Non-conservative quantification with proportional quantifiers: Crosslinguistic data[*]

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1.   Introduction

One of the best-known generalizations at the interface of syntax and semantics is the conservativity hypothesis proposed by Keenan & Stavi (1986, 260) in the form stated in (1).[1]

(1)   *The Conservativity Hypothesis:* Extensional determiners in all languages are always interpreted by conservative functions.[2]

Conservativity has been regarded as a robust generalization by many researchers. For example, it is cited in the textbook of Chierchia & McConnell-Ginet (1990), but also in much recent research on quantification (Peters & Westerståhl 2006, Szabolcsi 2010, Westerståhl 2014, Romoli 2014 and others). Two potential counterexamples that have been discussed in the literature on conservativity are specific uses of *only* as illustrated in (2a) and of *few* and *many* as in (2b) (after Westerståhl 1985, p. 403).

(2)   a.   Only Scandinavians have won the Abel prize.
       b.   Many Scandinavians$_F$ have won the Abel prize.

But both examples have been shown to be consistent with the conservativity hypothesis, though for different reasons. *Only* in (2a) looks non-conservative as (2a) has a different interpretation from the tautological *Only Scandinavians were ever Scandinavian winners*

[1]Keenan & Stavi use the term *Conservativity Universal*.

[2]Recall that an expression is defined as extensional if and only if its truth value is not sensitive to the replacement of extensionally identical arguments, i.e. $\text{Det}(R)(S) = \text{Det}(R')(S')$, if in the current world $R = R'$ and $S = S'$. A function f of two sets is conservative if $f(R,S) = f(R,R \cap S)$ for all sets R and S.

of the Abel prize. But *only* in English has many uses where it is clearly not a determiner. For example, it can combine with a definite description (*only the Irish*) or a pronoun (*only you*). Therefore, there is good reason to analyze English *only* as something other than a determiner in (2a) as well. Then the conservativity hypothesis is no longer relevant to (2a).[3]

Now consider the second challenge in (2b) *Many* is generally categorized as a determiner. So, if in the semantics, ⟦many⟧ takes the set of *Scandinavians* as its restrictor argument R and the set of *Abel prize winners* as its scope argument S, ⟦many⟧ would be a counterexample to (1): ⟦many⟧(R, S) would need to require that $R \cap S$ is a large proportion of S, but this is not conservative, as the tautological status of *Many Scandinavians$_F$ are Scandinavian winners of the Abel prize* also attests.

However, at least two different analyses that are consistent with the conservativity hypothesis have been suggested by Herburger (1997, 2000) and Cohen (2001). Under Herburger's analysis of (2b), *many* does not take the restrictor and the scope argument as the syntax suggests. Instead, the focus marking on *Scandinavian* reverses the roles of the two: *Abel prize winner* becomes the restrictor argument while *Scandinavian* becomes the scope argument. Herburger proposes that the switch of the arguments of *many* is done syntactically at the level of LF. *Many* in (2b) is then conservative at the level of LF.

Cohen (2001) proposes a different analysis. He suggests that, instead of allowing argument switch as proposed in Herburger, *many* in (2b) relates the restrictor R and scope S to a third set $\cup A$. $\cup A$ is determined by intonation and is always a superset of R and S. In (2b), $\cup A$ can amount to the set of all humans, for example. Cohen's semantics then requires that S's share of R be greater than S's share of $\cup A$, i.e. the percentage of Abel prize winners among Scandinavians be higher than among the world population. Cohen's proposal satisfies hypothesis (1) because it only considers the cardinalities of R, $R \cap S$, and $\cup A$.

In this paper, we discuss a novel class of examples that are problematic for the conservativity hypothesis in (1): non-conservative readings of proportional quantifiers based on measures such as *percent* and regular fractions like *quarter* and *fifth*. We refer to these nouns as *'Relative Measures'* in what follows and distinguish them from *'Absolute Measures'* like weight (*gram, ounce*, . . .) and length (*inch, meter*, . . .) measures. That relative measures can lead to non-conservative construals was first observed by Ahn (2012) for Korean and Sauerland (2014) discusses data from German. But even in English non-conservative construals are possible as (3) illustrates.

(3)   MIT hired 30% women$_F$ last year.   (non-conservative)

The interpretation of (3) can be paraphrased as *30% of the people MIT hired last year were women*. If the noun *women* is the restrictor argument R of *30%* and the remaining clause λx . *MIT hired x last year* forms the scope argument S, the interpretation of (3) clearly violates the conservativity hypothesis (1).

