Constraints on the lexical semantics of question-embedding predicates

Wataru Uegaki (Leiden University Centre for Linguistics)

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Project introduction

Searching for semantic universals in the modal domain

- Robust cross-linguistic similarities and (potential) universals in the lexical semantics of logical vocabularies (e.g., Barwise & Cooper 1981; Keenan & Stavi 1986).
- This project aims to extend the research on lexical semantic universals to the modal/attitudinal vocabularies.

Project goals

- Posit feasible lexical-semantic universals within the modal/attitudinal domain.
- Empirically evaluate these universals with a sample of 11 languages.
- Consider *explanations* for the proposed universals.

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Project members

Leiden	Lisa Bylinina, Jenny Doetjes, Wataru Uegaki
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Potsdam	Malte Zimmermann, Jordan Chark
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Amsterdam (CoSaQ group)	Jakub Szymanik, Shane Steinert-Threlkeld

Project outcomes

Database A public database of semantic features (relevant for the hypothesized semantic universals) of modal and attitudinal vocabularies in Dutch, English, French, German, Hungarian, Japanese, Mandarin Chinese, Ngamo, Romanian, Turkish, Zapotec + more.

Workshops Dec2018@Leiden, Oct2019@Konstanz, Mar2020@Berlin, Mar2021@Amsterdam

Publication Special issue in a peer-reviewed journal

Exciting future projects (Funded) future projects focusing on the explanations of universals.

Examples of feasible universals

Lexical encoding of modal force & flavor (Nauze '08)

No modal item is polyfunctional wrt *both* its modal force and flavor (e.g., epistemic, deontic) (cf. Vander Klok '13)

Constraint on the flavor of dual-less modals

If a language contains a modal auxiliary that lacks a dual, it is more likely that its modal flavor is epistemic rather than circumstantial (Matthewson '16; 'impressionistically...')

Lack of the Aristotelian 'O'-corner (Horn '72; Katzir&Singh '13)

There is no lexical item that expresses non-necessity.

Veridicality uniformity (Spector&Egré 2015)

A responsive predicate is veridical wrt declarative complements iff it is veridical wrt interrogative complements (counterex.: Predicates of Relevance, e.g., *care*, Theiler et al. '18).

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Explanations of universals

Linguistic explanation

Explanations in terms of syntax, semantics, morphology and their interfaces. E.g., Romoli's (2015) explanation of conservativity in terms of syntax-semantics interface.

Learnability-based explanation

Explanation in terms of ease of learning, based on the idea that languages tend to lexicalize word-meanings that are easy to learn. E.g., Hunter & Lidz '13; Steinert-Threlkeld & Szymanik '18.

Principles governing optimization of lexicon

Explanation in terms of (pragmatic/diachronic/...) principles that prefer a certain inventory of lexical items over another. E.g., Horn '72 and Katzir & Singh '13 on the lack of **nall*.

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The puzzle of responsive predicates

Responsive predicates

(1) a. John {**knows**/**realized**/**reported**} that Ann left.

b. John {**knows**/**realized**/**reported**} who left.

Responsive predicates

Predicates that can embed either *declarative* or *interrogative* complements (terminology after Lahiri 2002).

Other examples of responsive predicates:
learn, *forget*, *be certain (about)*, *predict*, *tell*, *report*, *decide*, *annoy*, *surprise*, *agree* (on), *matter* etc.

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The puzzle

Two basic assumptions

1. **Semantic distinction of clause types**
   Declarative complements and interrogative complements denote semantic objects with distinct types.
2. **Non-ambiguity**
   Responsive predicates are unambiguous between their declarative-embedding use and interrogative-embedding use.

The puzzle:
How do responsive predicates combine with two distinct semantic objects?

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Empirical motivation for non-ambiguity

Gapping

(2) John **knows/realized/reported** that Ann left and Bill ~~**knows/realized/reported**~~ which other girls left.

