Stechow (2010) argue that Russian, as opposed to English, is a non-SOT language in that its grammar does not provide the mechanism that systematically derives a simultaneous reading for past-under-past complements (i.e. temporal binding in their analysis as well as in Khomitsevich's). In reaction to observations presented in Altshuler (2008), they concede however that embedded imperfective predicates in Russian can sometimes receive a simultaneous interpretation, and they offer the following explanatory approach: "We have backward shifting in the embedded clause. But since the VP expresses a progressive state and the topic time is in the time of the state, the state might continue at the 'subjective now'... This gives us the feeling that the reading is simultaneous" (Grønn and von Stechow 2010: 137). Interestingly, this looks very similar to what pragmatic approaches (Altshuler and Schwarzschild 2013; Altshuler 2016; see also Gennari 2003) propose for English. Hence, since Grønn and von Stechow (2010) adopt a purely structural approach that makes no reference to embedded cessation implicatures, the "illusion" of a simultaneous reading is expected in non-SOT languages as well (although it should be noted that any variation between Russian and Japanese would remain unaccounted for).

In sum, several structural approaches to SOT variation in complement clauses acknowledge that non-SOT languages differ in the availability of simultaneous readings for past-under-past. For languages in which simultaneous readings are marginally possible, such as Hebrew or Russian, structural accounts however still assume that these languages differ from English in that they lack an SOT licensing rule or similar, and thus maintain a categorical difference between SOT and non-SOT languages on a theoretical level.

The results of our experiment suggest that Polish patterns with Russian and Hebrew in that simultaneous interpretations are available for past-under-past, but more restricted than in English. This result is prima facie compatible with both the structural and the implicature approach; the observed difference between Polish and English might be explained in two different ways: i) English has an SOT deletion mech-

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[14]Sharvit (2018) provides another analysis of temporal de re as a secondary mechanism to derive simultaneous readings, using time concept generators and thereby avoiding the well-known problems of syntactic res movement. In our own analysis presented in Sect. 8, we will adopt a version of Sharvit's concept generator analysis.

anism that derives simultaneous readings relatively freely. In Polish, simultaneous interpretations could only be "illusions" arising from non-cessation or accidental simultaneous readings arising from a de re LF, and are therefore more restricted. ii) English, just like Polish, does not have an SOT deletion mechanism and therefore has no truly simultaneous readings. Perceived simultaneous interpretations of past-under-past are "illusions" arising from non-cessation of the embedded stative predicate. In Polish, the embedded past stative clause gives rise to a cessation implicature and this cessation implicature is the reason for lower acceptability ratings in Polish than in English. The interpretation in i) refers to ideas presented in structural analyses of SOT variation; ii) is in the spirit of the implicature approach.

With regard to ii), it is worth noting that Altshuler and Schwarzschild (2013) and Altshuler (2016) use examples from Hebrew and Russian, respectively, to illustrate how cessation implicatures might account for the lack of simultaneous interpretations of past-under-past attitude complements. It therefore seems plausible to assume that these ideas should be transferable to Polish also in light of the results reported above. In Sect. 7, we present an experiment testing Polish past-under-past complement clauses in positive and negative contexts, and argue that the outcome discourages an analysis that makes reference to an embedded cessation implicature in Polish. In order to prepare this argument, in the next section we provide evidence that in Polish, just like in English, past tense stative clauses give rise to a cessation inference.

5 Experiment 2: Cessation in matrix clauses

In this experiment, we used an inference task to test whether Polish simple past sentences such as (52) give rise to the cessation inference suggesting that John is not in the UK anymore. In order to do that, we asked Polish speakers to rate how much they would conclude this inference from sentences like (52) and we compared the rate of the corresponding inference given by speakers of English with respect to sentences like (53).

(52) Jan był   w Wielkiej Brytanii.
      Jan be.3SG.PAST in Great   Britain
      'Jan was in the UK.'

(53) John was in the UK.

The main question we investigate in this experiment is whether drawing cessation inferences from matrix sentences is possible in Polish and how it compares to English. This functions as an important preliminary step towards testing the prediction of the implicature approach vs. the structural approach in Experiment 3.

5.1 Methods

5.1.1 Participants

In this experiment, a total of 162 participants were tested: 82 native speakers of Polish (26 female, 56 male, mean age: 23, age range: 18–53; 1 participant didn't give the

Progress: �

John was in the UK.

Would you conclude from the sentence above that John is not in the UK anymore?

	○ yes	○ no

Submit

Fig. 4 A target item as seen by the participants in the English version of the experiment

answer to these questions) living in Poland and 80 native speakers of British English living in the UK (50 female, 29 male, 1 participant did not answer this question, mean age: 35, age range: 19–64). 73 Polish participants and 71 English participants have a high-school degree or higher; 7 Polish participants didn't answer this question. All of the Polish participants reported knowledge of English and 24 of them reported further knowledge of at least one foreign language (German, Russian, Japanese, Turkish, Spanish or French). As for the English participants, 12 of them reported knowledge of at least one foreign language (French, Spanish, Korean, Russian, Urdu, German or Norwegian). All the participants were recruited via the online platform Prolific and they were compensated £1 for their participation.

5.1.2 Procedure

There were two trials in the experiment: a target and a control. During the trials the participants were presented with a sentence and a question containing a possible conclusion drawn from it. The sentence was the same in both trials but the question varied. Assuming that the sentence is true, the participants' task was to answer (with "yes" or "no") whether they think that the conclusion follows from the sentence. A target item as seen by the participants is presented in Fig. 4. The experiment was conducted 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 2.5 minutes to complete.

5.1.3 Materials

Each participant saw two trials in the experiment: a target and a control with a stative predicate, as presented below for the English and Polish version.

(54) TARGET (English)
      SENTENCE: John was in the UK.
      INFERENCE: Would you conclude from the sentence above that John is not in the UK anymore?

(55) CONTROL
      SENTENCE: John was in the UK.
      INFERENCE: Would you conclude from the sentence above that John was in Manchester?

(56) TARGET (Polish)
      SENTENCE:
      Jan był   w Wielkiej Brytanii.
      Jan be.3SG.PAST in Great   Britain
      'Jan was in the UK.'

      INFERENCE:

      Czy według Ciebie można wywnioskować z powyższego zdania, że Jana nie ma już w Wielkiej Brytanii?
      'Would you conclude from the sentence above that Jan is not in the UK anymore?'

(57) CONTROL
      SENTENCE:
      Jan był   w Wielkiej Brytanii.
      Jan be.3SG.PAST in Great   Britain
      'Jan was in the UK.'

      INFERENCE:

      Czy według Ciebie można wywnioskować z powyższego zdania, że Jan był w Manchesterze?
      'Would you conclude from the sentence above that Jan was in Manchester?'

5.2 Results and discussion

The results are plotted in Fig. 5. As becomes clear from the plots, participants in both languages endorsed the cessation inference target much more than the control baseline, confirming that this inference is present in Polish in matrix sentences just like in English. This impression was confirmed statistically: we fitted a logistic regression mixed effects model with Inference type (cessation vs. baseline) and Language as fixed effects, with by-participant and by-item random intercepts, as well as by-participant random slopes for inference type. Model comparisons revealed a significant effect of inference type ($\chi^2(1) = 241.04$, $p < .001$), no effect of language ($\chi^2(1) = 0.01$, $p = .8$), and a significant interaction ($\chi^2(1) = 0.03$, $p < .05$).

In sum, the results of this second experiment provide evidence that cessation inferences in matrix clauses are robustly available in both languages at similar ratings. Both Polish and English speakers strongly endorsed cessation inferences from simple past sentences and they did so much more than the baseline controls where the candidate inference was merely compatible with the target sentence.
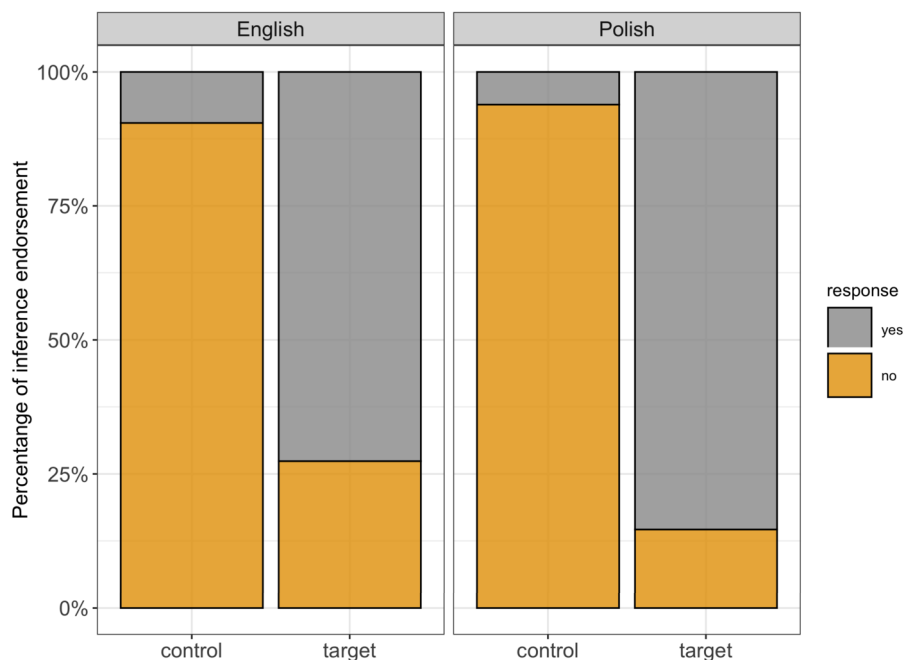
Fig. 5 Inference endorsement across conditions and languages

6 Interim summary and moving forward

The two approaches outlined in Sect. 3 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 mechanism, 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.

This difference in predictions comes from a characteristic property of scalar implicatures, which is their sensitivity to monotonicity. That is, while (28a) conveys (28b), (58) simply conveys that neither Kalina nor Alex are sick, with no implicature.

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

This is captured by a theory of implicature for two reasons. First, the alternatives of (58) are those in (59), 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 (60) is simply vacuous and the meaning predicted is the desired one that neither Kalina nor Alex are sick.

(59) Alt((28a)) = {it's not true that Kalina or Alex are sick, it's not true that Kalina and Alex are sick}

(60) $[\![$EXH[not[Kalina or Alex are sick]]$]\!]^c$ =
         $\lambda w.\neg \exists t[t = t_c \wedge (\text{sick}(k, w, t) \vee \text{sick}(a, w, t))]$

In addition, this approach has to explain why EXH is generally not merged below negation, giving rise to the weaker meaning in (61), which we could paraphrase as either neither Kalina or Alex are sick or both of them are.[15]

(61) $[\![$not[EXH[Kalina or Alex are sick]]]$]\!]^c$ =
         $\lambda w.\neg \exists t[t = t_c \wedge ((\text{sick}(k, w, t) \vee \text{sick}(a, w, t)) \wedge$
         $\neg(\text{sick}(k, w, t) \wedge \text{sick}(a, w, t))]$

The way this is generally accounted for is by restricting the distribution of EXH with a constraint, which prevents it to apply in the scope of negation (Chierchia 2004; Chierchia et al. 2012; Fox and Spector 2018; Enguehard and Chemla 2019). A version of this constraint is the non-weakening constraint in (62).

(62)   **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 (63), where a scalar term is embedded in the scope of an attitude predicate (Chierchia 2004; Sauerland 2004; Russell 2006; Geurts and Pouscoulous 2009; Geurts 2010; Chemla and Spector 2011; among many others).

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

In particular, sentences like (63) 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 (63), this issue translates into the question as to whether (63) 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 corresponds to the strength of Eric's belief about the truth of the negation of the conjunctive alternative.

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[15]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!

Whether there really are two scalar implicatures for a sentence like (63) 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 (61)). To illustrate how these two inferences can be derived as scalar implicatures in the EXH-based approach above, consider the alternatives in (64) 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 (65) and (66).[16] The former corresponds to the weak reading that Eric thinks that Kalina and Alex are sick and is compatible with him not knowing 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.

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

(65) $[\![$EXH[Eric thinks that Kalina or Alex are sick]$]\!]^{g,c} =$
       $\lambda w.\exists t[t = t_c \wedge \forall \langle w', t' \rangle \in \mathsf{bel}(\mathsf{eric}, w, t), (\mathsf{sick}(\mathsf{k}, w', t') \vee \mathsf{sick}(\mathsf{a}, w', t'))] \wedge$
       $\neg \exists t[t = t_c \wedge \forall \langle w', t' \rangle \in \mathsf{bel}(\mathsf{eric}, w, t), (\mathsf{sick}(\mathsf{k}, w', t') \wedge \mathsf{sick}(\mathsf{a}, w', t'))]$

(66) $[\![$Eric thinks EXH[that Kalina or Alex are sick]$]\!]^{g,c} =$
       $\lambda w.\exists t[t = t_c \wedge \forall \langle w', t' \rangle \in \mathsf{bel}(\mathsf{eric}, w, t), (\mathsf{sick}(\mathsf{k}, w', t') \vee \mathsf{sick}(\mathsf{a}, w', t')) \wedge$
       $\neg(\mathsf{sick}(\mathsf{k}, w', t') \wedge \mathsf{sick}(\mathsf{a}, w', t'))]$

When we go back to the possible implicatures of a sentence like (67), and we allow for embedded implicatures, we have two possible sites where EXH can be adjoined: globally, as illustrated above, or in the scope of the attitude predicate.

(67)   Eric thought that Kalina was sick.

The two options give rise to different truth conditions, as indicated in (68) and (69). The former, repeated from above, 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.

