Many Readings of *Most*

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- **Observation:** *Most* has more readings than previously thought
- **Claim:** Readings of *most* are correlated with readings of *many*
- **Analysis:** *most = many + -est*

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1 Two New Superlative Readings of *Most*

1.1 Known Readings: $> \frac{1}{2}$ and Regular Superlative Readings

Most is known to have two readings (Hackl 2009):[1]

(1)   a.   John read most of the books.
           ≈ John read more than half of the books   ($> \frac{1}{2}$ **reading**)
        b.   John read the most books.
           ≈ John read more books than anybody else   (**Regular superlative reading**)

These two readings are morphologically distinguished in English, *most of the NP* vs. *the most NP*. The corresponding German sentence is ambiguous (Hackl 2009:69).

(2)   Hans hat die meisten Bücher gelesen.
        John has the most   books read

        a.   John read more than half of the books.   ($> \frac{1}{2}$ **reading**)
        b.   John read more books than anybody else   (**Regular superlative reading**)

Observation: there are three truth conditionally distinct superlative readings:

1. Regular Superlative Reading
2. Proportional Superlative Reading
3. Fragile Superlative Reading

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[1]Hackl (2009) calls these readings *proportional* and *relative-superlative* readings.

The latter two were not discussed in the literature.[2]

1.2 Proportional Superlative Reading

We observe that (3) is ambiguous between two superlative readings:

(3)   Mali has the most illiterate people.

    a.   *Regular Superlative*
       |illiterate people in Mali| $>$ |illiterate people in x|, for all other countries x

    b.   *Proportional Superlative*
$$\frac{|\text{illiterate people in Mali}|}{|\text{people in Mali}|} > \frac{|\text{illiterate people in } x|}{|\text{people in } x|}, \text{ for all other countries } x$$

A proportional superlative reading compares proportions, while a regular superlative reading compares simple cardinalities.

These two readings are truth conditionally independent. In the situation (4), both (5a) and (5b) are true.

(4)   a.   Mali has 10 million illiterate people (74%)
    b.   Afghanistan has 18.5 million illiterate people (62%)
    c.   Pakistan has 74 million illiterate people (42%)

(5)   (Of these three countries)
    a.   Pakistan has the most illiterate people.   True under regular superlative
    b.   Mali has the most illiterate people.   True under proportional superlative

1.3 Fragile Superlative Reading

In Kotek, Sudo, Howard, and Hackl (2011a), we observed that *most of the NP* in subject position has a latent superlative reading. The acceptability of (6b) varies across speakers.

(6)   Most of the dots are blue.
    a. $\approx$ More than half of the dots are blue   ($> \frac{1}{2}$ **Reading**)
    b. $\approx$ For any non-blue color C, |blue dots| $>$ |C dots| (**Superlative Reading**)

(6a) asymmetrically entails (6b), so in a situation like (7), only (6b) is true.

(7)   6 blue dots, 4 yellow dots, 3 red dots, 3 green dots

We claim that the superlative reading we identified in Kotek et al. (2011a) is truth conditionally distinct from the regular superlative reading. The difference between the two superlative readings emerges when there are many alternative colors.

    A fragile superlative reading *breaks* as the number of relevant individuals increases, unlike a regular superlative reading

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[2]In Kotek, Sudo, Howard, and Hackl (2011b) we identified yet another type of superlative reading, a superlative reading with a partition effect. We do not discuss it in this talk.

For example, the superlative reading of (8) is judged true in (8a) and false in (8b) (note also that the $> \frac{1}{2}$ reading is false).[3]

(8)   Most of the dots are blue.

    a.   6 blue dots, 4 yellow dots, 3 red dots, 3 green dots

    b.   6 blue dots, 4 yellow dots, 3 red dots, 3 green dots, 3 white dots, 3 pink dots, 3 brown dots
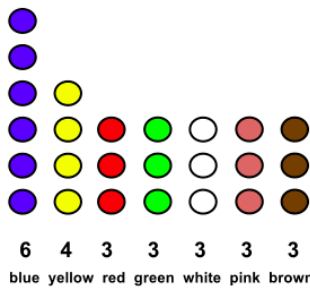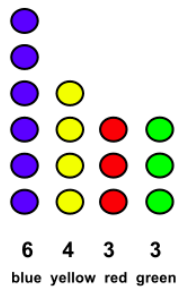
(9) has a regular superlative reading, which is true in both situations.

