Approximation of complex numerals using *some*

Curt Anderson (ande1472@msu.edu)
Michigan State University

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Abstract

This squib concentrates on two cases of *some* used with a numeral, as in *some twenty people* and *thirty some people*, what I call the pre-numeral and post-numeral *some*s. I argue that the post-numeral construction is sensitive to the syntactic structure of numerals, while the pre-numeral construction is not. Both constructions involve selecting from among a set of numerical alternatives, but these alternatives differ in their source; in the pre-numeral case, the alternatives represent at Lasersohnian pragmatic halo, but in the post-numeral case, they are conditioned by the syntax of the numeral through merger of a covert wh-word.

1 *Some* can play a role in approximation

English *some* is normally plays the role of a determiner, appearing before a noun phrase, as in (1). By and large, this use of *some* is the *some* that has most often caught the attention of linguists and philosophers, likely due to its frequent use. However, *some* can be used in a non-canonical way with numerals, as in (2) and (3).

(1) a. There were some dogs in the yard.

b. Some man is crossing the street.

c. I put some apple in the salad.

(2) a. Some twenty people attended the party.

b. Some 5 million people are without health insurance.

(3) a. Twenty-some people were at the party.

b. 5 million-some people are without health insurance.

The salient observation about the examples in (2) and (3) is that not only is *some* allowed to modify the cardinal number in a position before the number, but there exist cases where *some* can be in a modifier relationship with the number while appearing after it as well. Throughout the rest of the paper, I will call the former construction the *pre-numeral some* and the latter the *post-numeral some*.

The pre-numeral *some* is able to modify a variety of numerals, demonstrated in (4). However, quite mysteriously, the post-numeral *some* cannot modify some of these same numerals, as shown in (5).

(4) a. Some ten people attended the lecture.

b. Some five students were arrested after the riot.

c. The original text was written some twenty-five years ago.

(5) a. *Ten-some people attended the lecture.

b. *Five-some students were arrested after the riot.

c. *The original text was written twenty-five some years ago.

Finally, there are interpretational differences between these two non-canonical uses of *some* as well. In the pre-numeral *some*, the natural interpretation is one of approximation — values close to the number being modified by *some* are implicated in the meaning of the pre-numeral *some*. In contrast, with the post-numeral *some*, there is an "at least" interpretation — the values for the number implied in this construction start at the number being modified and continue up the scale.

A couple questions naturally arise here. The first is how these two uses of *some* are related to each other, and whether they are the same *some*. Second, how does the semantic system build an approximative meaning for the pre-numeral *some* and an "at least" interpretation for the post-numeral *some*? Finally, what is the nature of the syntactic restrictions between the two *some*s? This squib explores and answers each of these questions, analyzing *some* as being sensitive to Hamblin alternatives (Hamblin, 1973). These alternatives are constructed in separate ways for the two *some* constructions at issue in this paper, with the pre-numeral *some* invoking imprecision alternatives, alternatives that model Lasersohnian pragmatic halos (Lasersohn, 1999; Morzycki, 2011), while the post-numeral *some* implies a covert wh-word that abstracts over positions in the syntax of cardinal numbers, providing numerical alternatives to *some*.

2 Approximation with post-numeral *some*

To account for the post-numeral *some*, it's useful to return to its interpretation and to its restrictions. What I will show here is that there is a common source for both of these, namely that syntactic structure in complex numbers explains both the syntactic restrictions of post-numeral *some* and its interpretation. The core idea will be that numbers are derived compositionally, and that the post-numeral *some* is sensitive to this fact.

The nature of the restrictions on post-numeral *some* strongly suggests that numbers have complex syntactic structure. That numbers are built compositionally is not a new idea, having appeared at least as early as Hurford (1975), and more recently in Ionin and Matushansky (2006), Zweig (2005), and others. To start, we can notice that it is impossible for some numbers to combine with other numbers to form more complex numbers. This fact is demonstrated in (6). One of these is in principle a number that makes complete sense in English: in the absence of a word such as *eleven*, we might have otherwise predicted that **ten one* could have the same meaning.