Relative measures in English can also be used to express conservative quantification as in (4). Most languages use morphosyntactic means to distinguish between the conservative and non-conservative construals. In English, for example, this is done by the use of *of*, a preposition or a genitive case marker, and by the definite article *the*. The conservative

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[3]Zuber (2004) argues that Polish *sami* ('only') is a counterexample to the conservativity hypothesis (1).

construal has the morphosyntactic form referred to as *partitive* in descriptive grammars (e.g. Quirk et al. 1985).

(4)   MIT hired 30% of the women last year.   (conservative)

Our argument can only be made with relative measures because absolute measures have an intersective semantics (Krifka 1989). With absolute measures that are only concerned with the intersection $R \cap S$, non-conservative readings cannot be detected. This is illustrated by the equivalence of (5a) and (5b).

(5)   a.   Harvard bought 30 tons of concrete last year.
        b.   30 tons of Harvard's purchases last year were concrete.

The goal of this paper is to show a) that many languages can express both conservative and non-conservative interpretations of DP-internal relative measures, and b) that languages use different means to distinguish between the two interpretations.

To verify that a sentence like (4) is a counterexample to hypothesis (1), we need to establish that *30%* is a determiner that takes *women* as its restrictor. Throughout the paper, we point to evidence from various languages that supports this determiner analysis of the relative measure. There are, however, two limitations to our work here. One is that the concept *determiner* is not well understood. Keenan & Stavi (1986, 255) list *five percent of the*, *more than two thirds of the*, and other fractions as proportional determiners, but many syntactic analyses would not even regard these strings as constituents (Takahashi 2006, Ionin et al. 2006, among others). We argue that the relative measures in examples like (4) share many syntactic properties with expressions like *the*, *some*, and *every*, which are generally viewed as determiners. The second limitation is that we focus on the overt form and cannot preclude the possibility that a proposal such as that of Herburger (1997, 2000) mentioned above is at work for data like (4), and that the conservativity hypothesis (1) holds at LF (cf. Sauerland 2014 for an analysis along these lines).

In the next section, we discuss data from various languages that allow non-conservative construals. We survey how these languages distinguish between conservative and non-conservative interpretations of relative measures morphosyntactically. For each language, we also investigate whether the measure noun and the substance noun form a syntactic constituent.

2.   Non-conservative interpretations

Non-conservative readings of relative measures are detected in various languages. We already observed the contrast between (3) and (4) for English above, but English is somewhat restricted. Non-conservative readings are more widely available in other languages such as German, Georgian, Greek, French, Italian, Korean and Mandarin. While languages differ in how they distinguish non-conservative readings from conservative ones, there are certain patterns that emerge: across these languages, non-conservativity is associated with focus, indefiniteness, and the lack of genitive case marking on the substance noun when relevant.

2.1 English

The sentences in (6) show another contrast between conservative and non-conservative readings using the fraction *thirds*.

(6)   a.   The audience consists of two thirds women$_F$.   (non-conservative)
      b.   The audience consists of two thirds of the women.   (conservative)

In both (3) vs (4) and (6), the difference between the two construals is marked doubly by the presence of the partitive marker *of* and the definite marker *the*. Often partitives require a definite in English (Ladusaw 1982, and others), but English also allows structures with relative measures like (7) where *of* is construed with the bare plural *U.S. workers*. Since the example in (7) is interpreted conservatively, the presence of *of* seems to be the crucial marker of conservative construals in English.

(7)   [...] 52 percent of U.S. workers had said they had less than $10,000 in total savings and investments. (from politifact.com, May 30, 2015)

Some of the literature on measurement structures use the term *pseudo-partitive* for (7), and thus distinguishes them terminologically from examples like (6b) (Selkirk 1977, and others). But we aim for an analysis that makes use of only the lexical meanings of the parts of a structure – such as *of* and *the* – and general composition principles following e.g. Ionin et al. (2006). Therefore we will not use this term.

English is relatively restricted, only allowing the non-conservative reading in the object position. A couple of speakers consider non-conservative readings also possible in the subject position with examples like (8), but the judgment seems to vary and most speakers perceive (8) to be ungrammatical.

(8)   #20% women$_F$ came.

Even the passive of (3) is unacceptable for most English speakers:

(9)   #30% women$_F$ were hired last year.

The limited distribution may indicate that the non-conservative measures are adverbs of some type in (3) and (6a). As the discussion of floated quantifiers shows (Bobaljik 2001, Doetjes 1997, Fitzpatrick 2006, and others), it is difficult to discern between adverbs and other structures with quantifiers. At this point, our analysis of English remains preliminary, but the contrasts in (10), (11), and (12) show that there are nontrivial differences between non-conservative uses of relative measures and adverbials in English. .