(9)   Mr. Blue has the most dots.

1.4 Summary and Preview of the Analysis

Most has three superlative readings (in addition to the $> \frac{1}{2}$ reading):

- **Regular superlative reading:** Compares of simple cardinalities
- **Proportional superlative reading:** Comparison of proportions
- **Fragile superlative reading:** Similar to regular superlative but breaks

Following Hackl (2009), we analyze *most* as the spell-out of *many + -est* (cf. Bresnan 1973).[4] We claim that the three superlative readings stem from the ambiguity of *many*.

2 Parallel Ambiguities of *Many* and *Most*

Many is known to have three readings (Westerståhl 1984, Löbner 1987, Partee 1989, Büring 1996, Herburger 1997, Cohen 2001, Solt 2009, Krasikova to appear).

1. **Cardinal Reading**

   (10)   John wrote many papers last year.
   $\approx$ |papers John wrote last year| is large

2. **Proportional Reading**

   (11)   Many graduate students in this department are from Europe.

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[3]Fullwood, Kotek, Sudo and Hackl (in progress) for experimental work on this.
[4]See also our earlier work Kotek, Sudo, Howard, and Hackl (2011a,b).

$$\approx \frac{|\text{European graduate students}|}{|\text{graduate students}|} \text{ is large}$$

3. **'Focus Affected' (FA) Reading**[5]

(12)   Many cooks applied.   (adopted from Herburger 1997:61)

$$\approx \frac{|\text{cooks among the applicants}|}{|\text{applicants}|} \text{ is large}$$

For the purposes of this talk we do not make any assumptions about how these readings are accounted for (see Büring 1996, Cohen 2001, Herburger 1997, Solt 2009, Krasikova to appear). Also we do not justify the distinction among the three readings (see the works cited in this section).

Idea: The three superlative readings of *most* are based on the three readings of *many*:

Many		Superlative Most
Cardinal	$\Rightarrow$	Regular Superlative
FA	$\Rightarrow$	Proportional Superlative
Proportional	$\Rightarrow$	Fragile Superlative

2.1   Distributions of Three *Many*s

It is known that the three readings of *many* are not available everywhere. In particular, the *weak* vs. *strong* distinction is relevant (Partee 1989, Büring 1996, Cohen 2001, Herburger 1997, Solt 2009). Roughly,

- **Weak Environments:** Cardinal and FA *many* only
- **Strong Environments:** Proportional *many* only

(and in neutral contexts, all three readings are available)

Most existential determiners have both *weak* and *strong* readings. Certain constructions force either one of the readings. Also there are determiners that are obligatorily weak or strong, that can be used as diagnostics for weak/strong environments (Postal 1966, Milsark 1977, Diesing 1992, Anderssen 2011)

(13)   *Obligatorily weak determiners*   (14)   *Obligatorily strong determiners*
    a.   *sm* (vs. *some*)   a.   *every, each*
    b.   unstressed *a*   b.   partitives
    c.   non-generic bare plurals

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[5]aka 'reverse proportional' reading.

2.2 Weak Environments

In contexts where weak readings are forced, strong quantifiers like *every NP* and partitives cannot appear.[6]

- *There*-sentences

    (15) a.   There are sm students in the office.
          b.   *There are some (of the) students in the office.
          c.   *There are every student in the office.

- Possessive constructions

    (16) a.   I have sm cousins in California.
          b.   #I have some (of the) cousins in California.
          c.   #I have every cousin in California.

In these contexts, *many* has a cardinal or FA reading, but not a proportional reading.

(17) *Cardinal Many*

      a.   There are many students in Room A.
      b.   I have many cousins.

(18) *FA Many*

      a.   There are many illiterate people in Mali.
      b.   Mali has many illiterate people.

$$\boxed{\frac{|\text{illiterate people in Mali}|}{|\text{people in Mali}|} \geq d_s}$$

Correspondingly, *most* has a regular superlative or FA superlative reading but not a fragile superlative reading (superlative readings generally require a focus).

