Semantics as an abstraction from Pragmatics

Robert van Rooij
ILLC/Amsterdam

Interest

From

- Formal semantics and pragmatics

to

- Language change
- Evolution of language
- Language universals.

Mostly: concentrate on *syntax*. But

I am most interested in *semantics* and *pragmatics*

Linguistic structure

Popular asssumptions:

- **Syntax**: universal, innate
  Pragmatics: universal, rational principles
  Make exclusive use of on-the-spot reasoning
  Semantics: arbitrary conventions

However:

- **Syntax** influenced by linguistic *use*;
  Pragmatics makes use of (default) rules, and
  Semantics has also universals.

- My Interest:
  What is **balance** between
  1. *rules* and *reasoning* in pragmatics?
  2. *arbitrary* and *universal* rules in semantics?

- and how did rules *evolve*?

Semantic *universals*

- *properties, relations*
- meaning of *function* words.
  connectives, determiners/quantifiers, modals, tenses, (discourse) particles, prepositions, moods, comparatives, polarity items, ,...

- Assumption: all languages have them.
  ⇒ Semantics **not arbitrary**.

- Why is it natural to assume this?

  1. Words express *Innate* concepts. Others?
  2. Such words are very *useful*, **utility**
  3. they are *easy to learn*, and **learnability**
  4. they are *cheap* in *processing*. **complexity**

Example: Natural properties

All languages have color words, but not arbitrary which ones (Berlin & Kay; Goodman: grue, bleen)

Monotonicity important for ordering-based Ptys (e.g. *fast*, comes down to distributivity (*came*))

Natural Relations (Rubinstein)

- All languages have **linear relations**
  reflexive, transitive, antisymmetric, connected

- **indicator friendly**: (usefulness)
  Binary R can denote any element in any subset of a set iff R is a *linear ordering*.

- **describability**: (learnability)
  Linear orderings are (almost) optimal w.r.t. the criterion of minimizing the number of observations required for definition/learning

Semantics: stable meaning

- Want express *useful* + **stable/flexible** items

- **Helmholz, 19th century**
  Geometrical *invariants* in space-time (notions unaffected by transformations) are lexicalized in languages. (e.g. 'inside, behind, towards')

- Want to express concepts in *stable* way.

- **Grice, 1957** 'Meaning' (for more arbitrary)
  Pragmatics: The person X uses the term W to refer to the object O (at time t)
  Semantics: The term W denotes the object O

- How? Lewis: stable in community/time.
  Solution of recurrent coordination problem.

Concept formation by abstraction

1. **Absolute invariance** (universal demand)
   Weight is a relation concept: what you weigh depends on the gravitational field you are in. Mass is quantity that a body has, invariant of gravitational field. So, the latter is an intrinstic property of an object.

2. **Invariant under normal conditions**
   We can define a *stable* (dispositional) property observable in terms of counterfactuals: An object is observable if it would be observed if a *normal* observer were *suitably* placed.

3. **Agent irrelevance** (existential demand)
   It is irrelevant *who* or what does the observation (or verification, or proof).

Semantics: abstracting context

Pragmatics = context dependent.
Make context-independent by abstraction:

- Indexicals, pronouns (Kaplan)
  'I': the speaker of context

- adjectives (Kamp,...) $[CN \rightarrow CN]$
  big: Jumbo is a big mouse/elephant.

- modals (vFraassen) epistemic/deontic,...

- quantifiers, context set (Westerstahl)

- Questions (perhaps Answers) (own work)
  Domain, mention-all, mention-some, scalar...

Required presupposition on good communication:
There is enough **common ground**.

Semantics = ∃ closure

- *A man* is walking in the park.
  Pragm: speaker specific man in mind
  But, ◇ hearer doesn't know which man
  Semantics: ∃ quantify over it. (safe strategy)

- *He* is whisling.
  Pragm: S specific man in mind for pronoun.
  DRT/FCS: ∃ quantify over whole discourse.

