# CG41: Semantics

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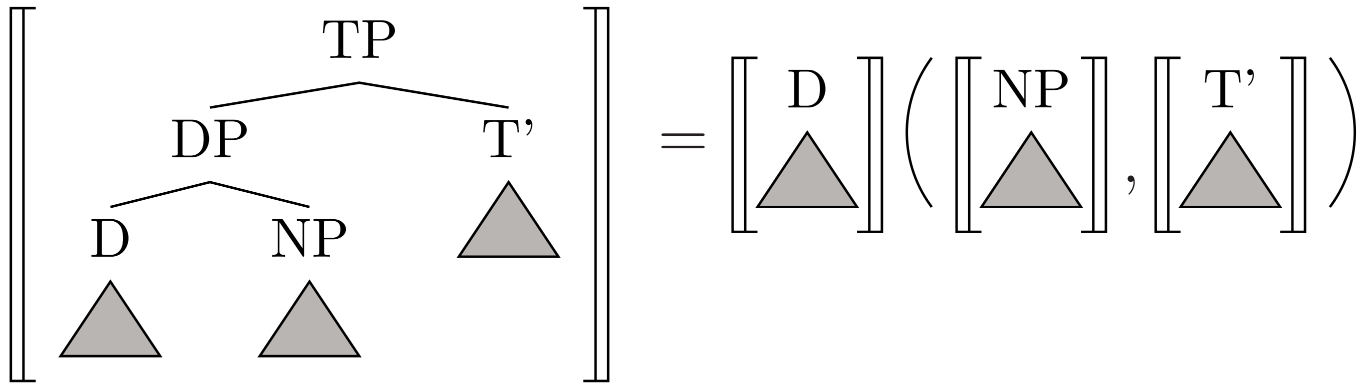
**Week 13, Fall 2007**

*Semantics 2 homework due Monday, 10th December!*

# Summary of this week's topics

- NPs denote *sets of individuals*, TPs denote *sets of situations*
- Determiners and adverbs are functions from a pair of sets to truth values
  - These functions are always *conservative*
  - *Negative polarity items* appear in *decreasing* contexts
  - *Presuppositions* and *focus* can supply the restrictor argument to adverbs when no overt argument phrase is present
- Some noun (phrases) and some predicates *refer cumulatively*
  - *mass nouns* and *(bare) plurals* refer cumulatively, while *(singular) count nouns* do not
  - *atelic event predicates* (which lack a culmination) refer cumulatively, while *telic event predicates* (which have a culmination) do not
  - The telicity of many predicates is determined by whether they include a cumulative reference NP

# D semantics review




i.e., the determiner D denotes a function ⟦D⟧. We give this function the set ⟦NP⟧ denoted by the NP and the set ⟦T′⟧ denoted by the T′, and the function returns either True or False.

$$\begin{aligned}
[\![every]\!](A,B) &= \textsf{True if } A \subseteq B \text{ and } \textsf{False} \text{ otherwise, i.e.,}\\
[\![every]\!](A,B) &= (A \subseteq B)\\
[\![some]\!](A,B) &= (A \cap B \neq \emptyset)\\
[\![most]\!](A,B) &= \left(|A \cap B| \geq \frac{1}{2}|A|\right)
\end{aligned}$$

# Example

- $[\![every]\!]$ is the function below that takes two sets as arguments:

$$[\![every]\!](A, B) \quad = \quad (A \subseteq B)$$

- Suppose we are in a situation where:

$$\begin{aligned} [\![student]\!] &= \{\text{Alex}, \text{Sam}\} \\ [\![swimmer]\!] &= \{\text{Alex}, \text{Sandy}\} \\ [\![snore]\!] &= \{\text{Alex}, \text{Sam}, \text{Sasha}\} \end{aligned}$$

Then:

$$\begin{aligned} [\![every]\!]([\![student]\!], [\![snore]\!]) &= \mathsf{True} \\ [\![every]\!]([\![swimmer]\!], [\![snore]\!]) &= \mathsf{False} \end{aligned}$$

# Decreasing determiners

- NP and T′ denote *sets of individuals*
- Determiners (D) denote *relations between sets of individuals*
  - the first argument is called the *restriction*
  - the second argument is called the *scope*
- A sentence $[_{\mathrm{TP}}\ [_{\mathrm{DP}}\ \mathrm{D\ NP}]\ \mathrm{T}']$ is true iff

$$[\![\mathrm{D}]\!]([\![\mathrm{NP}]\!], [\![\mathrm{T}']\!])$$

- A function $D$ from a pair of sets to truth values is *decreasing* or *downward-entailing* (on its second argument) iff:

$$\text{For all sets } A, B \text{ and } B', \text{ if } D(A, B) \text{ and } B' \subseteq B \text{ then } D(A, B')$$