(19) *Regular Superlative Most*

      a.   There are the most students in [Room A]$_F$.
      b.   [I]$_F$ have the most cousins.

(20) *FA Superlative Most*

      a.   There are the most illiterate people in [Mali]$_F$.
      b.   [Mali]$_F$ has the most illiterate people.

$$\boxed{\frac{|\text{illiterate people in Mali}|}{|\text{people in Mali}|} \geq \frac{|\text{illiterate people in } x|}{|\text{people in } x|} \text{ for all the other countries } x}$$

The fragile superlative reading is not available in these environments. Since the fragile superlative reading is stronger than the regular superlative reading (the former asymmetrically entails the latter), it is harder to see that it's absent in an upward entailing context. So let's embed the sentence in a downward entailing context.

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[6]Other weak environments include: *de dicto* objects of creation verbs and intensional transitive predicates, the object of the "reflexive possessor raising construction" (*have oneself ... X*).

(21) a. I doubt that there are the most illiterate people in [Mali]$_F$.
      b. I doubt [Mali]$_F$ has the most illiterate people.

If these sentences have a fragile superlative reading, they will become compatible with believing the following inequality as the number of relevant countries increases. But their truth conditions are insensitive to this manipulation.

(22) $$\frac{|\text{illiterate people in Mali}|}{|\text{people in Mali}|} \geq \frac{|\text{illiterate people in } x|}{|\text{people in } x|} \text{ for all the other countries } x$$

Compare this to the fragile superlative reading of (23).

(23) a. I doubt that most of the illiterate people are in [Mali]$_F$
      b. I doubt that most of the dots are [blue]$_F$
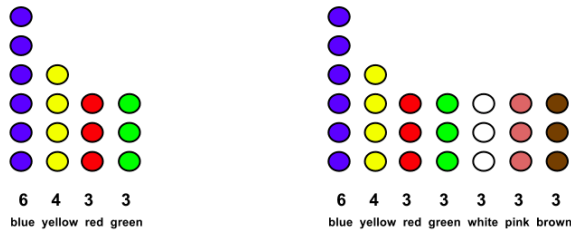
2.3 Strong Environments

In strong environments, obligatorily weak determiners like *sm* are ungrammatical.[7]

- Subjects of individual-level predicates (Carlson 1977)

  (24) a. *sm students are tall.
        b. Some (of the) students are tall.

- *De re* phrases (Musan 1995, Keshet 2008)

  (25) a. #sm graduate students were born in 1990.
        b. Some (of the) graduate students were born in 1990.

- Partitives

  (26) a. *sm of the people are semanticists
        b. Some of the people are semanticists

We expect that *many* only has a proportional reading in these contexts, and correspondingly, *most* only has a fragile superlative reading (and a $> \frac{1}{2}$ reading).

However, because of the vagueness of the standard, it is hard to make sure that a given situation makes cardinal *many* false and proportional *many* true, or vice versa (cf. Partee 1989).

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[7]Other strong environments include: subjects of psychological state predicates like *be nervous*, object of *hate*, object of secondary predicate constructions, German scrambling.

Huettner's test: Cardinal *many* is compatible with *all* but proportional *many* implicates *not all*.

(27)   a.   Many grad students are from California.
⤳ Not all of them are from California.

   b.   Many grad students are in California right now.
(no implicature of *many*)

(28)   a.   Many of the grad students are in California right now.
⤳ Not of all of them are in California right now.

   b.   Many grad students were born in 1990.
⤳ Not all of them were born in 1990.

Most of the NP, being partitive, only has a fragile superlative reading.[8]

(29)   Most of the grad students are in California right now.

   a.   CA 6, MA 4, HW 4
   b.   CA 6, MA 4, HW 4, TX 4, IL 4, UT 4, MD 4, NY 4

Most NP strongly prefers a generic interpretation (Matthewson 2001).[9]

2.4   Section Summary

We observed:

- Weak environments:
  - *Many*: Cardinal and FA
  - *Most*: Regular superlative and proportional superlative
- Strong environments:
  - *Many*: Proportional
  - *Most*: Fragile superlative

This supports the correlation between *many* and *most*:

(30)

Many		**Superlative Most**
Cardinal	⇒	Regular Superlative
FA	⇒	Proportional Superlative
Proportional	⇒	Fragile Superlative

3   Decompositional Analysis

3.1   Review of Hackl (2009)

Hackl proposes to decompose *most* into *many* and the superlative operator *-est* (cf. Bresnan 1973).