(68) $[\![$EXH[Eric thought that Kalina was sick]$]\!]^{g,c} =$
       $\lambda w.\exists t[t \prec t_c \wedge \forall \langle w', t' \rangle \in \mathsf{bel}(\mathsf{eric}, w, t), \exists t''[t'' \prec t' \wedge \mathsf{sick}(\mathsf{k}, w', t'')]] \wedge$
       $\neg \exists t[t \prec t_c \wedge \forall \langle w', t' \rangle \in \mathsf{bel}(\mathsf{eric}, w, t), \exists t''[t'' = t' \wedge \mathsf{sick}(\mathsf{k}, w', t'')]]$

(69) $[\![$Eric thought EXH[that Kalina was sick]$]\!]^{g,c} =$
       $\lambda w.\exists t[t \prec t_c \wedge \forall \langle w', t' \rangle \in \mathsf{bel}(\mathsf{eric}, w, t), \exists t''[t'' \prec t' \wedge \mathsf{sick}(\mathsf{k}, w', t'')] \wedge$
       $\neg \exists t'''[t''' = t' \wedge \mathsf{sick}(\mathsf{k}, w', t''')]]]$

With this background in place we can move to the divergent prediction of the two approaches.

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[16]For simplicity, we omit the semantic contribution of the embedded present tense in (65) and (66) as it is not relevant for us in this context.

To illustrate, consider a positive sentence like (70) first, repeated from above. Under the structural approach, and assuming that Polish does not allow SOT deletion, (70) is associated only with the shifted meaning in (34b), repeated in (71): 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.

(70)   Eryk uważał, że Kalina była chora.
        'Eric thought that Kalina was sick.'

(71) $\lambda w.\exists t[t \prec t_c \wedge \forall\langle w', t'\rangle \in \mathsf{bel}(\mathsf{eric}, w, t), \exists t''[t'' \prec t' \wedge \mathsf{sick}(\mathsf{kalina}, w', t'')]]$

Similarly, when we move to the negative counterpart of (70) in (72), the predicted reading is simply the negation of the shifted reading in (73). 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.

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

(73) $\lambda w.\neg\exists t[t \prec t_c \wedge \forall\langle w', t'\rangle \in \mathsf{bel}(\mathsf{eric}, w, t), \exists t''[t'' \prec t' \wedge \mathsf{sick}(\mathsf{kalina}, w', t'')]]$

In sum, the meaning of past-under-past under the structural approach, even in a non-SOT language, is in principle 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 (74) or as in (75). 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 resulting meaning is *incompatible* with Eric thinking that Kalina was sick at the time of thinking.

(74) $\lambda w.\exists t[t \prec t_c \wedge \forall\langle w', t'\rangle \in \mathsf{bel}(\mathsf{eric}, w, t), \exists t''[t'' \prec t' \wedge \mathsf{sick}(\mathsf{kalina}, w', t'')]]\wedge$
        $\neg\exists t[t \prec t_c \wedge \forall\langle w', t'\rangle \in \mathsf{bel}(\mathsf{eric}, w, t), \exists t''[t'' = t' \wedge \mathsf{sick}(\mathsf{kalina}, w', t'')]]$

(75) $\lambda w.\exists t[t \prec t_c \wedge \forall\langle w', t'\rangle \in \mathsf{bel}(\mathsf{eric}, w, t), \exists t''[t'' \prec t' \wedge \mathsf{sick}(\mathsf{kalina}, w', t'')]\wedge$
        $\neg\exists t'''[t''' = t' \wedge \mathsf{sick}(\mathsf{kalina}, w', t''')]]]$

In the negative case in (72), 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 (73). The implicature approach, however, also adopts the temporal profile of statives in (33). As a consequence, (73) ends up entailing the negation of the present alternative in (76): it's not true that Eric thought that Kalina was sick at the time of thinking. That is, (73) together with (33) is again incompatible with

a simultaneous context in which Eric thought that Kalina was sick at the time of thinking.[17]

(76) $\lambda w.\neg\exists t[t \prec t_c \land \forall\langle w', t'\rangle \in \text{bel}(\text{eric}, w, t), \exists t''[t'' = t' \land \text{sick}(\text{kalina}, w', t'')]]$

To sum up, the structural approach only predicts the shifted reading for non-SOT languages, which however 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 convey 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.

7 Experiment 3: Cessation in past-under-past complement clauses

We investigated the divergent predictions discussed 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 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 (77a) together with its potential cessation inference in (77b).[18] As discussed, only the implicature approach predicts (77b) as an inference of (77a) and therefore only under the implicature approach do we expect endorsement of this inference.

(77)   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 (78a) and the candidate inference in (78b). Under the implicature approach, (78a) contradicts the inference in (78b) (it entails its negation, see), so low inference endorsement is expected in this case.[19] Under the

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[17]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 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) $\lambda w.\neg[\exists t[t \prec t_c \land \forall\langle w', t'\rangle \in \text{bel}(\text{eric}, w, t), \exists t''[t'' \prec t' \land \text{sick}(\text{kalina}, w', t'')]] \land \neg\exists t[t \prec t_c \land \forall\langle w', t'\rangle \in \text{bel}(\text{eric}, w, t), \exists t''[t'' = t' \land \text{sick}(\text{kalina}, w', t'')]]]$

[18]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.

[19]If an implicature is computed under negation, contra the non-weakening principle, the resulting meaning is compatible with (ia). Given that the meaning is just compatible with the candidate inference, still low inference endorsement is expected.

structural approach, (78b) is merely compatible with (78a) and therefore similarly low inference endorsement is expected under this approach as well.

(78)   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 (79a) and (80a) containing a disjunction embedded under an attitude predicate. As discussed in Sect. 3, (79a) 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 (79), but not in negative ones like (80).[20] More precisely, the predictions are as follows: we expect endorsement of the inference in (79b) from (79a) and very low endorsement for the inference in (80b) from (80a).

(79)   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.*
(80)   a.   Eryk nie uważa, że Kalina lub Alex 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 (77b) and (79b) should be endorsed more than those in (78b) and (80b).[21] 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 disjunction cases. Or said it differently, only the structural approach is compatible

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[20]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 Sect. 2 for discussion.

[21]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).

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

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

with an interaction between monotonicity and type of inference. These predictions are summarised in Table 1. We turn now to describe the details of the experiment testing these predictions.

7.1 Methods

7.1.1 Participants

We tested 52 native speakers of Polish (12 female, 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. 51 participants reported knowledge of English and 12 participants reported further knowledge of at least one more foreign language (French, Italian, Russian, German or Spanish); 1 participant did not 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.

7.1.2 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 and 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"). An example of a target item as seen by the participants in the experiment is presented in Fig. 6. 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.

7.1.3 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 B.

Progress: ▓▓▓▓▓░░░

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

Fig. 6 An example of a target item as seen by the participants in the experiment

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 (81). In negative contexts, Anna's statement was followed by the inference that according to Eric, Kalina was still sick, as in (82).

(81)   PAST-UNDER-PAST — POSITIVE:

Rozmawiałam   ostatnio z   Erykiem. Uważał,   że   Kalina
talk.1SG.FEM.PAST recently with Eryk   think.3SG.PAST that Kalina
była   chora.
be.3SG.PAST sick
'I talked to Eryk recently. He thought that Kalina was sick.'

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

(82) PAST-UNDER-PAST — NEGATIVE:

Rozmawiałam   ostatnio z   Erykiem. Nie uważał,   że
talk.1SG.FEM.PAST recently with Eryk   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   Kalina be.3SG.PAST then   still   sick
'*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 an 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 way 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 (83). 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 (84), 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.

(83) DISJUNCTION — POSITIVE:

Rozmawiałam   ostatnio z   Erykiem. Uważa,   że   Kalina lub
talk.1SG.FEM.PAST recently with Eryk   think.3SG.PRES that Kalina or
Alek są   chorzy.
Alek be.3PL.PRES sick
'I talked to Eryk recently. He thinks that Kalina or Alek are sick.'

INFERENCE:

Według   Eryka, to   nieprawda, że   Kalina i   Alek są
according.to Eryk   this not.true   that Kalina and Alek be.3PL.PRES
obydwoje chorzy.
both   sick
'*According to Eryk, it's not the case that both Kalina and Alek are sick.*'

(84) DISJUNCTION — NEGATIVE:

Rozmawiałam   ostatnio z   Erykiem. Nie uważa,   że
talk.1SG.FEM.PAST recently with Eryk   NEG think.3SG.PRES that
Kalina lub Alek są   chorzy.
Kalina or Alek be.3PL.PRES sick
'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   Kalina and Alek be.3PL.PRES both   sick
'*According to Eryk, both Kalina and Alek are sick.*'

Again, if the participants access the implicature of (83), 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 (83) in positive contexts and to a lesser degree the inference that both Kalina and Alek are sick in negative context, which again is only compatible with (not an actual inference of) 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.

In the target trials, three different embedding verbs were used: *uważa* 'think,' *sądzi* 'think,' and *twierdzi* 'claim,' marked for imperfective aspect. Since it was crucial to use an embedded verb in present tense in disjunction-conditions (and we wanted to keep the aspectual interpretation constant throughout the items), we could not use the perfective form of the embedding verb (perfective verbs in the morphologically present form convey future temporal interpretation in Polish). As for the embedded verbs, same as in the other two experiments, they were stative predicates in the imperfective form, as the perfective form either does not exist or induces a change in meaning.

Besides the target 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 (85) and the bad control trial in (86).

(85)   GOOD CONTROL:

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

INFERENCE:

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

(86)   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 fathers

'I bumped into Paweł recently. He claimed that Michał and Łukasz will become fathers.'

INFERENCE:

Według   Pawła, to nieprawda, że Michał zostanie   ojcem.
according.to Paweł it not.true   that Michał become.3SG father
'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:

(87)   FILLER:

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

INFERENCE:

Według   Soni, Maciej i   Miłosz nie byli   milionerami.
according.to Sonia Maciej and Miłosz NEG be.3PL.PAST millionaire
'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 control trials that were supposed to elicit 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.

7.2 Results

Figure 7 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 Fig. 8.

We fitted an ordinal mixed effects model with Inference type and Monotonicity as fixed effects, and random by-participant and by-item intercepts, as well as by-participant random slopes for Inference type, Monotonicity, and their interaction. Model comparison revealed a significant effect of Inference type ($\chi^2(1) = 6.9$, $p < .01$), a significant effect of Monotonicity ($\chi^2(1) = 6.07$, $p < .05$), and a significant interaction between Inference type and Monotonicity ($\chi^2(1) = 15.38$, $p < .001$). In addition, restricting the comparison to the temporal sentences across the two polarities revealed no significant effect of Monotonicity ($\beta = -0.29$, $z = -1.13$, $p = .25$), confirming that the past-under-past sentences, unlike the disjunctive ones, did not differ across positive and negative. Overall, the results show that participants computed the implicature of disjunction more than the cessation inference (for which we have
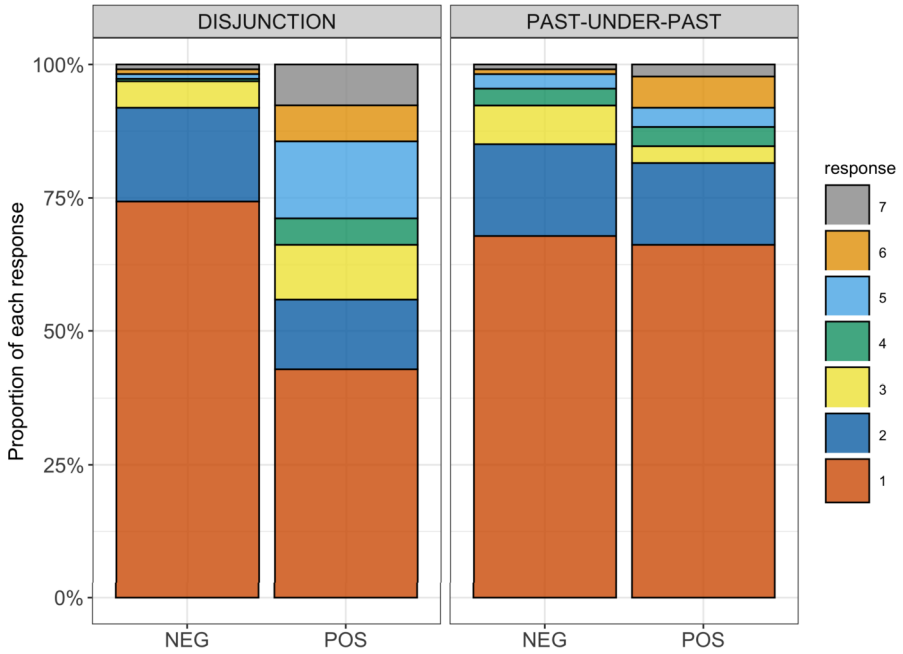
Fig. 7 Proportion of each response type across conditions, with 1 representing low endorsement and 7 high endorsement
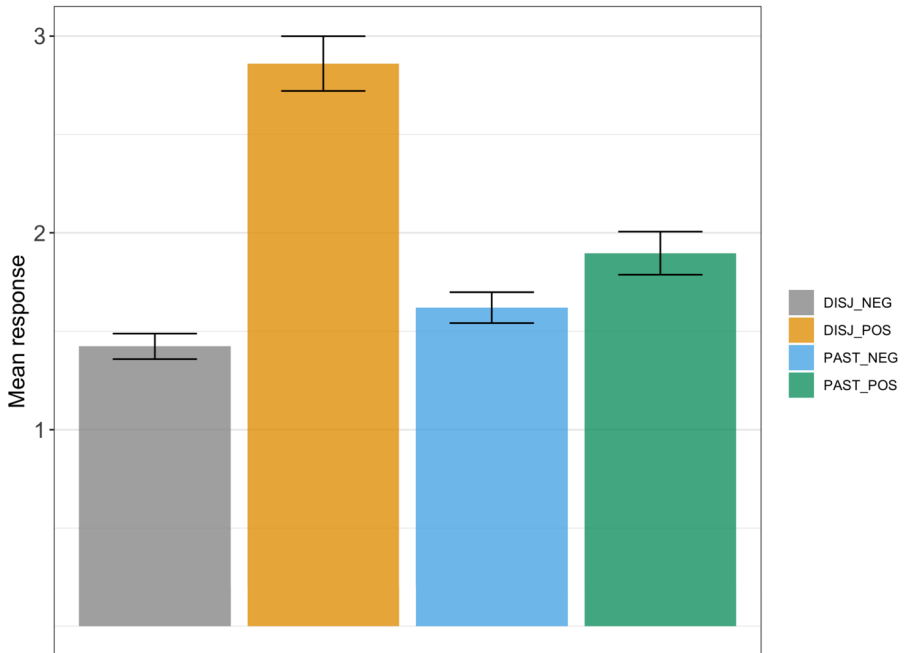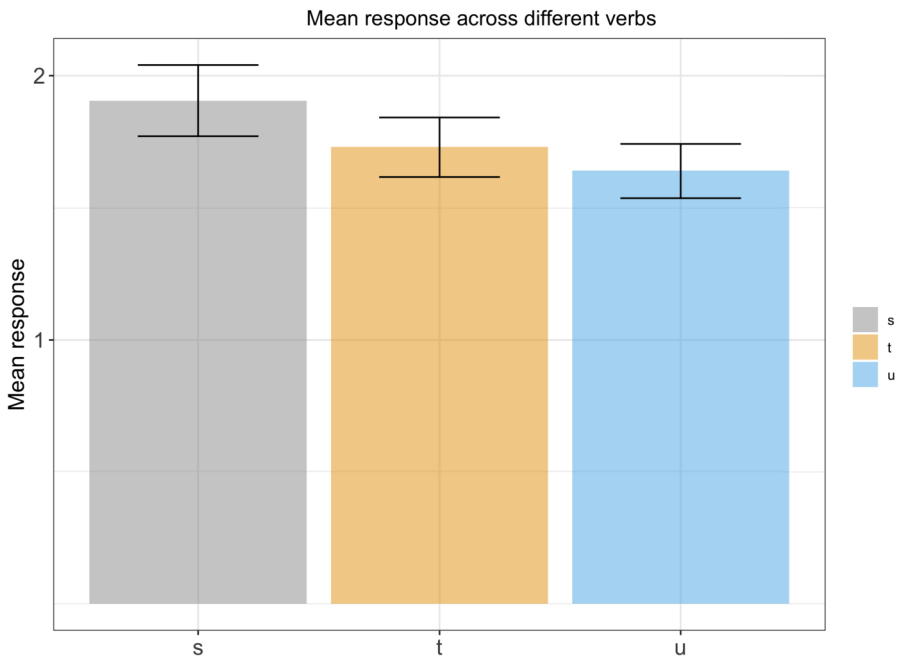