Cross-linguistic stability in the class of responsive predicates

(3) a. John-wa dono onnanoko-ga kita-ka
John-TOP which girl-NOM came-Q
sitteiru/kizuita/hookoku-sita.
know/realized/reported
'John knows/realized/reported which girl came.'

b. John-wa Mary-ga kita-to
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Four approaches

1. Question-to-Proposition reduction (e.g., Karttunen 1977)

Assimilating the semantics of *V-wh* to that of *V-that*.

2. Proposition-to-Question reduction (e.g., Uegaki 2015)

Assimilating the semantics of *V-that* to that of *V-wh*.

3. Uniformity (e.g., Inquisitive Semantics; Ciardellin et al. 2013)

Declarative and interrogative complements denote the same type of semantic objects. (rejection of assump. 1)

4. Ambiguity (e.g., George 2011)

Responsive predicates are ambiguous between declarative and interrogative-embedding uses. (rejection of assump. 2)

Roadmap

1. Question-to-Proposition reduction
2. Predicates of relevance: a problem for the Q-to-P reduction
3. An alternative: Proposition-to-Question reduction
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Question-to-Proposition reduction

- Responsive predicates semantically select for the denotation of the declarative complement, i.e., propositions.
- The compositional semantics involves a mechanism that turns a question into a proposition.

- Hintikka '62; Karttunen '77; Heim '94; Dayal '96; Beck & Rullmann '99; Lahiri '02; Spector & Egré '15; Cremers '16
- Analyses differ in the exact formulation of the reduction.
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Questions as sets of propositions

An interrogative complement denotes a set of propositions, obtained by, roughly, varying the argument corresponding to the *wh*-item.

(4) $[\![\text{who left}]\!]^w$
$= \{ p \mid \exists x[p = \lambda w'.\textbf{left}_{w'}(x)] \}$
$= \{$ ‘Ann left’, ‘Bill left’, ‘Carol left’,... $\}$
$= \{\textsf{A}, \textsf{B}, \textsf{C}, \ldots\}$

- Since we are concerned with the embedding phenomena, we do not go into the sub-clausal composition of *wh*-clauses (see e.g., Hamblin ’73; Karttunen ’77; Lahiri ’02; Ciardelli et al. ’17)

Exhaustivity of an answer

How much true information an answer conveys relative to the question meaning.

(5) [Situation: Only Ann and Bill left.] Who left?

(6) **Answers with three levels of exhaustivity**

a. **Mention-some answers**: 'Ann left', 'Bill left'

b. **Weakly-exhaustive answer**: 'Ann left and Bill left'

c. **Strongly-exhaustive answer**: 'Ann left and Bill left, and no one else left.'

I will assume that the default reading of embedded questions involves the weakly-exhaustive answer, following Karttunen '77; Heim '94; Dayal '96; Klinedinst & Rothschild '11; Uegaki '15.

Answerhood operator

(7) $\textbf{Ans}_w = \lambda Q_{\langle st,t\rangle} :\ \exists p \in Q[p = \textbf{Max}_{\text{inf}}(Q, w)].\ \textbf{Max}_{\text{inf}}(Q, w)$

(8) $\textbf{Max}_{\text{inf}}(Q, w) = p$ iff $w \in p \wedge \forall q \in Q[w \in q \rightarrow p \subseteq q]$

Ans takes a question meaning as its input and outputs its maximally-informative true ($\approx$ weakly-exhaustive) answer, presupposing that such an answer exists (Dayal 1996).

(9) a. $[\![\text{know}]\!]^w = \lambda p_{\langle s,t\rangle} \lambda x_e :\ \underline{p(w)}.\ \textbf{know}_w(x, p)$

b. $[\![\text{John knows who left}]\!]^w$
$= [\![\text{know}]\!]^w(\textbf{Ans}_w([\![\text{who left}]\!]))(\text{j})$
$= 1$ iff $\underline{\exists x[\textbf{left}_w(x)]} \wedge \textbf{know}_w(\text{j}, \textbf{Ans}_w([\![\text{who left}]\!]))$

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Prediction of (existing) Q-to-P reduction

- NB: I conflate variables in the object language and metalanguage.

