Quantifiers
Chris Potts, Ling 130a/230a: Introduction to semantics and pragmatics, Winter 2015
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Note This is a companion to Keenan 1996. It is only partially complete in the sense that it's waiting for you to fill in various blanks, flesh out ideas, and insert new examples.

1 A model

1.1 Universe

\[ U = \{ \text{Maggie, Lisa, Bart, Marge, Homer, Burns} \} \]

1.2 PNs

\[ [\text{Maggie}] = \text{Maggie} \quad [\text{Lisa}] = \text{Lisa} \quad [\text{Bart}] = \text{Bart} \]

\[ [\text{Marge}] = \text{Marge} \quad [\text{Homer}] = \text{Homer} \quad [\text{Burns}] = \text{Burns} \]

1.3 Ns and ADJs

\[ [\text{Simpson}] = \{ \text{Simpson, Simpson, Simpson, Simpson, Simpson, Simpson} \} \quad [\text{boss}] = \{ \text{boss, boss} \} \]

\[ [\text{child}] = \{ \text{child, child, child} \} \quad [\text{parent}] = \{ \text{parent, parent} \} \]

\[ [\text{female}] = \{ \text{female, female, female} \} \quad [\text{male}] = \{ \text{male, male, male} \} \]
[street-smart] = \{ , , , \} \\
[bald] = \{ , \}

[skateboarder] = \{ , \} \\
saxo-ma-phonist] = \{ , \}

\begin{equation}
\begin{align*}
\text{[skillful]} &= \left\{ \begin{array}{c}
\{ , , , \} \\
\{ , \} \\
\{ , \} \\
\{ , \} \\
\{ , \} \\
\{ , \} \\
\end{array} \right\} \rightarrow \left\{ \begin{array}{c}
\{ , , , \} \\
\{ , \} \\
\{ , \} \\
\{ , \} \\
\{ , \} \\
\{ , \} \\
\end{array} \right\} \\
\end{align*}
\end{equation}

1.4 $P_1$s

For any N or ADJ $X$, [is/are (a(n)) $X$] = [X]

[goes to school] = \{ , \} \\
[likes curling] = \{ , \}

[plays the saxo-ma-phone] = \{ \} \\
[skateboards] = \{ , \}

[shot Burns] = \{ \}
2 Quantificational determiner meanings

(1) \([\textit{every}] = \{ \langle A, B \rangle \mid A \subseteq B \}\)

(2) \([\textit{a(n)}] = \{ \langle A, B \rangle \mid A \cap B \neq \emptyset \}\)

(3) \([\textit{no}] = \)

(4) \([\textit{at least three}] = \{ \langle A, B \rangle \mid |A \cap B| \geq 3 \}\)

(5) \([\textit{at most three}] = \)

(6) \([\textit{exactly three}] = \)

(7) \([\textit{most}] = \{ \langle A, B \rangle \mid \frac{|A \cap B|}{|A|} > \frac{1}{2} \}\)  
\[ = \{ \langle A, B \rangle \mid |A \cap B| > |A - B| \}\]

(8) \([\textit{more than four}] = \)

(9) \([\textit{between five and ten}] = \)
2.1 A closer look at *most*

2.1.1 Mark Liberman’s survey

Mark Liberman noticed (10) and wrote: “I (think I) always took *most* to mean exactly “more than half”, so Irving’s “I wouldn’t say ‘most’ but I’d say ‘more than half’” took me aback.”

From: http://languagelog.ldc.upenn.edu/nll/?p=2510

(10) Kurt Andersen: I- I read somewhere that you said that now m- most of your audience, you believe, reads you not in English. They are not only overseas but people not in the United Kingdom or Australia. It's- it's people reading in-

John Irving: I wouldn't say- I wouldn't say “most” but I'd say “more than half”. Sure, more than half, definitely. I mean I- I sell more books in Germany than I do in the U.S. Uh I s- sell almost as many uh books in- in the Netherlands as I do in the- in the U.S.