(6) a. * three five

b. * ten one

c. * fifteen eight

However, numbers do combine with other numbers more generally. *Twenty-five* is composed of the two numbers *twenty* and *five*, for instance, while *one hundred twenty five* is composed of *one hundred* and *twenty five*. And this is of course recursive: *twenty-five* in *one hundred twenty five* is also built from *twenty* and *five*. The conclusion should be that complex numerals are built from smaller, less complex numerals.

What we notice about the post-numeral *some* is that it is sensitive to these same restrictions: the numbers in (6) cannot combine with the post-numeral *some* as well, shown in (7). The conclusion I draw from this is that the post-numeral *some* construction is sensitive to the restrictions inherent to how complex numerals are constructed.

(7) a. * three-some

b. * ten-some

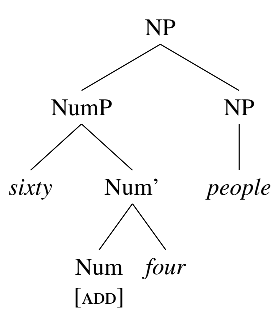
c. * fifteen-some

Some additional evidence that the post-numeral *some* is sensitive to the syntactic structure of the numeral comes from decimal numbers as well. Decimal numbers in English, at least in casual speech, appear to have a list-like structure to them, where they are simply a sequence of number (for instance, 1.634 is commonly *one point six three four*). The post-numeral *some* can abstract over small decimal numbers, provided there is a suitable context. (**??**) shows that this is indeed possible.

(8) *A student in a chemistry class need to fill a test tube with a quantity of fluid. The exact amount of fluid is 1.635 milliliters, but the student cannot remember this number. This student can say:*
I need to fill this with 1.63-some milliliters of fluid.

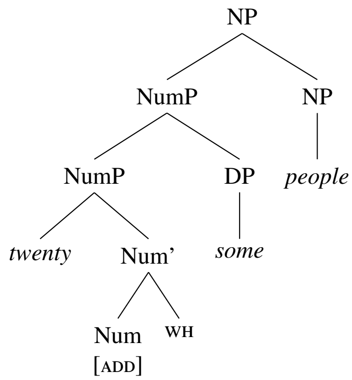
How do we model this? What I will assume is that numerals have complex syntactic structure, following Hurford (1975), Ionin and Matushansky (2006), and others. The particular implementation of this will not matter here; what will be crucial, however, is that there is some structure. When necessary, I will show syntactic structure for numerals schematically, but it should not be mistaken for a serious proposal about the structure of numerals. An example of this structure can be seen in (9), which represents a schematic structure for *sixty four people*. Num is a head with a feature that marks the mode of composition for the numerals it combines with, using features [ADD] (for addition) and [MULT] (for multiplication).

(9)



The post-numeral *some* construction is sensitive to the syntax of numerals. I suggest that in this construction there is a covert wh-word (represented in this paper as WH) that abstracts over a position in the syntax of a numeral. For instance, *twenty-some* is represented as [*twenty* WH]-*some* in the syntax. (10) schematically illustrates this, where a functional head Num puts *twenty* and WH into an addition relation.

(10)



Next comes the question of what the number words themselves actually denote. I assume that there exists a domain of numbers in the model D_n. Simple number words denote singleton sets whose member is a number in D_n. For instance, $[\![\textit{twenty}]\!]$ is just the set containing the number 20, $\{20\}$. In light of this, wh is going to denote a non-singleton set of numbers — the set of numbers denoted by lexical items that could have been inserted into the syntactic position wh occupies. In (10), *one* through *nine* could have been inserted into the tree into the position that wh is in. Therefore, in that example, wh denotes $\{1, \ldots, 9\}$.

(11) $[\![\textit{twenty}]\!] = \{\textit{20}\}$

(12) $[\![\textit{five}]\!] = \{\textit{5}\}$

(13) in (10), $[\![\textsc{wh}]\!] = \{\textit{1}, \ldots, \textit{9}\}$

The reader might ask the question of why number words denote sets rather than objects. Kratzer and Shimoyama (2002) analyze Japanese using a Hamblin semantics (Hamblin, 1973), the semantics of questions. However, rather than analyzing only questions using sets of alternatives, they propose that every expression be a set of alternatives (but often, the set is just a singleton). This is necessary in their view to provide an account of indeterminate pronouns in Japanese. I adopt a Hamblin semantics for every linguistic expression here in this paper due to the usefulness of working with sets when analyzing approximation.