Fig. 8 Mean inference endorsement across conditions

Mean response across different verbs

Fig. 9 Mean inference endorsement across the three different embedding verbs

no evidence that it was computed at all) and only the former exhibited sensitivity to monotonicity.

Finally, we performed two post-hoc analyses in order to investigate whether the type of embedding verb has an effect on the ratings and whether the nature of the property associated with the embedded predicate played a role in our results.

As for the embedding verbs, we used three types: *uważa, sądzi, twierdzi*. All of these can be translated as 'claim/think' in English. We compared the three types of embedding verb fitting an ordinal model on the Polish data with verb type as fixed effect (and by participant and by item random intercepts as well as by participant random slopes for verb type). The results, plotted in Fig. 9, showed no significant differences in the reported endorsement of the inference depending on the verbs that we used. (We used *uważa* as baseline, and we found no significant difference from that to the other two: *uważa* vs. *twierdzi*: $\beta = -0.13, z = -0.35, p = .72$; *uważa* vs. *sądzi*: $\beta = -0.11, z = -0.28, p = .77$).

To investigate whether the type of embedded predicate mattered, we coded the embedded stative predicates for permanent vs. temporary states and then conducted a post-hoc statistical analysis testing for a potential effect of duration. In the results, plotted in Fig. 10, we found no effect of the difference between more vs. less permanent states on inference endorsement (ordinal model fitted on the Polish data with complement duration as fixed effect revealed no effect of duration: $\beta = -0.4, z = -1.28 \, p = 0.2$).
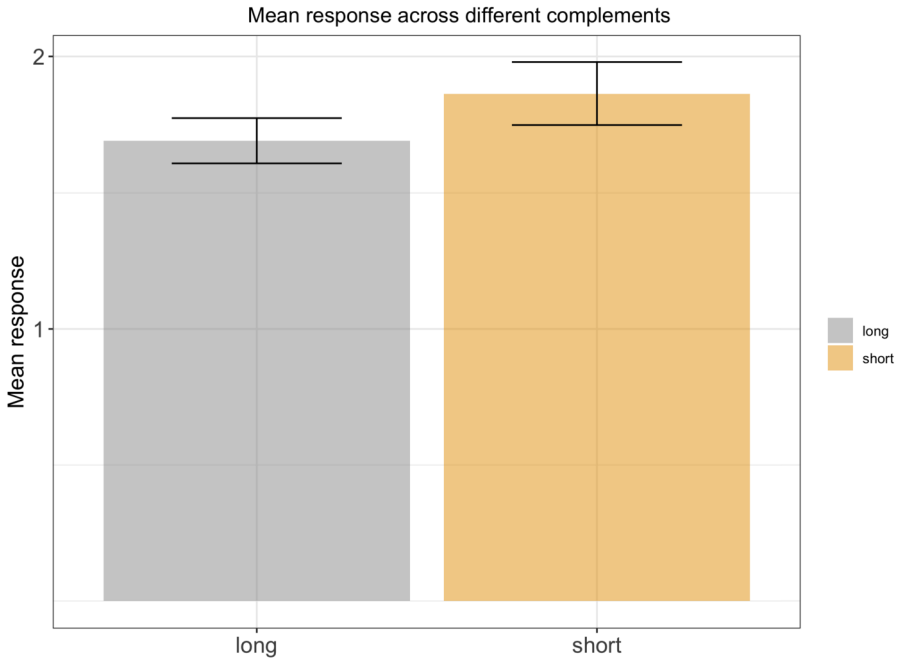
Mean response across different complements

Fig. 10 Mean inference endorsement across the different types of embedded predicate

7.3 Discussion

7.3.1 The challenge for the implicature approach

In this experiment, 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. Going back to the predictions outlined in Table 1: the implicature approach predicts a similar pattern in past-under-past sentences with respect to disjunction, with more endorsement in positive cases than in negative ones. The structural approach, on the other hand, expects no endorsement in either of the two conditions.

These results are therefore challenging for the implicature approach and cast doubts on the idea of treating SOT phenomena in this way. 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 for non-SOT languages, 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 presenting an analysis of the overall results of our experiments, we want to briefly address two potential issues associated with the results of Experiment 3: the issue of domain restriction and the role it plays in the implicature approach and the strength of the cessation inference.

7.3.2 Domain restriction

To illustrate the domain restriction issue, let us go back to simple past sentences and the meaning we associated them with in (88).

(88) $[\![\text{Kalina was sick}]\!]^c = \lambda w.\exists t[t \prec t_c \wedge \text{sick}(\text{kalina}, w, t)]$

One thing that we had not discussed explicitly in relation to sentences like (88) is the domain of quantification of the existential quantifier. That is, (88) is standardly analysed as in (89), where $g(C)$ represents the quantificational domain, i.e. the set of contextually salient time intervals.

(89) $[\![\text{Kalina was sick}]\!]^{g,c} = \lambda w.\exists t[t \in g(C) \wedge t \prec t_c \wedge \text{sick}(\text{kalina}, w, t)]$
(with C a variable ranging over sets of times)

Being precise about the domain of quantification is important for cases like (90), which fix that domain explicitly (i.e. $g(C)$ is the set of intervals corresponding to last week).

(90)   Last week, Kalina was sick.

This, in turn, correctly predicts that (90) 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 that (90) is compared to is (91), where $g(C)$ remains constant by assumption. Given that $g(C)$ does not contain the utterance time, (91) 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.

(91) $[\![\text{Last week, Kalina is sick}]\!]^{g,c} = \lambda w.\exists t[t \in g(C) \wedge t = t_c \wedge \text{sick}(\text{kalina}, w, t)]$

The same can be replicated at the embedded level for cases like (92) 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*).

(92) $[\![\text{Wczoraj, Eryk uważał, że Kalina była chora w zeszłym tygodniu}]\!]^{g,c} =$
         $\lambda w.\exists t[t \in g(C) \wedge t \prec t_c \wedge \forall \langle w', t' \rangle \in \text{bel}(eric, w, t), \exists t''[t'' \in g(C') \wedge t'' \prec$
         $t' \wedge \text{sick}(\text{kalina}, w', t'')]]]$

The implicature approach predicts no cessation inference for (92) because its alternative with embedded present in (93) is again necessarily false in virtue of the first conjunct of the embedded existential quantification (i.e. t'' cannot be part of $g(C')$ (= last week) if it's equal to Eric's attitude time t' at t, which is in turn part of $g(C)$ (= yesterday)).

(93)　⟦Wczoraj, Eryk uważał, że Kalina jest chora w zeszłym tygodniu⟧^{g,c} =
$\lambda w.\exists t[t \in g(C) \wedge t \prec t_c \wedge \forall \langle w', t' \rangle \in \mathsf{bel}(eric, w, t), \exists t''[t'' \in g(C') \wedge t'' = t' \wedge \mathsf{sick}(\mathsf{kalina}, w', t'')]]]$

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 (94), $g(C)$ will be easily fixed to last week, given its saliency in the context.

(94)　Context: We have been talking about last week.
⟦Kalina was sick⟧^{g,c} = $\lambda w.\exists t[t \in g(C) \wedge t \prec t_c \wedge \mathsf{sick}(\mathsf{kalina}, w, t)]$

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.

7.4 The strength of the inference

As discussed in detail in Sect. 3, the implicature approach in combination with most theories of scalar implicatures predicts two cessation inferences for sentences like (95): 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.

(95)　Eryk uważał, że Kalina była chora.
'Eryk thought that Kalina 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 (96). (96) 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.

(96)　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.

8 Analysis

In this section we propose an account of the main empirical findings obtained in our experiments, which are summarised in (97):

(97) a. Simultaneous readings for past-under-past attitude complements are available in Polish, but less acceptable than in English. (Experiment 1)
  b. A cessation inference arises in past-marked matrix clauses in Polish, just like in English. (Experiment 2)
  c. We find no evidence for an embedded cessation implicature in past-under-past attitude complements in Polish. (Experiment 3)

8.1 Accounting for simultaneous readings of past-under-past sentences

Let us consider (97a) first. Recall from Sect. 2 that Polish has previously been described as a non-SOT language with respect to attitude complements, both in the descriptive and in the theoretical literature. The results of our first experiment cast doubt on this broad generalisation, showing that simultaneous interpretations of past-under-past complements are in fact possible in Polish. However, we also observed a contrast with English in that past-under-past sentences in Polish received lower ratings in contexts triggering a simultaneous interpretation, suggesting that these readings are more restricted. These results are reminiscent of observations on "mixed" languages such as Hebrew (Ogihara and Sharvit 2012; Sharvit 2018; a.o.), where simultaneous readings of past-under-past attitudes have been reported to be marginally available (see also the discussion in Sect. 4.3). Ogihara and Sharvit (2012) and Sharvit (2018) propose that simultaneous readings for past-under-past arise from a de re LF, which is also available in English. In contrast to English however, mixed languages do not have an SOT deletion rule in their grammar, thus missing a structural mechanism to derive "true" (i.e. bound) simultaneous readings of embedded past.

In order to account for the results of Experiment 1, we adopt this idea for Polish, i.e. in contrast to previous descriptions of temporal interpretation in Polish attitude complements, we propose to classify Polish as a mixed language rather than a strict non-SOT language. Moreover, following Sharvit (2014), we adopt the assumption that both Polish and English have pronominal tense systems, and thus we diverge from the quantificational approach to tense taken in the implicature account by Altshuler and Schwarzschild (2013), Altshuler (2016) as well as the structural accounts by Ogihara (1995b, 1996), Kusumoto (1999, 2005), Arregui and Kusumoto (1998) (see also Sect. 2 for discussion).

Our implementation relies on various insights from existing structural analyses of SOT as proposed by Heim (1994), Sharvit (2003), Ogihara and Sharvit (2012), Sharvit (2014, 2018), Bochnak (2016), Bochnak et al. (2019) and others. As shown in Sect. 2.3, under a pronominal analysis of tense, PAST denotes an indexed pronoun with a presupposition on its reference. The relevant lexical entry (based on Heim 1994; Kratzer 1998; Matthewson 2006) is repeated in (98). (We add the symbol ($^<$) to represent the presupposition for ease of exposition, following Ogihara and Sharvit 2012).

