Interacting alternatives

Referential indeterminacy and questions

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What makes the life of a formal semanticist so difficult?

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And yet so interesting?

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Those bloody alternatives.

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A formal model of linguistic interpretation needs to keep track of all kinds of alternatives.

A simple example

- A simple example — without alternatives

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A simple example

- A simple example — without alternatives

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- The referential expression *Peter* refers to a certain individual.
- The predicate *smiled* expresses a certain property.
- The statement conveys the information that the individual referred to by *Peter* has the property expressed by *smiled*.
- The speaker proposes to add this piece of information to the conversational common ground, the body of information that all conversational participants publicly accept as true.

In what sense is this a simple example?

- This is a neat basic picture.
- But when we look beyond cases like (1) things quickly become more complex.
- These complexities are often due to the fact that linguistic expressions give rise to various kinds of alternatives.

Sources of alternatives

Indeterminacy

(2) A man smiled.

The indefinite *a man* does not denote a particular individual, but rather introduces a set of referential alternatives.

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(2) A man smiled.

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Questions

(3) Who smiled?

The speaker does not propose to add a specific piece of information to the common ground, but asks the addressee to pick one from various alternatives.

Sources of alternatives

Focus

(4) PETER$_F$ always smiled.

(5) Peter always SMILED$_F$.

Focus marking evokes focus alternatives, which in turn affect the interpretation of expressions like *always*, *only*, and *even*.

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Scalarity

(6) Some guests smiled.

The quantifier *some* is often taken to form a scale with *many* and *all*. The use of a scalar expression typically gives rise to the inference that stronger scalar alternatives are false.

Interacting alternatives

- The importance of all these kinds of alternatives is widely recognised and has received much attention.
- However, most of this work has concentrated on one type of alternative at a time.
- A question which has received less attention is how the various types of alternatives interact with each other.
- Much further insight can be gained, I believe, by systematically investigating such interactions.
- Today: some concrete steps in this direction, focusing on the interaction between referential indeterminacy and questions.

Dynamic inquisitive semantics

- More specifically, I will present the outlines of a framework which combines insights from:
  - Dynamic semantics
    designed to capture referential indeterminacy
    (Kamp, 1981; Heim, 1982; Groenendijk and Stokhof, 1991)
  - Inquisitive semantics
    designed to capture the alternatives introduced by questions
    (Ciardelli, Groenendijk, and Roelofsen, 2018)
- This is ongoing joint work with **Jakub Dotlačil.**
  - A basic (first-order, non-compositional) system has been presented at Sinn und Bedeutung.
  - The next step is to develop a full-blown compositional system. This comes with many challenges but also, we believe, creates many new opportunities.

Structure of the rest of the talk

1. Some motivating empirical phenomena
2. A rudimentary dynamic inquisitive semantics
3. Accounting for the motivating phenomena

Motivation

- First: motivation for a dynamic semantics of questions.
- Then: motivation for an inquisitive semantics of questions.

Motivation for a dynamic semantics of questions

- A dynamic semantics of questions is needed to capture certain types of anaphora.

  (Groenendijk, 1998; van Rooij, 1998; Haida, 2007)

- It also provides an attractive account of certain kinds of intervention effects.

  (Haida, 2007)

Anaphora

- Dynamic semantics has been motivated by contrasts like:

(7) a. [One of my ten marbles]^{u} is not here.
b. It$_{u}$ is probably under the sofa.

(8) a. Nine of my ten marbles are here.
b. #It is probably under the sofa.

- (7-a) and (8-a) are truth-conditionally equivalent but behave differently in discourse.
- This can be captured in dynamic semantics, because the meaning of a sentence is viewed as its context change potential.
- This includes the potential to introduce discourse referents.
- (7-a) introduces a discourse referent that can be picked up by subsequent anaphoric pronouns, but (8-a) does not.

Anaphora in questions

- Similar examples can be constructed with questions:

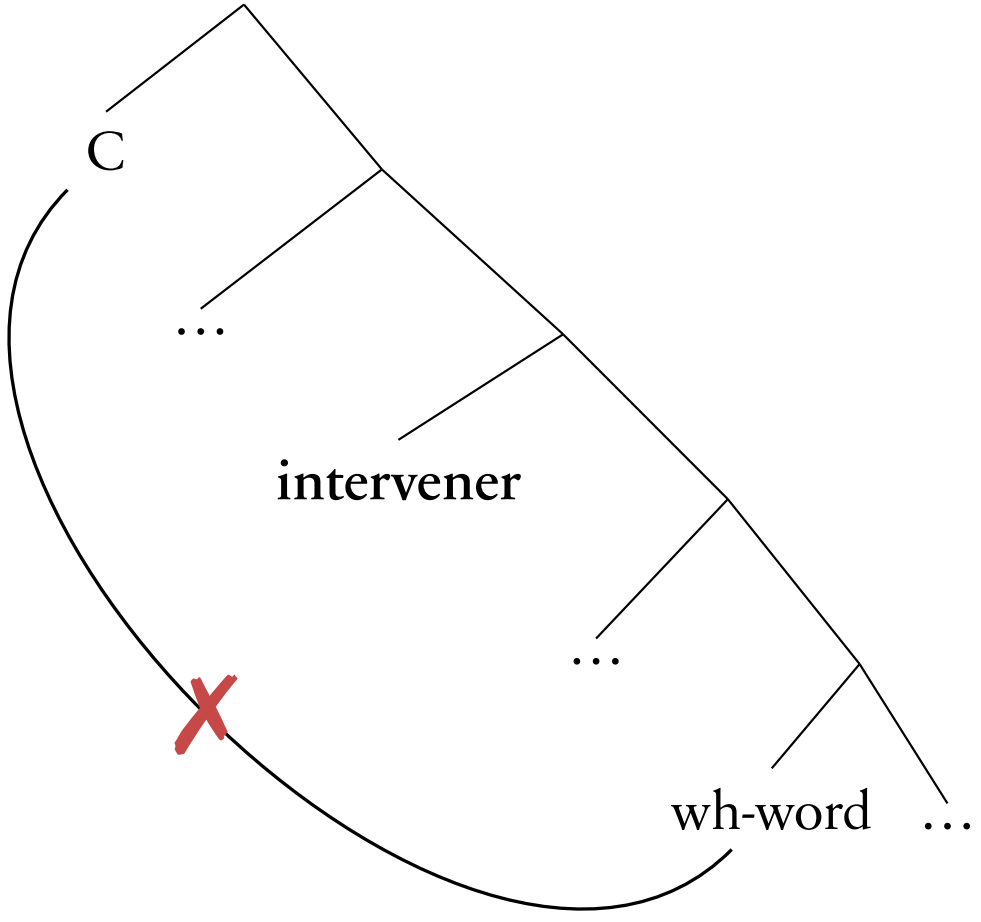
  (9) Which^{u} one of her three sons inherited the house?
  And is he$_{u}$ going to live there?

  (10) Which^{u} two of her three sons did not inherit the house?
  #And is he$_{u}$ going to live there?

- The initial questions in (9) and (10) are equivalent in terms of resolution conditions.
- But they differ in their potential to license anaphora.
- This requires a dynamic treatment of questions.
- Wh-words introduce discourse referents, just like plain existential indefinites.

Intervention effects

Certain operators lead to unacceptability when appearing between a wh-word and the associated interrogative complementizer.



Intervention effects: an example

Example from Beck (2006):

(11) a. Wer hat Luise **wo** angetroffen?
who-Nom has Luise where met
'Who met Luise where?'

b. ??Wer hat niemandem **wo** angetroffen?
who-Nom has nobody-Dat where met
'Who didn't meet anybody where?'

c. Wer hat **wo** niemandem angetroffen?
who-Nom has where nobody-Dat met
'Who didn't meet anybody where?'

Intervention effects: possible interveners

- Possible interveners (Beck, 2006):
  - Focus sensitive operators: *only*, *even*,…
  - Nominal quantifiers: *every*, *no*, *most*, *few*,…
  - Adverbial quantifiers: *always*, *often*, *never*,…
  - Negation: *not*

Intervention effects: two approaches

- How to understand the relation between the wh-word and the associated complementizer?

- Two prominent approaches (among others):

  - Focus approach (Beck, 2006) – wh-words introduce focus alternatives. Intervention effects arise when C cannot access these focus alternatives because they are consumed by a focus sensitive intervener.

  - Dynamic approach (Haida, 2007) – wh-words introduce discourse referents that C has to access. Intervention effects arise if such access is blocked by operators that do not let discourse referents project from their scope.

Intervention effects: the focus approach

- The focus approach works well for focus sensitive interveners like only and even.
- However, nominal quantifiers every, no, and most are problematic because they are not necessarily focus sensitive.
  Beck (2006, Section 4), and Haida (2007, Chapter 8)
- Experimental data suggest that the focus-sensitive particle also is not an intervener in German.
  Haida and Repp (2013)

Intervention effects: the dynamic approach

- The dynamic approach works well for quantifiers and negation, which are known to block discourse referents from projecting:

(12)
a. Jane bought a^{u} car.
   It$_{u}$ was black.
b. Jane didn't buy a^{u} car.
   *It$_{u}$ was black.
c. Most students bought a^{u} car.
   *It$_{u}$ was black.
d. Jane has often bought a^{u} car.
   *It$_{u}$ was black.

- Focus sensitive particles do not block discourse referents from projecting, so require a different explanation (Haida, 2007).
- Cross-linguistic variation as to which operators act as interveners is largely an open issue for both approaches.

