General introduction

Explaining linguistic properties of questions and question words

- Question words – in many lgs, formally related to indefinites

  - Indefinites and question words identical:
    - Dutch
      - *Wat heb je gelezen?*
      - *Heb je wat gelezen?*
    - Indefinites derived from question words:
      - English
        - *where* → *some-where*
      - Czech
        - *kdo* → *ně-kdo*
General introduction

Explaining linguistic properties of questions and question words

- Question words – related to indefinites in the way they update context:
  1. One of the ten marbles is not in the bag. It is probably under the sofa.
  2. ?? Nine of the ten marbles are in the bag. It is probably under the sofa.
  3. Which marble is not in the bag and is it under the sofa?
  4. ?? Which nine marbles out of ten are in the bag and is it under the sofa?
General introduction

Explaining linguistic properties of questions and question words

- Question words – typically focused
- Wie heeft wát gelezen?
  Who read what
- Wie heeft wat gelezen?
  Who read something
- šúka ki táku yaxtáka heLakhota
  dog the something/what bit Q
  ‘Did the dog bite something?’ ‘What did the dog bite?’
  (stress on táku)
General introduction

1. Indefiniteness & question words related
2. ... formally
3. ... in context update
4. Question words are focused

Deriving these properties in:
- dynamic semantics and partition semantics (Haida, 2008)
- inquisitive semantics (AnderBois, 2012)
- inquisitive dynamic semantics (Dotlačil & Roelofsen, 2017)
1 Introduction

2 Partition semantics

3 A dynamic partition semantics
1. John knows whether Mary walks.
   Mary walks.
   
   John knows that Mary walks.

2. John knows whether Mary walks.
   Mary does not walk.
   
   John knows that Mary does not walk.
Relationship between *whether*-complements and *that*-complements

- *whether*-complements and *that*-complements denote the same objects – propositions
- *whether*-complements – index-dependent
- *that*-complements – index-independent

$$\lambda j. \text{walk}'(i)(m) \leftrightarrow \text{walk}'(j)(m)$$

$$\{ j : \text{walk}'(i)(m) \leftrightarrow \text{walk}'(j)(m) \}$$
The relation between *whether* and *that* is not due to factivity

1. John tells us whether Mary walks.  
   Mary walks.  
   ————————————  
   John tells us that Mary walks.

2. John tells us whether Mary walks.  
   Mary does not walk.  
   ————————————  
   John tells us that Mary does not walk.
A note: some verbs do not validate the arguments:

- inquisitive verbs – *ask, wonder*
- verbs of conjecture – *guess, estimate*
- opinion verbs – *be certain about*
- verbs of relevance – *matter, care*
- verbs of dependency – *depend on*

Extensional vs. intensional verbs
1. John knows who walks.  
   Bill walks.  
   ______________________  
   John knows that Bill walks.

2. John tells us who walks.  
   Bill walks.  
   ______________________  
   John tells us that Bill walks.
1. John knows who walks.
   Bill walks.

   ________________

   John knows that Bill walks.

2. John tells us who walks.
   Bill walks.

   ________________

   John tells us that Bill walks.

\[ \lambda j. \lambda x. \text{walk'}(i)(x) = \text{walk'}(j)(x) \]
A primer on lambda calculus

lambda calculus

- notation for functions and application
- two main uses:
  - applying a function to an argument
  - forming functions by abstraction
Rules

- **whether formation**
  - if $\gamma \in P_t$, then whether $\phi \in P_{t'}$.
  - if $\gamma \leadsto \gamma'$, then whether $\phi \leadsto \lambda j(\gamma' \leftrightarrow (\lambda i \gamma'(j)))$.

- **that formation**
  - if $\gamma \in P_t$, then that $\phi \in P_{t'}$.
  - if $\gamma \leadsto \gamma'$, then that $\phi \leadsto \lambda i(\gamma')$. 
Abstract formation for *who*

If $\phi \in P_t$ then $F_{AF1,n}(\phi) \in P_{t///e}$.

Condition: $\phi$ contains an occurrence of $he_n$ which bears case c.

$F_{AF1,n}(\phi) = who(c)\psi$, where $\psi$ comes from $\phi$ by deleting the occurrence of $he_n$ in $\phi$.

If $\phi \rightsquigarrow \phi'$, then $F_{AF1,n}(\phi) \rightsquigarrow \lambda x_n.\phi'$. 
Clause formation

If $\gamma \in P_{t/\{e\}}$, then $F_{CF}(\gamma) \in P_t$.

If $\gamma \rightsquigarrow \gamma'$, then $F_{CF}(\gamma) \rightsquigarrow \lambda j(\gamma' = (\lambda i.\gamma')(j))$. 
John knows who walks.