Lots of readers left comments on Liberman’s post articulating their assumptions about what *most* means, and he collected them in a follow-up:

http://languagelog.ldc.upenn.edu/nll/?p=2511

(11) I think ‘most' licenses a default generalization, relative to a bunch of pragmatic factors, …

(12) I think ‘most’ has a normative or qualitative sense in addition to a quantitative sense.

(13) For me too, “most” has a defeasible implicature of “much more than a majority”.

(14) I would be with John Irving - 51% of a population isn't “most” but around 60-75% would be. (90% or more would be “almost all”; well, until it hit “all” at 100%; and 75-90% would be “a very large majority”).

(15) “Most X are Y”, to me, means a substantial majority of X are Y—certainly more than 50%-plus-1. Even two-thirds feels borderline.

(16) Most has always meant “more than half (but less than all)” to me. If there are 100 of us and I say “Most of us stayed behind” I mean between 51 and 99.

Liberman looked at some dictionaries:

(17) *OED*: modifying a plural count noun: the greatest number of; the majority of

(18) *Merriam-Webster*: the majority of

(19) *American Heritage*: in the greatest quantity, amount, measure, degree, or number: to win the most votes
2.1.2 Theories

(H) \[ \text{\{most\} } = \left\{ \langle A, B \rangle : \frac{|A \cap B|}{|A|} > \frac{1}{2} \right\} \]

(‘more than half’; see Quantifiers handout, (19))

\[ = \left\{ \langle A, B \rangle : |A \cap B| > |A - B| \right\} \]

(GH) \[ \text{\{most\} } = \left\{ \langle A, B \rangle : \frac{|A \cap B|}{|A|} > f \right\} \]

(where \( f \gg \frac{1}{2} \))

(P) \[ \text{\{most\} } = \left\{ \langle A, B \rangle : |A \cap B| > |C \cap B| \right\} \text{ for all relevant contrasts groups } C \]

(plurality)

2.1.3 Liberman’s Google experiment

Liberman also conducted an experiment using Google, by searching for

"most * percent"

picking out the first 150 with numerical percentages given, and then summarizing the distribution of those percentages with two histogram showing different ways of binning the data:

![Histograms showing different binning](image)

(a) Binning by 5% increments. 
(b) Binning by 10% increments.

Figure 1: Mark Liberman’s Google data on the percentages given to clarify most statements. The bimodal distribution on the left might be an artifact of the binning procedure; the plot at right suggests constant use from 60-90%.

Liberman’s conclusion: “it’s pretty clear that the whole range from 50.1 to 99.9 is getting some action.”

Liberman did an additional post giving lots of citations and abstracts for psycholinguistic and theoretical work on most:

[http://languagelog.ldc.upenn.edu/nll/?p=2516](http://languagelog.ldc.upenn.edu/nll/?p=2516)
2.1.4 Gigaword corpus study