Motivation for an inquisitive semantics of questions

- Existing dynamic theories of questions all assume that questions partition the common ground.
  (Groenendijk, 1998; van Rooij, 1998; Haida, 2007)
- Partition semantics is suitable to capture the exhaustive interpretation of questions like (13):

  (13) Which of the guests are vegetarian?

Motivation for an inquisitive semantics of questions

- However, the non-exhaustive interpretation of questions like (14) is difficult to capture in partition semantics:

  (14) What is a typical Swedish dish?

- In inquisitive semantics both exhaustive and non-exhaustive question interpretations can be captured straightforwardly.

Motivation for an inquisitive semantics of questions

- Another limitation of partition semantics is that it cannot deal with disjunctions of questions.

(15) Where can I rent a bike or who has one that I could borrow?

- The union of two partitions (equivalence relations) generally does not yield another partition.
- In inquisitive semantics disjunctions of questions can be handled on a par with conjunctions.

Summary

	Anaphora	Intervention	Non-exhaustive	Disjunction
Static inquisitive	No	No	Yes	Yes
Dynamic partition	Yes	Yes	No	No
Dynamic inquisitive	**Yes**	**Yes**	**Yes**	**Yes**

Some further benefits of the dynamic inquisitive approach will be discussed along the way.

1. Some motivating empirical phenomena
2. A rudimentary dynamic inquisitive semantics
3. Accounting for the motivating phenomena

Ingredients

- I will present a compositional dynamic inquisitive system, Inq_D, which combines elements of:
  - the basic static inquisitive system Inq_B
  - the dynamic system of Groenendijk *et al.* (1996) (GSV)
  - the compositional dynamic system of Muskens (1996)
- Ultimately, we also need to incorporate insights from dynamic systems that deal with *plurals*.
  (van den Berg, 1996; Nouwen, 2003; Brasoveanu, 2007)
- But how this should be done exactly is non-trivial.

Contexts in GSV

Contexts in GSV are intended to represent:

1. information about the world
2. information about the discourse referents
3. information about dependencies between the world and possible values of the discourse referents

Contexts in GSV

Formally, GSV a context is a set s of possibilities,
each a pair $\langle w, g \rangle$ where w is a world and g an assignment function

This encodes:

- Information about the world:

$$\textbf{worlds}(s) := \{w \mid \langle w, g \rangle \in s \text{ for some } g\}$$

- Information about the discourse referents:

$$\textbf{assignments}(s) := \{g \mid \langle w, g \rangle \in s \text{ for some } w\}$$

- Information about dependencies between the world and the possible values of the discourse referents

Contexts in GSV

An obvious limitation:

- Contexts represent information, but not contextual issues
- So they don't allow us to capture the update effect of questions

Contexts in inquisitive semantics

Contexts in inquisitive semantics are intended to represent:

1. information about the world
2. issues raised about the world

Contexts in inquisitive semantics

Formally, a context c is a set of information states,
each a set of possible worlds.

- Each information state in c contains enough information to resolve the raised issues.
- No information state in c contains any worlds that have been ruled out by the available information.
- Contexts are downward closed: if $s \in c$ and $t \subset s$, then $t \in c$.
- The information available in c is captured by $\textsc{info}(c) := \bigcup c$.
- A context c is inquisitive just in case $\textsc{info}(c) \notin c$.

Contexts in inquisitive semantics

An obvious limitation:

- In $\mathsf{Inq}_{\mathsf{B}}$, contexts do not represent information or issues about the possible values of discourse referents,
- let alone dependencies between the world and possible values of the discourse referents.

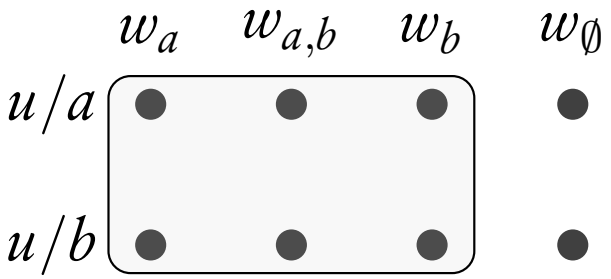
Contexts in dynamic inquisitive semantics

In Inq_D: a context c is a downward closed set of information states, each a set of possibilities (world-assignment pairs)

As in Inq_B:

- Each information state in c contains enough information to resolve the contextual issues.
- No information state in c contains any possibilities that have already been ruled out by contextual information.

Depicting contexts



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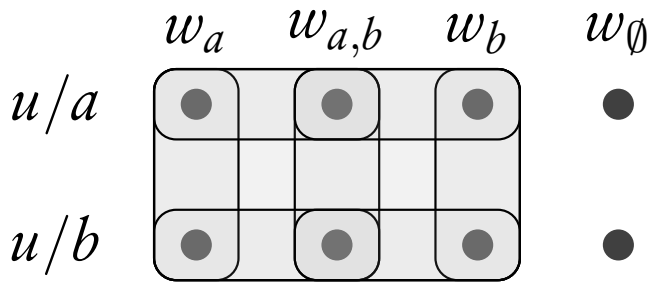

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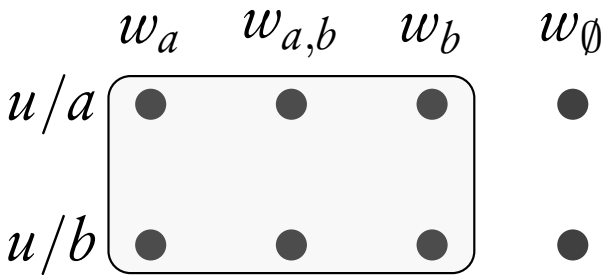

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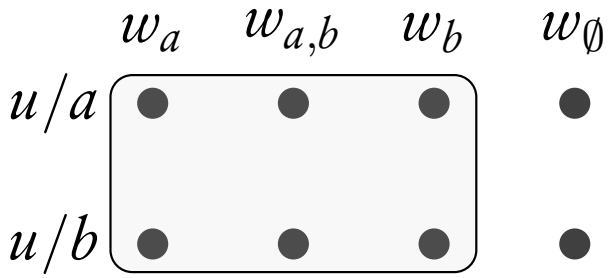

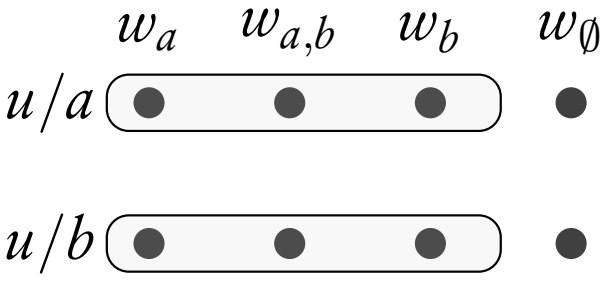

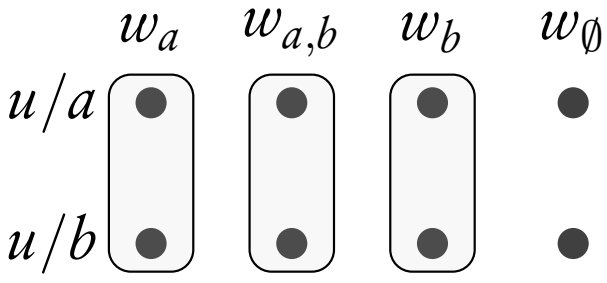

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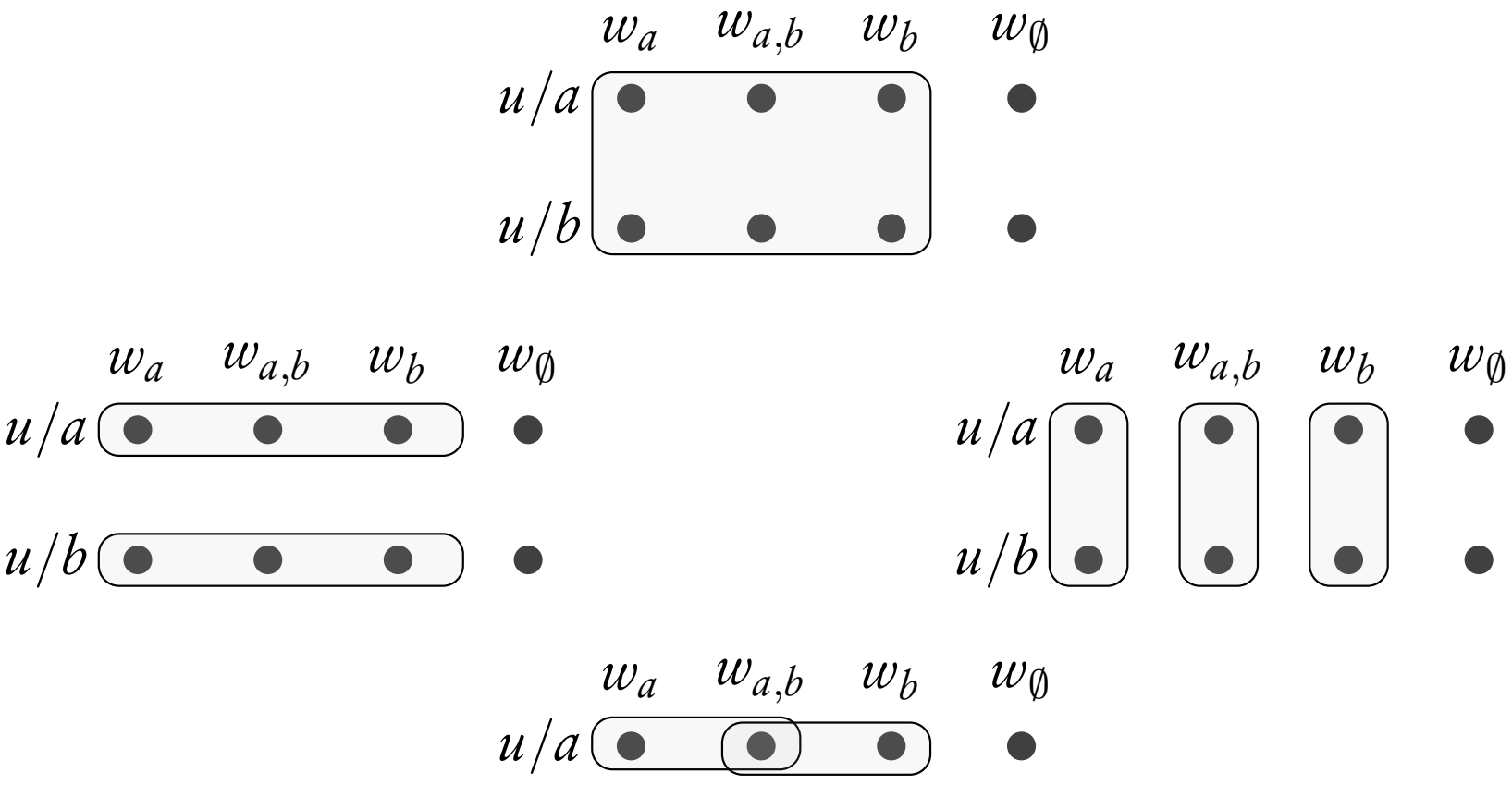