(98) $[\![\text{PAST}_i^<]\!]^{g,c}$ is defined only if $g(i) < t_c$, if defined,
         $[\![\text{PAST}_i^<]\!]^{g,c} = g(i)$

Under the assumption that tense has a pronominal semantics in Polish and English, (98) represents the denotation of past tense in both languages. We also follow Ogihara and Sharvit (2012) and Sharvit (2014) in maintaining that in English, an SOT deletion rule in the sense of Ogihara (1995b, 1996) can neutralise the anteriority meaning of the pronominal past tense, provided that it is c-commanded by another past tense. This means that the tense loses its presupposition and is bound by a λ-abstractor in the periphery of the embedded clause in order to create the right type of argument for the attitude verb (i.e., an argument of type ⟨i,⟨s,t⟩⟩; see Heim 1994; von Stechow 2009; among many others). By SOT deletion, we thus derive the LF in (100) for the English past-under-past sentence in (1), repeated below as (99). The matrix past is interpreted relative to the utterance time (t_c), the embedded (PSP-less) past pronoun is bound, resulting in a simultaneous reading.

(99)   Eric thought that Kalina was sick.

(100)   LF and truth conditions after SOT deletion (simultaneous reading)

   a.   [PAST$_1^<$ Eric think [λ$_2$ [PAST$_2^{\not<}$ Kalina sick]]]

   b. $[\![(1)]\!]^{g,c} = \lambda w.\ \forall \langle w', t' \rangle \in$ bel (eric, w, g(1)), Kalina is sick in w' at t', only defined if $g(1) < t_c$

According to the structural approach to SOT, this is how simultaneous readings can be derived in an SOT language like English. The results of Experiment 1 (see Sect. 4) beg the question of whether this LF is in fact also available in Polish, contrary to previous descriptions of Polish as a non-SOT language. This would explain the relatively high ratings that past-under-past sentences received in our Polish data. However, recall that we also observed a difference from English in this condition: past-under-past sentences still received significantly lower ratings in Polish than in English. If we simply classified Polish as an SOT language with an English-type tense deletion rule, it is not clear how this difference could be explained. The pattern that we observe in our quantitative data seem in line with previous observations on Hebrew and Russian, where simultaneous readings for past-under-past are not excluded, but appear to be more marginal than in English (see Sect. 4.3). These languages also pattern with strict non-SOT languages like Japanese in that simultaneous readings are most naturally expressed with embedded present. Descriptively, this is often captured by generalising that languages like Hebrew, Russian, and also Polish, have a relative present, which is shiftable in embedded contexts.[22] We capture this formally by

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[22] As discussed by Sharvit (2014), this might be true only for the attitude complement cases that we are concerned with, but not for relative clauses or temporal adverbial clauses. Relatedly, Grønn and von Stechow (2010) adopt a relative present analysis for attitude complements in Russian, but in their later work maintain that this relative present seems to be unavailable in adjunct clauses (Grønn and von Stechow 2012; von Stechow and Grønn 2013a,b). Since we cannot provide any new insights on tense in adjuncts in Polish, we simply adopt the fairly uncontroversial assumption that present in non-SOT languages is bound in attitude complements, and leave empirical investigation of the Polish tense in adjuncts for future research.

adopting Kusumoto ([1999])'s analysis of relative present tense in Russian. Kusumoto proposes that a relative present simply denotes the evaluation time (which we indicate with the index 0).[23] Hence, the relative present directly refers to the utterance time t_c in matrix clauses, but is bound when embedded in an intensional context.

(101) $[\![\mathrm{PRES}_0]\!]^{g,c}$ = t_c (when free), g(0) (when bound)   PRESENT IN POLISH

Since in attitude complements the Polish present will be bound to the attitude holder's now, it will give rise to truth conditions equivalent to those derived with a deleted past in English (see (100b)). Therefore, "truly" simultaneous readings under past-marked attitudes in Polish are expressed with embedded present. For completeness, (102) shows the LF and truth conditions of a present-under-past sentence in Polish.

(102)   a.   Eryk uważał, że Kalina jest chora.
                  'Eryk thought that Kalina is sick.'

          b.   [$\mathrm{PAST}_1^<$ Eryk think [λ_0 [PRES_0 Kalina sick]]]

          c.   = $\lambda w.\ \forall \langle w', t' \rangle \in$ bel(eryk,w,g(1)), Kalina is sick in w' at t',
                  only defined if g(1) < t_c

What about the simultaneous readings of past-under-past sentences in Polish? We partly follow Ogihara and Sharvit ([2012]) and Sharvit ([2018]) in their proposals for "mixed" languages. They assume that the LF in ([100a]) is not available in such languages. However, simultaneous readings for past-under-past can also be derived from a de re LF, which is available in SOT languages and mixed languages alike. This proposal crucially builds on the seminal works of Abusch ([1997]) and Heim ([1994]) on temporal de re. Unlike Heim ([1994]) and much subsequent work, however, we implement our analysis in terms of time concept generators in the definition of Sharvit ([2018])[24] (which in turn builds on previous works on concept generators for individual-denoting expressions, such as Percus and Sauerland [2003]; Charlow and Sharvit [2014]; a. o.). A time concept generator is a function that takes a (temporal) res and yields a suitable time concept, i.e. an acquaintance-based description by which the attitude holder represents this time to herself, at her time and world of evaluation. Hence, a time concept denotes a function from times to functions from worlds to times, type $\langle i, \langle s, i \rangle \rangle$. The time concept generator, accordingly, will be of type $\langle i, \langle i, \langle s, i \rangle \rangle \rangle$. The formal definition from Sharvit ([2018]: 221) is given in (103):

(103)   A time-concept generator suitable for x in world w and time t is a function f such that:

          a.   the domain of f is the set of times that x is acquainted with in w at t; and

[23]Kusumoto ([1999]) introduces a designated temporal pronoun *t** to represent the evaluation time. Note, moreover, that Kusumoto fairly explicitly generalises all her proposals for Russian to Polish.

[24]In Sharvit ([2018])'s system, tense semantics involves temporal quantfiers that undergo QR and introduce an existential tense meaning, as well as temporal pronouns that serve as arguments for the concept generator. This mixed framework is not explicitly defended in Sharvit ([2018]), but merely adopted under the assumption that the choice between a quantificational and pronominal semantics for tense does not matter with respect to SOT variation, see also Sect. [2.3].

b. for any t' in the domain of f:
  (i)   f(t') is a suitable time-concept;
  (ii)   for any <w',t"> ∈ ACC(x,w,t): f(t')(t")(w') is defined;
  (iii) f (t')(t)(w) = t';
  (iv)   for any <w',t"> in the domain of f(t'): f(t')(t")(w') is not after
         t".   ("Upper Limit Constraint"; see Abusch 1997)

In the relevant LF structure, the concept generator is introduced by embedding the res in a larger constituent that contains a concept generator variable G, which is abstracted over in the left periphery of the embedded clause and eventually quantified over by the attitude verb. The time concept function takes as additional arguments an unpronounced (evaluation) time and world variable, which are also bound in the left periphery. An LF-representation of the past-under-past sentence in (104a) is given in (104b).

(104)   a.   Eryk uważał, że Kalina była chora.
             'Eryk thought that Kalina was sick.'
        b.   [PAST$_1^<$ Eric think [λ₃ λ₄ λ₅ [[[[G₃ PAST$_2^<$] t₄] w₅] Kalina sick in
             w₅]]]

The complement clause thus denotes a function from time concept generators to properties of times (type ⟨⟨i,⟨i,⟨s,i⟩⟩⟩,⟨i,⟨s,t⟩⟩⟩) and has the denotation in (105).

(105)   ⟦ że Kalina była chora ⟧^{g,c} = λG$_{⟨i,⟨i,⟨s,i⟩⟩⟩}$.λt$_i$.λw$_s$. Kalina is sick in w at
        G(g(2), t, w), (where g(2) < t$_c$)[25]

To derive the sentence meaning, we need a lexical entry for the attitude verb that takes (105) as its complement:

(106)   ⟦ think^{dere} ⟧^{g,c} = λΠ$_{⟨⟨i,⟨i,⟨s,i⟩⟩⟩,⟨i,⟨s,t⟩⟩⟩}$.λx$_e$.λt$_i$.λw$_s$. ∃G:G is a time concept
        generator suitable for x in w at t & ∀⟨w',t'⟩ ∈ bel(x,w,t), Π(G)(t')(w') = 1

The truth conditions of (104) are given in (107):

(107)   ⟦(104)⟧^{g,c} = ⟦think^{dere}⟧^{g,c}(⟦(105)⟧^{g,c})(⟦Eryk⟧^{g,c})(⟦PAST$_1^<$⟧^{g,c})
        = λw. ∃G : G is a time concept generator suitable for Eryk in w at g(1) &
        ∀⟨w',t'⟩ ∈ bel(eryk,w,(g(1))), kalina is sick in w' at G(g(2),t',w')
        (where g(1) < t$_c$ and g(2) < t$_c$)

The concept generator yields a time concept of the embedded tense g(2). As per its past presupposition, this time concept must precede the utterance time. Moreover, the Upper Limit Contraint in (103b,iv) (which Sharvit 2018 adopts from Abusch 1997) specifies that the time picked out by the concept generator may not be in the future of the attitude holder's "now." This excludes an unattested forward-shifted reading under which (104) would mean that Kalina is sick after Eric's thinking time. However, the attitude holder's "now" itself is a suitable time concept. If the concept generator

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[25]Here we are following Geurts (1999) and Mandelkern (2016) among others, in assuming that presuppositions project through attitude predicates; see however Heim (1992) for a different view and discussion.

Table 2 Availability of LFs and readings for past-under-past complement clauses

	de re LF	Reading	Bound LF	Reading
past-under-past^{Polish}	✓	SHIFT, (SIM)	×	
past-under-past^{English}	✓	SHIFT, (SIM)	✓	SIM

picks out "now" as the attitude holder's description of g(2) at the attitude time, this yields a simultaneous reading. The backward-shifted reading arises when the concept generator picks out essentially any other suitable time concept (examples would be "yesterday" or "last week"), yielding a time interval that precedes both the utterance time and the matrix attitude time.

Taking stock, we have proposed that, both in Polish and in English, the grammar makes available a "bound LF" and a "de re LF" for attitude complement clauses. In the former case, the complement clause is essentially semantically tenseless, thus yielding purely simultaneous readings as the time of the embedded state is bound to the matrix attitude time. The de re LF, by contrast, yields a backward-shifted reading for past-under-past sentences, unless the concept generator in the embedded clause picks "now" as a time concept for the embedded past. A crucial difference between English and Polish is that in English, past-under-past sentences can have a bound LF, assuming that binding of the embedded pronominal past requires SOT deletion (Ogihara and Sharvit 2012; Sharvit 2014; Bochnak 2016; among others). In Polish, by contrast, the bound LF is available for present-under-past sentences only, resulting in the widely reported observation that simultaneous readings are canonically expressed with embedded present in this language. We propose that this contrast accounts for our principle finding from Experiment 1: simultaneous readings for past-under-past are possible in Polish because they can be derived from a de re LF if the attitude holder happens to represent the embedded tense as their subjective "now" (this is sometimes referred to as an "accidentally simultaneous reading," see Ogihara and Sharvit 2012; Bochnak et al. 2019). However, while this is the only way to derive a simultaneous reading for past-under-past in Polish, an English past-under-past sentence, in addition, can have the bound LF that only gives rise to the simultaneous reading. Table 2 provides an interim summary.

Let us now turn to present-under-past sentences. For Polish, we have adopted the assumption that present is essentially semantically zero, i.e. it denotes the utterance time in matrix clauses and is obligatorily bound in attitude complements, giving rise to simultaneous readings.

What about the present tense in English? According to traditional wisdom, the English present has a deictic rather than a relative meaning. In present-under-past attitude complements, it therefore yields a double access reading, in contrast to a purely simultaneous reading as derived in languages with a relative present (see Sect. 2.1 and the references therein). Coming back to the results of Experiment 1, the data we obtained for embedded present sentences do not really reflect this generalisation. While the study was not designed to distinguish double access from purely simultaneous readings, it is notable that present-under-past sentences received virtually the same high ratings in simultaneity contexts in English as in Polish. What seems even more

surprising is the finding that English present-under-past sentences were rated significantly better in contexts constructed to elicit a backward-shifted interpretation, which is prima facie unexpected in either language.

In the pronominal theory of tense adopted here, the double access reading of present-under-past is captured by assuming that the English present imposes a presuppositional restriction that cannot be deleted when embedded under past tense (because in present-under-past configurations the SOT rule cannot apply), which prevents a genuinely simultaneous reading. The lexical entry for the English present in (108) is adapted from Heim (1994) and Sharvit (2014) ("o" stands for overlap).

(108) $[\![\text{PRES}^o_i]\!]^{g,c}$ is defined only if g(i) overlaps t_c, if defined,
          $[\![\text{PRES}^o_i]\!]^{g,c} = $ g(i)   PRESENT IN ENGLISH

Under a concept generator analysis, we thus derive the truth conditions in (109c) from the LF in (109b) for the English present-under-past sentence in (109a).