How do numbers get composed in this system? We can assume that the mode of composition features [add] and [mult] are read off of the Num heads at LF and LF representations such as those in (14) are interpreted using the rules in (15a) and (15b). These rules depend on multiplication and addition, and so $+$ and $\times$ are defined over pairs of objects in D_n. Note that the output of the rules in (15) are sets of numbers rather than a single number; this is a reflection of the Hamblinized grammar being used here. More generally, these rules resemble the rule of pointwise function application needed in a Hamblin semantics. Of course, this is not an accident; numbers denote alternatives in this analysis, a special kind of alternative — numerical alternatives.

(14) LF representations for numerals have the format [A [add] B] or [A [mult] B]

a. LF: [twenty [add] five]
"twenty-five"

b. LF: [two [mult] thousand]
"two thousand"

(15) a. **Pointwise Addition** (= [ADD])

Where $[\![A]\!]$ and $[\![B]\!]$ are sets of numbers,

$[\![C]\!] = \{c : \exists a \in [\![A]\!] \wedge \exists b \in [\![B]\!] \wedge c = a + b\}$

b. **Pointwise Multiplication** (=[MULT])

Where $[\![A]\!]$ and $[\![B]\!]$ are sets of numbers,

$[\![C]\!] = \{c : \exists a \in [\![A]\!] \wedge \exists b \in [\![B]\!] \wedge c = a \times b\}$

The idea behind these rules is simple: everything from the first set is added (or multiplied) in turn with each item from the second set. With two singletons, this process is trivial; all that is done is add (or multiply) the only item from the first with the only item from the second. Pointwise Addition and Multiplication is much more interesting with non-singleton sets, which is what we see when WH is present. In this case, the sole item from the singleton set is add (or multiplied) with each item in the set that WH denotes, as in (16).

(16) $[\![\textit{twenty}\ \text{WH}]\!]$

$= [\![\textit{twenty}]\!] + [\![\text{WH}]\!]$

$= \{20\} + \{1, \ldots, 9\}$

$= \{20 + 1, \ldots, 20 + 9\}$

$= \{21, 22, 23, \ldots, 29\}$

Numbers by themselves aren't useful, since nothing can be predicated of them. I stipulate a typeshift PRED that maps objects from D_n to $D_{\langle et \rangle}$, creating properties from numbers. A similar typeshift is independently motivated by Partee (1987) and others to map objects from D_e to $D_{\langle et \rangle}$. The PRED typeshift is defined in (17), where I assume that the $^{\cup}$ operator (Chierchia, 1984) is defined not only over individuals but also numbers. PRED($[\![\textit{three}]\!]$) would then be a function of type $\langle et \rangle$ that's true for individuals that have a cardinality of 3.

(17) $[\![\text{PRED}]\!] = \{\lambda n \lambda x.^{\cup}n(x)\}$

The idea is that PRED is how numerals can be interpreted with nouns: they are interpreted intersectively, using Predicate Modification (18). *Twenty people* is the intersection of *twenty* and *people*, as shown in (19).

(18) **Predicate Modification (PM)** (adapted from Heim and 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 $[\![\alpha]\!] = \{\lambda x.\ [\![\beta]\!](x) \wedge [\![\gamma]\!](x)\}$.

(19) $[\![\textit{twenty people}]\!] = \{\lambda x.\text{PRED}([\![\textit{twenty}]\!])(x) \wedge \textbf{people}(x)\}$

After the DP is composed, the rest of the sentence can in principle be computed using a rule of Hamblin Function Application (see the definition in (20)) when necessary, which applies a set of functions to a set of arguments in a pointwise fashion, and a version of Heim's (1982) existential closure, in order to interpret indefinites. (Hamblin Function Application is necessary due to the set-based representations.) At the end of the derivation, due to assuming singleton denotations throughout, the denotation of the entire sentence will likewise be a singleton. A default rule of existential closure maps the singleton set to a proposition, which can then be interpreted.