Extension and subsistence

A state s' extends a state s, $s' \geq s$, iff:

- s' contains more information about the world than s (fewer possibilities), and/or
- s' contains more information about discourse referents than s (more discourse referents and/or fewer possible values)

A state s subsists in a state s' iff:

- $s' \geq s$, and
- every possibility in s is still in s', modulo the addition of new discourse referents

A state s subsists in a context c iff

- there is some $s' \in c$ such that s subsists in s'.
- In this case, s' is called a descendant of s in c.

Types

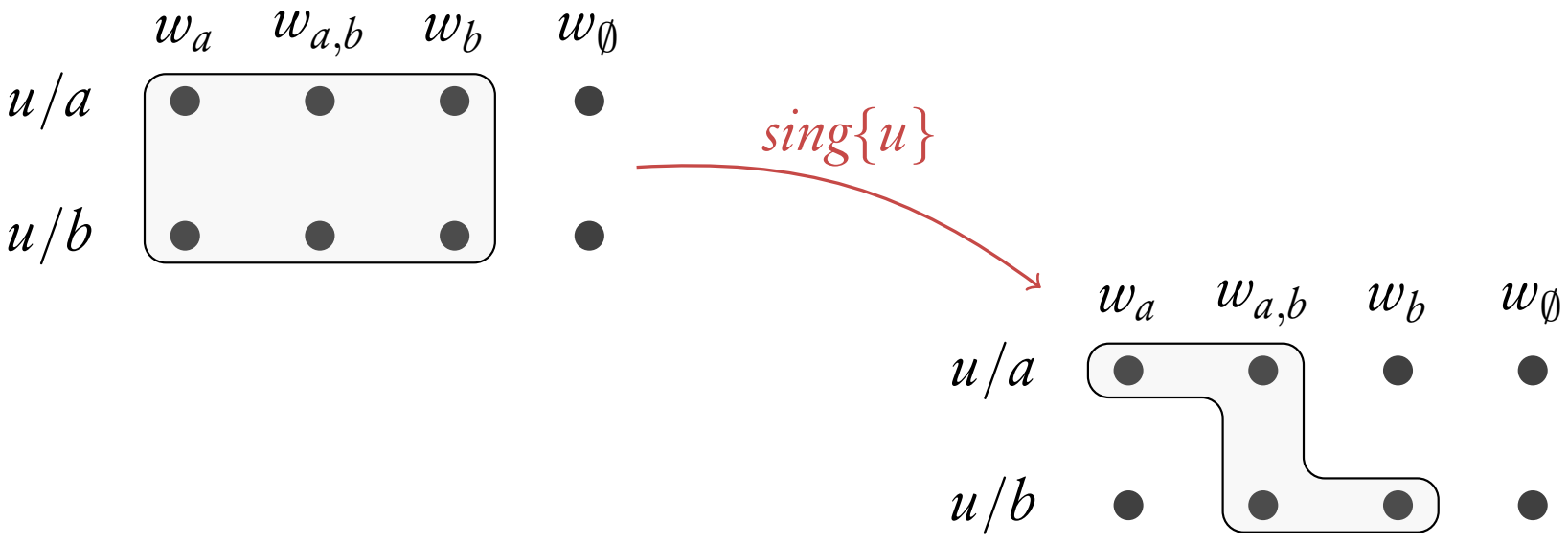
We assume four basic types:

- e for individuals
- s for possible worlds
- t for truth values
- r for discourse referents

Object	Type	Type abbreviation	Variables
dref assignment function	(re)	-	-
possibility	$(s \times a)$	-	p
information state	$((s \times a)t)$	i	s
context	(it)	k	c, c'
update function	(kk)	T	A, B

Semantics: predication and conjunction

(16) $R\{u\} := \lambda c_k \lambda s_i.\ s \in c \ \wedge\ \forall p \in s.\ R(w_p)(g_p(u))$



(17) $A_T; B_T := \lambda c_k.B(A(c))$

Semantics: dref introduction

- Introducing a dref u in a context c leads to the largest context c' such that every $s' \in c'$ is a descendant of some $s \in c$ and has u in its domain.

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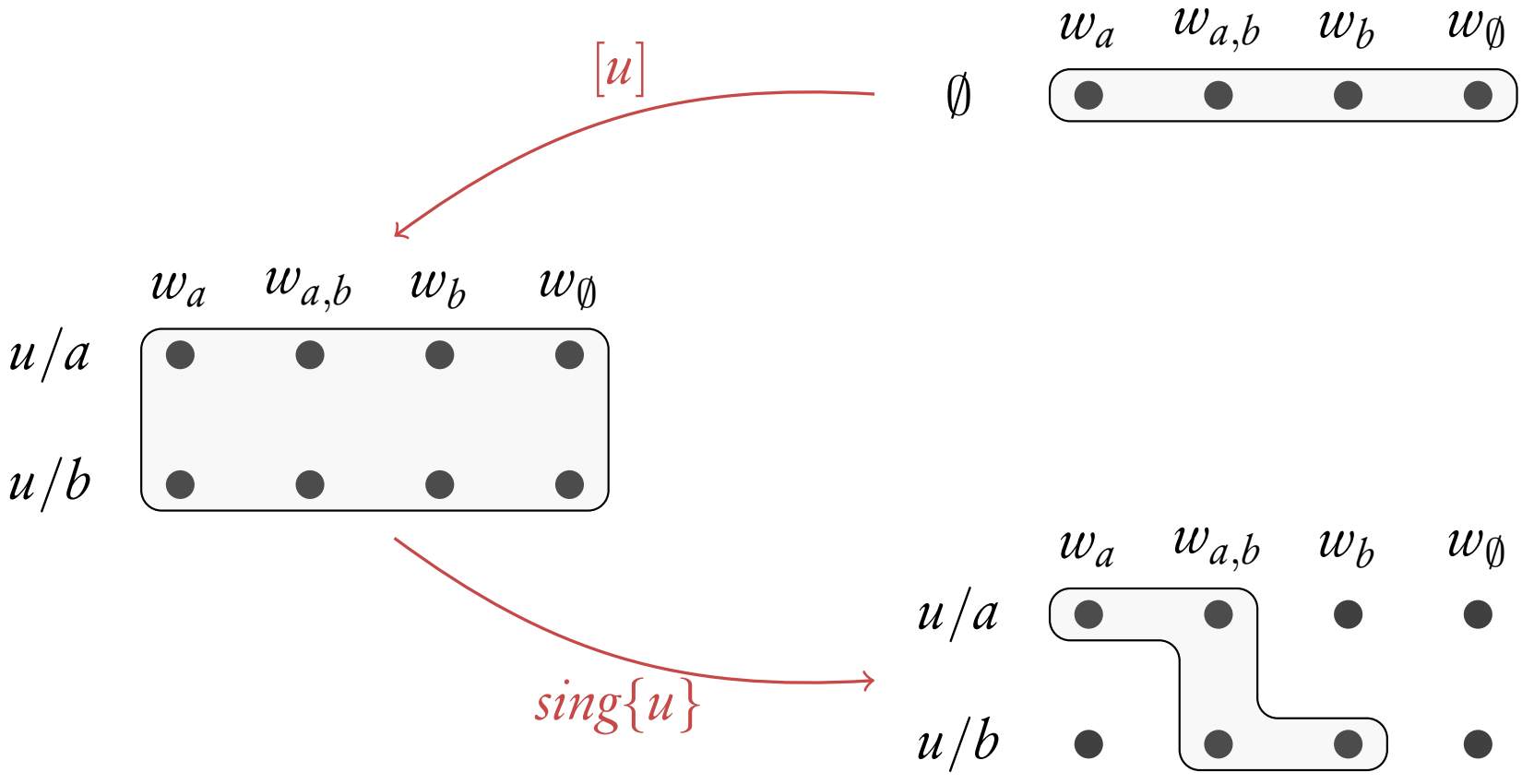
- $$[u] := \lambda c_k \lambda s_i. \left\{ \begin{array}{l} \exists s' \in c. \\ \forall p \in s. \;\; \exists p' \in s'. \; (p'[u]p) \wedge \\ \forall p' \in s'. \exists p \in s. \;\; (p'[u]p) \end{array} \right\}$$