(109)   a.   Eric thought that Kalina is sick.
          b.   [$\text{PAST}^<_1$ Eric think [λ_3 λ_4 λ_5 [[[[G_3 PRES^o_2] t_4] w_5] Kalina sick in w_5]]]
          c. $\lambda w. \exists G :$ G is a time concept generator suitable for Eric in w at g(1) & $\forall \langle w',t' \rangle \in$ bel(eric,w,(g(1))), kalina is sick in w' at G(g(2),t',w'), (where g(1) < t_c and g(2) o t_c)

The double access reading arises as follows (see also Ogihara and Sharvit 2012 for discussion): the presupposition of the embedded present requires overlap with the utterance time. However, the Upper Limit Constraint specifies that the time concept generator cannot yield an interval that follows the attitude time. Hence, any suitable time concept for the embedded present must include both the attitude time and the utterance time. We would like to suggest that such an analysis of English present-under-past can also help us make sense of the curiously high ratings we observed with backward-shifting contexts in Experiment 1. Ogihara and Sharvit(2012: 650) propose that a suitable conceptual description for an embedded present as in (109) would be something like "the month surrounding [the attitude holder's] now," provided that this description includes the utterance time. Notably, this description would also include a time interval that *precedes* the matrix attitude time, thus making the description compatible with Kalina being sick before Eric's thinking. Given the presupposition of the English present tense, we would still end up with a double access reading. However, since our experiment was not designed to control for truth at the utterance time, participants might have ascribed a time concept to the attitude holder which spans the utterance time, the matrix attitude time and a time interval preceding the attitude time. In other words, they interpreted the sentence in (109a) such that Kalina was sick before Eric's thinking time, she was sick at his thinking time, and is still sick at the utterance time. The Polish present might be more restrictive in its interpretation in present-under-past clauses; it is strictly bound to the attitude time, which would make it less plausible to stretch out the duration of the embedded state such that it can accommodate a past-oriented speech report. This said, since the main goal of our first experiment was to investigate the availability of simultaneous readings for past-under-past sentences, we leave for future research whether the ratings we obtained

for present-under-past sentences in English indicate a challenge for the double access generalisation. Next, we turn to accounting for the results of Experiment 2.

8.2 Accounting for the cessation inference in matrix clauses

Experiment 2 showed that in Polish, just like in English, a stative past matrix clause gives rise to a cessation inference. As discussed in Sect. 3.2, under the quantificational approach to tense cessation inferences can be analysed as scalar implicatures, assuming that stative predicates have the temporal profile in (33), as proposed by Altshuler and Schwarzschild (2013). Recall also that cessation implicatures are obviated when the context provides an explicit reference time for the past tense, which is modeled as a contextual restriction of the temporal quantifier under the quantificational approach to tense. Conceptually, the pronominal approach generalises to these occurrences of (past) tense where cessation inferences typically do not arise, as tense is assumed to denote an anaphoric expression that refers to a time that is salient in the context. Hence, additional assumptions are needed to derive the cessation inference we observe when there is no such salient past reference time, as was the case in Experiment 2. We follow Cable (2017) here, who discusses cessation inferences in the Tlingit (Na-Dene) language, using a pronominal tense framework. Cable proposes that cessation implicatures in matrix clauses arise because existential closure applies to the (past) tense pronoun as a special rescue operation when there is no salient past reference time.

The "basic" referential meaning of our test sentence from Experiment 2 is shown in (110a), where the interpretation of the pronominal past depends on the contextual assignment function. However, when the context fails to provide a reference time, existential closure applies to the pronominal past tense, resulting in an existential past meaning as in (110b).

(110)   Jan był w Wielkiej Brytanii.
        'Jan was in the UK.'

   a.   [$PAST_1^<$ [Jan be in the UK]]
        $[\![(110)]\!]^{g,c} = \lambda w.$ Jan is in the UK in w at $g(1)$,
        defined if $g(1) < t_c$

   b.   [$\exists_1$ [$PAST_1^<$ [Jan be in the UK]]]   (existential closure)
        $[\![(110)]\!]^{g,c} = \lambda w. \exists t_1. t_1 < t_c$ & Jan is in the UK in w at t_1

Given what we have assumed about the present tense in Polish, the corresponding present sentence refers directly to the utterance time, giving rise to the truth conditions in (111).

(111)   Jan jest w Wielkiej Brytanii.
        'Jan is in the UK.'
        $[\![(111)]\!]^{g,c} = \lambda w.$ Jan is in the UK in w at t_c

This configuration triggers the scalar implicature calculation that derives cessation inferences in the proposal of Altshuler and Schwarzschild (2013), i.e. assuming the Temporal Profile of Statives (33), the truth of (111) entails the truth of (110) under

the existential reading in (110b), while it is logically independent from the referential meaning in (110a). Thus, a cessation inference is predicted (only) in the absence of a salient reference time.[26]

8.3 Accounting for the absence of the cessation inference in complement clauses

Assuming that the cessation inference that we observe in matrix clauses is indeed an implicature derived along the lines of Altshuler and Schwarzschild (2013), we need to explain why this implicature does not arise in past-under-past attitude complements, as indicated by the results of Experiment 3. Recall the truth conditions we derive for past-under-past and present-under-past in Polish, repeated in (112) and (113), respectively. The embedded past in (112) is interpreted as the argument of a concept generator and presupposed to denote a time prior to the utterance time, while the embedded present in (113) is interpreted as bound. There is no entailment relationship here, so no cessation implicature is predicted to arise for (112).

(112)   a.   Eryk uważał, że Kalina była chora.
          'Eryk thought that Kalina was sick.'

       b. $= \lambda w. \exists G$: G is a time concept generator suitable for Eryk in w at g(1) & $\forall \langle w',t' \rangle \in$ bel(eryk,w,(g(1)), kalina is sick in w' at G(g(2),t',w').
          (where $g(1) < t_c$ and $g(2) < t_c$)

(113)   a.   Eryk uważał, że Kalina jest chora.
          'Eryk thought that Kalina is sick.'

       b. $= \lambda w. \forall \langle w', t' \rangle \in$ bel(eryk,w,g(1)), kalina is sick in w' at t'.
          (where $g(1) < t_c$)

An immediate question is whether the existential closure operation assumed as an option for the past matrix clause in (110) could also apply in the embedded clause in (112), deriving a cessation implicature in parallel to the matrix sentences and in line with what Altshuler and Schwarzschild (2013) propose.

In fact, Ogihara and Sharvit (2012) and Sharvit (2014), who analyse SOT variation with pronominal tenses but who are not concerned with cessation inferences, assume that existential closure can apply relatively freely also to embedded tense. Diverging from the technical implementation we have adopted from Heim (1994), Kratzer (1998) and much subsequent work, they assume that past tense pronouns are doubly-indexed, with the first index denoting the evaluation time and the second index denoting the (past) reference time. In their analysis then, the evaluation time index of an embedded past can be bound by the attitude verb and the referential index can be bound by existential closure, as illustrated in (114) (adapted from Ogihara and Sharvit 2012: 646). This derives a backward-shifted reading for past-under-past sentences, and it would also predict an embedded cessation implicature in Polish.

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[26]The same applies to matrix clauses in English, although under the analysis adopted here the truth conditions of the English present sentence will look slightly different. Since we do not compare cessation in matrix clauses to embedded clauses in English, we omit the representations for English for space reasons.

(114)   Joseph believed that Mary loved him.
          [$PAST^<_{0,1}$ Joseph believe [λ_0 $\exists_2$ [$PAST^<_{0,2}$ Mary love him]]]

Note that under the more conventional implementation that we adopted, the meaning of pronominal past is indexical in that its presupposition requires precedence relative to the time of the utterance context. The past tense carries only one index, and if this index is bound by existential closure, we derive truth conditions that do not relate the embedded tense to the matrix attitude time, which is prohibited (for discussion see von Stechow 1995, 2009; among many others). That is, for the past-under-past sentence in (110), we would derive the (illicit) truth conditions in (115b) from the LF in (115a):

(115)   a.   [$PAST^<_1$ Eryk think [$\exists_2$ [$PAST^<_2$ Kalina is sick]]]
          b. $\lambda w.$ $\forall \langle w', t' \rangle \in$ bel (eryk,w,g(1)), $\exists t_2$ [$t_2 < t_c$ and Kalina is sick in w' at t_2] (defined if $g(1) < t_c$)

If this LF is indeed excluded, this would imply that backward-shifted readings of embedded pronominal past always involves a "de re" LF.[27] This is in line with Heim's (1994) original discussion of English as well as subsequent analyses of SOT languages in a pronominal framework (e.g. Bochnak 2016). In these proposals, simultaneous readings of past-under-past are analysed as binding, and backward-shifted readings as temporal de re. This is different in the analysis by Ogihara and Sharvit (2012), who derive backward-shifted readings with existential closure (see above) and propose that temporal de re is available only in certain, restricted circumstances.[28] Following up on this idea, Bochnak et al. (2019) propose, based on data from under-researched (optionally) tenseless languages, that the availability of temporal de re might be subject to cross-linguistic variation. Both of these works however contrast temporal de re as derived by res-movement (following Heim 1994) with alternative construals where the embedded tense can be interpreted in situ. From this perspective (and given that syntactic res-movement is independently known to be problematic, see Heim 1994; Charlow and Sharvit 2014; a.o.), restricting temporal de re in the grammar seems desirable. By contrast, under the analysis we adopt, embedded past tense is interpreted in situ under the de re construal, as the argument of a concept generator. As far as we can see, there is no conceptual reason to assume that this construal should be restricted, as it essentially requires that the attitude holder has a concept of the temporal location of the eventuality she holds an attitude about. It seems plausible to assume that in canonical attitude reports this is indeed the case. That is, a speaker reporting "Eric thought that Kalina was sick" will presumably allocate to the attitude holder a concept of *when* Kalina was sick, rather than attributing to the attitude holder the thought that Kalina was sick at some indefinite time in the past.

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[27]Of course, another alternative would be to assume that past tense is ambiguous, as suggested, e.g., in Kratzer (1998) for English. In Kratzer's analysis, English past tense morphology can realise i) an indexical pronominal past (i.e., the meaning we adopted from Heim 1994), ii) a zero bound pronoun (similar to what we assume for embedded present in Polish) or iii) a perfect aspect-like temporal shifter.

[28]Ogihara and Sharvit (2012) formulate this as a hypothesis rather than a claim. Hence, they do not define under what circumstances exactly temporal de re construals would be available.

An existential construal of the embedded past might still be needed in some cases, e.g. to model sentences like "Eric thought that Kalina was sick, but he had no idea when" (either as existential closure in the implementation of Ogihara and Sharvit 2012, or, e.g., by insertion of a covert adverbial meaning 'once/sometime'). However, we hold that this existential reading would be the restricted one, i.e., a "rescue operation" as stated in Cable (2017). At least with respect to the sentences we tested in Experiment 3, nothing prevents the embedded past from being interpreted as the argument of a concept generator and without existential closure. We propose that, since this LF is generally available for the embedded pronominal past, no cessation implicature was detected in our experiment.

Note that this is different from obviation of cessation implicatures by contextual domain restriction in Altshuler and Schwarzschild's (2013) proposal (see Sect. 7.3). The attitude holder's temporal concept plays an important part in their analysis as well, in the shape of the restriction of the embedded quantificational tense, which Altshuler and Schwarzschild (2013) refer to as "reference time concept." As commonly assumed in quantificational analyses of tense, the domain restriction serves a similar purpose as an anaphoric pronoun in the pronominal tense analysis: it denotes a free variable that picks out a salient reference time if such a time is provided by the context. If the context does not provide a salient past reference time, and if the domain of the quantifier includes the local evaluation time, a cessation implicature is predicted for a past stative sentence in matrix clauses. Altshuler and Schwarzschild's (2013) proposal is that the same can apply to past-under-past attitude complements. Their example is given in (116), with the reference time concept in (116b).

(116)   Context: Suppose that a month ago, Bob and Pat took their son Scotty to Paris for an appointment with a world-famous doctor. Recalling that visit, Bob utters:

   a.   That famous French doctor believed-C_1 that Scotty was-C_1 anxious.

   b. $g(C_1) = \lambda w.\lambda t.$ t is a time during Bob's and Pat's visit to the famous French doctor in w.   (Altshuler and Schwarzschild 2013: 52)

The context provides one past reference time ('one month ago'), and both temporal quantifiers are restricted to this time. In such a scenario, Altshuler and Schwarzschild (2013) predict a cessation implicature for the embedded past in languages that have a relative present as a competitor. This is because the contextual domain of the embedded past corresponds to the matrix attitude time ("the belief concerned the goings on during the time the belief was held"; Altshuler and Schwarzschild 2013: 52), which also makes the present alternative true in this context. Hence, in Altshuler and Schwarzschild's (2013) analysis, a contextually given reference time in the past of the local evaluation time is necessary to obviate the embedded cessation implicature (see (92) for illustration). In our Experiment 3 on Polish, just like in example (116), no such time was provided. Therefore, an analysis along the lines of Altshuler and Schwarzschild (2013) would lead us to expect the implicature to arise.

Since Experiment 3 did not bear out this prediction for Polish, we proposed a pronominal analysis that predicts no embedded cessation implicature in past-under-past attitude complements, provided that the attitude holder can be assumed to have a concept of the temporal location of the embedded state, which then corresponds to

the interpretation of the embedded past. Since this time concept can in principle be the attitude holder's now, past-under-past sentences in Polish can be used to report simultaneous attitudes (Experiment 1).

Finally, we have to refine our explanation of why, in Experiment 1, Polish past-under-past attitude reports still received lower ratings in contexts triggering simultaneous readings when compared to past-under-past sentences in English. Recall that we propose that pronominal tenses that can't be bound are canonically interpreted as arguments of concept generators, and that this analysis is in principle compatible with a simultaneous interpretation of past-under-past if the concept generator picks out "now" as the attitude holder's time concept. However, it seems uncontroversial that in Polish, simultaneous readings can also be unambiguously expressed with present-under-past, which we analysed as binding of the embedded relative present. We hold that this is the reason why the simultaneous interpretation is dispreferred for past-under-past in Polish. Here our analysis converges with Ogihara and Sharvit (2012), who attribute the same preference to express simultaneous readings with present-under-past in Hebrew to a general pragmatic principle of preference for bound pronouns (citing Schlenker 1999, a.o.).[29] They propose that the LF of present-under-past, where the embedded tense is bound, is preferred over the de re LF of past-under-past whenever these yield practically indistinguishable (i.e. simultaneous) readings. Therefore simultaneous readings are marked for past-under-past and (some) Polish speakers might be reluctant to ascribe the time concept "now" to an attitude holder in an attitude report, thus judging past-under-past sentences as unacceptable in simultaneous contexts. Since all alternative suitable time concepts correspond to a backward-shifted reading, past-under-past sentences receive higher ratings when a past attitude is reported. For English, by contrast, our analysis yields a bound LF for past-under-past as well, explaining why a simultaneous reading seems to be more available in this language.[30]

Summing up, in light of the results of our experiments, we propose that Polish is a "mixed" language with respect to the interpretation of past-under-past attitude complement clauses. We observed that such constructions allow for simultaneous readings, but to a lesser extent than in English. In the analysis we propose, the meaning of past-under-past attitudes is derived via concept generators, which can pick out the attitude holder's "now" as a time concept, resulting in an accidental simultaneous reading. In contrast to English, however, the grammar of Polish does not generate a bound reading for past-under-past attitudes. Following Ogihara and Sharvit (2012)

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[29]A similar point pertaining to a concept generator analysis is made by Pearson 2015: 112), who proposes that binding should be preferred because it does not involve the covert structure posited for concept generators.