(20) **Hamblin Function Application** (Kratzer & Shimoyama, 2002)

If α is a branching node with daughters β and γ, and $[\![\beta]\!] \subseteq D_\sigma$ and $[\![\gamma]\!] \subseteq D_{\langle \sigma, \tau \rangle}$, then $[\![\alpha]\!] = \{c(b) : b \in [\![\beta]\!] \wedge c \in [\![\gamma]\!]\}$

(21) $[\![laughed]\!] = \{\lambda x \lambda w.\mathbf{laughed}(x)(w)\}$

(22) $[\![twenty\ people\ laughed]\!] = \{\lambda w \exists x.\textsc{pred}([\![twenty]\!])(x) \wedge \mathbf{people}(x) \wedge \mathbf{laughed}(x)(w)\}$

The set-based representation will pay off when we consider numerals with WH. Recall that the purpose of WH was to introduce a set of alternatives into the representation. When WH is in the numeral, the NumP will denote a non-singleton set of numbers. I suggest that the role of the post-numeral *some* is to map this set of alternatives — which can be thought of as possible values for the NumP — to a single alternative or possibility.

The method of doing this will be a choice function (Reinhart, 1997; Winter, 1997; Kratzer, 1998), a function from a set to a member of that set. The choice functional analysis for *some* can be developed as in (23), where the Hamblin alternatives of the expression α, a placeholder for the NumP, are mapped to a singleton. I will assume that the choice functional variable is bound by an existential quantifier by the same existential closure mechanism suggested previously.

(23) **Choice functional *some* (first version)**
$[\![some\ \alpha]\!] = \{f([\![\alpha]\!])\}$
where f is a choice functional variable

The derivation of *twenty* WH *some people* would proceed as follows. WH combines with *twenty*, forming a set of numerical alternatives. *Some* selects from among these alternatives, and the typeshift PRED maps the number to a property. This combines intersectively with the denotation of the NP.

(24) *twenty* WH *people*

a. $[\![twenty\ \textsc{wh}]\!] = \{21, 22, 23, \ldots, 29\}$

b. $[\![[twenty\ \textsc{wh}]\ some]\!] = \{f([\![twenty\ \textsc{wh}]\!])\}$

c. $[\![\textsc{pred}\ [[twenty\ \textsc{wh}]\ some]]\!] = \{\lambda x.^{\cup}f([\![twenty\ \textsc{wh}]\!])(x)\}$

d. $[\![[\textsc{pred}\ [[twenty\ \textsc{wh}]\ some]]\ people]\!] = \{\lambda x.^{\cup}f([\![twenty\ \textsc{wh}]\!])(x) \wedge \mathbf{people}(x)\}$

In summary, *some* is inherently sensitive to alternatives, picking from among alternatives by way of a choice function. A covert wh-word provides the set of alternatives in this system, by supplying alternatives that could fill a position in a complex numeral.

3 Supporting evidence from Japanese

The analysis of the post-numeral *some* in the previous section gains additional support from Japanese, by virtue of Japanese's compositional number system and several similarities between the English post-numeral *some* and a similar construction in Japanese. Like English, Japanese builds larger numbers by putting together smaller numbers. As shown in (25a), Japanese *juu-ichi* "eleven" is built by putting together the morphemes *juu* "ten" and *ichi* "one." Relatedly, in (25b), *ni* "two" and *juu* "ten" are put together to form the numeral *ni-juu* "twenty."

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

b. ni -juu
two ten
'twenty'

Like in the English post-numeral *some* construction, Japanese has a way of being imprecise about the precise value of some number. (26) has an interpretation similar to the English post-numeral *some*, where the ones position of a complex number is abstracted over to get an "at least" interpretation with the remaining number. Tellingly, the element that appears in the ones position of the abstract number is a wh-word, *nan*, mirroring the wh-word I assume is covertly present in the English post-numeral construction. Japanese is more flexible in what may be abstracted over, however, as demonstrated in (27), where, due to the Japanese equivalent of English "twenty" being composed of "two" and "ten," the speaker can also make asserts about some multiple of ten.