Entailment prediction

Let V be a responsive predicate. Then, for every entity-denoting term x and every interrogative complement Q, $\ulcorner x\ Vs\ Q \urcorner$ entails that there is a proposition $p \in Q$ such that $\ulcorner x\ Vs\ p \urcorner$.

- That is: V-Q entails that for some answer to Q, V-p.
- Entails one direction of the veridicality uniformity (decl-veridicality $\Rightarrow$ int-veridicality).

Illustration with the Ans-based theory

In the **Ans**-based theory, the Entailment Prediction holds.

- **Ans**-based theory: $[\![\text{x Vs Q}]\!]^w \Leftrightarrow [\![\text{V}]\!]^w(\textbf{Ans}_w(Q))(x)$.
- If $\textbf{Ans}_w(Q)$ is defined, then for some $p \in Q$, $\textbf{Ans}_w(Q) = p$
- Thus, under the **Ans**-based theory, if $[\![\text{x Vs Q}]\!]^w = 1$, there is $p \in Q$ such that $[\![\text{V}]\!]^w(p)(x) = 1$

Roadmap

1. Question-to-Proposition reduction
2. Predicates of relevance: a problem for the Q-to-P reduction
3. An alternative: Proposition-to-Question reduction
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Predicates of relevance: the phenomenon

Predicates of relevance: *care*, *matter*, *be relevant* etc.

(10) a. John **cares** that Mary left.

b. John **cares** (about) which girls left.

- (10a) entails that John believes that Mary left.
- For any girl, (10b) does *not* entail that John believes that she left. (10b) can be true as long as he knows that some girl left, and is wondering which one did.

(Elliott, Klinedinst, Sudo & Uegaki 2017)

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Preds of relevance as counterex. to Entailment Prediction

(11) **The Q-to-P reduction account of *care***
$[\![x \text{ cares } Q]\!]^w \Leftrightarrow [\![\text{care}]\!]^w(\textsf{Ans}_w(Q))(x)$.

- Given the Entailment Prediction, (11) predicts that $\ulcorner x$ cares $Q\urcorner$ entails that there is $p \in Q$ such that $\ulcorner x$ cares that $p\urcorner$.
- Given our observation, $\ulcorner x$ cares that $p\urcorner$ entails that x believes that p.
- Thus, (11) predicts that $\ulcorner x$ cares $Q\urcorner$ entails that there is $p \in Q$ such that x believes that p.
- But, this is contrary to our observation: *John cares (about) which girls left* doesn't entail that there is a girl such that John believes that she left.

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Proposition-to-Question reduction

- Responsive predicates semantically select for the denotation of an interrogative complement, i.e., questions.
- The compositional semantics involves a mechanism that turns a proposition into a question.

The semantics of *know* (simplified)

(12) $[\![\text{know}]\!]^w = \lambda Q_{\langle st,t\rangle} \lambda x.\mathbf{know}_w(x, \mathbf{Ans}_w(Q)) \quad : \langle\langle st,t\rangle, \langle e,t\rangle\rangle$

(13) $[\![\text{John knows who left}]\!]^w$ = 1 iff
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Proposition-to-Question reduction: declarative-embedding

The semantics of *know* (simplified)

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Entailment Prediction in the P-to-Q reduction

Entailment Prediction

⌜*x Vs Q*⌝ entails that there is a proposition $p \in Q$ such that ⌜*x Vs* that *p*⌝

- The P-to-Q reduction approach does not commit to this prediction because, under the approach, the interpretation of ⌜*x Vs Q*⌝ does not have to be analyzed in terms of the subject's relationship to specific answers.
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Predicates of relevance: the phenomenon

Predicates of relevance: *care*, *matter*, *be relevant* etc.

(10) a. John **cares** that Mary left.

b. John **cares** which girls left.

- (10a) entails that John believes that Mary left.
- For any girl, (10b) does *not* entail that John believes that she left. (10b) can be true as long as he knows that some girl left, and is wondering which one did.