- Ralph believes that *Ortcutt* is a spy.
  Communicated information (intuitively):
  Speaker has a specific guise of O of John in mind and states that John believes that O under this guise is a spy.
  Semantics (Kaplan, Richard, vRooij97):
  ∃ quantify over guises/counterpart functions.

∃-closure: **safe** view on semantics.
⇒ It gives rise to *stable meanings*.

Semantics: *invariance* (Tarski)

Characterize 'logical' items by invariance

- **Quantity** (individual neutrality):
  permutation invariant, dependence only on *number* of individuals. (vBenthem, Keenan)
  Which expressions are permutation invariant?
  Type e: no expression.
  Type $\langle(t,t),t\rangle$: the Boolean *connectives*.
  Type $\langle(e,e),t\rangle$: *identity* and its Boolean compounds, *universal* and *empty* relation.
  Type $\langle e(et)t\rangle$: only *elementhood*.
  Type $\langle(e(et)(et)\rangle$: many, e.g. *reflexivization*.

- **Quality**: extra assumption, or more general
  Permutation invariant if extra assumption:
  all $\rightarrow$ *all blond*, possessives: *Mary's*.

  Generalize: Reflexivization only P-invariant Boolean homomorphism in type $\langle(e(et)(et)\rangle$.
  cf. Keenan&Stabler on **linguistic invariants**

Semantics: context *invariance*

- Meaning independent of *domain* D_e (EXT)
  e.g. *every*, but not *everything*, *no*, *not*.

- Assume extra assumption of Restriction:
  REST: if $E \subseteq E'$, then for $A_1, ..., A_k \subseteq E'$:
  $f_E(A_1 \cap E, ..., A_k \cap E) = f_{E'}(A_1, ..., A_k) \cap E$.
  Fact: QUANT and REST characterize
  Boolean operations uniformly. (vBenthem)

- Compare with **Gazdar's explanation**.
  Gazdar '79 excludes potential connectives by
  1. non-redundance, (e.g. $T(1) = 1, T(0) = 0$)
  2. relevance (e.g. $P(1) = 1, P(0) = 1$)
  3. processing: no negative n-ary connective

  $\Rightarrow$ Only $\neg$, $\wedge$ and $\vee$!!!

  Assume: Syntax structures linearly unordered

Processing constraints

- **Conservativity**: $D_E(A, B)$ iff $D_E(A, A \cap B)$

- **Monotonicity**:
  R $\uparrow, \downarrow$ $D_E(A, B) \& B \subseteq / \supseteq B' \Rightarrow D_E(A, B')$
  L $\uparrow, \downarrow$: $D_E(A, B) \& A \subseteq / \supseteq A' \Rightarrow D_E(A', B')$

- **Fact**: The square of opposition quantifiers are the double monotone ones (modulo variety).

- Why not 'not all'? Horn: implicature 'some'.

- **Continuity**: $f(\bigcup_i A_i) = \bigcup_i (f(A_i)$
  Can compute at simple arguments.
  Give motivation for Quinean operators.

- **Computability**: what machine is required in machine hierarchy to implement a **verifying** machine? (semantic automata)

Natural place in logical space

- The Priorean basic tenses (**P, F**) are those that satisfy Quality (order preserving automorphisms) and Continuity.

- Extra structure on temporal constructions: e.g. must denote convex sets → more of the natural temporal expressions.

- In general: Logical Space is Vector Space (van Fraassen, Stalnaker, Gardenfors):
  Compatible with possible worlds semantics
  Which areas $\Diamond$ expressed by NL sentence?
  Which areas form *natural* properties?
  Are there natural constraints? (eg. convexity)
  (see also Zwarts & Winter's vector semantics)

- Modalities express *invariance* under *transformations* of location functions.
  What are natural constraints?

Abstraction from utility

(Merin, van Rooij)

- Linear intuition → Boolean semantics:
  1. Define '¬' i.t.o. utility: $b = \neg a$ iff $\forall U, g$: $U(g, b) \gtreqless 0$ iff $U(g, a) \lesseqgtr 0$.

