Uncertain numerals

Erin Zaroukian • zaroukian@cogsci.jhu.edu • Johns Hopkins University

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Abstract

Goals:

- Explain a peculiar approximative interpretation associated with numerals that have been marked as uncertain (e.g. *maybe twenty*)
- Assess predictions of this analysis
- See what this analysis can tell us about other means of approximation (e.g. *approximately twenty*)

Results:

- These approximative peculiarities can be explained through possible world semantics using information associated with numerals
- This analysis extends to other scalars, yielding correct interpretations
- This analysis allows us to formalize certain similarities and differences between these uncertain numerals and other means of approximation

The phenomena

You can use words like *maybe* to mark your uncertainty with respect to an item, and as a result your interlocutor might entertain alternatives to this uncertain item.

(1) a. A: Who won the race? ⟵ A's question
B: Maybe John. ⟵ B's answer (cf. #Approximately John.)
b. {John, Ann, Pete} ⟵ set of alternatives entertained by A in response to B's answer

When the uncertain item is a numeral, there is a strong tendency for the set of alternatives to resemble approximation.

(2) a. A: How many people competed?
B: Maybe twenty. (cf. Approximately twenty.)
b. {18, 19, 20, 21, 22}

However, this does not occur for all uncertain numerals.

(3) a. A: Which bus will get me downtown the quickest?
B: Maybe (the) twenty. (cf. #Approximately (the) twenty.)
b. {20, 6, 77, 15}

Furthermore, when this approximation effect occurs, the range of alternatives depends on the numeral.

(4) a. A: How many people competed?
B: Maybe twenty-seven. (cf. Approximately twenty-seven.)
b. {26, 27, 28}

Puzzles:

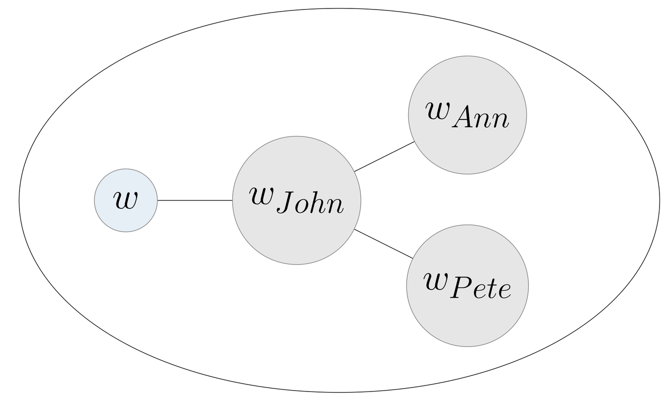
I. Why do uncertain numerals give rise to approximative readings, as in (2)?
II. Why do some uncertain numerals fail to give rise to approximative readings, as in (3)?
III. Why do some uncertain numerals give rise to more approximate readings than others?

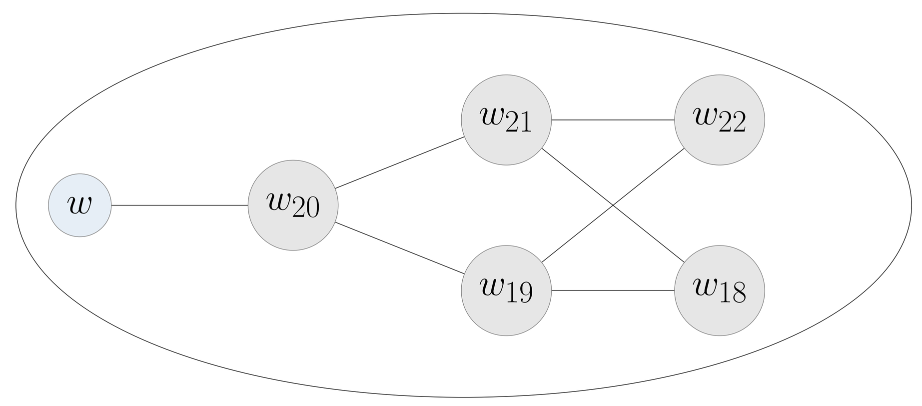
Analysis

Consider these phenomena in the context of possible world semantics and assume alternatives are sets of possible worlds. For example, (1) with *maybe John* might look something like:

Possible world semantics (Kratzer 1981)

- Modal base f determines which worlds are accessible from a given world w - accessible worlds are the ones in which all the propositions in f are true
- Ordering source g determines how close the possible worlds are - w_a is as least as close to w as w_b iff all the proposition in f that are true in w_b are also true in w_a



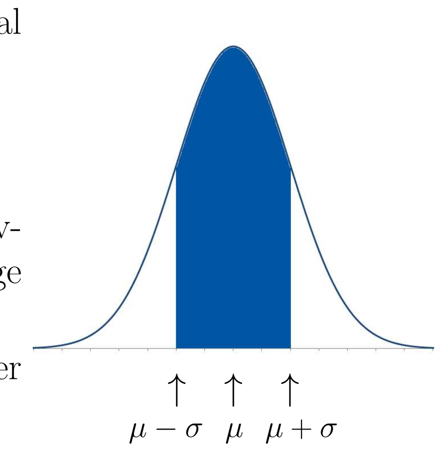


To explain approximation, we will assume that numerals contribute information to f and g such that the possible words are those in which nearby numbers are true, as shown for *maybe twenty* in (2) at left.