- *no, less than 3, at most 30* are decreasing Ds
- *some, every, at least 2, exactly 4* are non-decreasing Ds

# Proof that *no* is a decreasing determiner

- A determiner $D$ is *decreasing* iff it denotes a decreasing function:

  For all sets $A, B$ and $B'$, if $[\![D]\!](A, B)$ and $B' \subseteq B$ then $[\![D]\!](A, B')$

- $[\![no]\!] = (A \cap B) = \emptyset$

- **Proof that $[\![no]\!]$ is decreasing:**
  We assume the left hand side, i.e., let $A$, $B$ and $B'$ be any sets such that:
  - $[\![no]\!](A, B)$, and
  - $B' \subseteq B$,

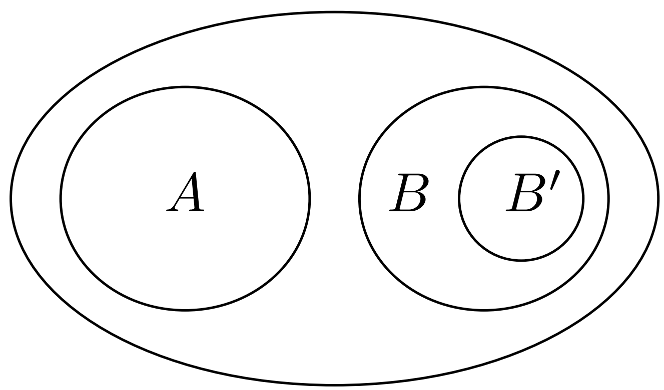
  and show that $[\![no]\!](A, B')$ is also true.
  - From $[\![no]\!](A, B)$, it follows that $A \cap B = \emptyset$
  - From $B' \subseteq B$, it follows that $A \cap B' \subseteq A \cap B$
  - Therefore $A \cap B' = \emptyset$
  - Therefore $[\![no]\!](A, B')$ is True
  - Therefore $[\![no]\!]$ is decreasing

# Intuitive proof that *no* is a decreasing determiner

- A determiner $D$ is *decreasing* iff it denotes a decreasing function, i.e.,:

  For all sets $A, B$ and $B'$, if $[\![D]\!](A, B)$ and $B' \subseteq B$ then $[\![D]\!](A, B')$

- $[\![no]\!] = (A \cap B) = \emptyset$
- **Informal proof that $[\![no]\!]$ is decreasing:**
  If $[\![no]\!](A, B)$ is True then $A$ and $B$ are disjoint.
  But if $B'$ is a subset of $B$, then $A$ and $B'$ are also disjoint (see diagram).




Therefore $[\![no]\!](A, B')$ is True also. Therefore *no* is decreasing.

# *some* is not a decreasing determiner

- A determiner $D$ is *non-decreasing* iff it does not denote a decreasing function:

  There are sets $A, B$ and $B'$ such that $[\![D]\!](A, B)$ and $B' \subseteq B$ but not $[\![D]\!](A, B')$

- $[\![some]\!](A, B) = (A \cap B \neq \emptyset)$

- **Showing that $[\![some]\!]$ is non-decreasing:**

  We provide sets $A$, $B$ and $B'$ such that $[\![some]\!](A, B) = \mathsf{True}$ and $B' \subseteq B$, but $[\![some]\!](A, B') = \mathsf{False}$.

  Let:

$$
\begin{aligned}
A &= \{\text{Alex}, \text{Sandy}\} \\
B &= \{\text{Alex}\} \\
B' &= \emptyset
\end{aligned}
$$

  Then $[\![some]\!](A, B) = \mathsf{True}$ but $[\![some]\!](A, B') = \mathsf{False}$, so $[\![some]\!]$ is not decreasing

# Entailments of decreasing determiners

- If $D$ is a *decreasing determiner* in a sentence $S_1 = [_{\text{TP}}\, [_{\text{DP}}\, \text{D NP}]\ \text{T}'_1]$ and there is another $\text{T}'_2$ phrase such that $[\![\text{T}'_2]\!] \subseteq [\![\text{T}'_1]\!]$, then:
  $S_1$ entails $S_2 = [_{\text{TP}}\, [_{\text{DP}}\, \text{D NP}]\ \text{T}'_2]$
- This provides a way of checking that we have the correct denotation for a determiner
- Example with *no:* Since $[\![no]\!]$ is decreasing and $[\![snores\ loudly]\!] \subseteq [\![snores]\!]$, we predict *No student snores* should entail *No student snores loudly*
- Example with *some:* Since $[\![some]\!]$ is not decreasing, we do not predict that *Some student snores* should entail *Some student snores loudly*