Semantics: dref introduction



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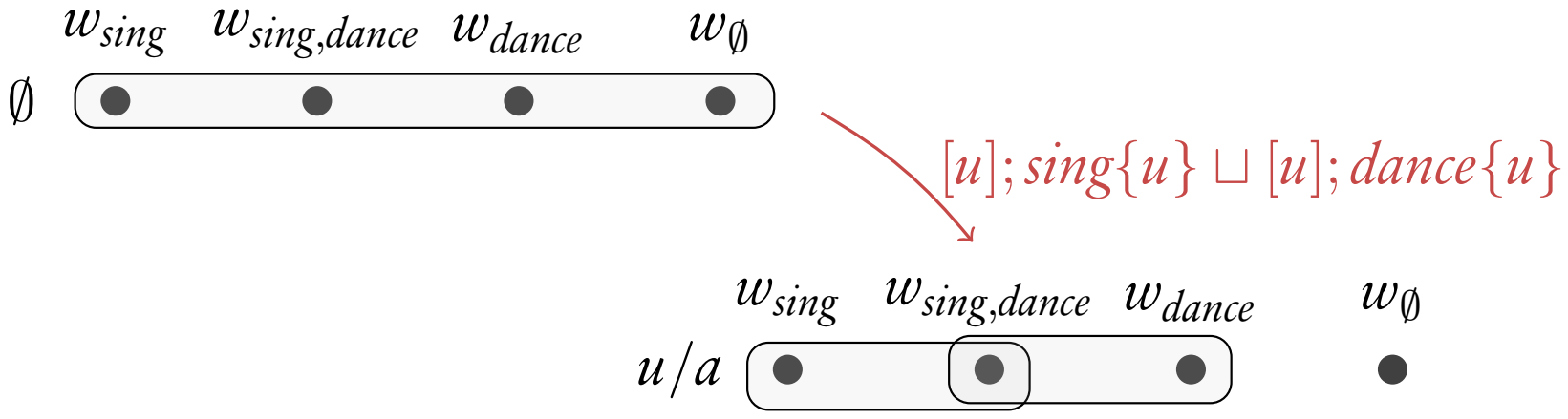

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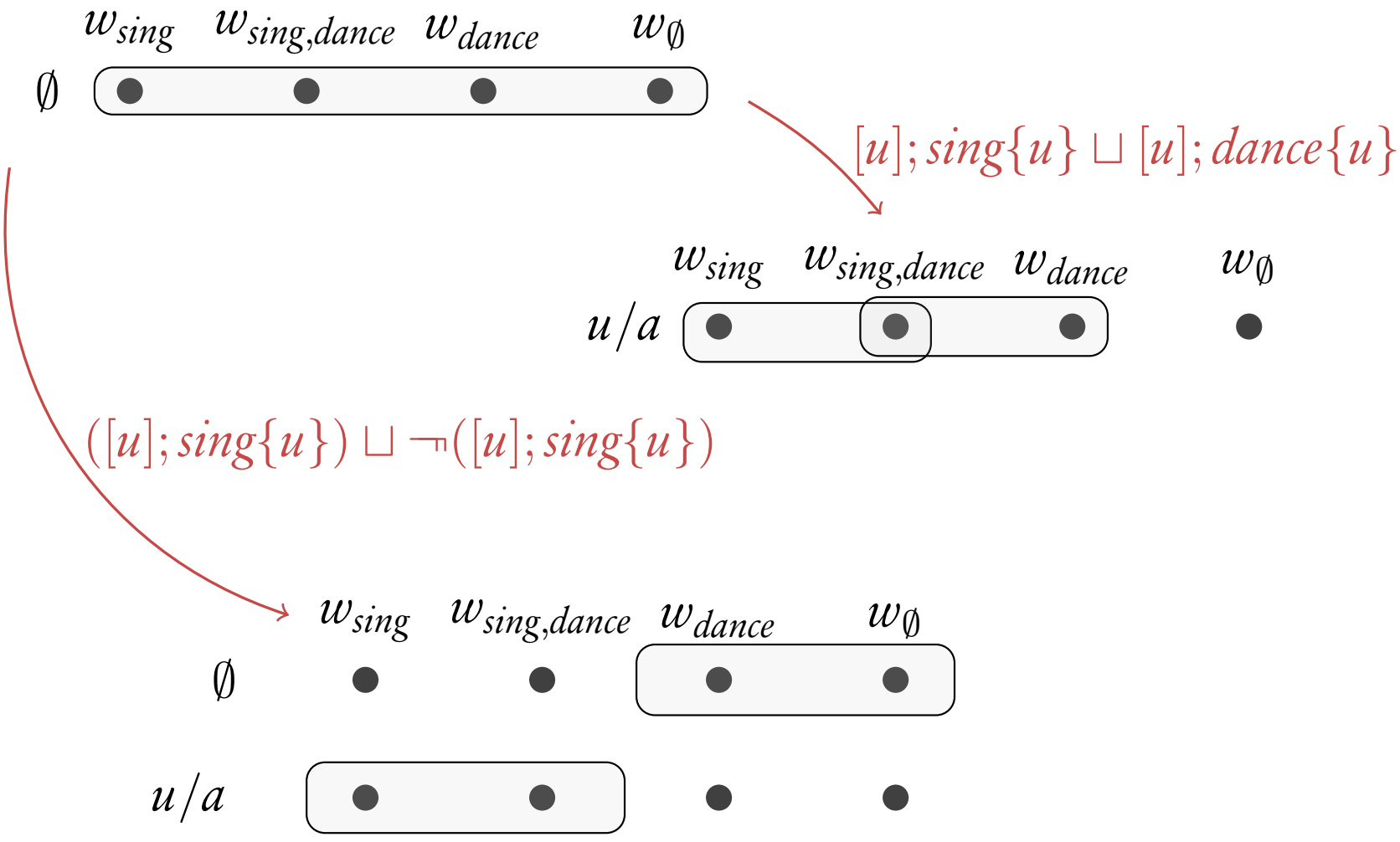

Semantics: disjunction

This accounts for a contrast observed by Stone (1992):

(19) Bill either rented a^{u} blue car or a^{u} red car.
It$_{u}$ was probably a cabriolet.

(20) Bill either rented a^{u} car or hitchhiked.
*It$_{u}$ was probably a cabriolet.

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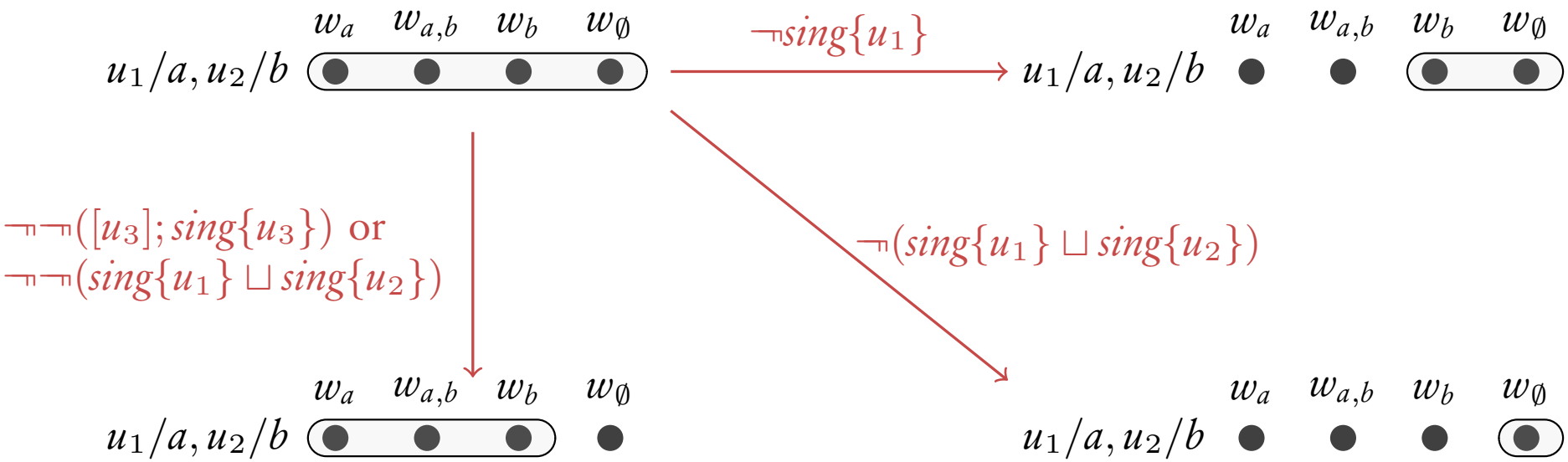
And also accounts for:

(21) **A:** Bill either rented a^{u} car or he hitchhiked.
B: The former, of course. It$_{u}$ was a cabriolet.

(22) **A:** Did Bill rent a^{u} car$^{\uparrow}$ or did he hitchhike$^{\downarrow}$?
B: The former, of course. It$_{u}$ was a cabriolet.