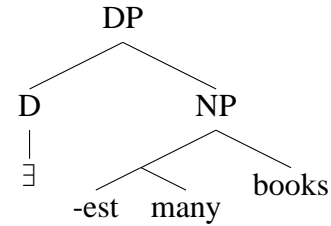[8]In object position, the fragile superlative reading of *most of the NP* is less prominent, but seems to be available (at least for some speakers), e.g. *%[John]$_F$ read most of the books.*

[9]In principle, one can get generic superlative readings of *most NP* and we expect them to break in strong environments. This appears to us to be on the right track, but the judgments are inconclusive: e.g. *Most endangered species are [reptiles]$_F$, Most graduate students were born in [1990]$_F$.*

(31)   *most = many + -est*

Hackl postulates the same structure for the phrases in (32).

(32)   a.   most of the books
         b.   the most books

DP tree:

```
            DP
           /  \
          D    NP
          |   /  \
          ∃  /    \
            /\    books
        -est many
```

The semantics of the items involved are:[10]

(33)   a. $[\![\,\text{many}\,]\!](d)(x) \Leftrightarrow |x| \geq d$
         b. $[\![\,\text{-est}\,]\!](C)(P_{\langle d,et\rangle})(x) \Leftrightarrow \exists d[P(d)(x) \wedge \forall y \in C[x \neq y \rightarrow \neg P(d)(y)]]$
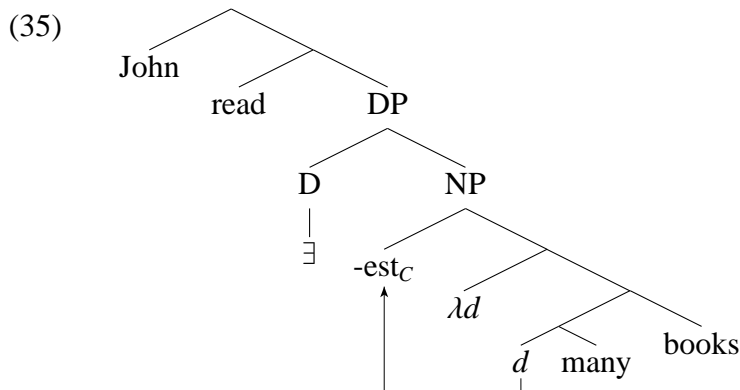   c. $[\![\,\exists\,]\!](P)(Q) \Leftrightarrow P \cap Q \neq \varnothing$

Because of the type mismatch between *many* and *-est*, *-est* undergoes covert movement.

Hackl shows how to derive the $> \frac{1}{2}$ and regular superlative readings by differentiating the scope of *-est* and the comparison class *C*.

3.1.1 $> \frac{1}{2}$ Reading

(34)   John read most of the books

Ignoring QR of the object, the LF of (34) looks like (35).

(35)

```
         John
              \
          read   DP
                /  \
               D    NP
               |   /  \
               ∃  -est_C
                     λd
                    /  \
                   /    books
                  d  many
```

10In addition *-est* presupposes: (i) $x \in C$, (ii) $|C| > 1$, and (iii) $\forall y \in C \exists d[P(d)(y)]$.

