Approximation of complex numerals using *some*

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1 Introduction

An interesting linguistic puzzle:

- What is the role of *some* in DP-internal approximation?
- How do the expressions in (1) differ, and what restrictions do they have?

(1) a. 20-some people attended class today.
b. Some 80 people were arrested for rioting.

This sheds some light on the nature of approximation.

- Approximation is naturally modeled using alternative semantics (Hamblin, 1973; Rooth, 1985, 1992).
- Alternatives should be present grammatically.

Where we're going:

- §2: Introduce data on two constructions involving *some*.
- §3: Argue for a particular view of the syntax of cardinal numbers.
- §4: Propose a compositional semantics for approximation with *some*, with cross-linguistic support from Japanese.
- §5: Final thoughts on what this means.

2 Two *some*s?

Some can be used as an approximator when used with cardinal numbers.

(2) Some thirty people were at the party.
(3) Some 2 million people were killed.

The order of the cardinal number and the quantifier *some* can be reversed.

(4) Thirty-some people were at the party.
(5) a. 2 million-some people were killed.
b. *2-some million people were killed.

It's use as an approximator can extend to interval ranges.

(6) a. Some 30 to 40 people showed up.
b. Some 10 to 20 percent of people suffer from ragweed allergies.

It does seem that the *some*s are different. Two different interpretations.

(7) Some 30 people arrived. (approximative interpretation)
(8) 30-some people arrived. (at least interpretation)

Also stackable, which also suggests that they are doing different work here.

(9) Some thirty-some people.

The rest of the talk:

- Pre-numeral *some*: construction where *some* occurs before the numeral (e.g., *some 300*)
- Post-numeral *some*: construction where *some* occurs after the numeral (e.g., *20-some*)

3 Syntactic Intuitions

Ionin and Matushansky (2006); Zweig (2005); Hurford (1975, a.o.): Cardinal numbers are syntactically complex. Larger numbers built from smaller numbers.

Claim: Post-numeral *some* is sensitive to the syntactic structure of numerals.

Why might we think this? Restrictions on post-numeral *some*.

(10) a. *10-some people
b. *3-some people

This can't strictly be related to low numbers being more precise!

- Pre-numeral *some* can modify *10*.
- *10* can be interpreted imprecisely.

(11) Some 10 people.
(12) There were 10 people at the party. (allows for "around ten people" interpretation)

Evidence for syntax:

- 3 doesn't allow any complex cardinals (**three one*), and neither does 10 (**ten one*)
- *Twenty-one* does exist, and *20-some* also exists.

Additionally, decimals allow for *some*, and decimals seem to have a list-like structure to them.

(13) 1.623 (*one point six two three*)
(14) (Two students forget the exact number of milliliters to fill a test tube two). We needed to fill this up to 1.6-some milliliters.

Interpretation of post-numeral *some*?

- *20-some*: numbers between 20 and 29.
- *A hundred-some* allows for numbers between 100 and 200 (although lower numbers may be preferred).

Importantly, the number being approximated can compose with the numeral modified by *some*.

- *1, 2, . . . , 9* all can compose with *20*
- *1, 2, . . . , 10, . . . 99* can all compose with *100*.

Interim conclusion: This is expected if we think that the post-numeral *some* construction is sensitive to the syntactic structure of the numeral it modifies. Namely, what is going on is that *some* can approximate the next set of numbers that can combine with the number it modifies.

4 Proposal

4.1 Post-numeral *some*

Various pieces needed to get off the ground.

Syntax:

- Syntax for cardinal numbers (Ionin & Matushansky, 2006; Zweig, 2005; Hurford, 1975), although this study will abstract away from any particular implementation.
- Covert wh-word (represented as WH) that can abstract over positions within a complex cardinal number.

Semantics:

- Hamblin semantics for wh-words (Hamblin, 1973). Wh-words denote sets of alternatives (a la Rooth (1985) and focus alternatives).
- Alternatives are determined syntactically.
- Alternatives are *grammatically* represented. They interact compositionally. (Kratzer & Shimoyama, 2002)

Assume a domain of numbers D_n.