John knows who does not walk.
Rules

Abstract formation for *which*-phrases
If $\phi \in P_t$ and and $\delta \in P_{CN}$, then $F_{AF2,n}(\delta, \phi) \in P_{t///e}$.
Condition: $\phi$ contains an occurrence of $he_n$ which bears case $c$.

$F_{AF1,n}(\phi) = which(c)\delta(c)\psi$, where $\psi$ comes from $\phi$ by deleting the occurrence of $he_n$ in $\phi$.

If $\phi \rightsquigarrow \phi'$ and $\delta \rightsquigarrow \delta'$, then
$F_{AF1,n}(\delta, \phi) \rightsquigarrow \lambda x_n.(\delta'(x_n) \land \phi')$. 
De dicto/de re ambiguity

1. John knows who walks.

_______________________

John knows which spy walks.

This holds under the de re reading, but not under the de dicto reading
De dicto/de re ambiguity

1 John knows who walks.

John knows which spy walks.

This holds under the de re reading, but not under the de dicto reading

Abstract formations right now derive only de dicto readings
Problems

Syncategorematic treatment of clause formation and wh-words

- wh-words are of different syntactic categories; this depends on the number of wh-words they co-occur with (duplication of rules)
- wh-words are subject to the same grammatical principles that the same lexical categories are but that cannot be expressed (missing generalization)
- clause formation markers are subject to the same principles as other complementizers, which is not expressed (missing generalization)
Problems

- As shown, a compositional analysis only derives de re reading of which-phrases

Even if we achieved a compositional analysis, wh-words would be treated as lambda abstractions.

- Indefinite-interrogative affinity is unaccounted for
Dynamic version of Groenendijk & Stokhof (1982)

- allows for categorematical treatment of wh-words
- as a bonus, makes the connection between wh-words and indefinites explicit
A man came in. He whistled.

$\exists x (\text{man}'(x) \land \text{came} - \text{in}'(x)) \land \text{whistled}'(x)$

$\exists x (\text{man}'(x) \land \text{came} - \text{in}'(x) \land \text{whistled}'(x))$

Few men came in. They whistled.
More observations

1. If a donkey sleeps, it snores.
2. \( \forall x (\text{donkey}'(x) \land \text{sleep}'(x) \rightarrow \text{snore}'(x)) \)
3. \( \exists x (\text{donkey}'(x) \land \text{sleep}'(x)) \rightarrow \text{snore}'(x) \)
DPLC

Dynamic predicate logic with lambda calculus
Syntax of DPLC

Types

1. \( t \in PRT \)
2. If \( a \in PRT \) then \( \langle e, a \rangle \in PRT \) and \( \langle s, a \rangle \in PRT \)
3. \( T \), the set of DPLC types, is the set \( PRT \cup \{e, s\} \).

Syntax

1. Every constant and variable of type \( a \) is in \( ME_a \).
2. If \( \alpha \in ME_{\langle b, a \rangle}, \beta \in ME_b \), then \( \alpha(\beta) \in ME_a \)
3. If \( \alpha \in ME_a, \beta \in ME_a \), then \( \alpha = \beta \in ME_t \)
4. If \( \alpha, \beta \in ME_t \), then \( \neg \alpha, \ldots (\alpha \leftrightarrow \beta) \in ME_t \)
5. If \( \alpha \in ME_t \) and \( v \) is a variable, then \( \exists v\alpha \) and \( \forall v\alpha \in ME_t \)
6. If \( \alpha \in ME_a \) and \( v \) is a variable of type \( b \in \{e, s\} \), then \( \lambda v\alpha \in ME_{\langle b, a \rangle} \)
Possible denotations of DPLC

Types

1. $D_e = D$
2. $D_s = S$
3. $D_t = \{0, 1\}$
4. $D_{\langle a, b \rangle} = D_b^{D_a}$
Semantics of DPLC

1. $[[c]]_{M_g} = F(c)$ for every constant $c$

2. $[[v]]_{M_g} = g(v)$ for every variable $v$

3. $[[\lambda v. \alpha]]_{M_g} =$ function $f \in D_b^{Da}$ such that for all $d \in D_b$ it holds that $f(d) = [[[\alpha]]_{M,g[v/d]}$ ($\alpha$ is of type $a$ and $v$ is of type $e$ or $s$)

4. $[[\alpha(\beta)]]_{M,g} = [[[\alpha]]_{M,g}([[[\beta]]]_{M,g})$

5. $[[\exists v \phi]]_{M,g} = 1$ iff there is a $d \in D_e$ such that $[[\phi]]_{M,g[v/d]} = 1$

