Plurality

foundations of semantics and pragmatics, january 8, 2013
Today

- Introduction
- Collectivity and distributivity
- Singular and plural individuals and the structure of the domain $D_e$
- More on distributivity
- Group nouns
Introduction

• Plurality in morphosyntax:

(1)  a The girl *is/*are smiling.
    b The girls *is/*are smiling.
    c Tina *is/*are smiling and Mary *is/*are smiling.
    d Tina and Mary *is/*are smiling.

• A syntactic theory has to distinguish between singular and plural NPs (and VPs). What about a semantic theory?
• Intuitive hypothesis: singular NPs denote singular individuals (*Tina, the girl, a girl...*), plural NPs denote plural individuals (*Tina and Mary, the girls, two girls, all girls...*)

• But:

  (2) a. All of the girls *are* smiling.
      b. Each of the girls *is* smiling.

  (3) a. The committee *is* in a meeting.
      b. The committee *are* in a meeting (British English)
Introduction (3)

• But (continued):

(4) a. The committee meets weekly / gathered for a group portrait / is a good team
   b. *Tina meets weekly / gathered for a group portrait / is a good team

• Conclusion: intuitions about ‘singular’ and ‘plural’ aren’t enough, we need a theory about the semantic/logical structure of NPs.
And what about VPs?

• The predicates in (4) (*meet*, *gather*, *be a good team*) can only take plural arguments (plural NPs or groups). We call these predicates **collective**.

• Predicates like *smile*, *laugh*, *dance* are called **distributive**.

• Note the entailments:
  
  a) **Distributive predicates**: All the girls / Tina, Mary and Alice are smiling → Tina is smiling and Mary is smiling and Alice is smiling

  b) **Collective predicates**: Tina and Mary are a good team → Tina is a good team and Mary is a good team
And what about VPs? (2)

• There are also **mixed predicates**, that allow both collective and distributive interpretations:

  a) Tina and Mary carried a piano upstairs.
     \[\rightarrow\] Tina carried a piano upstairs and Mary carried a piano upstairs.
     \[\rightarrow\] Tina and Mary together carried a piano upstairs.

  b) Tina and Mary write songs.
     \[\rightarrow\] Tina writes songs and Mary writes songs.
     \[\rightarrow\] Tina and Mary write songs together.
Singular and plural individuals

• So, how do we define ‘singular’ and ‘plural’ arguments?

• We have two sets:
  – The (arbitrary) set of singular individuals, $D_{\text{sg}}$
  – The (non-arbitrary, defined in terms of $D_{\text{sg}}$) set of plural individuals, $D_{\text{pl}}$

• **Question 1**: are $D_{\text{sg}}$ and $D_{\text{pl}}$ independent domains (with their own type), or do they form a single domain?
Singular and plural individuals (2)

• **Answer:** $D_{sg}$ and $D_{pl}$ form a single domain

• **Why?**
  
  – Mixed predicates
  
  – Coordination of singular and plural NPs
  
  – Recall from the class on pragmatics: plural nouns include singular individuals in their denotation
    
    a) Do you have children?
      
      – Yes, one. / #No, one.
    
    b) This exam does not contain difficult questions.
Singular and plural individuals (3)

• So, we define a single domain with entities of two sorts:

\[ D_e = D_{sg} \cup D_{pl} \]

• **Question 2**: how can we define \( D_{pl} \) on the basis of \( D_{sg} \)?

• **Answer**: there are two options...
The union theory

• First option: **union** of sets

\[
\begin{align*}
D_{\text{sg}} &= \{ \{x\} \mid x \in E \}, \text{ where } E \neq \emptyset \text{ and arbitrary} \\
D_{\text{e}} &= \text{the closure of } D_{\text{e}} \text{ under union} \\
&= \{ A \subseteq E \mid A \neq \emptyset \} \\
D_{\text{pl}} &= D_{\text{e}} - D_{\text{sg}}
\end{align*}
\]

(a set is **closed under** an operation iff every result of performing that operation on members of the set is itself a member.)
The set formation theory