[30]Note that this reasoning about a preference for bound pronouns also leads us to expect that simultaneous readings are canonically expressed with past-under-past in English, since a bound LF is available in this case, and indeed many previous discussions of SOT in English suggest just that. However, in Experiment 1 we saw higher ratings for present-under-past than for past-under-past sentences in contexts triggering simultaneous readings in English, just like in Polish. As we pointed out above, Experiment 1 did not distinguish between purely simultaneous readings and double access readings for embedded present, as its main purpose was to compare the availability of simultaneous readings for past-under-past sentences in Polish and English, so we leave it to future empirical research whether simultaneous readings under past attitudes are better expressed with present or past in English.

and Sharvit (2018), we assume that this is the difference between "mixed" languages (like Polish) and genuine SOT languages (like English). A question that our analysis does not address is what would distinguish mixed languages from genuine non-SOT languages. We briefly address this question in our concluding section.

9 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 or at the matrix evaluation time. 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 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 readings to the presence of a cessation implicature associated with past tense.

In Sect. 7 of 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, are a challenge for the implicature approach, and cast 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. At the same time, the results of our first experiment reported in Sect. 4 present a potential challenge to the background assumption, widely held in the literature, that there is a clear SOT/non-SOT contrast with regard to attitude complement clauses in the first place. In this experiment, we found that simultaneous interpretations seem to be available in Polish, but to a lesser degree than in English. Hence, rather than positing a binary distinction between languages that show SOT effects in attitude complements and languages that do not, with English belonging to the former class and Polish to the latter, our results support a more refined analysis that can capture gradient variation between languages. As both the implicature approach and certain variants of the structural approach are in principle equipped to do so (see Sect. 4.3 for discussion), the question remains which analysis best captures cross-linguistic differences such as those we observe between English and Polish. As a step forward towards this goal, we tested a prediction made by the implicature approach which was not borne out in our study. This is challenging for the implicature approach, but it does not rule out the possibility that cessation implicatures have a role to play in the interpretation of embedded tense. A possible direction for future research would

be to conduct similar studies in other so-called non-SOT languages. In particular, differences in the availability of simultaneous interpretations of past-under-past between Japanese on the one hand and Hebrew, Russian and, apparently, Polish call for systematic empirical investigation. The implicature approach advanced by Altshuler and Schwarzschild (2013) and Altshuler (2016) builds on an asymmetric entailment relation between present and past tense, which in turn builds on a quantificational approach to tense semantics. However, Sharvit (2014) argues that tense has a pronominal semantics in Polish but a quantificational semantics in Japanese. If this is indeed the case, variation in the availability of simultaneous interpretations in complement clauses might turn out to depend (at least partly) on the difference between pronominal and quantificational tense after all, and a parallel study on embedded cessation implicatures in Japanese might yield different results.[31] The literature on possible variation between pronominal and quantificational tense languages is scarce, but the studies that are available reveal a potentially interesting pattern: tense forms for which a quantificational semantics has been explicitly defended have also been reported to exhibit strict non-SOT in past-under-past complement clauses (see Sharvit 2014 on Japanese, Mucha 2017 on Medumba, Mucha and Fominyam 2017 on Awing, and Chen et al. 2021 on Javanese and Atayal). As is well known, SOT effects in languages like English have been considered an important argument for a pronominal tense analysis, based on the perceived parallel with bound pronouns in the individual domain (e.g. Kratzer 1998). In the analysis we adopted, bound readings in attitude complements depend on a structural SOT deletion mechanism, which is subject to cross-linguistic variation. Languages that have this mechanism in their grammar show the English-type SOT pattern in complement clauses, and this should be independent of whether tense is pronominal or quantificational in a language. However, we have proposed in Sect. 8 that embedded pronominal tense can generally be interpreted via concept generators, and that this construal gives rise to "accidental" simultaneous readings next to the backward-shifted readings of past-under-past sentences. Moreover, no embedded cessation implicature is generated for embedded pronominal past in past-under-past attitude complements. The generalisation that emerges is that whenever a past tense has a pronominal semantics, we expect it to show either SOT or mixed behaviour in past-under-past complement clauses. On the other side of this generalisation, we might hypothesise that all past tenses that exhibit strict non-SOT in complement clauses have quantificational meaning. This pattern, if supported by future research, might well have its cause in embedded cessation implicatures, if these arise with quantificational tense only.

Taking a somewhat broader perspective, we should note that our investigations had a strong focus on the empirical investigation of past-under-past complement clauses. Hence, our findings do not result in a comprehensive account of embedded tense in

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[31] A different perspective was offered to us by an anonymous reviewer, who suggested that the results of our studies on the interpretation of embedded tense in Polish might have been influenced by the participants' L2 knowledge of English and/or their relatively young average age. If this is the case, we might expect to find very similar results in parallel studies on other languages that have previously been described as non-SOT, if the participants speak an SOT language as L2. In accord with the reviewer's suggestion, another interesting route for further research would thus be to look at language contact as well as language change as factors that potentially affect SOT variation.

Polish, as such an account would also need to consider tense in adjunct clauses, and it would have to pay closer attention to present and future forms in embedding environments. A more comprehensive analysis of a closely related language, namely Russian, was proposed in Grønn and von Stechow (2010, 2012), leading to the insight that certain assumptions that seem appropriate for the analysis of tense in attitude complements, such as a relative semantics for the Russian present, might need to be revised in light of cross-linguistic comparison of tense in adjunct clauses. For Polish, a big step in this direction was made in Sharvit (2014), where a comparison of embedded tense in Polish, English and Japanese is provided. We contributed experimental data that address Polish past-under-past attitude complements in particular. We hope to have shown that experimental studies can help us refine our empirical and theoretical accounts of SOT phenomena and shed light on variation within and across languages, and that future experimental work will fill the gaps we have to leave.

Appendix A: Target trials – Experiment 1

A.1 English

(1)   a.   *Context:* Last week, Emma said to Ben: "Milo was sick."
               Emma said that Milo was sick.
       b.   *Context:* Last week, Emma said to Ben: "Milo was sick."
               Emma said that Milo is sick.
       c.   *Context:* Last week, Emma said to Ben: "Milo is sick."
               Emma said that Milo was sick.
       d.   *Context:* Last week, Emma said to Ben: "Milo is sick."
               Emma said that Milo is sick.

(2)   a.   *Context:* Two weeks ago, Oliver said to Ben: "Amy was in London."
               Oliver claimed that Amy was in London.
       b.   *Context:* Two weeks ago, Oliver said to Ben: "Amy was in London."
               Oliver claimed that Amy is in London.
       c.   *Context:* Two weeks ago, Oliver said to Ben: "Amy is in London."
               Oliver claimed that Amy was in London.
       d.   *Context:* Two weeks ago, Oliver said to Ben: "Amy is in London."
               Oliver claimed that Amy is in London.

(3)   a.   *Context:* Last Monday, Liam said to Ben: "Silas was scared."
               Liam said that Silas was scared.
       b.   *Context:* Last Monday, Liam said to Ben: "Silas was scared."
               Liam said that Silas is scared.
       c.   *Context:* Last Monday, Liam said to Ben: "Silas is scared."
               Liam said that Silas was scared.
       d.   *Context:* Last Monday, Liam said to Ben: "Silas is scared."
               Liam said that Silas is scared.

(4)   a.   *Context:* Last weekend, Luna said to Ben: "Mr. Miller was rich."
               Luna claimed that Mr. Miller was rich.

    b.   *Context:* Last weekend, Luna said to Ben: "Mr. Miller was rich."
         Luna claimed that Mr. Miller is rich.

    c.   *Context:* Last weekend, Luna said to Ben: "Mr. Miller is rich."
         Luna claimed that Mr. Miller was rich.

    d.   *Context:* Last weekend, Luna said to Ben: "Mr. Miller is rich."
         Luna claimed that Mr. Miller is rich.

(5)   a.   *Context:* Last week, Levi said to Ben: "Mrs. Smith was a professional athlete."
         Levi said that Mrs. Smith was a professional athlete.

    b.   *Context:* Last week, Levi said to Ben: "Mrs. Smith was a professional athlete."
         Levi said that Mrs. Smith is a professional athlete.

    c.   *Context:* Last week, Levi said to Ben: "Mrs. Smith is a professional athlete."
         Levi said that Mrs. Smith was a professional athlete.

    d.   *Context:* Last week, Levi said to Ben: "Mrs. Smith is a professional athlete."
         Levi said that Mrs. Smith is a professional athlete.

(6)   a.   *Context:* Two weeks ago, David said to Ben: "Jasper's wife was in the hospital."
         David claimed that Jasper's wife was in the hospital.

    b.   *Context:* Two weeks ago, David said to Ben: "Jasper's wife was in the hospital."
         David claimed that Jasper's wife is in the hospital.

    c.   *Context:* Two weeks ago, David said to Ben: "Jasper's wife is in the hospital."
         David claimed that Jasper's wife was in the hospital.

    d.   *Context:* Two weeks ago, David said to Ben: "Jasper's wife is in the hospital."
         David claimed that Jasper's wife is in the hospital.

(7)   a.   *Context:* Last Tuesday, Veronica said to Ben: "Julia was angry with me."
         Veronica said that Julia was angry with her.

    b.   *Context:* Last Tuesday, Veronica said to Ben: "Julia was angry with me."
         Veronica said that Julia is angry with her.

    c.   *Context:* Last Tuesday, Veronica said to Ben: "Julia is angry with me."
         Veronica said that Julia was angry with her.

    d.   *Context:* Last Tuesday, Veronica said to Ben: "Julia is angry with me."
         Veronica said that Julia is angry with her.

(8)   a.   *Context:* Last weekend, my boss said to Ben: "Leo was a smoker."
         My boss claimed that Leo was a smoker.

    b.   *Context:* Last weekend, my boss said to Ben: "Leo was a smoker."
         My boss claimed that Leo is a smoker.

    c.   *Context:* Last weekend, my boss said to Ben: "Leo is a smoker."
         My boss claimed that Leo was a smoker.

    d.   *Context:* Last weekend, my boss said to Ben: "Leo is a smoker."
         My boss claimed that Leo is a smoker.

(9)   a.   *Context:* Last week, Olivia said to Ben: "Iris was nervous."
           Olivia said that Iris was nervous.

        b.   *Context:* Last week, Olivia said to Ben: "Iris was nervous."
           Olivia said that Iris is nervous.

        c.   *Context:* Last week, Olivia said to Ben: "Iris is nervous."
           Olivia said that Iris was nervous.

        d.   *Context:* Last week, Olivia said to Ben: "Iris is nervous."
           Olivia said that Iris is nervous.

(10)   a.   *Context:* Two weeks ago, Isla said to Ben: "Robert was in love with me."
           Isla claimed that Robert was in love with her.

        b.   *Context:* Two weeks ago, Isla said to Ben: "Robert was in love with me."
           Isla claimed that Robert is in love with her.

        c.   *Context:* Two weeks ago, Isla said to Ben: "Robert is in love with me."
           Isla claimed that Robert was in love with her.

        d.   *Context:* Two weeks ago, Isla said to Ben: "Robert is in love with me."
           Isla claimed that Robert is in love with her.

(11)   a.   *Context:* Last Wednesday, Arthur said to Ben: "Claudia was on vacation."
           Arthur said that Claudia was on vacation.

        b.   *Context:* Last Wednesday, Arthur said to Ben: "Claudia was on vacation."
           Arthur said that Claudia is on vacation.

        c.   *Context:* Last Wednesday, Arthur said to Ben: "Claudia is on vacation."
           Arthur said that Claudia was on vacation.

        d.   *Context:* Last Wednesday, Arthur said to Ben: "Claudia is on vacation."
           Arthur said that Claudia is on vacation.

(12)   a.   *Context:* Last weekend, Kai said to Ben: "Ava was in a relationship with Damian."
           Kai claimed that Ava was in a relationship with Damian.

        b.   *Context:* Last weekend, Kai said to Ben: "Ava was in a relationship with Damian."
           Kai claimed that Ava is in a relationship with Damian.

        c.   *Context:* Last weekend, Kai said to Ben: "Ava is in a relationship with Damian."
           Kai claimed that Ava was in a relationship with Damian.

        d.   *Context:*Last weekend, Kai said to Ben: "Ava is in a relationship with Damian."
           Kai claimed that Ava is in a relationship with Damian.

(13)   a.   *Context:* Last week, Felix said to Ben: "Joseph was lonely."
           Felix said that Joseph was lonely.

        b.   *Context:* Last week, Felix said to Ben: "Joseph was lonely."
           Felix said that Joseph is lonely.

        c.   *Context:* Last week, Felix said to Ben: "Joseph is lonely."
           Felix said that Joseph was lonely.

    d.   *Context:* Last week, Felix said to Ben: "Joseph is lonely."
        Felix said that Joseph is lonely.