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Predicates of relevance in non-reductive theories

x *cares* Q presups. that x believes that Q has a true answer

(18) $[\![\text{care}]\!]^w = \lambda Q_{\langle st,t\rangle} \lambda x : \underline{\textbf{bel}_w(x, \lambda v.\exists p \in Q[p(v)])}.\textbf{care}_w(x, Q)$

(19) $[\![\text{which girl left}]\!]^w = \{\text{A}, \text{B}, \text{C}\}$

(20) $[\![\text{John cares which girl left}]\!]^w = 1$ iff
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Roadmap

1. Question-to-Proposition reduction
2. Predicates of relevance: a problem for the Q-to-P reduction
3. An alternative: Proposition-to-Question reduction
4. Constraints on the denotation of responsive predicates

Impossible responsible predicates?

- So far, we have compared the approaches based on how much they can deal with existing responsive predicates.
- We can also compare the approaches based on the *restrictiveness* of theories, i.e., whether each approach places a reasonable constraint on the space of possible denotations of responsive predicates.
- **Spector & Egré (2015)**: A theory of responsive predicates have to be able to account for the fact that it is hard to imagine a language having **shknow*:

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*Shknow in different approaches

It is easy to capture the restriction against **shknow* in the Q-to-P reduction:

(23) a. $[\![\text{x shknows p}]\!]^w = 1$ iff $[\![\text{shknow}]\!]^w(p)(x)$
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The P-to-Q reduction/uniform approach can in principle define **shknow*.

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Constraints on lexical denotations

- The P-to-Q reduction/uniform approach is powerful, but maybe *too* powerful.
- However, this does not constitute an argument against the approaches themselves, as we can place constraints on the lexical denotations on top of the basic framework for responsive predicates.
- **Analogue to the GQ theory**: natural languages lexicalize only a small subset of denotations that can be expressed as a GQ/determiner. The GQ theory has sought to formulate empirically feasible constraints on lexical denotations (e.g., monotonicity, conservativity).

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Strawson Entailment Property

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A responsive predicate V has the Strawson entailment property iff for every entity-denoting term x and every interrogative complement Q, $\ulcorner x\ Vs\ Q \urcorner$ entails that there is a proposition $p \in Q$ such that, if the presupposition of $\ulcorner x\ Vs\ p \urcorner$ is satisfied, $\ulcorner x\ Vs\ p \urcorner$ is true.

A constraint on responsive predicate denotations

All responsive predicates have the Strawson entailment property.

shknow, *care* and the Strawson Entailment Property

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Constraints in Theiler et al. (2018)

C-distributivity (Theiler et al. 2018)

A predicate V with one clausal and one individual argument slot is **c-distributive** if and only if, for any individual x, any world w, and any nucleus meaning P such that $decomp(P)$ is defined: $V(E(P))(x)$ is true in w iff $V(E(P'))(x)$ is true in w for some $P' \in decomp(P)$

- One direction of this ($\Rightarrow$) is very similar to the Entailment Prediction.
- C-distributivity entails one direction of the veridicality uniformity (decl-veridicality $\Rightarrow$ int-veridicality).
- We can certainly weaken this using Strawson-entailment to capture Predicates of Relevance.

Constraints in Theiler et al. (2018)

Choice property (Theiler et al. 2018)

A declarative-embedding verb V has the **choice property** just in case for any two declarative nucleus meanings P and P' such that $info(P) \cap info(P') = \varnothing$, and any world w, $V(E(P))(x)$ and $V(E(P'))(x)$ cannot both be true at w.

- If a predicate is C-distributive and has the choice property, it obeys the direction of the veridicality uniformity, i.e., int-veridicality $\Rightarrow$ decl-veridicality.
- No counterexample is found for this direction of the veridicality uniformity.

Conclusions and future research

Summary:

- The P-to-Q reduction/uniform approach overcomes the problem with the traditional Q-to-P reduction approach concerning Predicates of Relevance.
- The power of the P-to-Q reduction/uniform approach can be properly restricted by independent constraints on lexical denotations, e.g., the Strawson Entailment Property.

Future and ongoing research:

- Proper refinement of the constraint (Theiler et al. '18).
- Cross-linguistic empirical evaluation of the constraints (Roberts '18; Uegaki & Roelofsen '18).
- Explanations of the constraints (Steinert-Threlkeld '18).

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