Questioning and time

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The core data

- Past tense in statives triggers the inference that the expressed state does not hold at the present (henceforth cessation inference):

(1) #Two was prime

(2) #The students know that two was prime

  - $\rightsquigarrow$ 2 has been prime in the past and is non-prime at the present
  - This contradicts common knowledge (math. properties are eternal).
  - Therefore, (1) and (7) are odd (cf. Magri 2009).

- The oddity of (1) and (2) contrasts with the naturalness of (3) and (4), which come with interrogative force.

(3) Was two prime again?

(4) Do you know which number was prime?

  - (3) has a reading in which it does not imply that 2 ceased to be prime.
  - Likewise, (4) has a reading in which it does not imply any number to have been prime at one time and non-prime later.

Contextual requirements

(3) Was two prime again?

(4) Do you know which number was prime?

- (3) is a "remind-me" question: the questioner conveys that she knew the answer at an earlier time. Therefore, questions with an unknown answer are infelicitous as remind-me questions:

  (5) #Was the Goldbach conjecture true again?

- (4) requires contextual support for the non-deviant reading to come out, for instance, the context in (6).

  (6) Math test context: Students have to tell which number of the pair $\langle 1, 2 \rangle$ is prime. After the test, a student asks her classmate the question in (4).

Not a uniform phenomenon

(3) Was two prime again?

(4) Do you know which number was prime?

- It is not simply the case that questions don't trigger cessation inferences: (7) is deviant, as it implies that two is no longer prime or no longer not prime.

  (7) #Do you know whether two was a prime?

- The contrast between (3) and (7) shows that the natural readings of (3) and (4) have different sources.
- Our main claims:
  - The natural reading of (3) is a reference time phenomeon.
  - The natural reading of (4) is owed to the **which**-phrase, which can range over the members of a conceptual cover.

Reference time phenomena

- Ordinary statives can be claims about a contextually given past time:

(8) Q: What did you notice when you looked into the room?
A: There was a book on the table. It was in Russian.
↛ The book on the table ceased to be in Russian

- This doesn't work in the same way for analytic statives: (9-Q) fixes a past reference time (the time after the first stop of the bus); still, the past tense version of the last conjunct of (9-A) is odd.

(9) Q: Why are you so sure that exactly thirty-three seats were empty after the first stop?
A: Well, the bus I drove that day had forty seats, seven passengers entered the bus at the first stop, and forty minus seven {is | #was} thirty-three.

- We will show under which conditions analytic statives can be restricted to a past reference time.

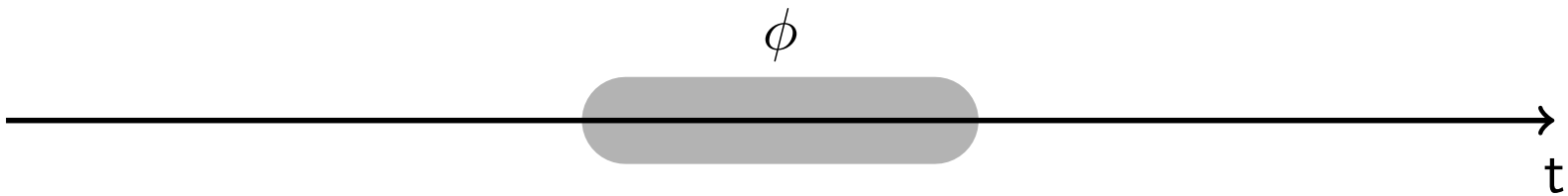
Tense semantics: cessation inferences are scalar implicatures

- Cessation inferences are scalar implicatures (Musan 1995; Altshuler and Schwarzschild 2013; henceforth A&S).
- Following A&S, we assume the Temporal Profile of Statives:

(10) The Temporal Profile of Statives (TPS)

For any tenseless stative clause ϕ and world w, if ϕ is true in w at moment m, then there is a moment m' preceding m at which ϕ is true in w and there is a moment m'' following m at which ϕ is true in w.