(26) Juu -nan -nin -ka -ga kita.
ten -what -CL(people) -ka -NOM came
'10 plus x people came.'

(27) Nan -juu -nin -ka -ga kita.
what -ten -CL(people) -ka -NOM came.
'x multiple 10 people came.'

Japanese looks like English in an additional way as well. Focusing on the particle *ka* in (26) and (27), we see that it's roughly at the level of the DP. *Ka* is acting analogously to *some* in this position, where it closes off the alternatives generated from the wh-word. Indeed, *ka* is sometimes analyzed as carrying existential force, and analyses such as Slade, 2011 and Cable, 2010 which argue that *ka* encodes a choice functional variable, similar to the analysis of *some* proposed in this paper.

Supporting the intuition that *ka* closes off sets of alternatives is data on the properties of questions using this construction in Japanese. Shimoyama (2001) suggests that indeterminate phrases in Japanese can be given a Hamblin semantics, where they directly denote sets of alternatives. The scopal properties of indeterminate phrases can be given an *in situ* (as opposed to raising) analysis in this way, by having the alternatives expand upwards throughout the course of the derivation by pointwise combination with other alternatives in the sentence. Operators like *ka* in Japanese can associate with indeterminate phrases and stop these alternatives from expanding, a type of intervention effect. With a wh-word, which also supplies a set of alternatives, the question particle *ka* might associate with these alternatives if there is no other intervening *ka* to capture the alternatives. If there is an intervening *ka*, however, what we expect is for the question word to only be able to associate with the singleton alternative — that is, for there to be only a yes/no question interpretation. As shown in (28a) and (28b), this is what we find. When the operator *ka* is present low, at the level of the DP, it stop the alternatives from the wh-word from expanding, forcing the yes/no question interpretation. When *ka* is not present at the DP level, the alternatives from the wh-word — the numerical alternatives associated with abstracting over part of the complex numeral — can continue to expand upward, until they are caught by the question particle *ka*. At that point, they are used in forming the question, a question that's seeking information about which number of people came.

(28) a. Nan -juu -nin -ka -ga kita ndesu ka?
what -ten -CL(people) -ka -NOM came be Q
'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 be Q
'What is the number x, such that x multiple 10 people came?' (wh-question)

The Japanese data is important in a few key respects. It supports that idea that numerals are built up compositionally in natural language. It also lends support to the analysis of the post-numeral *some* being sensitive to the structure of numerals via a covert wh-word due to the fact that Japanese has both a wh-word and an operator used in indefinite phrases in a structure with similar meaning.

4 Pre-numeral *some* and pragmatic halos

The pre-numeral *some* has a different interpretation from the post-numeral interpretation, namely in having an approximative rather than "at least" interpretation. To illustrate, whereas *twenty-some* has a natural interpretation where any number from the range 21 to 29 would satisfy the phrase, *some twenty* requires numbers close to 20, such as 18, 19, or 21. And, crucially, these numbers do not have to have 20 as their lower bound; they can start below 20 as well. Since pre-numeral *some* doesn't seem to depend on the syntactic form of the numeral, I will assume that there is a different method of approximation at work in the pre-numeral construction, and that the cover wh-word WH implicated in the post-numeral construction is not used in the pre-numeral construction.

The interpretation in the pre-numeral *some* cases seems most closely to approximate scalar approximation or imprecision (Sauerland & Stateva, 2007; Lasersohn, 1999). The way I will model this is by appealing to Lasersohnian pragmatic halos. As suggested by Morzycki (2011), halos might play a role in the compositional semantics, where they can be formalized using an alternative semantics. The issue is how to get a halo around the number in the first place. I propose that the halo is coerced via presupposition accommodation, namely to satisfy the felicity requirements of *some*.

Well-known is that the determiner *some* enforces certain epistemic requirements on the speaker, namely that the referent of the *some* indefinite be unidentified by the speaker. Strawson (1974) observes that this contrasts with *a(n)* indefinites, which do not have the same requirement.

(29) a. I've been stung by a wasp.

b. #I've been stung by some wasp.