Semantics: negation

(23) $\neg A_T := \lambda c \lambda s.\, s \in c \wedge \neg \exists t \subseteq s (t \neq \emptyset \wedge t \text{ subsists in } A(c))$



Semantics: non-inquisitive projection

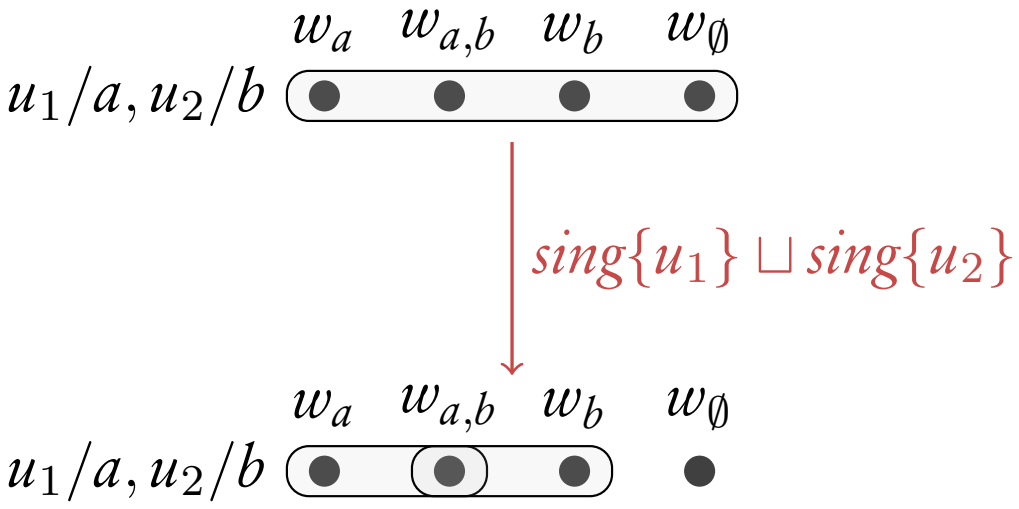
- Non-inquisitive projection of a context c:

  $!c := \lambda s.\, s \subseteq \textsc{info}(c)$

- Non-inquisitive projection of an update function A:

  $!A := \lambda c \lambda s.\, s \in !(A(c)) \wedge (s \geq s' \text{ for some } s' \in c)$

Comparing negation and non-inquisitive projection



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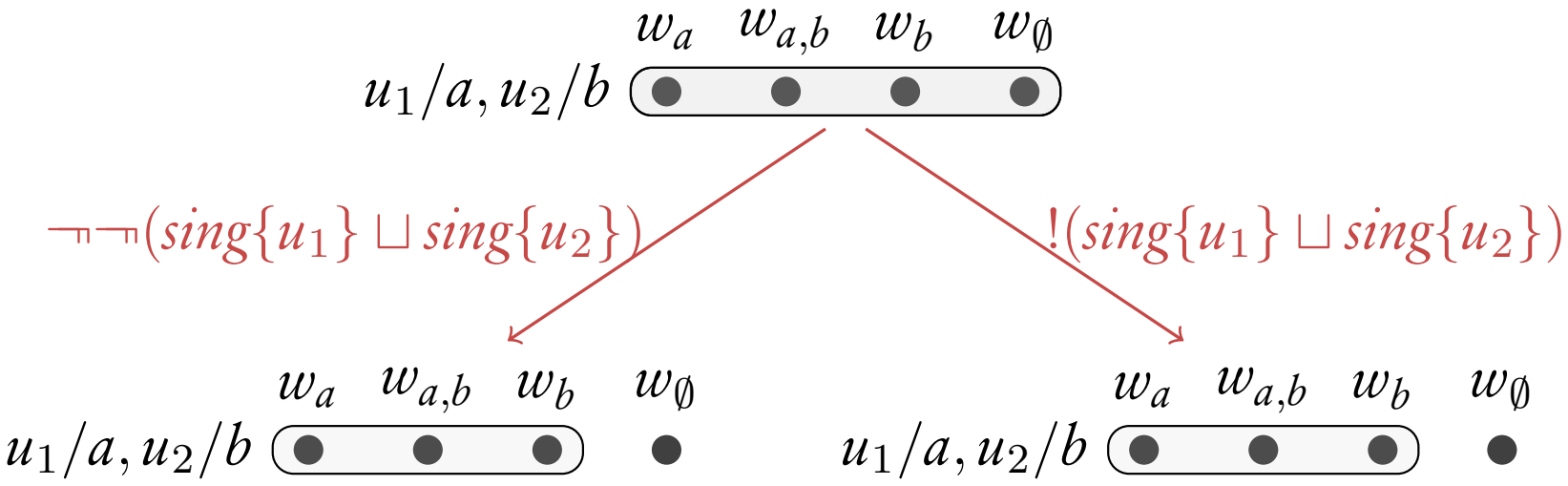

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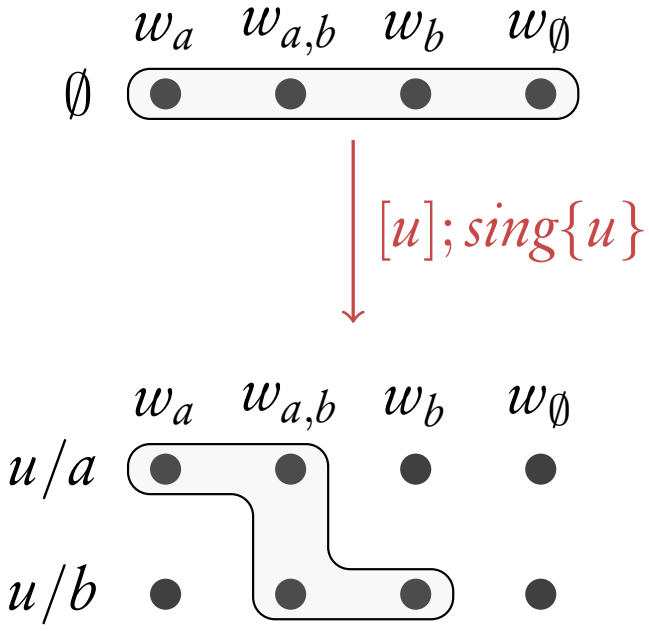

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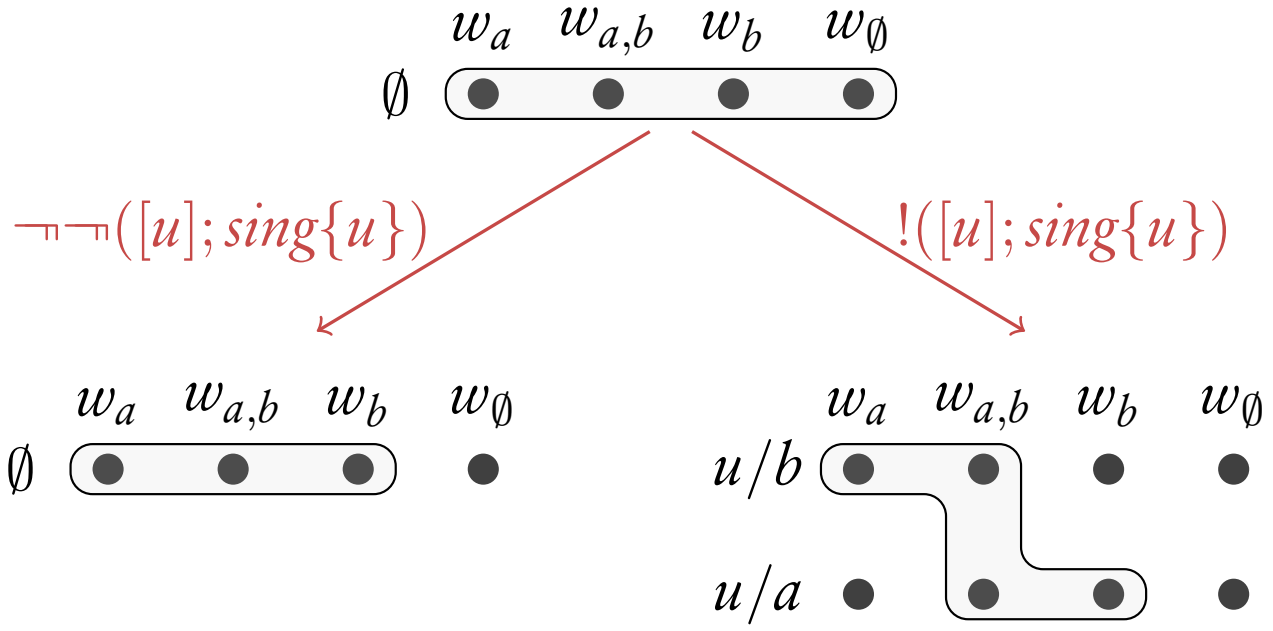

Semantics: ensuring inquisitiveness

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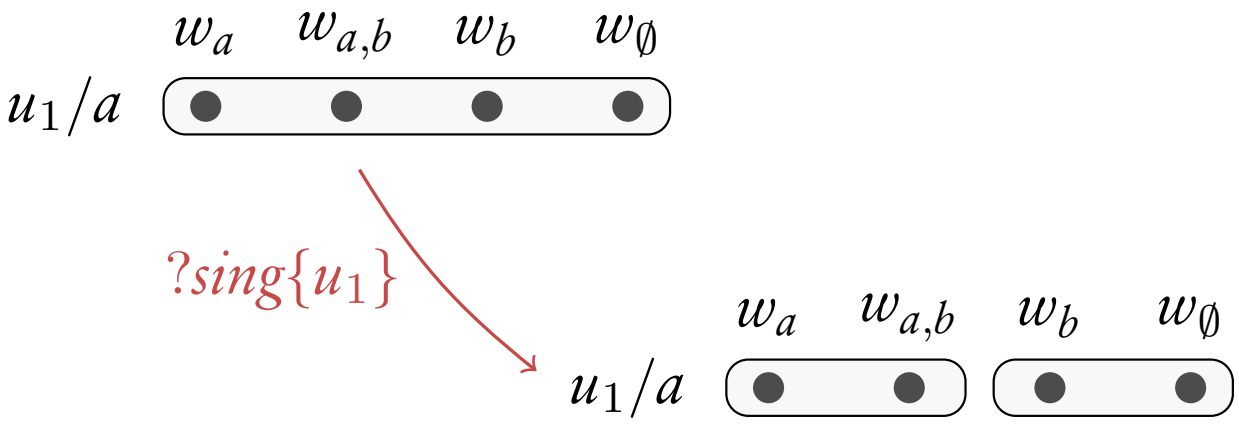