- This means that every (convex) interval $\{m : \phi \text{ is true in } w \text{ at moment } m\}$ is open on both sides:



Tense semantics: past and present tense

- The tense operators past and present denote the following functions:

  $[\![\text{PAST}]\!] = [\lambda C \lambda p \lambda t \lambda w . \exists t' (t' \prec t \wedge t' \in C \wedge p(t')(w) = 1)]$

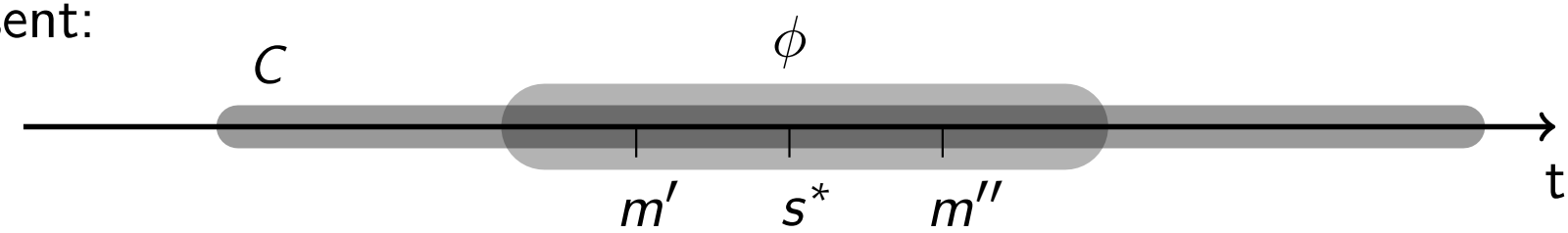
  $[\![\text{PRESENT}]\!] = [\lambda C \lambda p \lambda t \lambda w . \exists t' (t' = t \wedge t' \in C \wedge p(t')(w) = 1)]$

  - C is a domain restriction representing the reference time.
  - In syntax, tense is thus adjoined to a syntactic variable that is assigned the value C by the context.

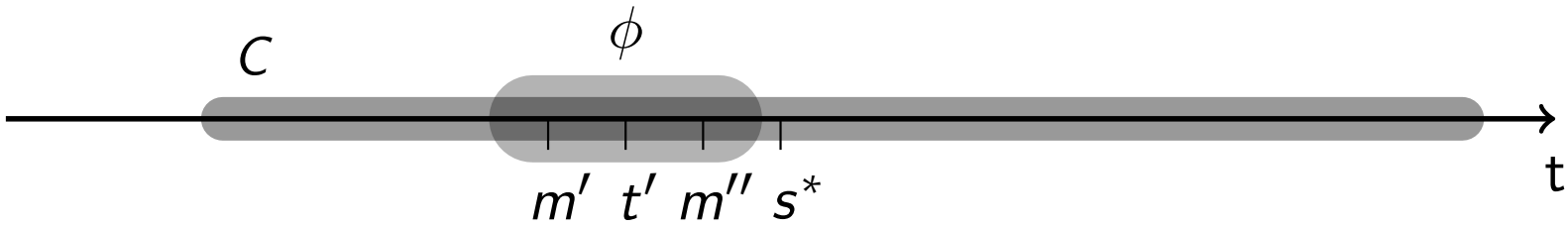
- It follows from these assumptions that for any (left-open) C that includes the speech time s^*, $[\![\text{PRESENT}]\!](C)([\![\phi]\!])(s^*)$ will asymmetrically entail $[\![\text{PAST}]\!](C)([\![\phi]\!])(s^*)$ in a non-trivial way.

The logical strength of past and present tense

Present:



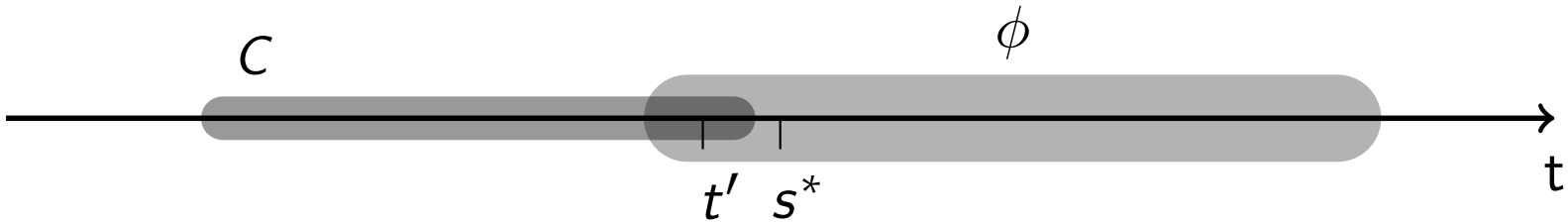
Past:



- Given the TPS, if $[\![\text{PRESENT}]\!](C)([\![\phi]\!])(s^*)$ is true (in the world of evaluation) then ϕ is true at a moment m' preceding s^*; hence $[\![\text{PAST}]\!](C)([\![\phi]\!])(s^*)$ is also true, since m' validates the existential formula in this proposition.
- Conversely, assuming continuity of time, if $[\![\text{PAST}]\!](C)([\![\phi]\!])(s^*)$ is true then the TPS can always be satisfied without ϕ being true at s^*.
- Thus, if a speaker conveys $[\![\text{PAST}]\!](C)([\![\phi]\!])(s^*)$ she implicates that the stronger alternative $[\![\text{PRESENT}]\!](C)([\![\phi]\!])(s^*)$ is false.

Reference time effects

- If a domain restriction C doesn't include the speech time s^*, $[\![\text{PRESENT}]\!](C)([\![\phi]\!])(s^*)$ is trivially false, since there is no point in time t' such that $t' = s^*$ and $t' \in C$:



- Consequently, if $s^* \notin C$ the cessation implicature of $[\![\text{PAST}]\!](C)([\![\phi]\!])(s^*)$, viz. that $[\![\text{PRESENT}]\!](C)([\![\phi]\!])(s^*)$ is false at the world of evaluation, is trivially true, i.e. vacuous.
- Thus, fixing a past reference time trivializes the cessation implicature of past statives.

Questions semantics

- We adopt the following rather standard assumptions about questions:
  - (i) The semantic value of a question is the set of its possible answers.
  - (ii) To ask a question is to state a request, and to know a question is to know the true answers to it.
  - (iii) A question q is parsed as as [ANS q] as the complement of **know**, and as [QUEST q] as a matrix clause.
- The function of ans is to map an answer set Q to the conjunction of all true members of Q.
- For QUEST, we furthermore assume that it is (syntactically) decomposed into an imperative operator MAKE and a 'I know the answer' component (cf. Sauerland and Yatsushiro 2017):

  (11) MAKE [I-KNOW [ANS q]]

- Thus, QUEST maps an answer set Q to the proposition that the speaker requests that the hearer make known all the true members of Q.

Explanation of the data: the deviant examples

- We assume that scalar implicatures are derived in grammar by a syntactically represented exhaustification operator, exh (Chierchia, 2004; Fox, 2007; Chierchia et al., 2012).
- Thus, we assume that (1) is parsed as given in (a), where A is the alternative set in (b).

(1) #Two was prime.

a. exh_A [two was prime]

b. $A = \left\{ \begin{array}{l} \lambda w.\, \text{prime}_w(2) \text{ at } t' \prec s^* \\ \lambda w.\, \text{prime}_w(2) \text{ at } s^* \end{array} \right\}$

- On these assumptions, (1) denotes a contextual contradiction:

$[\![(11a)]\!] = \lambda w.\, \text{prime}_w(2) \text{ at } t' \prec s^* \wedge \neg\, \text{prime}_w(2) \text{ at } s^*$

Explanation of the data: the deviant examples (cont'd)

- To account for the oddity of (2), we assume the parse in (a), where A is the set in (b) and $X = [\![\textbf{the students}]\!]$.