8

According to the lexical entries above,

(36)

$$\left[\!\!\left[\begin{array}{c} \text{NP} \\ \text{-est}_C \quad \lambda d \\ d \quad \text{many} \quad \text{books} \end{array} \right]\!\!\right]$$

$$= \lambda X. \exists d[d\text{-}\mathbf{many}\text{-}\mathbf{books}(X) \wedge \forall Y \in C[X \neq Y \rightarrow \neg(d\text{-}\mathbf{many}\text{-}\mathbf{books}(Y))]]$$

It is assumed: C is a non-overlapping cover of $[\![\text{ books }]\!]$.
The overall truth conditions are:

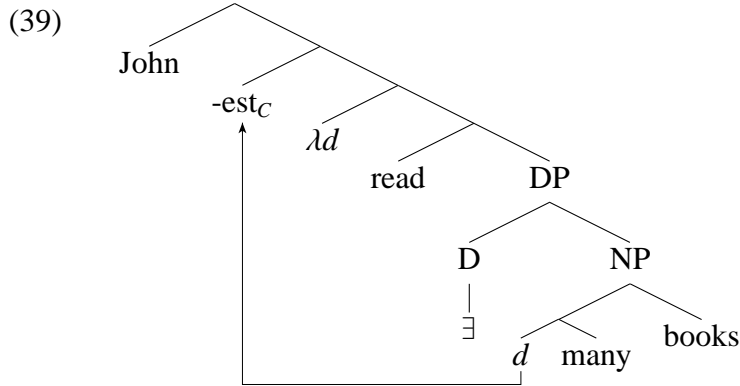(37) $\exists d \exists X[d\text{-}\mathbf{many}\text{-}\mathbf{books}(X) \wedge {}^*[\mathbf{read}(j)](X) \wedge \forall Y \in C[X \neq Y \rightarrow \neg(d\text{-}\mathbf{many}\text{-}\mathbf{books}(Y))]]$

  $\Leftrightarrow$ John read more than half of the books

3.1.2 Regular Superlative Reading

The regular superlative reading of (38) is assumed to involve the same lexical items, but the LF position of *-est* is outside of the local DP as in (39).

(38) John read the most books

(39)

The comparison class is assumed to be alternatives to John:[11]   e.g. $C = \{\text{John, Bill, Mary}\}$

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[11]We tacitly assume that the alternative set C is a function of the focus (Szabolcsi 1986, Heim 1999, Kotek et al. 2011b).

The VP denotation looks as follows.

(40)

$$\Bigg[\Bigg[\begin{array}{c} \text{VP} \\ \text{-est}_C \quad \lambda d \\ \text{read} \quad \text{DP} \\ \text{D} \quad \text{NP} \\ \exists \\ d \quad \text{many} \quad \text{books} \end{array}\Bigg]\Bigg]$$

$$= \lambda z.\ \exists d \left[\begin{array}{l} \exists X[d\text{-}\mathbf{many\text{-}books}(X) \wedge \mathbf{read}(z, X) \wedge \\ \forall z'[z \neq z' \rightarrow \neg\exists Y[d\text{-}\mathbf{many\text{-}books}(Y) \wedge \mathbf{read}(z', Y)]]] \end{array}\right]$$

The overall truth conditions are:

(41)

$$\exists d \left[\begin{array}{l} \exists X[d\text{-}\mathbf{many\text{-}books}(X) \wedge {}^*[\mathbf{read}(j)](X) \wedge \\ \forall z \in C[j \neq z \rightarrow \neg\exists Y[d\text{-}\mathbf{many\text{-}books}(Y) \wedge {}^*[\mathbf{read}(z)](Y)]]] \end{array}\right]$$

⇔ John read more books than Bill did and John read more books than Mary did
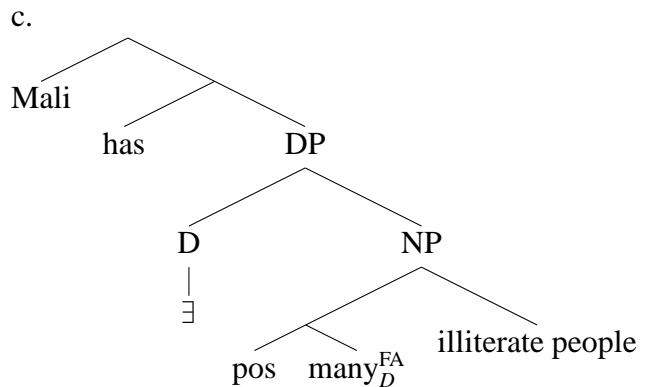
3.2 Proportional Superlative Reading

Given an appropriate semantics of FA *many*, the decompositional analysis of *most* derives the proportional superlative reading of *most*.