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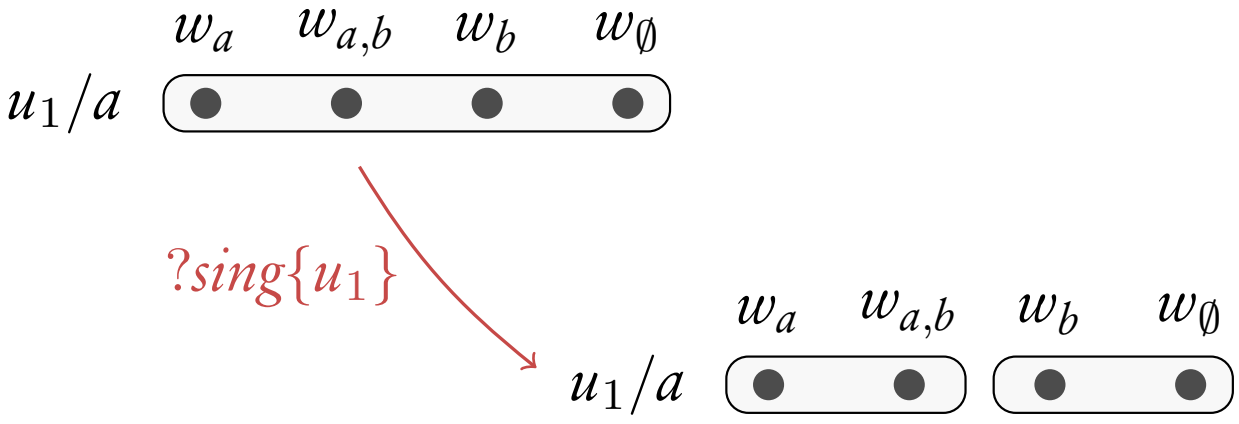

(25) $\langle ? \rangle A := \begin{cases} ?A & \text{if } A \text{ is not inquisitive} \\ A & \text{otherwise} \end{cases}$

Semantics: asking for a witness of a discourse referent

Version 1

States in the output context must fix the value of u.

(26) $?u := \lambda c \lambda s.\, s \in c \;\wedge\; \exists x_e.\, \forall p \in s.\, g_p(u) = x$

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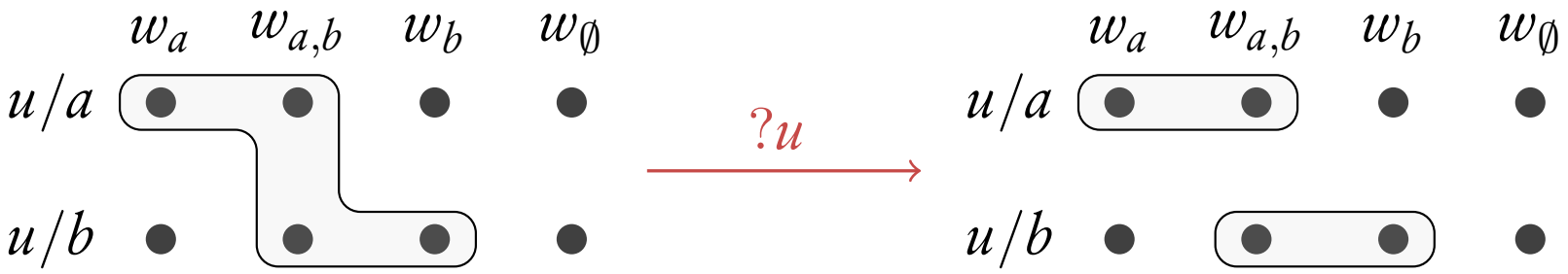

Semantics: asking for a witness of a discourse referent

Version 2

States in the output context must contain enough information about the world to guarantee the existence of a specific witness for u.

(27) $$?u := \lambda c \lambda s. \left(\begin{array}{l} s \in c \ \wedge \\ \exists x_e. \, \forall p \in s. \, \exists p' \in \textsc{info}(c). \\ (w_{p'} = w_p \wedge g_{p'}(u) = x) \end{array} \right)$$

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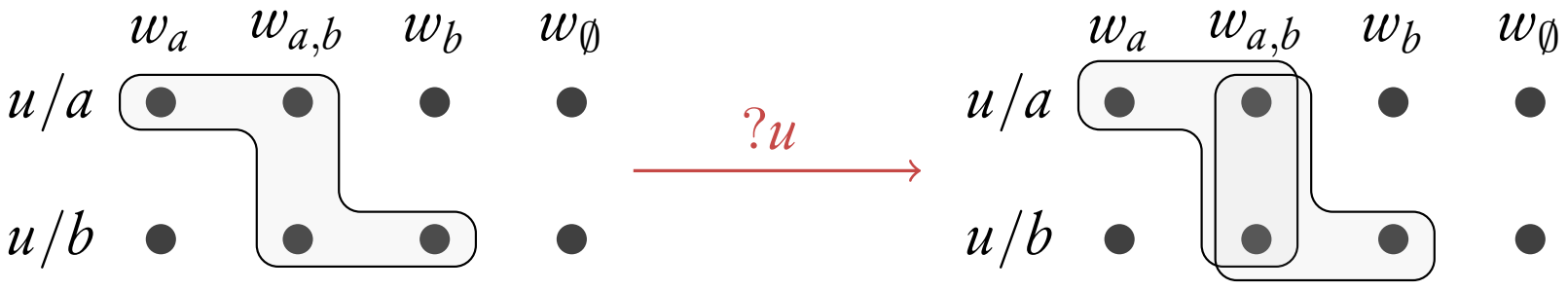


Semantics: asking for a *functional* witness

Asking for a witness (version 1):

(28) $?u := \lambda c \lambda s.\, s \in c \ \wedge \ \exists x_e.\, \forall p \in s.\, g_p(u) = x$

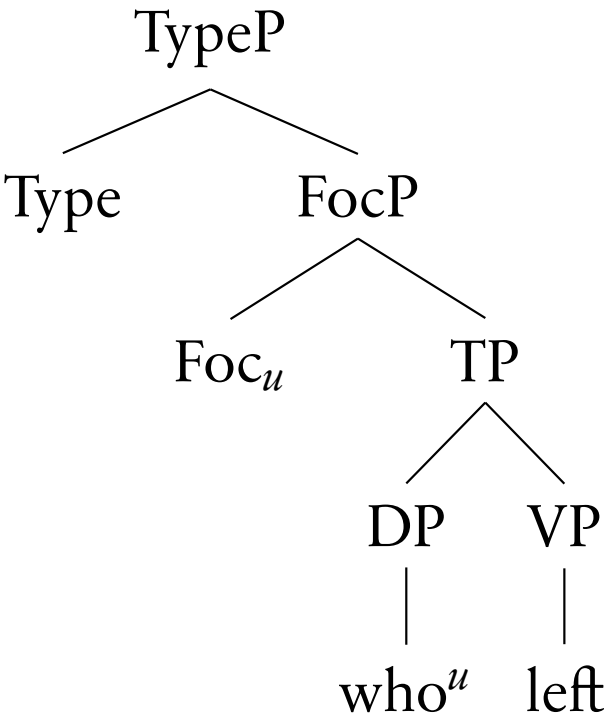
Asking for a functional witness:

(29) $?u_1, \ldots, u_n := \lambda c \lambda s.$

$$\left\{ \begin{array}{l} s \in c \ \wedge \\ \exists f.\, \forall p \in s.\, g_p(u_n) = f(g_p(u_1), \ldots g_p(u_{n-1})) \end{array} \right\}$$

(and similar for version 2)

Translation of interrogatives



$[\![\text{who}^u]\!] = \lambda P_{rT}.\ [u]; P(u)$

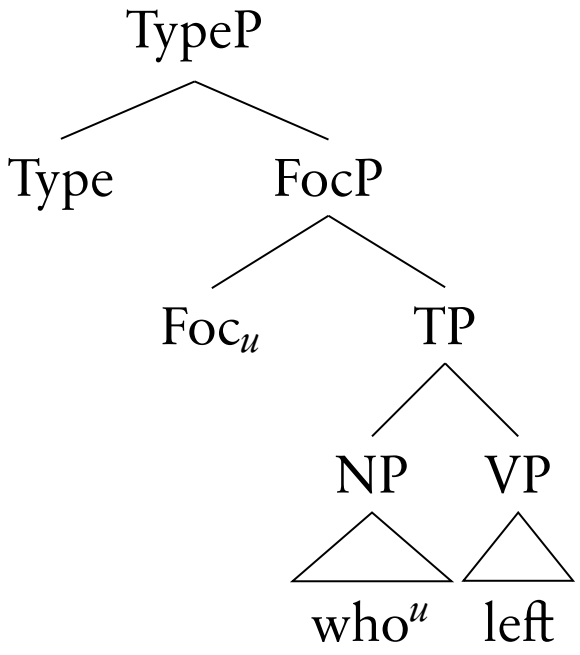
$[\![\text{Foc}_u]\!] = \lambda A_T.\ !A; ?u$