(14) a.   *Context:* Two weeks ago, Hazel said to Ben: "Charlotte was bored with life."
        Hazel claimed that Charlotte was bored with life.
    b.   *Context:* Two weeks ago, Hazel said to Ben: "Charlotte was bored with life."
        Hazel claimed that Charlotte is bored with life.
    c.   *Context:* Two weeks ago, Hazel said to Ben: "Charlotte is bored with life."
        Hazel claimed that Charlotte was bored with life.
    d.   *Context:* Two weeks ago, Hazel said to Ben: "Charlotte is bored with life."
        Hazel claimed that Charlotte is bored with life.

(15) a.   *Context:* Last Thursday, Cora said to Ben: "Thomas was in AA."
        Cora said that Thomas was in AA.
    b.   *Context:* Last Thursday, Cora said to Ben: "Thomas was in AA."
        Cora said that Thomas is in AA.
    c.   *Context:* Last Thursday, Cora said to Ben: "Thomas is in AA."
        Cora said that Thomas was in AA.
    d.   *Context:* Last Thursday, Cora said to Ben: "Thomas is in AA."
        Cora said that Thomas is in AA.

(16) a.   *Context:* Last weekend, Edward said to Ben: "Mr. Kane was a teacher."
        Edward claimed that Mr. Kane was a teacher.
    b.   *Context:* Last weekend, Edward said to Ben: "Mr. Kane was a teacher."
        Edward claimed that Mr. Kane is a teacher.
    c.   *Context:* Last weekend, Edward said to Ben: "Mr. Kane is a teacher."
        Edward claimed that Mr. Kane was a teacher.
    d.   *Context:* Last weekend, Edward said to Ben: "Mr. Kane is a teacher."
        Edward claimed that Mr. Kane is a teacher.

(17) a.   *Context:* Last week, Amelia said to Ben: "Jack was depressed."
        Amelia said that Jack was depressed.
    b.   *Context:* Last week, Amelia said to Ben: "Jack was depressed."
        Amelia said that Jack is depressed.
    c.   *Context:* Last week, Amelia said to Ben: "Jack is depressed."
        Amelia said that Jack was depressed.
    d.   *Context:* Last week, Amelia said to Ben: "Jack is depressed."
        Amelia said that Jack is depressed.

(18) a.   *Context:* Two weeks ago, Isabella said to Ben: "Mila was unemployed."
        Isabella claimed that Mila was unemployed.
    b.   *Context:* Two weeks ago, Isabella said to Ben: "Mila was unemployed."
        Isabella claimed that Mila is unemployed.
    c.   *Context:* Two weeks ago, Isabella said to Ben: "Mila is unemployed."
        Isabella claimed that Mila was unemployed.

    d.   *Context:* Two weeks ago, Isabella said to Ben: "Mila is unemployed."
       Isabella claimed that Mila is unemployed.

(19)   a.   *Context:* Last Friday, Adrian said to Ben: "Carola was in prison."
       Adrian said that Carola was in prison.
    b.   *Context:* Last Friday, Adrian said to Ben: "Carola was in prison."
       Adrian said that Carola is in prison.
    c.   *Context:* Last Friday, Adrian said to Ben: "Carola is in prison."
       Adrian said that Carola was in prison.
    d.   *Context:* Last Friday, Adrian said to Ben: "Carola is in prison."
       Adrian said that Carola was in prison.

(20)   a.   *Context:* Last weekend, Oscar said to Ben: "Matilda was injured."
       Oscar claimed that Matilda was injured.
    b.   *Context:* Last weekend, Oscar said to Ben: "Matilda was injured."
       Oscar claimed that Matilda is injured.
    c.   *Context:* Last weekend, Oscar said to Ben: "Matilda is injured."
       Oscar claimed that Matilda was injured.
    d.   *Context:* Last weekend, Oscar said to Ben: "Matilda is injured."
       Oscar claimed that Matilda is injured.

(21)   a.   *Context:* Last week, Finn said to Ben: "Ethan was a coffee-addict."
       Finn said that Ethan was a coffee-addict.
    b.   *Context:* Last week, Finn said to Ben: "Ethan was a coffee-addict."
       Finn said that Ethan is a coffee-addict.
    c.   *Context:* Last week, Finn said to Ben: "Ethan is a coffee-addict."
       Finn said that Ethan was a coffee-addict.
    d.   *Context:* Last week, Finn said to Ben: "Ethan is a coffee-addict."
       Finn said that Ethan is a coffee-addict.

(22)   a.   *Context:* Two weeks ago, Antony said to Ben: "Henry was too fat."
       Antony claimed that Henry was too fat.
    b.   *Context:* Two weeks ago, Antony said to Ben: "Henry was too fat."
       Antony claimed that Henry is too fat.
    c.   *Context:* Two weeks ago, Antony said to Ben: "Henry is too fat."
       Antony claimed that Henry was too fat.
    d.   *Context:* Two weeks ago, Antony said to Ben: "Henry is too fat."
       Antony claimed that Henry is too fat.

(23)   a.   *Context:* Last Saturday, Maya said to Ben: "Boris was mourning."
       Maya said that Boris was mourning.
    b.   *Context:* Last Saturday, Maya said to Ben: "Boris was mourning."
       Maya said that Boris is mourning.
    c.   *Context:* Last Saturday, Maya said to Ben: "Boris is mourning."
       Maya said that Boris was mourning.
    d.   *Context:* Last Saturday, Maya said to Ben: "Boris is mourning."
       Maya said that Boris is mourning.

(24)   a.   *Context:* Last weekend, Amara said to Ben: "Jayden was on parental
       leave."
       Amara claimed that Jayden was on parental leave.

b. *Context:* Last weekend, Amara said to Ben: "Jayden was on parental leave."
Amara claimed that Jayden is on parental leave.

c. *Context:* Last weekend, Amara said to Ben: "Jayden is on parental leave."
Amara claimed that Jayden was on parental leave.

d. *Context:* Last weekend, Amara said to Ben: "Jayden is on parental leave."
Amara claimed that Jayden is on parental leave.

A.2 Polish

(1)   a.   *Context:* W zeszłym tygodniu Kalina powiedziała: "Eryk był chory".
Kalina powiedziała, że Eryk był chory.

       b.   *Context:* W zeszłym tygodniu Kalina powiedziała: "Eryk był chory".
Kalina powiedziała, że Eryk jest chory.

       c.   *Context:* W zeszłym tygodniu Kalina powiedziała: "Eryk jest chory".
Kalina powiedziała, że Eryk był chory.

       d.   *Context:* W zeszłym tygodniu Kalina powiedziała: "Eryk jest chory".
Kalina powiedziała, że Eryk jest chory.

(2)   a.   *Context:* Dwa tygodnie temu Piotr powiedział: "Joanna była w Londynie".
Piotr stwierdził, że Joanna była w Londynie.

       b.   *Context:* Dwa tygodnie temu Piotr powiedział: "Joanna była w Londynie".
Piotr stwierdził, że Joanna jest w Londynie.

       c.   *Context:* Dwa tygodnie temu Piotr powiedział: "Joanna jest w Londynie".
Piotr stwierdził, że Joanna była w Londynie.

       d.   *Context:* Dwa tygodnie temu Piotr powiedział: "Joanna jest w Londynie".
Piotr stwierdził, że Joanna jest w Londynie.

(3)   a.   *Context:* W zeszły poniedziałek Leon powiedział: "Paweł był przestraszony".
Leon powiedział, że Paweł był przestraszony.

       b.   *Context:* W zeszły poniedziałek Leon powiedział: "Paweł był przestraszony".
Leon powiedział, że Paweł jest przestraszony.

       c.   *Context:* W zeszły poniedziałek Leon powiedział: "Paweł jest przestraszony".
Leon powiedział, że Paweł był przestraszony.

       d.   *Context:* W zeszły poniedziałek Leon powiedział: "Paweł jest przestraszony".
Leon powiedział, że Paweł jest przestraszony.

(4)   a.   *Context:* W zeszły weekend Pola powiedziała: "Pan Kowalski był bogaty".
             Pola stwierdziła, że Pan Kowalski był bogaty.

       b.   *Context:* W zeszły weekend Pola powiedziała: "Pan Kowalski był bogaty".
             Pola stwierdziła, że Pan Kowalski jest bogaty.

       c.   *Context:* W zeszły weekend Pola powiedziała: "Pan Kowalski jest bogaty".
             Pola stwierdziła, że Pan Kowalski był bogaty.

       d.   *Context:* W zeszły weekend Pola powiedziała: "Pan Kowalski jest bogaty".
             Pola stwierdziła, że Pan Kowalski jest bogaty.

(5)   a.   *Context:* W zeszłym tygodniu Filip powiedział: "Pan Nowak był zawodowym lekkoatletą".
             Filip powiedział, że Pan Nowak był zawodowym lekkoatletą.

       b.   *Context:* W zeszłym tygodniu Filip powiedział: "Pan Nowak był zawodowym lekkoatletą".
             Filip powiedział, że Pan Nowak jest zawodowym lekkoatletą.

       c.   *Context:* W zeszłym tygodniu Filip powiedział: "Pan Nowak jest zawodowym lekkoatletą".
             Filip powiedział, że Pan Nowak był zawodowym lekkoatletą.

       d.   *Context:* W zeszłym tygodniu Filip powiedział: "Pan Nowak jest zawodowym lekkoatletą".
             Filip powiedział, że Pan Nowak jest zawodowym lekkoatletą.

(6)   a.   *Context:* Dwa tygodnie temu Dawid powiedział: "Żona Kacpra była w szpitalu".
             Dawid stwierdził, że żona Kacpra była w szpitalu.

       b.   *Context:* Dwa tygodnie temu Dawid powiedział: "Żona Kacpra była w szpitalu".
             Dawid stwierdził, że żona Kacpra jest w szpitalu.

       c.   *Context:* Dwa tygodnie temu Dawid powiedział: "Żona Kacpra jest w szpitalu".
             Dawid stwierdził, że żona Kacpra była w szpitalu.

       d.   *Context:* Dwa tygodnie temu Dawid powiedział: "Żona Kacpra jest w szpitalu".
             Dawid stwierdził, że żona Kacpra jest w szpitalu.

(7)   a.   *Context:* W zeszły wtorek Weronika powiedziała: "Julia była zła na swoją siostrę".
             Weronika powiedziała, że Julia była zła na swoją siostrę.

       b.   *Context:* W zeszły wtorek Weronika powiedziała: "Julia była zła na swoją siostrę".
             Weronika powiedziała, że Julia jest zła na swoją siostrę.

       c.   *Context:* W zeszły wtorek Weronika powiedziała: "Julia jest zła na swoją siostrę".
             Weronika powiedziała, że Julia była zła na swoją siostrę.

d.   *Context:* W zeszły wtorek Weronika powiedziała: "Julia jest zła na swoją siostrę".
Weronika powiedziała, że Julia jest zła na swoją siostrę.

(8)   a.   *Context:* W zeszły weekend Julian powiedział: "Szymon był palaczem".
Julian stwierdził, że Szymon był palaczem.

b.   *Context:* W zeszły weekend Julian powiedział: "Szymon był palaczem".
Julian stwierdził, że Szymon jest palaczem.

c.   *Context:* W zeszły weekend Julian powiedział: "Szymon jest palaczem".
Julian stwierdził, że Szymon był palaczem.

d.   *Context:* W zeszły weekend Julian powiedział: "Szymon jest palaczem".
Julian stwierdził, że Szymon jest palaczem.

(9)   a.   *Context:* W zeszłym tygodniu Ewelina powiedziała: "Magda była nerwowa".
Ewelina powiedziała, że Magda była nerwowa.

b.   *Context:* W zeszłym tygodniu Ewelina powiedziała: "Magda była nerwowa".
Ewelina powiedziała, że Magda jest nerwowa.

c.   *Context:* W zeszłym tygodniu Ewelina powiedziała: "Magda jest nerwowa".
Ewelina powiedziała, że Magda była nerwowa.

d.   *Context:* W zeszłym tygodniu Ewelina powiedziała: "Magda jest nerwowa".
Ewelina powiedziała, że Magda jest nerwowa.

(10)   a.   *Context:* Dwa tygodnie temu Ewa powiedziała: "Robert był zakochany w Monice".
Ewa stwierdziła, że Robert był zakochany w Monice.

b.   *Context:* Dwa tygodnie temu Ewa powiedziała: "Robert był zakochany w Monice".
Ewa stwierdziła, że Robert jest zakochany w Monice.

c.   *Context:* Dwa tygodnie temu Ewa powiedziała: "Robert jest zakochany w Monice".
Ewa stwierdziła, że Robert był zakochany w Monice.

d.   *Context:* Dwa tygodnie temu Ewa powiedziała: "Robert jest zakochany w Monice".
Ewa stwierdziła, że Robert jest zakochany w Monice.

(11)   a.   *Context:* W zeszłą środę Artur powiedział: "Klaudia była na wakacjach".
Artur powiedział, że Klaudia była na wakacjach.

b.   *Context:* W zeszłą środę Artur powiedział: "Klaudia była na wakacjach".
Artur powiedział, że Klaudia jest na wakacjach.

c.   *Context:* W zeszłą środę Artur powiedział: "Klaudia jest na wakacjach".
Artur powiedział, że Klaudia była na wakacjach.

d.   *Context:* W zeszłą środę Artur powiedział: "Klaudia jest na wakac-
jach".
Artur powiedział, że Klaudia jest na wakacjach.