(10)   a.   MIT will mostly/*30% hire women this year. (vs (3))
       b.   The audience consists mostly/*two thirds of women. (vs (6a))

(11)   Who does the audience consist of mostly/*30%?

(12)   MIT hired mostly/*30% {the women over there / them / some linguists}.

Finally, Solt (2014) considers Q-adjective uses of *many* such as in (13). Similar uses are possible with non-conservative measures.

(13)   The many / 30% women MIT hired last year are listed in the directory.

Other languages make use of other means to distinguish between non-conservative and conservative construals of relative measures, and we think the data point more clearly to an analysis where the relative measure forms a constituent with the substance noun.

2.2   German (Non-Bavarian)

The non-conservative reading is possible in both subject (14b) and other argument positions in German (Sauerland 2014). In all positions, focus is needed for non-conservative readings. If the substance noun is genitive marked, the only possible reading is conservative. If, on the other hand, the substance noun appears with a case that matches that of the relative measure, the non-conservative reading results.

(14)   a.   30 Prozent   Studierender arbeiten.
                30 percent-NOM students.GEN work
                '30 percent of students work.'   (conservative)

         b.   30 Prozent   STUDierende   arbeiten hier.
                30 Percent-NOM studierende.NOM work   here
                '30 percent of workers here are students.'   (non-conservative)

Definiteness is also weakly relevant: like in English, lack of definiteness marking is correlated with non-conservative readings though (14a) is an exception. That the relative measure appears case-marked points us toward an analysis where the relative measure and the substance noun form a constituent.

2.3   Georgian

Georgian also indicates non-conservative readings by matching case marking on the measure noun and the substance noun, as shown in (15b) and (16b) (Ekaterine Egutia, informant). Other morphological markings include focus and word order: the non-conservative reading requires the substance noun to be focused and to follow the measure noun.

(15)   a.   Profesorebi-s   erti-mesamed-i movida.
                professor-GEN one-third-NOM came
                'One-third of the professors came.'   (conservative)

         b.   Erti-mesamed-i profesoreb-i   movida.
                one-third-NOM professor.PL-NOM came
                'One-third professors came.'   (non-conservative)

(16) a. Harvard-ma kalebi-s   ormutzda.at-i prochent-i   daasakma.
          Harvard-ERG women-GEN fifty-NOM   percent-NOM hired.
          'Harvard hired 50% of the women.'   (conservative)

      b. Harvard-ma ormutzda.at-i prochent-i   kal-i   daasakma.
          Harvard-ERG fifty-NOM   percent-NOM woman-NOM hired
          'Harvard hired 50% women.'   (non-conservative)

As in German, relative measures in Georgian appear case-marked in all examples. They never appear with Georgian adverbial endings such as *-d*, suggesting that these are determiners rather than adverbials.

2.4   Greek

Greek is a third language that uses case agreement to distinguish between the non-conservative and the conservative readings as (17) shows (Artemis Alexiadou, p.c.). For the conservative interpretation, some speakers may prefer the prepositional variant also given in (17a).

(17) a. I   eteria   proselave 30% ton   dopion   / apo tus   dopius
          the company hired   30% the.GEN locals.GEN / from the.ACC locals.ACC
          'The company hired 30% of the locals.'   (conservative)

      b. I   eteria   proselave 30% dopius
          the company hired   30% locals.ACC
          'The company hired 30% locals.'   (non-conservative)

Example (18) shows that the non-conservative interpretation is also available for subjects.

(18)   30% dopii proselifthisan
        30% locals hired.NONACTIVE-3PL
        '30% locals were hired.'   (non-conservative)

2.5   French

In French, disambiguation is made by focus and definiteness (Benjamin Spector, p.c.). Specifically, if the substance noun appears with a definite 'of', only the conservative reading is possible as shown in (19). If, on the other hand, the indefinite 'of' appears, as in (20), the non-conservative reading results.

(19) a. Ce film   a   été vu par deux tiers des   journalistes.
          this movie has been seen by two thirds of.the journalists
          'Two thirds of the journalists have seen this movie.'   (conservative)

      b. Ce film   a   été vu par deux tiers de journalistes$_F$
          this movie has been seen by two thirds of journalists
          'Two thirds of the people who have seen this movie are journalists.'

                                                               (non-conservative)

2.6 Italian

Italian shows parallel patterns as in French (Silvia Darteni, p.c.): definiteness marks the distinction between conservative and non-conservativve readings. Only when the indefinite 'of' is used is the non-conservative reading possible.