6. $[[\phi \land \psi]]_{M,g} = 1$ iff there is a $h \in /\phi/_{M,g}$ such that $[[\psi]]_{M,h} = 1$

7. $[[\alpha \leftrightarrow \beta]]_{M,g} = 1$ iff $/\alpha/_{M,g} = /\beta/_{M,g}$


Semantics of DPLC

1. For $\gamma \neq (\phi \land \psi)$ or $\exists v. \phi$ or $\lambda v_1 \ldots \lambda v_n. \phi(\alpha_1) \ldots (\alpha_n)$:
   
   $/\gamma/_{M,g} = \{ g \}$ if $[[\gamma]]_{M,g} = 1$, $\emptyset$ otherwise

2. $/\phi \land \psi/_{M,g} = \{ h : \text{there is a } k \in /\phi/_{M,g} \text{ such that } h \in /\psi/_{M,k} \}$

3. $/\exists v \phi/_{M,g} = \{ h : \text{there is a } d \in /D_e \text{ such that } h \in /\psi/_{M,g[v/d]} \}$

4. $/\lambda v_1 \ldots \lambda v_n. \phi(\alpha_1) \ldots (\alpha_n)/_{M,g} = /\phi/_{M,g[v_1/d_1 \ldots v_n/d_n]}$, where $d_1 = [[\alpha_1]]_{M,g} \ldots d_n = [[\alpha_n]]_{M,g}$
Equivalence in DPLC

- \( \phi \sim \psi \iff \forall M \forall g : \phi_{M,g} = \psi_{M,g} \)

- Fact: \( \phi \sim \psi \iff \phi \leftrightarrow \psi \) is valid

- \( \phi \) and \( \psi \) are equivalent iff they have the same context change potential.
Proposition 1

\[ ([\lambda x_1 \ldots \lambda x_n. \phi = \lambda x_1 \ldots \lambda x_n. \psi])_{M,g} = 1 \]
\[ \iff \]
\[ ([\exists x_1 \ldots \exists x_n. \neg \neg \phi \leftrightarrow \exists x_1 \ldots \exists x_n. \neg \neg \psi])_{M,g} = 1 \]

Why is this important?
Proposition 1 (first step)

1. $[[\lambda x. \phi = \lambda x. \psi]]_{M, g} = 1$
2. $\forall d \in D_e : [[\phi]]_{M, g[x/d]} = 1 \iff [[\psi]]_{M, g[x/d]} = 1$
3. $\forall d \in D_e : [[\neg \neg \phi]]_{M, g[x/d]} = 1 \iff [[\neg \neg \psi]]_{M, g[x/d]} = 1$
4. $\forall d \in D_e : /\neg \neg \phi/_{M, g[x/d]} = /\neg \neg \psi/_{M, g[x/d]}$
5. $\bigcup \{ g[x/d] : [[\neg \neg \phi]]_{M, g[x/d]} = 1 \} = \bigcup \{ g[x/d] : [[\neg \neg \phi]]_{M, g[x/d]} = 1 \}$
6. $/\exists x . \neg \neg \phi/_{M, g} = /\exists x . \neg \neg \psi/_{M, g}$
7. $[[\exists x . \neg \neg \phi \iff \exists x . \neg \neg \psi]]_{M, g} = 1$
Proposition 1 (induction step)

1. 
\[
[[\lambda y \lambda x_1 \ldots x_n.\phi = \lambda y \lambda x_1 \ldots x_n.\psi]]_{M,g} = 1
\]

\[\iff\]

2. 
\[
\forall d \in D_e : [[\lambda x_1 \ldots x_n.\phi = \lambda x_1 \ldots x_n.\psi]]_{M,g[y/d]} = 1
\]

\[\iff\]

3. 
\[
\forall d \in D_e : [[\exists x_1 \ldots x_n.\neg\neg\phi = \exists x_1 \ldots x_n.\neg\neg\psi]]_{M,g[y/d]} = 1
\]

\[\iff\]

4. 
\[
\forall d \in D_e : /\exists x_1 \ldots x_n.\neg\neg\phi/_{M,g[y/d]} = /\exists x_1 \ldots x_n.\neg\neg\psi/_{M,g[y/d]} = 1
\]

\[\iff\text{(by lemma 2)}\]

5. 
\[
/\exists y \exists x_1 \ldots x_n.\neg\neg\phi/_{M,g} = /\exists y \exists x_1 \ldots x_n.\neg\neg\psi/_{M,g} = 1
\]

\[\iff\]

6. 
\[
[[\exists y \exists x_1 \ldots x_n.\neg\neg\phi \iff \exists y \exists x_1 \ldots x_n.\neg\neg\psi]]_{M,g} = 1
\]