Strawson argues that (29b) is odd because of the felicity requirements of *some*. Wasps are normally not individually identifiable, but the example implicates that, in principle, the wasp could have been identified, due to the unidentifiablity requirements of *some*.

To generate the unidentifiability requirement of *some*, Weir (2012) proposes that *some* incorporates an anti-singleton presupposition on its domain. This follows Alonso-Ovalle and Menéndez-Benito (2010), who originally propose a similar requirement on Spanish *algún*. (30) demonstrates this (f is a subset selection function).

(30) $[\![\textit{algún}]\!] = \lambda f_{\langle et,et\rangle}\lambda P_{\langle et\rangle}\lambda Q_{\langle et\rangle}$: **anti-singleton**$(f).\exists x\left[f(P)(x)\wedge Q(x)\right]$
(Alonso-Ovalle & Menéndez-Benito, 2010)

The anti-singleton presupposition is intended to generate an implication that the speaker cannot or will not identify the referent of the indefinite noun phrase.[1] The anti-singleton presupposition can be attached to the choice functional *some* I am assuming, where the presupposition (underlined in (31)) requires that the set of alternatives that the choice function choose from not be a singleton.

(31) **Choice functional *some* (final version)**
$[\![\textit{some}\ \alpha]\!] = \underline{[\![\alpha]\!]\text{ is not a singleton}}.\{f([\![\alpha]\!])\}$
where f is a choice functional variable

The presupposition is satisfied in the post-numeral *some* case, due to fact that the covert wh-word supplies a set of alternatives for *some* to choose from. In the pre-numeral case, however, there is no non-singleton set of alternatives, since numerals denote singletons. The anti-singleton presupposition fixes this problem; the presupposition is accommodated by assuming that the number *some* combines with does in fact denote a non-singleton. The mechanism to do this is to union the denotation of *twenty* with its pragmatic halo (schematically as in (33), where *halo* is a contextually sensitive function returning the pragmatic halo of some linguistic object).

(32) $[\![\textit{some twenty}]\!] = \underline{[\![\textit{twenty}]\!]\text{ is not a singleton}}.\{f([\![\textit{twenty}]\!])\}$ Presupposition failure!

(33) $[\![\textit{twenty}]\!]^c = [\![\textit{twenty}]\!] \cup \textit{halo}_c([\![\textit{twenty}]\!])$

The lesson is that the pragmatic halo can be present just when we need it; it's accommodated due to the pragmatic requirements of *some*.

5 Conclusion

In this paper I show that there are two approximative constructions using *some* with separate semantic representations, but that they can be treated in similar ways by making use of a choice functional analysis of *some*, and by making alternatives available in the semantics. Theoretically interesting in this analysis is the source of the alternatives. In the post-numeral *some* construction, the alternatives are generated through merger of a covert wh-word. The wh-word is interpreted *in situ*, where it directly denotes a set of numerical alternatives that are possible in the syntactic position on the wh-word. In a real sense, the alternatives are determined by the syntactic environment of the wh-word, making the post-numeral *some* sensitive to the syntactic properties of the numeral it combines with. The alternatives in the pre-numeral *some*, instead, are coerced to match the anti-singleton requirement of *some*; the pragmatic halo of the numeral is used for the set of alternatives in this case.

A remaining puzzle presents itself that I have no solution for currently: why the post-numeral *some* can be used with the quantity word *dozen*, as in *a dozen-some eggs*, and possibly also with other teen numerals such as *fifteen* (*fifteen-some people*).[2] Judgements vary on whether these are in fact acceptable (I'm not convinced that I accept them). If they are acceptable, they would present a putative counter-example to my proposal here, and I have no account for

[1] Farkas (2002) proposes that the epistemic requirements of *some* come from a requirement that there are at least two possible values for the variable introduced by *some*. Although Farkas's proposal is situated within a different semantic/pragmatic framework, the idea seems intuitively related to the anti-singleton requirement.

[2] I thank a WECOL audience member for pointing out the *dozen* example.

why they would be acceptable at all, given that neither *dozen* nor *fifteen* combine with other numbers to former larger number phrases.

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