- Addition and multiplication are defined over pairs of elements in D_n.
- Furthermore, assume a typeshift PRED that maps elements of D_n to $D_{\langle et \rangle}$.[1]

(15) $\forall n \in D_n, \text{PRED}(n) = \lambda x.{}^{\cup}n(x)$
'The property of having a cardinality of n'

I assume that cardinal numbers denote singleton sets of numbers. *20* simply denotes the set containing only the number 20.

[1] See Partee (1987) for a similar proposal for mapping between D_e and $D_{\langle et \rangle}$.

(16) a. $[\![20]\!] = \{20\}$

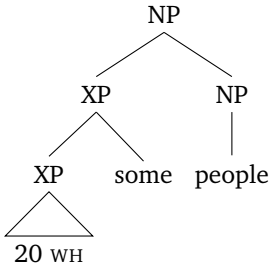
b. $[\![5]\!] = \{5\}$

The post-numeral *some* has the entailment that WH is filling a spot in the syntax of the number it modifies.

(17) 20-some people

(18) [20 WH]-some people

(19)



The covert wh-word is a set of numbers that can fit in a particular syntactic slot.

(20) $[\![\text{WH}]\!] = \{1,2,3,4,\ldots,9\}$

For (18), $[\![\text{WH}]\!] = \{1,...,9\}$, since only numbers 1 through 9 can combine with 20.

How do we get an actual number (e.g., 25)? I assume a rule of pointwise addition that composes two sets.

- With singletons, the process is simple: add both the numbers together.
- With larger sets (e.g., $[\![\text{WH}]\!]$), everything from one set is added to everything from the second.
- This resembles Hamblin Function Application (Kratzer & Shimoyama, 2002), independently needed in an alternative semantics.

(21) **Pointwise Addition**
Where $[\![A]\!]$ and $[\![B]\!]$ are sets of numbers,
$[\![C]\!] = \{c : \exists a \in [\![A]\!] \wedge \exists b \in [\![B]\!] \wedge c = a + b\}$

(22) $[\![\textit{twenty-one}]\!] = [\![20]\!] + [\![1]\!] = \{20+1\}$

(23) $[\![20\ \text{WH}]\!] = [\![20]\!] + [\![\text{WH}]\!]$
$= \{20+1, 20+2, 20+3, 20+4, \ldots, 20+9\}$

For even more complex numbers, like *sixty four thousand seven hundred forty one*, a Pointwise Multiplication rule is needed as well. Otherwise, recursive application of Pointwise Multiplcation and Pointwise Addition will suffice to build larger numbers.

The result of PA is always a set. Something has to be selected from the set. This is the role played by *-some*.

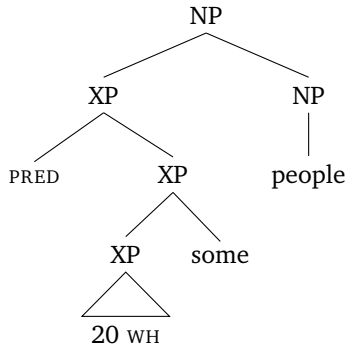
I suggest that *-some* encodes a choice functional variable (f), determined by the context. A choice function is a local typeshift from a set to a member of that set.

(24) $[\![\alpha\textit{-some}]\!] = f([\![\alpha]\!])$

(25) $[\![\textit{[20 WH]-some}]\!] = f([\![\textit{20 WH}]\!])$
$= f(\{20+1, 20+2, 20+3, \ldots, 20+9\})$
$=$ some number from the set $\{20+1, 20+2, 20+3, \ldots, 20+9\}$

I assume that numerals can be typeshifted to properties via PRED. This allows the numeral and the noun to combine intersectively via Heim and Kratzer's (1998) Predicate Modification (as they are both properties, type $\langle et \rangle$).