  (2) #The students know that two was prime.

  a. exh_A [the students [know [that two was prime]]]

  b. $A = \left\{ \begin{array}{l} [\![\textbf{know}]\!](\lambda w.\, \text{prime}_w(2) \text{ at } t' \prec s^*)(X) \\ [\![\textbf{know}]\!](\lambda w.\, \text{prime}_w(2) \text{ at } s^*)(X) \end{array} \right\}$

- Next, we assume that the factive "presupposition" of **know** is an entailment (Romoli, 2012):

  (12) $[\![\textbf{know}]\!](\phi)(x) = \lambda w.\text{BEL}^x_w(\phi) \wedge \phi(w)$

- Then, $[\![(11a)]\!]$ entails the following disjunction:

  $(\lambda w.\, \text{BEL}^x_w(\lambda w'.\, \text{prime}_{w'}(2) \text{ at } t' \prec s^*) \wedge \neg\, \text{BEL}^x_w(\lambda w'.\text{prime}_{w'}(2) \text{ at } s^*))$
  $\vee(\lambda w.\, \text{prime}_w(2) \text{ at } t' \prec s^* \wedge \neg\, \text{prime}_w(2) \text{ at } s^*)$

  - Both disjuncts are contextual contradictions.
  - First disjunct: if BEL^x_w entails that being prime or not is eternal.

Explanation of the data: the deviant examples (cont'd)

- Likewise, (7) has the parse in (a) and the alternative set in (b).

(7) #The students know whether two was prime.

a. exh_A [the students [know [ans [whether two was prime]]]]

b. $A = \left\{ \begin{array}{l} [\![\textbf{know}]\!]\,(\text{ANS}_w(\text{Q}(\lambda w'.\,\text{prime}_{w'}(2)\,\text{at}\,t' \prec s^*)))(X) \\ [\![\textbf{know}]\!]\,(\text{ANS}_w(\text{Q}(\lambda w'.\,\text{prime}_{w'}(2)\,\text{at}\,s^*)))(X) \end{array} \right\}$

- Thus, because of the fact in (13), the oddity of (7) follows in the same way as the oddity of (2).

(13) $\text{ANS}_w(\text{Q}(\phi)) = \left\{ \begin{array}{ll} \phi & \text{if } \phi(w) = 1 \\ \lambda w'.\neg\phi(w') & \text{otherwise} \end{array} \right.$

The non-deviant examples – **wh**-questions

- What's crucial for (4) to have a natural reading is that the embedded clause is a **which**-question.

  (4) Do you know which number was prime?

- Importantly, **which**-phrases can range over the members of a conceptual cover (Aloni, 2001).
- Conceptual covers are "methods of identification." Technically, they are sets C of individual concepts f such that in each world w each individual d (of the discourse domain D) is the instantiation of one and only one individual concept in that world:

  (14) $\forall w \forall d \in D \, \exists! f \in C : f(w) = d$

- This means that the embedded **wh**-question in (4) can have the following denotation, where $g(\mathrm{C})$ is a conceptual cover:

  (15) $[\![\textbf{which}_{\mathrm{C}} \textbf{ number was prime}]\!]^g =$
  $\{p \mid \exists f \in g(\mathrm{C}). \, p = [\lambda w. \, \mathrm{prime}_w(f(w)) \text{ at } t' \prec s^*]\}$

The conceptual cover of our example

- In our math test context (students have to tell which number of the pair $\langle 1, 2\rangle$ is prime), the discourse domain is the set in (16a), and we assume that the set C_D in (16b) is a contextually available conceptual cover of this domain.

(16) a. $D = \{1, 2\}$

b. $C_D = \left\{ \begin{array}{l} \lambda w.\,\text{the odd no on the test sheet in } w \\ \lambda w.\,\text{the even no on the twst sheet in } w \end{array} \right\}$

- Thus, if $g(\mathrm{C}) = C_D$, the **wh**-question of (4) denotes the following set.

(17) $[\![\textbf{which}_{\mathrm{C}}\ \textbf{number was prime}]\!]^g =$
$\left\{ \begin{array}{l} \lambda w.\,\text{prime}_w(\text{the odd no on the test sheet in } w) \text{ at } t' \prec s^* \\ \lambda w.\,\text{prime}_w(\text{the even no on the test sheet in } w) \text{ at } t' \prec s^* \end{array} \right\}$

- Importantly, sentences that express the answer propositions in (17) do not trigger an odd cessation implicature:

(18) The {odd | even} number on the test sheet was prime.