(42)   a.   Mali has many illiterate people.   b. $\dfrac{|\text{illiterate people in Mali}|}{|\text{people in Mali}|} \geq d_s$

Let us assume that *many* has a reading in (43a) (possibly not as an atomic lexical item).

(43)   a. $[\![\,\mathbf{many}^{\mathrm{FA}}\,]\!](D)(d)(X) \Leftrightarrow \dfrac{|X|}{|D|} \geq d$

       c.

   b. $D = $ people in Mali

$$\begin{array}{c} \\ \text{Mali} \\ \text{has} \quad \text{DP} \\ \text{D} \quad \text{NP} \\ \exists \\ \text{pos} \quad \mathbf{many}^{\mathrm{FA}}_D \quad \text{illiterate people} \end{array}$$
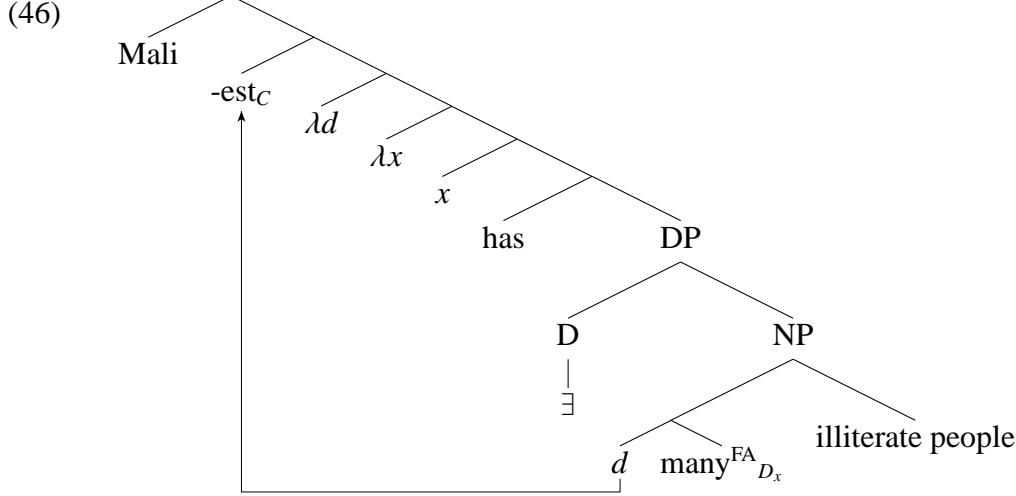
10

The predicted truth conditions are:

(44) $\quad \exists X \left[\textbf{illiterate-people}(X) \wedge \dfrac{|X|}{|\textbf{people in Mali}|} \geq d_s \right]$

With the above semantics of *many*^{FA}, and an assumption that D can be dependent on the subject, the proportional superlative reading is derived via the same mechanism that Hackl (2009) uses.

(45) Mali has the most illiterate people.

(46)

(47) a. $D_x =$ people in x
      b. $C = \{$Mali, Afghanistan, Pakistan$\}$

The predicted truth conditions are:

(48)

$$\exists d \exists X \left[\begin{array}{l} \text{*}\textbf{illiterate-in-Mali}(X) \wedge \dfrac{|X|}{|\textbf{people in Mali}|} \geq d \wedge \\[2ex] \forall z \in C \left[\text{Mali} \neq z \rightarrow \neg \exists Y \left[\text{*}\textbf{illiterate-in-}z(Y) \wedge \dfrac{|Y|}{|\textbf{people in }z|} \geq d \right] \right] \end{array} \right]$$
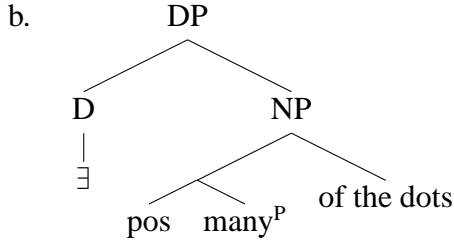
$$\Leftrightarrow \text{ for } z \in \{\text{Afghanistan, Pakistan}\}, \dfrac{|\text{illiterate people in Mali}|}{|\text{people in Mali}|} > \dfrac{|\text{illiterate people in }z|}{|\text{people in }z|}$$

3.3 Fragile Superlative Reading

It turns out that it is not as straightforward to derive the fragile superlative reading from proportional *many*.