  2. $U(a \text{ and } b) = U(a) + U(b)$. *Addition*
     Normal condition: a, b *independent* on g.
     $U(a \cap b) = U(a) + U(b)$.

  3. $U(a \text{ or } b) = \alpha U(a) + (1 - \alpha)U(b)$. *Choice*
     Normal condition: a, b *disjount.*
     $U(a \cup b) = \alpha U(a) + (1 - \alpha)U(b)$.

- *Entailment relation*
  $a \models b$ iff for all 'safe' $U : U(a) \geq U(b)$.
  For *questions* for all U (not only safe ones).

- Also: linguistic *scales* and *licensing* conditions
  $U(\alpha_{NPI}) \geq U(\alpha_{alt})$, if α DE → licensing.

Gricean pragmatics

Language use and organization such that communicate *useful* information in an *efficient* but still *effective* and *reliable* way

- Grice's Cooperative principle

- Four conversational maxims:
  - *Quality*: speak the truth
  - *Quantity*: the whole truth
  - *Relevance*: but only what is of interest
  - *Manner*: and in an efficient way

Presupposes: preferences similar (aligned)

Manner: Efficiency

- **Grice's Manner** *iconicity* principle:
  (un)marked form gets (un)marked meaning

  - *kill* $\leftrightarrow$ *cause to die*, *not* $\leftrightarrow$ *un*
  - *intonation/focus* $\leftrightarrow$ *unstressed*

- Meanings *underspecified*, still default rule

- Compare solutions 1 and 2 and assume
  $P(t_1) > P(t_2)$ and $C(m_1) < C(m_2)$
  Both are separating equilibria.
  Both are evolutionary stable

  But, if *mutation* or *correlation*,
  then only solution 1 can emerge.

$\Rightarrow$ **Evolutionary** analysis of why *iconicity*.
Moreover: *underspecification* explained.

Binding and centering theory

- John came in. *He* sat down. co-ref.
  John came in. *The man* sat down. disjoint
- John likes *his father*. co-ref.
  John likes *the man's* father. disjoint

- Co-reference of *he*, *his* $\leftrightarrow$ disjoint *the man*

- *Explain* by Horn's division:
  he: Light/underspecified to salient objects,
  expensive names/descriptions to non-salient.

- Salience by P: Coding with *highest exp. util*
  $\Rightarrow$ stable in evolution

- $\diamond$ explanation centering. Also Binding rules?

- Why 'John like **him/himself* as coreference?
  Disjoint Reference Presumption in clause

Quality: Why speak truth?

	a_1	a_2
t_H	$x, 1$	$z, 0$
t_L	$y, 0$	$w, 1$

Communication possible only if $x \geq z$ and $y \leq w$.
In general: only if *preferences aligned*.

- **Problem**: Why honest if preferences diverge?

	a_1	a_2
t_H	$1, 1$	$0, 0$
t_L	$1, 0$	$0, 1$

Both types prefer a_1 $\rightsquigarrow$ 'I am t_H' is *not credible*

- Solution: **Costly** signalling (Spence, Zahavi)
- C(t_H, 'I am t_H') $< 1 <$ C(t_L, 'I am t_H').
- *Production* costs vs. *Social* costs.
- Evolution: speaking *truthful* is *costless*.

Quan/Rel: Information Exchange

- Standard: info not verifiable
  $\rightarrow$ No incentive to speak the truth

- Even if truth demanded, *misleading* still $\diamond$

	a_1	a_2
t_H	$1,1$	$0,0$
t_L	$1,0$	$0,1$

- $S(t_H) =$ 'I am t_H', $\quad S(t_L) =$ 'I am t_H or t_L'

  $\Rightarrow \quad S^{-1}(\text{'I am } t_H\text{'}) = \{t_H\}$
  $S^{-1}(\text{'I am } t_H \text{ or } t_L\text{'}) = \{t_L\}$

- **Pragmatic interpretation**
  $Prag(\phi, <) = \{t \in [\phi] | \neg \exists t' \in [\phi] : t' < t\}$

  where $t' < t$ if speaker strictly prefers t to t'.