(20) a. Gianni ha parlato a un terzo delle donne
    Gianni has talked to a   third of.the women
    'Gianni talked to a third of the women.'   (conservative)

   b. Gianni ha parlato a un terzo di donne
    Gianni has talked to a   third of women
    'A third of those Gianni talked to were women.' (non-conservative)

In both French and Italian, the syntactic position of the relative measure argues against an adverbial account.

2.7 Korean

In Korean, focus, case, and word order determine the available readings (Ahn 2012). As in English and German, the non-conservative reading requires focus on the substance noun, and the substance noun cannot be genitive marked. Also, the measure noun must move out of the case-marked DP for the non-conservative reading. Note that the relative measure *osip-phulo* in (21a) 'floats' out of the accusative marked DP *yeca-(uy) osiip-phulo*, resulting in (21b).

(21) a. Hyosa-ka   [yeca-(uy) osip-phulo]-lul ceyyonghayssta.
    company-NOM woman-GEN fifty-percent-ACC hired
    'The company hired fifty percent of the women.' (conservative)

   b. Hyosa-ka   yeca$_F$-lul osip-phulo ceyyonghayssta.
    company-NOM woman-ACC fifty-percent hired
    'The company hired fifty percent women.' (non-conservative)

The non-conservative reading is also possible in the subject position as in (22).

(22) Kyosu$_F$-ka isip-phulo wassta.
   professor-NOM twenty-percent came
   '20 percent of those who came were professors.' (non-conservative)

Because the relative measure appears 'floated' outside the case-marked DP, hence the name 'floating quantifier (FQ) construction', it might be tempting to analyze the relative measure as an adverbial, like *only* in English.[4] However, a closer look at the FQ and case-marking suggests that the relative measure is not an adverbial.

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[4]This was suggested by Park (2007) for *taypwupwun* ('most'), which allows a similar non-conservative reading when floated outside of the case-marked DP.

It is possible for floating quantifiers to be case-marked in Korean. However, when it is case-marked, only the conservative reading is possible.

(23)   KYOSU-ka   isip-phulo-ka   wassta.
       professor-NOM twenty-percent-NOM came

    a.   '20 percent of the professors came.'   (conservative)
    b.   *'20 percent of those who came were professors.'   (non-conservative)

Ko (2005) provides syntactic evidence suggesting that caseless numeral quantifiers form a constituent with its associate NP in the underlying structure, while case-marked numeral quantifiers do not.

2.8   Mandarin

In Mandarin, relative measures are ambiguous. The only distinction between the two readings is that the non-conservative reading requires focus on *běndì-rén* 'local person' (Hongyuan Sun, p.c.).

(24)   Tāmen lùyòng le   5% de běndì-rén
       3PL   hire   PERF 5% DE local-person

    a.   'They hired 5% of the locals.'
    b.   '5% of the persons they hired are locals.'

Because adverbs in Mandarin appear pre-verbally, the relative measure '*5%*' cannot be analyzed as an adverbial.

3.   Generalizations

In all languages, non-conservative readings are associated with non-genitive marked, non-definite substance nouns. Focus is also required on the substance noun. These findings are summarized in the table in (25).

(25)   *Marking of non-conservative (vs conservative) construal of relative measures*

language(s)	morphological marking
English	focus, case (*of*), definiteness
German, Georgian, Greek	focus, case
French, Italian	focus, definiteness
Korean	focus, definiteness, word order
Mandarin	focus

Additionally, case-marking and positions of the relative measure in these languages resemble those of determiners, suggesting that the relative measure forms a constituent with the substance noun.

4.   Conclusion

In this survey we looked at data from various languages where relative measures like 'percent' and 'thirds' result in non-conservative readings. We have shown that these readings are quite widely-spread, appearing in languages including English, German, Georgian, Greek, French, Italian, Korean, and Mandarin.

Languages have different ways of distinguishing non-conservative readings from conservative readings, and we have listed some general patterns: non-conservative construals are associated with indefinite, non-genitive marked substance nouns, and crucially require focus on the substance noun.

At least on the surface, relative measures in many of these languages pattern with determiners morphosyntactically, setting these apart from the two previous counterexamples of the conservativity hypothesis discussed in the introduction.

That many languages allow non-conservative readings of relative measures that are syntactically determiners has not received much attention because most of the previous literature on measurement have focused on absolute measures, for which the non-conservative and the conservative interpretations are equivalent. In this paper we introduced data from a number of languages and tried to come up with some morphosyntactic generalizations. Further research looking at other languages and how non-conservative construals in those languages pattern with the generalizations introduced in this paper would be necessary for a more complete understanding of this phenomenon, as well as for determining whether these data represent a true counterexample to the conservativity hypothesis.

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