(49) a. Many of the dots are blue   b. $\dfrac{|\text{blue dots}|}{|\text{dots}|} \geq d_s$

(50) a. $[\![\,\text{many}^{P}\,]\!](d)(P)(X) \Leftrightarrow \dfrac{|X|}{|P|} \geq d$ where P is the NP denotation

11

b.

$$
\begin{array}{c}
\text{DP} \\
\diagup \quad \diagdown \\
\text{D} \qquad \text{NP}
\end{array}
$$

D — ∃

pos many^P of the dots

The problem for *most* is that if the denominator is constant across alternatives, the resulting truth conditions will be identical to the regular superlative reading (see Kotek et al. 2011b for how to account for a superlative reading in subject position).

(51)   Most of the dots are [blue]$_F$.

C is a set of alternative colors:

(52)   a. $C_1 = \{$blue, red, yellow, green$\}$
        b. $C_2 = \{$blue, red, yellow, green, white, pink, brown$\}$

(53)

$$
\exists d \exists X \left[\begin{array}{l} {}^*\textbf{blue-dots}(X) \wedge \dfrac{|X|}{|\textbf{dots}|} \geq d \wedge \\[2mm] \forall P \in C \left[\textbf{blue} \neq P \rightarrow \neg \exists Y \left[{}^*P\textbf{-dots}(Y) \wedge \dfrac{|Y|}{|\textbf{dots}|} \geq d \right] \right] \end{array} \right]
$$

$$
\Leftrightarrow \frac{|\text{blue dots}|}{|\text{dots}|} > \frac{|P \text{ dots}|}{|\text{dots}|} \quad \text{for other colors } P \in C
$$

But this is truth conditionally equivalent to a regular superlative reading:

$$
(53) \quad \Leftrightarrow \quad \frac{|\text{blue dots}|}{|\text{dots}|} > \frac{|P \text{ dots}|}{|\text{dots}|} \quad \text{for other colors } P \in C
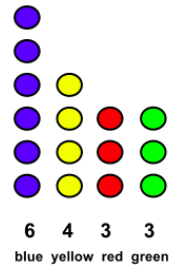$$

We suggest that the relation $>$ that *many* expresses is coarse:

For $p > q$ to be true, p needs to be sufficiently larger than q.

When $|\text{dots}|$ is large, the difference between $\dfrac{|\text{blue dots}|}{|\text{dots}|}$ and $\dfrac{|P \text{ dots}|}{|\text{dots}|}$ will be small.
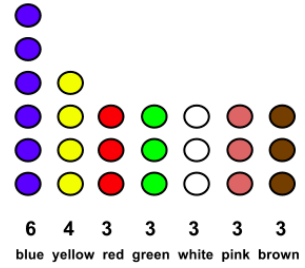
(54)

$$
\left(\frac{6}{16} > \frac{4}{16} \right) \wedge \left(\frac{6}{16} > \frac{3}{16} \right) \quad \Leftrightarrow \quad (.375 > .25) \wedge (.375 > .1875)
$$

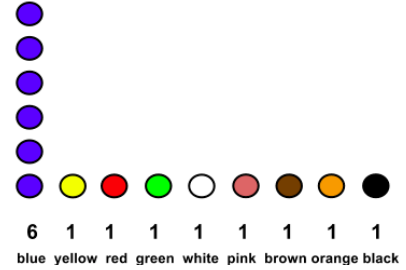6   4   3   3
blue yellow red green

(55)

$$\left(\frac{6}{25} > \frac{4}{25}\right) \wedge \left(\frac{6}{25} > \frac{3}{25}\right) \quad \Leftrightarrow \quad (.24 > .16) \wedge (.24 > .12)$$

6	4	3	3	3	3	3
blue	yellow	red	green	white	pink	brown

(56)

$$\frac{6}{14} > \frac{1}{14} \quad \Leftrightarrow \quad .429 > .071$$

6	1	1	1	1	1	1	1	1
blue	yellow	red	green	white	pink	brown	orange	black

We are currently working on the nature of this breaking phenomenon using experimental methods (Fullwood, Kotek, Sudo and Hackl, in progress).