(12)   a.   *Context:* W zeszły weekend Oskar powiedział: "Kasia była w związku
z Damianem".
Oskar stwierdził, że Kasia była w związku z Damianem.

b.   *Context:*W zeszły weekend Oskar powiedział: "Kasia była w związku
z Damianem".
Oskar stwierdził, że Kasia jest w związku z Damianem.

c.   *Context:* W zeszły weekend Oskar powiedział: "Kasia jest w związku z
Damianem".
Oskar stwierdził, że Kasia była w związku z Damianem.

d.   *Context:* W zeszły weekend Oskar powiedział: "Kasia jest w związku z
Damianem".
Oskar stwierdził, że Kasia jest w związku z Damianem.

(13)   a.   *Context:* W zeszłym tygodniu Jacek powiedział: "Józef był samotny".
Jacek powiedział, że Józef był samotny.

b.   *Context:* W zeszłym tygodniu Jacek powiedział: "Józef był samotny".
Jacek powiedział, że Józef jest samotny.

c.   *Context:* W zeszłym tygodniu Jacek powiedział: "Józef jest samotny".
Jacek powiedział, że Józef był samotny.

d.   *Context:* W zeszłym tygodniu Jacek powiedział: "Józef jest samotny".
Jacek powiedział, że Józef jest samotny.

(14)   a.   *Context:* Dwa tygodnie temu Agata powiedziała: "Iwona była znudzona
życiem".
Agata stwierdziła, że Iwona była znudzona życiem.

b.   *Context:* Dwa tygodnie temu Agata powiedziała: "Iwona była znudzona
życiem".
Agata stwierdziła, że Iwona jest znudzona życiem.

c.   *Context:* Dwa tygodnie temu Agata powiedziała: "Iwona jest znudzona
życiem".
Agata stwierdziła, że Iwona była znudzona życiem.

d.   *Context:* Dwa tygodnie temu Agata powiedziała: "Iwona jest znudzona
życiem".
Agata stwierdziła, że Iwona jest znudzona życiem.

(15)   a.   *Context:* W zeszły czwartek Wanda powiedziała: "Tomasz był w AA".
Wanda powiedziała, że Tomasz był w AA.

b.   *Context:* W zeszły czwartek Wanda powiedziała: "Tomasz był w AA".
Wanda powiedziała, że Tomasz jest w AA.

c.   *Context:* W zeszły czwartek Wanda powiedziała: "Tomasz jest w AA".
Wanda powiedziała, że Tomasz był w AA.

d.   *Context:* W zeszły czwartek Wanda powiedziała: "Tomasz jest w AA".
Wanda powiedziała, że Tomasz jest w AA.

(16) a. *Context:* W zeszły weekend Edward powiedział: "Pan Gajewski był nauczycielem".
          Edward stwierdził, że Pan Gajewski był nauczycielem.
      b. *Context:* W zeszły weekend Edward powiedział: "Pan Gajewski był nauczycielem".
          Edward stwierdził, że Pan Gajewski jest nauczycielem.
      c. *Context:* W zeszły weekend Edward powiedział: "Pan Gajewski jest nauczycielem".
          Edward stwierdził, że Pan Gajewski był nauczycielem.
      d. *Context:* W zeszły weekend Edward powiedział: "Pan Gajewski jest nauczycielem".
          Edward stwierdził, że Pan Gajewski jest nauczycielem.

(17) a. *Context:* W zeszłym tygodniu Natasza powiedziała: "Henryk miał depresję".
          Natasza powiedziała, że Henryk miał depresję.
      b. *Context:* W zeszłym tygodniu Natasza powiedziała: "Henryk miał depresję".
          Natasza powiedziała, że Henryk ma depresję.
      c. *Context:* W zeszłym tygodniu Natasza powiedziała: "Henryk ma depresję".
          Natasza powiedziała, że Henryk miał depresję.
      d. *Context:* W zeszłym tygodniu Natasza powiedziała: "Henryk ma depresję".
          Natasza powiedziała, że Henryk ma depresję.

(18) a. *Context:* Dwa tygodnie temu Dorota powiedziała: "Milena była bezrobotna".
          Dorota stwierdziła, że Milena była bezrobotna.
      b. *Context:* Dwa tygodnie temu Dorota powiedziała: "Milena była bezrobotna".
          Dorota stwierdziła, że Milena jest bezrobotna.
      c. *Context:* Dwa tygodnie temu Dorota powiedziała: "Milena jest bezrobotna".
          Dorota stwierdziła, że Milena była bezrobotna.
      d. *Context:* Dwa tygodnie temu Dorota powiedziała: "Milena jest bezrobotna".
          Dorota stwierdziła, że Milena jest bezrobotna.

(19) a. *Context:* W zeszły piątek Adrian powiedział: "Karolina była w więzieniu".
          Adrian powiedział, że Karolina była w więzieniu.
      b. *Context:* W zeszły piątek Adrian powiedział: "Karolina była w więzieniu".
          Adrian powiedział, że Karolina jest w więzieniu.
      c. *Context:* W zeszły piątek Adrian powiedział: "Karolina jest w więzieniu".
          Adrian powiedział, że Karolina była w więzieniu.

d. *Context:* W zeszły piątek Adrian powiedział: "Karolina jest w więzieniu".
Adrian powiedział, że Karolina jest w więzieniu.

(20) a. *Context:* W zeszły weekend Kamil powiedział: "Matylda była ranna".
Kamil stwierdził, że Matylda była ranna.

b. *Context:* W zeszły weekend Kamil powiedział: "Matylda była ranna".
Kamil stwierdził, że Matylda jest ranna.

c. *Context:* W zeszły weekend Kamil powiedział: "Matylda jest ranna".
Kamil stwierdził, że Matylda była ranna.

d. *Context:* W zeszły weekend Kamil powiedział: "Matylda jest ranna".
Kamil stwierdził, że Matylda jest ranna.

(21) a. *Context:* W zeszłym tygodniu Jerzy powiedział: "Tadeusz był uzależniony od kawy".
Jerzy powiedział, że Tadeusz był uzależniony od kawy.

b. *Context:* W zeszłym tygodniu Jerzy powiedział: "Tadeusz był uzależniony od kawy".
Jerzy powiedział, że Tadeusz jest uzależniony od kawy.

c. *Context:* W zeszłym tygodniu Jerzy powiedział: "Tadeusz jest uzależniony od kawy".
Jerzy powiedział, że Tadeusz był uzależniony od kawy.

d. *Context:* W zeszłym tygodniu Jerzy powiedział: "Tadeusz jest uzależniony od kawy".
Jerzy powiedział, że Tadeusz jest uzależniony od kawy.

(22) a. *Context:* Dwa tygodnie temu Antoni powiedział: "Dariusz był otyły".
Antoni stwierdził, że Dariusz był otyły.

b. *Context:* Dwa tygodnie temu Antoni powiedział: "Dariusz był otyły".
Antoni stwierdził, że Dariusz jest otyły.

c. *Context:* Dwa tygodnie temu Antoni powiedział: "Dariusz jest otyły".
Antoni stwierdził, że Dariusz był otyły.

d. *Context:* Dwa tygodnie temu Antoni powiedział: "Dariusz jest otyły".
Antoni stwierdził, że Dariusz jest otyły.

(23) a. *Context:* W zeszłą sobotę Anka powiedziała: "Borys był w żałobie".
Anka powiedziała, że Borys był w żałobie.

b. *Context:* W zeszłą sobotę Anka powiedziała: "Borys był w żałobie".
Anka powiedziała, że Borys jet w żałobie.

c. *Context:* W zeszłą sobotę Anka powiedziała: "Borys jest w żałobie".
Anka powiedziała, że Borys był w żałobie.

d. *Context:* W zeszłą sobotę Anka powiedziała: "Borys jest w żałobie".
Anka powiedziała, że Borys jest w żałobie.

(24) a. *Context:* W zeszły weekend Martyna powiedziała: "Roman był na urlopie wychowawczym".
Martyna stwierdziła, że Roman był na urlopie wychowawczym.

b. *Context:* W zeszły weekend Martyna powiedziała: "Roman był na urlopie wychowawczym".
Martyna stwierdziła, że Roman jest na urlopie wychowawczym.

    c.   *Context:* W zeszły weekend Martyna powiedziała: "Roman jest na urlopie wychowawczym".
         Martyna stwierdziła, że Roman był na urlopie wychowawczym.
    d.   *Context:* W zeszły weekend Martyna powiedziała: "Roman jest na urlopie wychowawczym".
         Martyna stwierdziła, że Roman jest na urlopie wychowawczym.

Appendix B: Target trials – Experiment 3

(1)   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. He doesn't think that Kalina or Aleksander are sick.'
         ↝ *Według Eryka, Kalina i Aleksander obydwoje są chorzy.*
         'According to Eryk, both Kalina and Aleksander are sick.'
     c.   Rozmawiałam ostatnio z Erykiem. Uważał, że Kalina była chora.
         'I talked to Eryk recently. He thought that Kalina was sick.'
         ↝ *Według Eryka, Kalina nie była już wtedy chora.*
         'According to Eryk, Kalina was not sick anymore then.'
     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, Kalina was still sick then. '

(2)   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 był już wtedy w Londynie.*
         'According to Joanna, Piotr was not in London anymore then.'

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 był wtedy nadal w Londynie.*
    'According to Joanna, Piotr was still in London then.'

(3) 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, Jan was not married anymore then.'
     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, Jan was still married then.'

(4) 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, Marek wasn't rich anymore then.'
     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, Marek was still rich then.'

(5) a. Rozmawiałam ostatnio z Barbarą. Sądzi, że Filip lub Milena są zawodowymi lekkoatletami.
         'I talked to Barbara recently. She thinks that Filip or Milena 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. She 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. She thought that Milena was a professional athlete.'
         ⤳*Według Barbary, Milena nie była już wtedy zawodową lekkoatletką.*
         'According to Barbara, Milena was not a professional athlete anymore then.'

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

(6)   a.   Widziałam ostatnio Dawida. Twierdzi, że Monika lub Sebastian są w szpitalu.
         'I saw Dawid recently. He claims that Monika or 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, Sebastian was not in the hospital anymore then.'

    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, Sebastian was still in the hospital then.'

(7)   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, her mother was not angry with her anymore then.'

    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, her mother was still angry with her then.'

(8)   a.   Wpadłam ostatnio na Szymona. Sądzi, że Anna lub Tomasz są palaczami.

'I bumped into Szymon recently. He thinks that Anna or Tomasz 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 Tomasz 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 Tomasz are smokers.'

⇝*Według Szymona, Anna i Tomasz obydwoje są palaczami.*

'According to Szymon, both Anna and Tomasz 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, Tomasz was not a smoker anymore then.'

    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, Tomasz was still a smoker then.'

(9)   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 claimed that Magda was nervous.'

⤳*Według Eweliny, Magda nie była już wtedy nerwowa.*

'According to Ewelina, Magda was not nervous anymore then.'

        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, Magda was still nervous then.'

(10)   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 him.'

⤳*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 him.'

        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 him.'

⤳*Według Dariusza, Ewa i Robert obydwoje są w nim zakochani.*

'According to Dariusz, both Ewa and Robert were in love with him.'

        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, Ewa was not in love with him anymore then.'

        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, Ewa was still in love with him then.'

(11) 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 było już wtedy na wakacjach.*
          'According to Agnieszka, Artur was not on vacation anymore then.'

      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, Artur was still on vacation then.'

(12) 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 somebody.'
          ⤳*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 somebody.'

      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 somebody.'
          ⤳*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, Kasia was not in a relationship with somebody anymore then.'

      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, Kasia was still in a relationship with somebody then.'

(13)   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, Krystian was not lonely anymore then.'

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, Krystian was still lonely then.'

(14)   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, Iwona was not bored with life anymore then.'

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, Iwona was still bored with life then.'

(15)   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, her brother was not in AA anymore then.'

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, her brother was still in AA then.'

(16)   a.   Wpadłam ostatnio na Edwarda. Uważa, że Pan Nowak lub Pani Kowalska 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 nauczycielami.*
'According to Edward, both Mr. Nowak and Mrs. Kowalska are teachers.'

c.   Wpadłam ostatnio na Edwarda. Uważał, że Pan Nowak był nauczycielem.
'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, Mr. Nowak was not a teacher anymore then.'

    d.   Wpadłam ostatnio na Edwarda. Nie uważał, że Pan Nowak był nauczycielem.

          '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, Mr. Nowak was still a teacher then.'

(17)   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, Natasza was not depressed anymore then.'

    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, Natasza was still depressed then.'

(18)   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, Kacper was not unemployed anymore then.'

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, Kacper was still unemployed then.'

(19)   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, Karola was not in prison anymore then.'

       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, Karola was still in prison then.'

(20)   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, Kamil was not injured anymore then.'

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

(21) 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, Jadwiga was not a coffee-addict anymore then.'

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, Jadwiga was still a coffee-addict then.'

(22) a. Widziałam ostatnio Antoninę. Uważa, że Krystyna lub Józef są otyli.
'I saw Antonina recently. He thinks that Krystyna or Józef are obese.'
⤳*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 obese.'

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
obese.'
⤳*Według Antoniny, Krystyna i Józef obydwoje są otyli.*
'According to Antonina, both his Krystyna and Józef are obese.'

c. Widziałam ostatnio Antoninę. Uważała, że Józef był otyły.
'I saw Antonina recently. He thought that Józef was obese.'
⤳*Według Antoniny, Józef nie był już wtedy otyły.*
'According to Antonina, Józef was not obese anymore then.'

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

(23)   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.’

⤳ *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, Anka was not mourning anymore then.’

       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, Anka was still mourning then.’

(24)   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, Martyna was not on parental leave anymore then.’

    d.   Wpadłam ostatnio na Romana. Nie twierdził, że Martyna była na ur-
lopie 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, Martyna was still on parental leave then.'

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