(26)



(27) **Predicate Modification (PM)** (Heim & Kratzer, 1998)
If α is a node and $\{\beta, \gamma\}$ are its daughters and $\beta \in D_{\langle et \rangle}$ and $\gamma \in D_{\langle et \rangle}$, then $[\![\alpha]\!] = \lambda x.\ [\![\beta]\!](x) \wedge [\![\gamma]\!](x)$.

(28) a. $[\![\textit{people}]\!] = \lambda x.\textbf{people}(x)$

b. $[\![\textit{[20 WH]-some}]\!] = f([\![\textit{20 WH}]\!])$

c. $[\![\textit{[PRED [20 WH]-some] people}]\!]$
$= \textbf{PM}([\![\textit{PRED [20 WH]-some}]\!], [\![\textit{people}]\!])$
$= \lambda x.\text{PRED}([\![\textit{[20 WH]-some}]\!])(x) \wedge \textbf{people}(x)$

Choice function here represents ignorance of the actual number: it can be anything within the range [20,30). But that's ok. This is the reading we want. Any of these numbers are permissible, and all are able to be coerced into properties that can combine with the noun.

4.1.1 Evidence from Japanese

Japanese provides some support for this analysis. In Japanese, cardinal numbers are syntactically complex and fully compositional. Not only is "eleven" composed as "ten-one," but "twenty" is composed of "two-ten."

(29) a. juu-ichi
ten-one
'eleven'

b. ni-juu
two-ten
'twenty'

A similar construction to the post-numeral *some* in English can be found in Japanese using an overt wh-word and a particle *-ka*.[2]

As would be predicted, abstracting over either the ones place (30) or the tens place (31) is acceptable, with the corresponding difference in interpretation.

(30) Juu -nan -nin -ka -ga kita.
Ten -what -CL(people) -KA -NOM came
'10 plus x people came.' (Japanese)

(31) Nan -juu -nin -ka -ga kita.
What -ten -CL(people) -KA -NOM came.
'x multiple 10 people came.' (Japanese)

Interestingly, (30) is acceptable even though **ten-some* is unacceptable in English. This is expected, since Japanese *10* through *19* are compositional, while the English equivalents are not.

[2] I thank Ai Taniguchi, Ai Kubota, and Yusuke Kubota for their help here.

Two important similarities between the English and Japanese constructions.

Similarity 1: A WH-word *nan* abstracts over a numeral. As expected, the WH-word can target either part of the complex numeral.

Similarity 2: In the Japanese construction, a particle *-ka* attaches to the noun phrase.

- *-ka* selects from among the numerical alternatives.
- Importantly, *-ka* and *-some* are semantically related.
- Line of research argues that *-ka* encodes a choice functional variable (Hagstrom, 1998; Yatsushiro, 2009; Cable, 2010; Slade, 2011), like the analysis of *-some* here.

Furthermore, the alternatives from the WH-word are syntactically represented.

- Kratzer and Shimoyama (2002) (and others) show how the scope of a quantificational particle like *-ka* affects the interpretation of a question,
- With *-ka* attached low, at the DP level, a yes/no question interpretation arises, since the alternatives are closed off and cannot project to the end of the derivation, as in (32a).
- Without *-ka* at the DP level, the alternatives from the numeral continue to project, forcing the interpretation to be a question about which number, as in (32b).

The Japanese data for the equivalent of post-numeral *some* is as you would expect, given those facts.

(32) a. Nan -juu -nin -ka -ga kita ndesu ka?
What -ten -CL(people) -KA -NOM came COPULA KA
'Is it the case that x multiple 10 people came?'
(yes/no question)

b. Nan -juu -nin -ga kita ndesu ka?
What -ten -CL(people) -NOM came COPULA KA
'What is the number x, such that x multiple 10 people came?'
(wh-question)

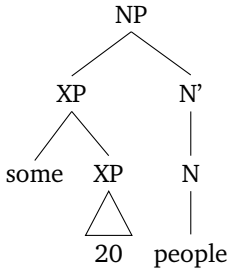
To summarize, Japanese provides independent evidence for the analysis here.

- Overt presence of a wh-word
- Wh-word can target smaller numerals within the larger complex numeral.
- Quantificational element in Japanese, *-ka*, parallels the use of English *-some* in the post-numeral construction.