I used Liberman’s methodology, except rather than searching the Net, I searched the English Gigaword, a 1 billion word corpus of English newswire text. My regular expression:

```regex
(\(?^|\[.!?\]) # Sentence/line boundary
(.*? # Try to keep the sentence context.
\bmost # ‘most’ preceded by a word boundary.
\s+
(?:\[\w\-\']*\s+){1,4} # Allow up to 4 word-like things here.
\(\[\d.]+ # Opening parenthesis character.
\[d.]+ # The percentage.
(\s+percent\%) # Closing parenthesis character.
\) # Try to keep the rest of the sentence.
)  # Sentence/line boundary.

The results are very similar to Liberman’s, except that I had three cases below 50%, where the sense seems to be that of the plurality theory (P):

(20) most homes (39 percent) have a separate room where the pc is
(21) found that most of them (42 percent) focus on what he dubs
(22) most of the country (42 percent) will

![Gigaword percentages from 'most' statements (47 relevant matches)](http://stanford.edu/class/linguist130a/data/ling130a-gigamost.csv)

Figure 2: Gigaword cited *most* percentages

Here’s the spreadsheet of my examples:

http://stanford.edu/class/linguist130a/data/ling130a-gigamost.csv
3 Quantifier properties

3.1 Intersectivity

(23) A determiner $D$ is intersective iff $D(A)(B) = D(B)(A)$ for all $A$ and $B$.
   
   • some?
   • every?
   • no?
   • at most four?

3.2 Conservativity

(24) A determiner $D$ is conservative iff $D(A)(B) = D(A)(A \cap B)$ for all $A$ and $B$.
   
   • some?
   • every?
   • no?
   • few?
   • most?

Proposed universal (Barwise & Cooper 1981) Every lexical determiner in every language is conservative.

Keenan (1996:55):

“With at most a few exceptions¹ English Dets denote conservative functions.”

From Keenan’s footnote 1:

“All putative counterexamples to Conservativity in the literature are ones in which a sentence of the form Det As are B’s is interpreted as $D(B)(A)$, where $D$ is conservative. So the problem is not that Det fails to be conservative, rather it lies with matching the Noun and Predicate properties with the arguments of the Det denotation.” (Keenan 1996:63)

3.2.1 Potential counterexample #1: only

(25) Only dogs bark.

But! The evidence strongly suggests that only is not a determiner.

   i. It can modify a wide range of constituents, not just nominals.
   ii. It precedes determiner elements (e.g., only some books).
3.2.2 Potential counterexample #2: many

(26) Many Scandinavians have won the Nobel Prize.

\[ \text{many} = \left\{ (A,B) \mid \frac{|A \cap B|}{|B|} \geq k \right\} \]

where \( k \) is a contextually-set percentage

Expected semantics (Partee 1989):

\[ \left\lfloor \text{scandinavian} \cap \text{nobelist} \right\rfloor \geq k \]

- Suppose that there are 20 million Scandinavians.
- Suppose that there are 1000 Nobel Prize winners, 600 of whom are Scandinavian.
- Then the expected semantics is wildly false.

The flipped semantics (expected for Many Nobel Prize winners are Scandinavian).

\[ \left\lfloor \{x \mid \text{scandinavian}(x) \land \text{nobelist}(x)\} \right\rfloor \geq k \]

where \( k \) is a contextually-set percentage

- Suppose that there are 1000 Nobel Prize winners, 600 of whom are Scandinavian.
- Then the flipped semantics is going to be true as long as \( k \) is \( \frac{3}{5} \) (60%) or greater.

Alternative reading for many

(28) \[ \text{many}_{\text{cardinal}} = \left\{ (A,B) \mid |A \cap B| > n \right\} \] where \( n \) is some contextually supplied value.

(29) a. There are many cookies left.
    b. There are many books in the library.
    c. There are many cars in the U. S.
3.3 Monotonicity

(30) A function \( D \) is increasing (upward monotone) iff wherever \( A \subseteq B \), \( D(A) \subseteq D(B) \).

(31) A function \( D \) is decreasing (downward monotone) iff wherever \( A \subseteq B \), \( D(B) \subseteq D(A) \).

(32) A function \( D \) is nonmonotone iff \( D \) is neither increasing nor decreasing.

(33) a. \textit{some} \((\uparrow)(\uparrow)\)
   
b. \textit{no} \((\downarrow)(\downarrow)\)

c. \textit{every} \((\ )\)

d. \textit{at most ten} \((\ )\)

e. \textit{few} \((\ )\)

f. \textit{exactly three} \((\ )\)

g. \textit{most} \((\ )\)

Pattern from day #1

(34) a. Sam didn’t ever take notes.
   b. *Sam ever took notes.

(35) a. At no time did Sam ever take notes.
   b. *At some times, Sam ever took notes.

(36) a. Sam took the class without ever taking notes.
   b. *Sam took the class while ever taking notes.

(37) a. No student ever took notes.
   b. No student who ever studied semantics took notes.

(38) a. *A student ever took notes.
   b. *A student who ever studied semantics took notes.

(39) a. Every student who ever studied semantics took notes.
   b. *Every student ever took notes.
References