• Second option: set formation
• Unlike the union theory, this option gives you sets with internal structure:

\[ D_{SG} = E, \text{ where } E \neq \emptyset \text{ and arbitrary} \]
\[ D_e = \text{the closure of } D_{SG} \text{ under set formation, without singletons} \]
\[ = \bigcup_{i \geq 0} D_i \]
\[ \text{where } D_0 = D_{sg} \text{ and } \forall i \geq 1: D_i = D_{i-1} \cup \emptyset(D_{i-1}) - \emptyset - \{\{x\} \subseteq D_{i-1} : x \in D_{i-1}\} \]

• Let’s do that step by step 😊
The set formation theory (2)

\[ D_0 = D_{sg} = E \]

\[ D_1 = D_0 \cup \mathcal{P}(D_0) - \emptyset - \{ \{x\} \subseteq D_0 : x \in D_0 \} \]

(= \( D_0 \) and the power set of \( D_0 \), without the empty set and singletons)

\[ D_2 = D_1 \cup \mathcal{P}(D_1) - \emptyset - \{ \{x\} \subseteq D_1 : x \in D_1 \} \]

(= \( D_1 \) and the power set of \( D_1 \), without the empty set and singletons)

...etcetera
What’s the difference?

• Suppose we want to coordinate *John* and *the boys*, where \([[[John]] = j]\) and \([[[the boys]] = \{a,b,c\}\)]
  
  – In the **union theory** the denotation of \([[[John and the boys}}\) is the union of the sets \(\{j\}\) and \(\{a,b,c\}\) = the set \(\{j,a,b,c\}\)
  
  – In the **sets theory** the denotation of \([[[John and the boys}}\) is the structured set \(\{j,\{a,b,c\}\}\)

• Can we test the difference empirically?
Union vs set formation: empirical evidence

• Hoeksema (1983): set formation

(5)  a. [Blücher and Wellington] and Napoleon fought each other at Waterloo

    b. Blücher and [Wellington and Napoleon] fought each other at Waterloo

• According to Hoeksema, the union theory does not account for the different truth conditions of (a) and (b)

[[fight each other at Waterloo]] = \{n,b,w,...\} (union theory) or \{\{n,\{b,w\}\},...\} (sets theory)
Union vs set formation: empirical evidence (2)

• Landman (1989): set formation

(6)  a. The cards below seven and the cards from seven up were separated.
    b. The cards below ten and the cards from ten up were separated.

(7)  a. The young animals and the old animals were introduced to each other.
    b. The cows and the pigs were introduced to each other.

• Again, the union theory predicts identical truth conditions
Union vs set formation: empirical evidence (3)

• Schwarzschild’s (1996) counterargument:

(8) a. The cows and the pigs were separated.
   b. $\rightarrow$ The animals were separated.

But if we can do this, the following entailments also hold:

(9) a. The cows and the pigs were separated (by age).
   b. $\rightarrow$ The animals were separated (by age).
   c. $\rightarrow$ The young and the old animals were separated.

• Conclusion: union theory is sufficient.
Link (1983): lattices

- Recall, according to the union theory, if $E = \{a, b, c\}$, then $D = \{\{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{a, b, c\}\}$
- Often, $D$ is formalised in a slightly different way, following Link (1983): as a **complete join semi-lattice**
Lattices (2)

• Why? Because of the parallel between mass nouns and plural count nouns, Link doesn’t want to formalise the latter in terms of sets

\[(10)\]  
\begin{align*}
\text{a. } x \text{ is a pop star and } y \text{ is a pop star } & \iff x \text{ and } y \text{ are pop stars} \\
\text{b. this stuff is water and that stuff is water } & \iff \text{ this stuff + that stuff is water}
\end{align*}

• For plural count nouns, Link’s semilattices are isomorphic to \(D_e\) according to the union theory: \(a \oplus b\) is equivalent to \(\{a, b\}\)

\(\text{(isomorphic: they can be directly mapped onto each other, without losing structural information.)}\)
More on Link

• What about plural predication? i.e., if \([[[\text{laugh}]]] = \{n,w\}\), how can we ensure that (11) is true?

(11) Napoleon and Wellington laughed.