4.2 Pre-numeral *some*

For the pre-numeral *some*, I assume it forms a constituent with the number and is adjoined above the numeral.

(33)



No wh-word is necessary here, since there is no evidence that pre-numeral *some* relies on the syntactic structure of the numeral, as the examples in (34) show.

(34) a. An emergency services source said: "Some ten people are feared dead, with many wounded."[3]

b. Some five people are behind bars after a double traffic yieled more than 1,200 pounds of marijuana in northwest Pharr.[4]

c. Bill looked and saw a group of some fifteen people enter.[5]

Evidence that *some* is not the head of the DP comes from e.g., *some 20* being licit as a measure phrase.

[3] http://www.express.co.uk/news/world/414410/Paris-horror-as-train-derails-killing-seven-people-and-leaving-dozens-crushed

[4] http://www.valleycentral.com/news/story.aspx?id=712286

[5] https://www.msu.edu/~gobeski1/Monkey.htm

(35) a. The room was some 20 feet wide.

b. It's still some 10 degrees too warm to snow.

In attempting to keep the same analysis of *some* across both constructions, I also assume that alternatives are present here.

- Alternatives model Lasersohnian pragmatic halos (Lasersohn, 1999). Numbers come with a halo of "good enough" values around them.
- Pragmatic halos are grammatical represented (Morzycki, 2011).

(36) $[\![20]\!]^c = \{n : n \text{ is close}_c \text{ to } 20\}$
$= \{18, 19, 20, 21, 22\}$

Role of *some* is to select from among the alternatives. This is the same *some*.

(37) $[\![some\ \alpha]\!] = f([\![\alpha]\!])$

Again, after *some* picks from the set, the typeshift PRED applies to make the number into a property. This property can combine intersectively with the denotation of the noun (see the derivation in the previous section for an example of this).

Why alternatives at all? Why should *some* be sensitive to pragmatic halos here at all? How do we get a halo around *20* in the first place?

Strawson (1974): Use of *some* implies identificational information about the indefinite NP that the speaker is not disclosing. (38c) is unacceptable because it implies that it should be possible to distinguish among wasps. (See also Becker (1999).)

(38) a. I've been stung by some insect.

b. I've been stung by a wasp.

c. * I've been stung by some wasp.

Farkas (2002): Model the epistemic non-specificity of *some* by requiring that the variable that *some* introduces not have the same value across multiple possibilities in the context. Farkas even suggests that this is at play in cases with pre-numeral *some*.

Alonso-Ovalle and Menéndez-Benito (2010): Spanish *algún* carries an antisingleton presupposition, intended to model its inherent epistemic uncertainty. Weir (2012) extends this analysis to English *some*.

Suggestion: the same antisingleton presupposition is found with the *some* investigated here.

- The presupposition is rendered irrelevant in the post-numeral *some* cases, due to having a set of more than one number.
- In the pre-numeral cases, the antisingleton presupposition has the effect of creating the pragmatic halo.

Halos can be thought of as presupposition accommodation:

- $[\![20]\!]$ is normally a singleton.
- But, *some* has an antisingleton presupposition.
- To fix this mismatch, $[\![20]\!]$ is coerced to having a non-singleton denotation, as in (36), by substituting in the halo of *20* for $[\![20]\!]$.

Moral of the story? Pragmatic halos grammatically present when we need them, via presupposition accommodation.

5 Conclusion

What can we conclude?

- We want alternatives to be grammatically represented, in order to be picked up by operators such as *some* and *-ka*.
- Alternatives may be quite pervasive in a way that accords with the program of Chierchia et al. (2008), Kratzer and Shimoyama (2002), Büring (1997), and others.
- Approximation (at least in this case study) involves examining and picking from alternatives.

Further work?

- More cross-linguistic data on similar constructions.
- How does the *some* examined here relate to the determiner *some* (*some dogs*)?
- Integrating this analysis more thoroughly with other analyses of the syntax of cardinal numbers.

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