So how do we get the right information into f and g? Assume that numerals contribute information about what is close to them in a given context, as in Krifka (2009):

Numeral:

- Represents a range of possible values
- Probabilities of values are best represented with a normal distribution
  - distribution over a number line
  - centered at the uttered numeral (μ)
  - standard deviation (σ) determined pragmatically, involving preference to assign round interpretations (i.e. large σs) to round numerals
    - ∗ Therefore *twenty* will tend to be associated with a larger σ than *twenty-seven*
  - numeral represents the range within σ, other values are too unlikely



So, let's assume numerals are associated with the propositions

$p_\sigma = \lambda y.y \in \{[\![\mu - \sigma]\!], ..., [\![\mu + \sigma]\!]\}$ ⟵ value is within one standard deviation of the uttered numeral

$p_x = \lambda y.y \in \{[\![\mu - x]\!], ..., [\![\mu + x]\!]\}, 0 < x < \sigma$ ⟵ values closer to the uttered numeral are more likely

where, when the numeral is uncertain, the modal operator introduces $p_\sigma \in f$ and $p_x \in g$.

Finally, note that the numeral in (3) is acting as a label, not as a scalar, and could not easily express a range.

Now we can solve the puzzles as follows:

Solutions:

I. Uncertain numerals give rise to approximative readings because they introduce p_σ into f and p_x into g, so possible worlds are those in which the numeral is close to the uncertain numeral.
II. Some uncertain numerals fail to give rise to approximative readings because they are not scalar and therefore do not contribute p_σ and p_x
III. Some uncertain numerals give rise to more approximate readings than others because they are associated with larger σs, so p_σ allows more possible worlds.

Predictions

Other words are similar to numerals in that they express ranges which may be best represented by a normal distribution, so they are expected to contribute similar information to f and g when marked as uncertain, resulting in an approximate reading.

This is indeed the case. For example, when a color term is used scalarly, it gives an approximate reading when combined with *maybe*.

(5) a. A: You say you got a good look at John's car. What color is it?
B: Maybe blue.
b. { }

Colors even show roundness effects.

(6) a. A: You say you got a good look at John's car. What color is it?
B: Maybe cyan.
b. { }

In fact, you get approximation with any uncertain scalar. To see this, take any element X, consider its scalar interpretation (e.g. would it would have to mean to make sense in a sentence like *Well, it was only approximately X*, cf. Sauerland & Stateva 2007), and then consider what it would mean under the same interpretation if you marked it as uncertain.

- Example: Consider a scalar interpretation of Beef Stroganoff, as in *Well, it was only approximately Beef Stroganoff.* Under this same interpretation, in *What Mary cooked was maybe Beef Stroganoff*, you get the reading that what Mary cooked was somewhere near the ideal of Beef Stroganoff, or approximately Beef Stroganoff.

Extensions

If uncertainty markers can act like approximators, then what are true approximators like *approximately*?

- Instead of involving alternatives, true approximators express that something falls within a range, perhaps with a denotation like

$$[\![\textbf{approximately}]\!] = \lambda n.\lambda y.\exists z \in \{x | \mu_\mathbf{n} - \sigma_\mathbf{n} \le x \le \mu_\mathbf{n} + \sigma_\mathbf{n}\} | \#y = z$$

(takes a scalar n and some y and returns true if the location of y is within σ of n on the relevant scale)

- As a result, approximators are less accommodating when it comes to outside information.

(7) It's Susan's birthday today, and she's maybe/#approximately 30.

- Here the fact that it is Susan's birthday makes intermediate ages like 31 and 3 months impossible. This restriction cannot be accommodated by *approximately*, while with *maybe* this restriction can be entered into the modal base f.

- However, like *maybe* and bare scalars, true approximators show roundness effects (cf. *approximate twenty* vs. *approximately twenty-seven*), which is expected since each determines possible range through σ.

Conclusions

Here we have seen that the peculiar approximative interpretation associated with uncertain numerals can be explained through a possible world semantics with assignment of propositions regarding the numeral's range to f and g.

Furthermore, this analysis can be successfully applied to other scalar terms.

Overall this analysis unites different kinds of approximators, including roundness, uncertainty markers, and true approximators, while at the same time providing a source for their differences.