4   Conclusions

- **Observation:** *Most* has more readings than previously thought
  - Three superlative readings: regular, proportional, fragile
  - $> \frac{1}{2}$ reading
- **Claim:** The three superlative readings of *most* are parallel to the three readings of *many*
- **Analysis:** Hackl's decompositional analysis (*most = many + -est*) gives an account of the three superlative readings

4.1 $> \frac{1}{2}$ *Reading*

Under the proposed analysis the $> \frac{1}{2}$ reading is expected to be three-way ambiguous as well due to the three-way ambiguity of *many*. It turns out that all three *many*s give rise to the same truth conditions when *-est* says in the DP.

(57)
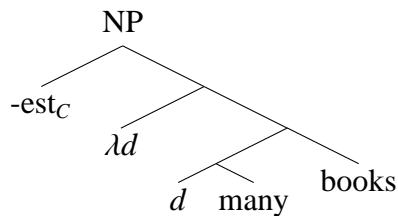
(58)   *Cardinal Many*

$\lambda X. \exists d[\mathbf{books}(X) \wedge |X| \geq d \wedge |\forall Y \in C[X \neq Y \rightarrow \neg(\mathbf{books}(Y) \wedge |Y| \geq d)]]$

(59)   *FA Many*

$\lambda X. \exists d[\mathbf{books}(X) \wedge \dfrac{|X|}{|D|} \geq d \wedge |\forall Y \in C[X \neq Y \rightarrow \neg(\mathbf{books}(Y) \wedge \dfrac{|Y|}{|D|} \geq d)]]$

13

(60)　*Proportional Many*

$$\lambda X. \exists d[\textbf{books}(X) \wedge \frac{|X|}{|\textbf{books}|} \geq d \wedge |\forall Y \in C[X \neq Y \rightarrow \neg(\textbf{books}(Y) \wedge \frac{|Y|}{|\textbf{books}|} \geq d)]]$$

That is, under the latter two readings, the denominators are the same between the two fraction terms, and therefore they don't affect the truth conditions.[12]

Note also that with the partitive structure *most of the NP*, it is expected that only (60) is available, and *the most NP* seems to force *-est* to move outside (cf. Szabolcsi 1986, Hackl 2009).

Also given the coarseness of $>$, our analysis might give an account of the difference between the $> \frac{1}{2}$ *most* and *more than half*: the judgments for *most* are less sharp than *more than half* when the difference between two sets is small.[13]

4.2　*Fewest*

Fewest has a regular and a FA superlative reading.

(61)　Pakistan has the fewest illiterate people.

　　a.　*Regular Superlative:*
　　　For any other country y, |illiterate people in Pakistan| $<$ |illiterate people in y|
　　b.　*FA Superlative*
　　　For any other country y, $\dfrac{|\text{illiterate people in Pakistan}|}{|\text{people in Pakistan}|} < \dfrac{|\text{illiterate people in } y|}{|\text{people in } y|}$

Whether *fewest* has a fragile superlative reading is not testable: the reading is not expected to break.

Fewest also lacks an otherwise expected $< \frac{1}{2}$ reading (see Hackl 2009 for an explanation).

One puzzling difference between *most* and *fewest*: **Fewest of the NP* is ungrammatical (but *few of the NP* is grammatical).

4.3　*More*

More has readings based on cardinal and FA *many* (Partee 1989):

(62)　a.　There are more illiterate people in Pakistan than in Mali.　True under cardinal reading
　　b.　There are more illiterate people in Mali than in Pakistan.　　True under FA reading

It seems that *more* does not allow a proportional reading.

(63)　Mali has more illiterate people than Pakistan does.

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[12]It is not immediately clear what the appropriate value of D would be in this case, but it cannot be quantified into by *-est* unlike in the case of the proportional superlative reading.

[13]See Solt (2011) and our unpublished work (Sudo, Kotek and Hackl, to be presented at CogSci 2012) for quantitative data.

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