• An operator ★ pluralises distributive predicates:

\[
\text{if } [[\text{laugh}]] = \{n,w\} \text{ then } ★[[\text{laugh}]] = \{\{n\},\{w\},\{n,w\}\}
\]

• Collective predicates only have pluralities in their extension to begin with.
Distributivity

• And what about the other way around? How to ensure that (12a) entails (12b)?

(12) a. Napoleon and Wellington / the men laughed.
   b. Napoleon laughed and Wellington laughed.

• **Option 1**: meaning postulates / lexical semantics
Distributivity (2)

• Scha (1981): formally, both collectivity and distributivity are analysed as predication over a plural individual. The difference arises from meaning postulates.

• Observation: non-maximality (room for exceptions)

  (13)  a. The girls laughed.
   b. The girls gathered in the garden.

• So, \( \text{pred}(X) \) is true if a significantly large part of \( X \) is participating in the event expressed by \( \text{pred} \)...
  – ...where our lexical knowledge determines what it means to ‘participate in’ an event.
Distributivity (3)

• Another observation: some interpretations are neither really collective nor really distributive.

(14) a. The squares contain the circles.
     b. The sides of square 1 run parallel to the sides of square 2.
Distributivity (4)

• Meaning postulates:

\[ \text{laugh}(X) = 1 \text{ iff for (almost) every atom } x \text{ in } X: \text{laugh}(x) \]

\[ \text{contain}(X,Y) = 1 \text{ iff for every atom } y \text{ in } Y, \text{ there is an atom } x \text{ in } X \text{ such that contain}(x,y) \]

\[ \text{run_parallel_to}(X,Y) = 1 \text{ iff for every atom } x \text{ in } X, \text{ there is an atom } y \text{ in } Y \text{ such that run_parallel_to}(x,y), \text{ and for every atom } \text{ every atom } y \text{ in } Y, \text{ there is an atom } x \text{ in } X \text{ such that run_parallel_to}(x,y) \]
Distributivity (5)

- **Option 2**: D-operator (covert quantifier over members of the plurality) in formal structure
- Why? Because option 1 cannot account for the distributive interpretation of sentences like

  (15) a. The girls are wearing a dress.
    b. These dogs obey their master.
    c. The children are hiding somewhere.

  (16) a. De kinderen vinden zichzelf erg slim.
    *The children consider themselves rather clever.*

- So we need a D-operator (at least for these cases).
Where is the D-operator located?

• Either it’s part of the NP, or of the predicate
• Answer according to many: the latter
• Why: coordination of collective and distributive predicates (Dowty 1987, Lasersohn 1995):

(17) John and Mary [met in the pub] and [had a beer]

(Data question: how many interpretations does John and Mary met in the pub and hid somewhere have?)
Group nouns

- Nouns like *team, committee, family, group*...
- Are group nouns singular or plural individuals?

- **Option 1: plural**
  - Like plurals, but unlike singulars, group NPs are compatible with collective predicates
  - In British and Canadian English, group NPs may take plural agreement
Group nouns (2)

• Option 2 (widely accepted): atomic

  – In many cases \texttt{pred(group)} does not entail \texttt{pred(sum-of-group-members)} & vice versa:

  (18)  
  a. The committee is old / has 3 members  
  b. The committee members are old  
  c. *The committee members have 3 members

  – Sentences with group subjects systematically lack distributive interpretations (see next slide)
Group nouns (3)

• Distributivity contrasts between plural and group NPs:

  (19) a. The children are hiding somewhere.
      b. The class is hiding somewhere.
  (20) a. The children are sleeping or drawing.
      b. The class is sleeping or drawing.

  (21) a. De kinderen vinden zichzelf nogal slim.
        *the children consider themselves rather clever*
      b. De klas vindt zichzelf nogal slim.
        *the class considers itself rather clever*
Impure atoms

• Link (1984), Landman (1989): groups (and plural NPs via a type shift) denote ‘impure atoms’
  
  – \( \uparrow\{a,b,c\} = \{\{a,b,c\}\} \)
  – This denotation is atomic (a singleton set), but derived from a sum

• Landman’s claim (in essence): distributivity is the result of applying a predicate to a sum, collectivity is the result of applying a predicate to an impure atom.