Testing our hypothesis

- A variant of (4) that cannot be interpreted relative to a conceptual cover has a deviant cessation implicature:

(19) a. #Do you know which number of one and two was prime?
b. #The smallest even natural number was prime

- Moreover, (4) and (18) do have a cessation implicature, viz. that the test sheet ceased to be present, which is denied below:

(20) Take a look at the math test sheet here.
a. Do you know which number {is | #was} prime?
b. The odd number on the sheet {is | #was} prime

(For the derivation of this "lifetime effect," see Sudo & Romoli 2017.)

- Finally, we observe the same with non-interrogative quantifiers (for (21a), assume that the test sheet contained the list $1, 2, 3, 4, 5$):

(21) a. Most numbers were prime
b. #Most numbers below six were prime

The non-deviant examples – remind-me questions

- The remind-me question in (3) conveys cessation of a state:

  (3) Was two prime again?
  $\rightsquigarrow$ the speaker knew but no longer knows the answer

- However, the same is true for the present tense counterpart of (3):

  (22) Is two prime again?
  $\rightsquigarrow$ the speaker knew but no longer knows the answer

- Thus, the cessation component of remind-me questions is not contributed by past tense. It is contributed by **again**:

  (23) MAKE [[I-KNOW [ANS q]] again]
  presupposes: the speaker knew the answer to q prior to s^*

- So where did the cessation implicature of the past tense go? – It's not the case that all scalar implicatures disappear in remind-me questions:

  (24) #Did Ilia give birth to Romulus or Remus again?

The reference time of remind-me questions

- We claim that the obviation of the cessation implicature of past tense in remind-me questions is a reference time effect.
- That is, the cessation implicature is trivialized by fixing a reference time that excludes s^*.
- What is the reference time of the question in (25)?

  (25) What was your name again?

- We assume that the reference time of a remind-me question is the time interval during which the speaker knew the answer to her question.
- As just observed, remind-me questions convey that this time interval ended before s^*.

Fixing the reference time of analytic statives

- We observed that what works for ordinary statives seems not to work for statives that deal with numbers:

(26) Q: Why are you so sure that exactly thirty-three seats were empty after the first stop?
A: Well, the bus I drove that day had forty seats, seven passengers entered the bus at the first stop, and forty minus seven {is | #was} thirty-three.

- However, we find examples where fixing a past reference time for the interpretation of a past analytic stative does work:

(27) Twenty-nine minutes had elapsed since she had tried to call Anthony. To pass the last minute, she thought about the number 29. It was a prime number. (Ken Follett)

(28) André Winter studierte stumm die Liste, speziell die Ziffer [11] vor dem Namen Felix. Elf war eine Primzahl. (Andreas Steinhöfel)

Fixing the reference time of analytic statives (cont'd)

- The reference time of the felicitous examples is provided by the runtime of a propositional attitude (think about, study).
- Our assumption that the reference time of a remind-me question is the runtime of an epistemic attitude of the speaker is consistent with this finding.
- Why would analytic statives impose the requirement that the reference time be provided by a mental state? – We think that this is because mental states are about abstract entities.
- We find the same requirement for other abstract entities:

(29) Q: Why do you think that the owner of the briefcase was Russian?
A: When I opened the briefcase, I saw that it contained the first edition of *Anna Karenina*. *Anna Karenina* {is | #was} a Russian novel.

The reference time of a stative assertion about the abstract entity *Anna Karenina* cannot be linked to the runtime of the seeing event.

A tentative description of what works

- A sentence can fix the reference time of a subsequent past stative iff the situation it describes contains the entity that the stative is about.
- Abstract entities can be contained in mental states but not in (minimal) concrete situations.
- We don't know why this restriction holds (if it holds).
- It seems to be worth exploring if it indeed holds.

Conclusions

- Past tense in analytic statives induces an odd cessation implicature.
- This implicature (its oddity) can be obviated in two ways:
  1. by replacing the referring subjects with quantifiers, which can range over objects with non-permanent properties (i.e., by turning them into non-analytic statives)
  2. by putting them into an environment that can establish a suitable past reference time.
- Remind-me questions provide such an environment because they presuppose a past mental state.
- The suitability of a (past) mental state lies in the fact that it can contain the abstract objects that analytic statives are about.

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