Foc removes inquisitiveness of TP and requests a witness for the drefs introduced by wh-words in TP

(30) $[\![\text{Foc}_u\ \text{who}^u\ \text{left}]\!] = !([u]; \mathit{left}\{u\}); ?u$

$\equiv\quad [u]; \mathit{left}\{u\}; ?u$

Translation of interrogatives



$[\![\text{Type}]\!] = \lambda A_T.\ \langle ? \rangle A$

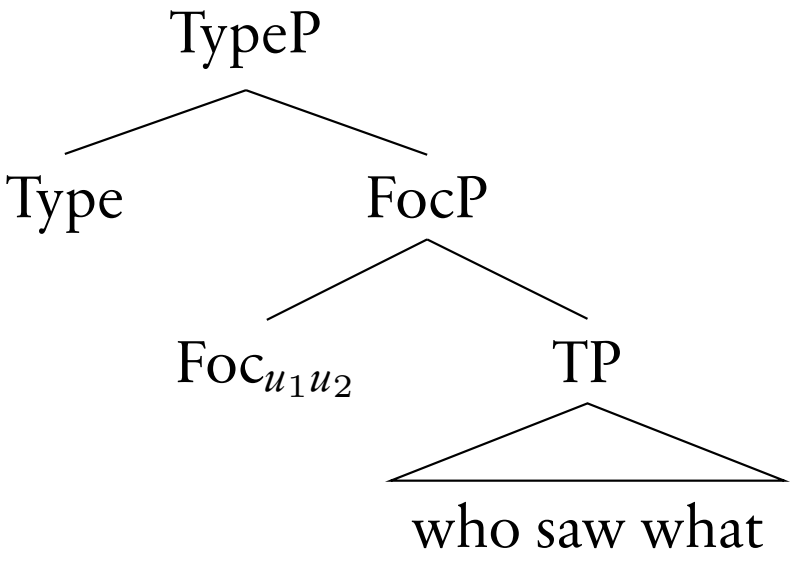
ensures inquisitiveness
this is vacuous in wh-questions
but crucial in polar questions

(31) $[\![\text{Who}^u \text{ left}]\!] = [u]; \mathit{left}\{u\}; ?u$

(32) $[\![\text{Did someone}^u \text{ leave}]\!] = \langle ? \rangle([u]; \mathit{left}\{u\})$

$\equiv ([u]; \mathit{left}\{u\}) \sqcup \neg([u]; \mathit{left}\{u\})$

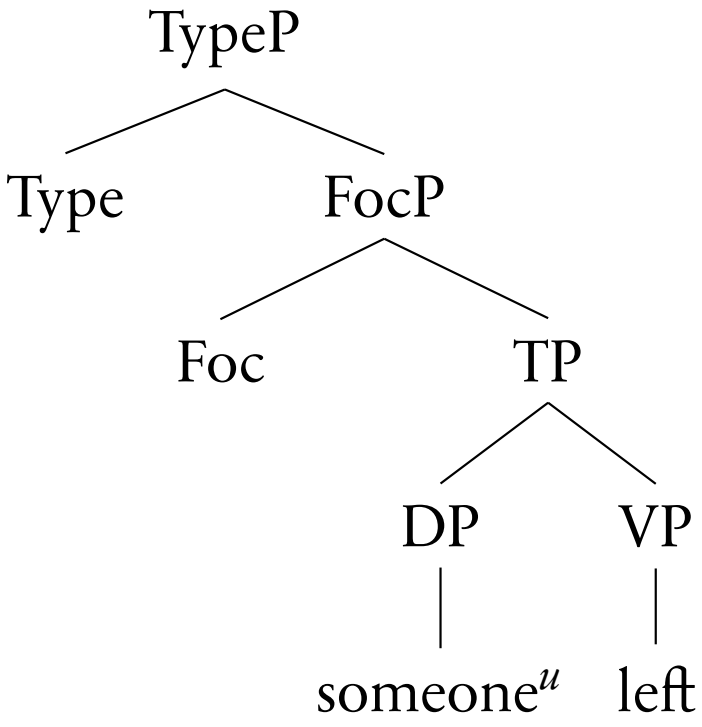
Translation of interrogatives



$$[\![\text{Foc}_{u_1,u_2}]\!] = \lambda A.\ !A; ?u_1u_2$$

(33) $$[\![\text{Who saw what}]\!] = !([u_1]; [u_2]; saw\{u_1, u_2\}); ?u_1u_2$$
$$\equiv \quad [u_1]; [u_2]; saw\{u_1, u_2\}; ?u_1u_2$$

Translation of declaratives



$[\![\text{someone}^u]\!] = \lambda P_{rT}.[u]; P(u)$

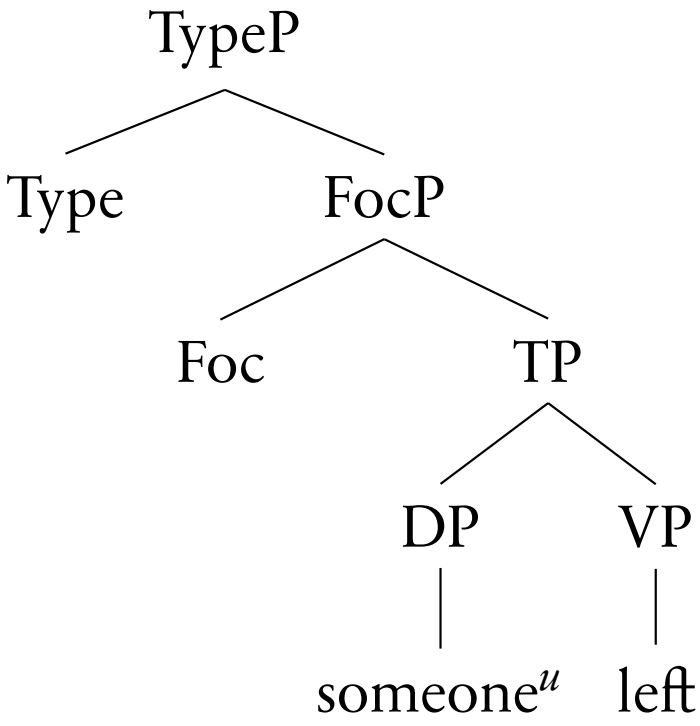
$[\![\text{Foc}]\!] = \lambda A.\ !(A)$

removes inquisitiveness of the TP just like Foc in interrogatives when there are no wh-elements

(34) $[\![\text{Foc}_u\ \text{someone}^u\ \text{left}]\!] = !([u]; \mathit{left}\{u\})$

$\equiv\ [u]; \mathit{left}\{u\}$

Translation of declaratives



$[\![\text{Type}]\!] = \lambda A.\ !(A)$

also removes inquisitiveness
vacuous here but needed for
FocP disjunctions

(35) $[\![\text{Someone}^{u}\ \text{left}]\!] \equiv [u]; \mathit{left}\{u\}$

1. Some motivating empirical phenomena
2. A rudimentary dynamic inquisitive semantics
3. Accounting for the motivating phenomena

Anaphora

(36) ⟦Someone^{u} left. He$_{u}$ was wearing glasses.⟧

$\equiv [u]; \mathit{left}\{u\}; \mathit{glasses}\{u\}$

(37) ⟦Who^{u} left? Was he$_{u}$ wearing glasses?⟧

$\equiv [u]; \mathit{left}\{u\}; ?u; ?\mathit{glasses}\{u\}$

- A wh-word introduces a dref, just like an indefinite.
- The associated Foc head requests a witness for this discourse referent.
- This does not affect the binding possibilities of the wh-word.
- So anaphora with wh-antecedents can be captured.

Donkey anaphora in conditional questions

The system can also deal with donkey anaphora, both in statements and in questions.

(38) If a farmer owns a donkey, does he beat it?

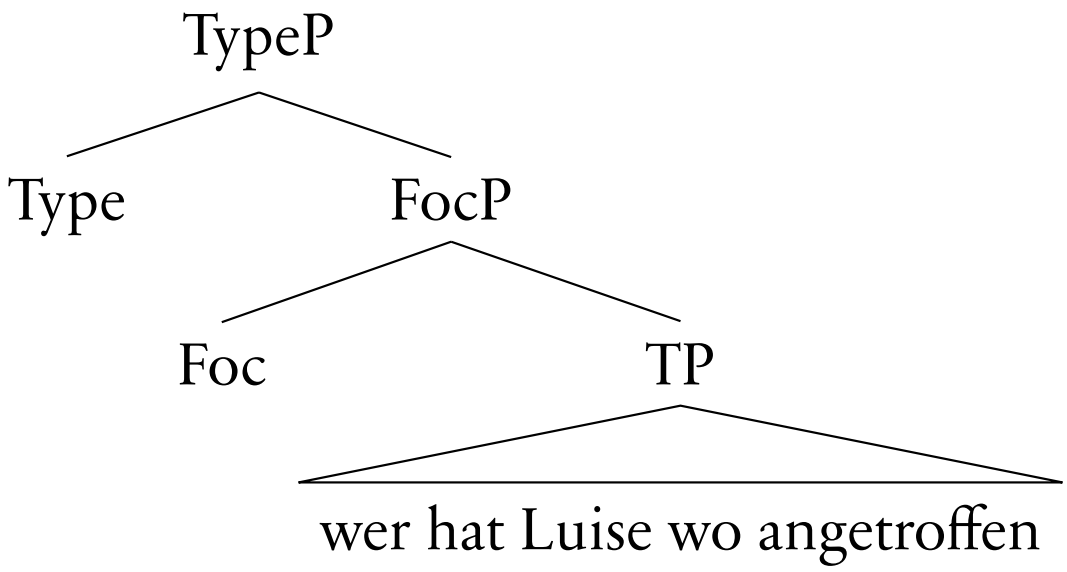
(39) $$A \twoheadrightarrow B := \lambda c_k \lambda s_i.\ s \in c \wedge \left(\begin{array}{l} \forall t \subseteq s : \\ t \text{ subsists in } A(c) \rightarrow \\ t \text{ subsists in } B(A(c)) \end{array} \right)$$

(40) $$([u_1]; [u_2]; F\{u_1\}; D\{u_2\}; O\{u_1, u_2\}) \twoheadrightarrow ?beat\{u_1, u_2\}$$

Such cases are beyond the reach of existing dynamic theories of questions, because those are based on partition semantics.