# Negative polarity items and decreasing contexts

- *at all, much, ever, any* are *negative polarity items* (NPIs)
- A predicate is in a *decreasing context* if replacing it with one that denotes a smaller set cannot make the sentence's truth value change from True to False (no matter what the situation is)
- *NPIs only appear with predicates in decreasing contexts*
  1. *I don't like pizza at all*
     ⋆*I like pizza at all*
  2. *No student likes pizza much*
     ⋆*Some/every student likes pizza much*
  3. *At most two students ever fail the exam*
     ⋆*At least two students ever fail the exam*
- Decreasing determiners are downward-entailing

# Adverbs and quantification

- TPs denote *sets of situations*

$$[\![\textit{Sam met Sandy}]\!] = \text{set of situations in which Sam met Sandy}$$

- Adverbs denote functions from pairs of sets of situations to truth values

$$\begin{aligned}
[\![\textit{always}]\!](A,B) &= (A \subseteq B) \\
[\![\textit{usually}]\!](A,B) &= \left(|A \cap B| \geq \tfrac{1}{2}|A|\right) \\
[\![\textit{seldom}]\!](A,B) &= (|A \cap B| \leq 5)
\end{aligned}$$

- Adverbial sentences of the form *if* $\mathrm{TP}_1$ *then* AP $\mathrm{TP}_2$ are true iff:

$$\mathrm{AP}(\mathrm{TP}_1, \mathrm{TP}_2)$$

E.g., *If Sam comes to the party, we always have a good time* is true iff

$$[\![\textit{always}]\!]([\![\textit{Sam comes to the party}]\!], [\![\textit{we have a good time}]\!])$$

# Decreasing adverbs

- An $AP$ is *decreasing* iff it denotes a decreasing function, i.e.,:

  For all sets $A, B$ and $B'$, if $[\![AP]\!](A,B)$ and $B' \subseteq B$ then $[\![AP]\!](A,B')$

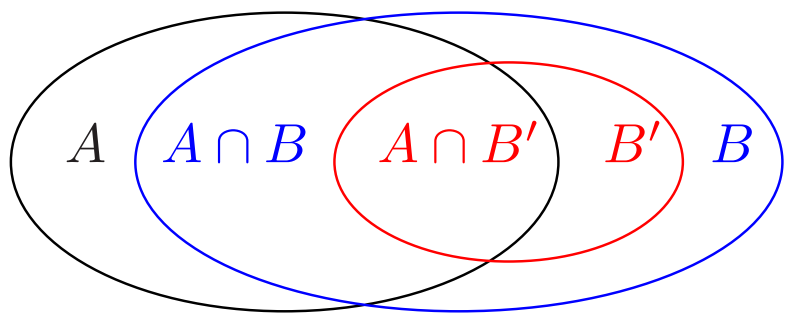
- $[\![seldom]\!]$ is decreasing because:
  - $[\![seldom]\!](A,B) \; = \; (|A \cap B| \leq 5)$
  - If $[\![seldom]\!](A,B) = \mathsf{True}$ and $B' \subseteq B$ then:

    $|A \cap B| \leq 5$ (meaning of *seldom*)

    $A \cap B' \subseteq A \cap B$ because $B' \subseteq B$

    $|A \cap B'| \leq 5$

    $[\![seldom]\!](A,B') = \mathsf{True}$



# Decreasing adverbs, entailments and NPIs

- *seldom* is a decreasing adverb
  - The second clause is a decreasing context:

    *If Sam comes to the party, we seldom have a good time*

    entails

    *If Sam comes to the party, we seldom have a great time*

    (assuming that $[\![\textit{we have a great time}]\!] \subseteq [\![\textit{we have a good time}]\!]$)
  - NPIs are licensed in the second clause:

    *If Sam comes to the party, we seldom ever have any fun at all*
- *usually* is not a decreasing adverb
  - The second clause is not a decreasing context:

    *If Sam comes to the party, we usually have a good time*

    does not entail

    *If Sam comes to the party, we usually have a great time*
  - NPIs are not licensed in the second clause:

    $^{\star}$*If Sam comes to the party, we usually ever have any fun at all*

# Presuppositions can serve as AP restriction

- Determiners and APs are functions of pairs of sets. The first argument is called the *Restriction* and the second argument is called the *Scope*

- Where does the restriction come from in sentences without an overt restriction?