Implicatures & minimal models

Horn, Levinson, Atlas: Two kinds of implicatures:

- Q-implicatures (Quantity 1, Relevance)
  Say as much as you can! (scalar implicatures)
  $\rightsquigarrow$ *Interpret* in least informative/relevant way.

  Exhaustive interpretation (Gr & St, 1984).
  i.t.o. **minimal models** (vRooij&Schulz, '04):
  $exh(\phi, <_P) = \{w \in [\phi] | \neg\exists v \in [\phi] : v <_P w\}$

- I-implicatures (Quantity 2, Manner)
  Don't say more than you must!
  $\rightsquigarrow$ *Interpret* in most stereotypical way.

  John killed the sheriff $\rightsquigarrow$ by knife or pistol.

  $v \prec_C w$ iff v is more 'normal' than w in C.
  $I(\phi, \prec_C) = \{w \in [\phi] | \neg\exists v \in [\phi] : v \prec_C w\}$

  Note: minimal model analysis (Asher&Lasc).

Complicating games

- Equilibrium: $\langle S, R \rangle$

- Semantic meaning $\phi = [\phi]$
  Communicated meaning ϕ: $S^{-1}(\phi)$

- $S \in [T \rightarrow M]$ (function from states)
  $R \in [M \rightarrow A]$ (interpr: $A = T$)

- More naturally: $S \in [(T \times C \times \cdots) \rightarrow M]$

- C represents:
  1. External context (sp, h, salient d, etc.)
  2. Common ground (knowledge)
  3. Knowledge of agents (e.g. speaker)
  4. Question under Discussion
  5. $\cdots$

- Assume **appropriateness** conditions:
- $S^{-1}(\phi)$ tells us more about utterance context.
- Presup (King of France) $\rightarrow$ common ground
- Pronoun $\rightarrow$ unique most salient d
- Focus $\rightarrow$ QUD
- Gricean maxims $\rightarrow$ what speaker knows
- $S^{-1}(\phi) = \{s \in STATE$:
  1. ϕ is asserted appropriately in Context(s)
  2. Index(s) makes ϕ true
  3. $\neg\exists s' \in STATE$ in which (1) and (2) AND in s' speaker could have said something better $\}$

Conventionalization (Lang. change)

- $\forall\phi : S^{-1}(\phi) \rightsquigarrow [\phi] \Rightarrow$ less reasoning, inform.
  Conventionalization as *automation* (Givon)
  Defaults can also be linguistic rules

- Natural for *frequently used* 'inferences'
  1. Presupposition, Focus (accomm., QUD)
  2. Weak Exhaust: $[\text{John}]_F$ came $\rightarrow \neg\mathbf{K}C(m)$
  3. if 'relevance' *context independence* if approved always by everybody, e.g. '$\models$'.
  4. *Illocutionary* meaning, not *perlocutive*

  .

- Less natural if Relevance $\Uparrow \neq$ Information $\Uparrow$
  or if extra assumption (e.g. *competence*)

  $$[\text{John}]_F \text{ came} \rightarrow \mathbf{K}\neg C(m)$$

  Maximize relevance *context-dependent*, e.g.
  - Involved in non-cooperative game, or
  - speaker has specific goals. (P, U)

Conclusions

- Semantics and pragmatics is more interesting than sometimes assumed. Semantics has universals, pragmatics has rules.

- Semantic concepts must be *stable*, but there are diverse ways to achieve this. *Look* what is invariance under context change ('logical constants') versus *make* context independent (abstract from context).

- We would like to have cognitive/pragmatic motivation for semantic universals. But there is no unique way to receive this.

- Question: do 'logical constants' really evolve, or are they inherent to symbolic system?