Intervention effects

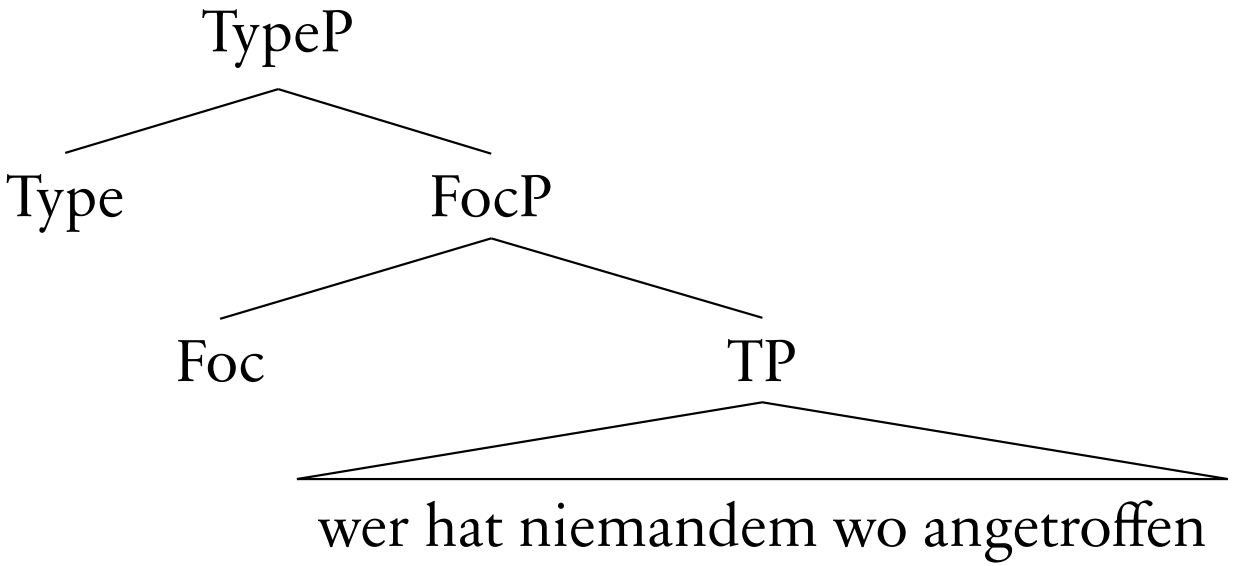
- Baseline: a grammatical example



(41) ⟦ Who met Luise where? (German) ⟧

$\equiv [u_1]; [u_2]; meet(u_1, L, u_2); ?u_1u_2$

Intervention effects



(42) ⟦ Who met nobody where? (German) ⟧

$\equiv [u_1]; \neg([u_3]; [u_2]; meet(u_1, u_3, u_2)); ?u_1u_2$

This goes wrong because negation blocks access to discourse referents in its scope

Intervention effects and distributivity

Mayr (2014): plural quantifiers intervene only when interpreted distributively

(43) Wo haben sich mehr als drei Maler wann eine Pizza geteilt?
where have self more than three painters when a pizza shared
'Where did more than three painters share a pizza when?'

(44) *Wo haben sich mehr als drei Maler wann rasiert?
where have self more than three painters when shaved
'Where did more than three painters shaved when?'

Intervention effects and distributivity

- This contrast is predicted because plural quantifiers block direct access to discourse referents in their scope only when they are interpreted distributively:
  (cf. Kamp and Reyle 1993)

(45) More than ten students shared a pizza. It was huge.

(46) More than ten students submitted an abstract to the conference. #It received good reviews.

Are witness requesting operators ever 'visible'?

- Languages like Tlingit (Cable, 2010) have so-called indeterminate phrases and Q-particles, which together form either existential or interrogative phrases.
- The position of the Q-particle determines the interpretation:
  - Q-particle below left periphery ⇒ existential interpretation
  - Q-particle in left periphery ⇒ interrogative interpretation

(47) Daa **sá** aawaxáa i éesh?
what Q he.ate.it your father
'What did your father eat?' (Tlingit)

(48) Tlél goodéi **sá** xwagoot.
not where.to Q I.went
'I didn't go anywhere.' (Tlingit)

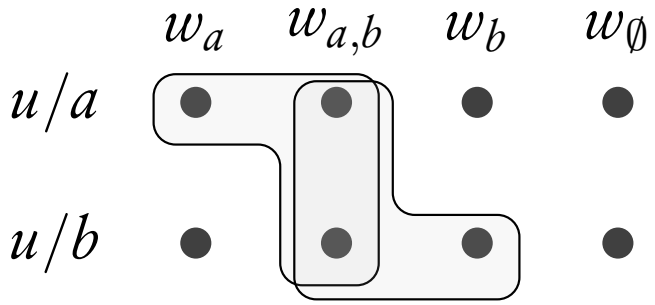
Proposal: Q-particles are witness requesting operators

- Similar patterns are found in Japanese and Sinhala
  Hagstrom (1998), Cable (2010), Uegaki (2018)
- **Generalization:**
  - Q below left periphery ⇒ existential interpretation
  - Q in left periphery ⇒ interrogative interpretation
- This is predicted if indeterminates are treated just like we have treated English indefinites and wh-words, and Q-particles are treated as witness requesting operators.
  - Q below left periphery ⇒ issue raised neutralized by ! in Foc
  - Q in left periphery ⇒ issue raised above Foc, not neutralized

Exhaustive and non-exhaustive readings

Non-exhaustive readings are straightforwardly captured:

(49) Who has a bike that I could borrow for 15 minutes?



Exhaustive and non-exhaustive readings

- But how to derive exhaustive readings?

- Proposal: exhaustive/non-exhaustive question readings arise from strong/weak interpretations of indefinites, which have been proposed independently to account for strong/weak readings of donkey anaphora.

Strong/weak readings of donkey anaphora

- Strong:

  (50) If a farmer owns a donkey, he beats it.

- Weak:

  (51) If Bill has a dime, he puts it in the parking meter.

- Brasoveanu (2008) argues that these readings are due to an ambiguity in the semantics of indefinites

  (52) $[\![\text{someone}^{u}_{weak}]\!] = \lambda P_{rT}.[u]; P(u)$

  (53) $[\![\text{someone}^{u}_{strong}]\!] = \lambda P_{rT}.[u]; P(u); \mathbf{max}\{u\}$

  (54) $\mathbf{max}\{u\} := \lambda c \lambda s.\, s \in c \wedge \forall p \in s.\, \forall p' \in \textsc{info}(c).$
  $(w_p = w_{p'} \rightarrow g_{p'}(u) \leq g_p(u))$

Back to exhaustive/non-exhaustive readings of wh-questions

- Suppose that wh-words involve the same ambiguity:

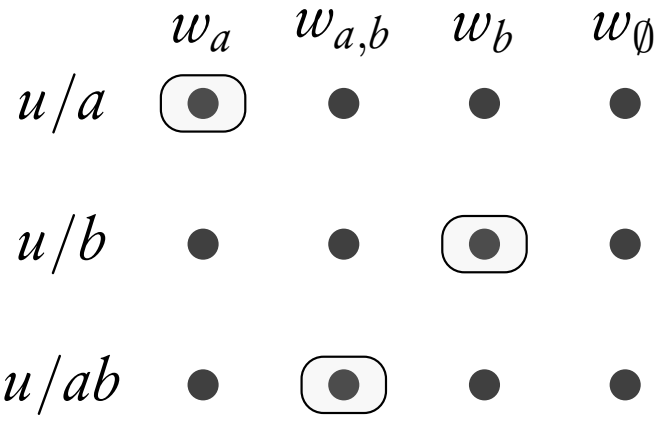
(55) $[\![\text{who}^u_{weak}]\!] = \lambda P_{rT}.[u]; P(u)$ [as before]

(56) $[\![\text{who}^u_{strong}]\!] = \lambda P_{rT}.[u]; P(u); \mathbf{max}\{u\}$

- Then we derive the two readings for wh-questions:
  - who^u_{weak} $\Rightarrow$ non-exhaustive
  - who^u_{strong} $\Rightarrow$ exhaustive

(57) Who^u_{strong} is vegetarian?

$[u]; veg\{u\}; \mathbf{max}\{u\}; ?u$



Conclusion

- Inq_D integrates insights from dynamic and inquisitive semantics
- It can capture the anaphoric potential of wh-words
- It predicts intervention effects due to failed dynamic binding
- It can capture both exhaustive and non-exhaustive question interpretations
- In fact, it allows us to connect the existence of exhaustive and non-exhaustive readings of questions to the existence of strong and weak readings of donkey anaphora.
- More generally, this highlights the interest of systematically investigating the interaction between different kinds of alternatives.

THANK YOU

$[u]; \mathit{has\text{-}a\text{-}question}\{u\}; ?u$

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