  *Sam usually/always/seldom regrets eating a third slice of pizza*

  means the same thing as:

  *When Sam eats a third slice of pizza, Sam usually/always/seldom regrets eating it*

  *In most/all/few of the cases when Sam eats a third slice of pizza, Sam regrets eating it*

- *The verb's presuppositions can serve as the restriction when no overt restriction is supplied*

# Focus can serve as AP restriction

- A word or phrase is *focused* when uttered with heavy stress or intonation
- Focus expresses new information or contrast
- The *focus frame* is specified by the non-focused part of the sentence
  *Sam kisses Sasha*
  focus: Sasha
  focus frame: Sam kisses someone
- The focus frame can serve as the AP restriction
  *Sam usually/always/seldom kisses SASHA*
  means roughly the same thing as:
  *When Sam kisses someone, Sam usually/always/seldom kisses Sasha*

# Mass/count nouns

**Count nouns** refer to things composed of *discrete* or *quantized* entities, e.g., *chairs*, *students*, *promises*, etc.

- Appear with count determiners, e.g., *a tree*, *ten trees*, *many leaves*
- Don't appear with measure phrases, e.g., ⋆*much tree*, ⋆*ten pieces of tree*

**Mass nouns** refer to things that are *continuous* or *infinitely divisible* entities, e.g., *flour*, *wine*, *gravel*, etc.

- Don't appear with count determiners, e.g., ⋆*a flour*, ⋆*two gravels*, ⋆*many waters*, etc.
- Appear with measure phrases, e.g., *much oil*, *ten gallons of flour*

- In appropriate contexts, a count noun can be used as a mass noun, and vice versa, e.g.,
  *There's cat all over the road*, *How many beers do you have on tap?*
- Mass/count is a lexical property, e.g., *advice* is mass in English (unlike *a promise*) but French *avis* is count; *table*, *chair* are count, but *furniture* is mass

# Cumulative and Distributive reference

**Cumulative reference:** An expression $E$ *refers cumulatively* iff the sum of any two things referred to by $E$ is also referred to by $E$

- *Mass nouns refer cumulatively*, e.g., if $x$ is *water* and $y$ is *water* and I put $x$ and $y$ together, $x + y$ is also *water*
- *Singular count nouns do not refer cumulatively,* e.g., if $x$ is *(a) tree* and $y$ is *(a) tree*, then $x + y$ are *trees*, not *(a) tree*
- *Plurals refer cumulatively,* e.g., if $x$ and $y$ are both *(a stack of) chairs*, then $x + y$ is also *(a stack of) chairs*

**Distributive reference:** $E$ *refers distributively* iff any part of a thing referred to by $E$ is also an $E$

- Count nouns do not refer distributively: e.g., a part of a chair is not a chair
- Mass nouns need not refer distributively either: e.g., an arbitrary part of furniture is not furniture

$\Rightarrow$ distributivity isn't a defining property of mass nouns

# Telic vs atelic predicates

**Telic predicates** have an inherent *end-point* or *culmination* e.g., *(Sam) drowned in the lake, finished the homework, built a house, woke, glanced at Sandy* (ignore iterated reading) etc.

- appear with modifiers like *within an hour*, but not *for an hour*
- are not cumulative (like count nouns)

**Atelic predicates** don't have an inherent end-point or culmination e.g., *(Sam) swam in the lake, worked on the homework, was building a house, wandered, watched Sandy* etc.

- appear with modifiers like *for an hour*, but not *within an hour*
- are cumulative (like mass nouns)

# Telicity and mass/count nouns arguments

- Claim: *cumulativity is the key property characterizing both the telic/atelic and count/mass distinctions*
- Many (but not all) verbs form *atelic predicates* when they have a *cumulative DP object*
  - *Sam ate <u>pizza</u> for/*within an hour*
  - *Sam built <u>houses</u> for/*within an hour*

  and form *telic predicates* when they have a *non-cumulative DP object*
  - *Sam ate <u>her pizza</u> *for/within an hour*
  - *Sam built <u>a house</u> *for/within an hour*
- But some verbs are inherently atelic
  - *Sam pressed on/admired/stroked a chair for/*within an hour*
- This seems to generalize to *paths* as well
  - *Sam walked <u>to the store</u> *for/within an hour*
  - *Sam walked <u>in the forest</u> for/*within an hour*