Processing of scalar quantifiers: 
the case of Locatives

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Workshop on Linguistic and Cognitive Aspects of Quantification

Budapest 2015
Processing of scalar quantifiers + N
Processing of scalar quantifiers + N

• Comparative: more than 5, fewer than 8
Processing of scalar quantifiers $+ N$

- Comparative: more than 5, fewer than 8
- Superlative: at least $N$, at most $N$
Processing of scalar quantifiers + N

- Comparative: more than 5, fewer than 8
- Superlative: at least N, at most N
- Locative: over N, under N
Processing of scalar quantifiers + N

What do we want to know?
Processing of scalar quantifiers + N

What do we want to know?

- Locative: processing status?
Processing of scalar quantifiers + N

What do we want to know?

• Locative: processing status?
Processing of scalar quantifiers + N

What do we want to know?

- Locative: processing status?
Locative Quantifiers

(Corver & Zwarts, 2005)

- Cross-linguistic phenomenon

Au fost [sub 20 de copii] la petrecere.

“There were under 20 children at the party”  (Romanian)

Det vat [rundt 20 unger] pa festen.

“There were around 20 kids at the party.”  (Norwegian)
Locative Quantifiers

(Corver & Zwarts, 2005)

➤ Cross-linguistic phenomenon

pað voru [um 20 börn] í boðinu

“There were round 20 children at the party.” (Icelandic)

Ipirxan pano apo 20 paiðja sto parti.

“There were over 20 kids at the party.” (Greek)
Locative Quantifiers
(Corver & Zwarts, 2005)

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“There were round 20 children at the party.” (Icelandic)

Ipirxan pano apo 20 paiðja sto parti.

“There were over 20 kids at the party.” (Greek)

also: Spanish, Russian, Polish, Hebrew, English, Dutch
Locative Quantifiers
(Corver & Zwarts, 2005)

• Cross-linguistic phenomenon

• Number of prepositions that participate in these constructions varies across languages.
Locative Quantifiers

(Corver & Zwarts, 2005)

• Cross-linguistic phenomenon

• Number of prepositions that participate in these constructions varies across languages.

  i.e. in Dutch around 12

  in Russian the set is smaller
Locative Quantifiers (Corver & Zwarts, 2005)

• Cross-linguistic phenomenon

• Number of prepositions that participate in these constructions varies across languages.

• The orientation of the prepositions is often vertical.
Locative Quantifiers in English

no drinking under 21
Locative Quantifiers in English

- no drinking under 21
- the temperature is above/below 30 Celcius
Locative Quantifiers in English

- no drinking under 21
- the temperature is above/below 30 Celsius
- under 40 guests
Locative Quantifiers in English

no drinking under 21
the temperature is above/below 30 Celcius
under 40 guests
over 80 students
Processing of scalar quantifiers + N

what we know so far from previous experimental studies?
Processing of scalar quantifiers + N

what we know so far from previous experimental studies?

Comparatives being responded to and acquired earlier than the Superlatives
Processing of scalar quantifiers + N

what we know so far from previous experimental studies?

- Different reasoning patterns: Geurts & Nouwen (2007)
Processing of scalar quantifiers + N

what we know so far from previous experimental studies?

Yet we have no evidence about the processing status of the Locative Quantifiers
Processing of scalar quantifiers + N

what we know so far from previous experimental studies?

- Yet we have no evidence about the processing status of the Locative Quantifiers
- Are attested as numeral modifiers in numerous languages
Numeral Modifiers
Numeral Modifiers

LOCATIVES
Nouwen (2010) Class A / Class B distinction

<table>
<thead>
<tr>
<th>Class A</th>
<th>Class B</th>
</tr>
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<tbody>
<tr>
<td>more than N</td>
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</tr>
<tr>
<td>under N</td>
<td>from N</td>
</tr>
<tr>
<td>between N and R</td>
<td>from N to R</td>
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Nouwen (2010) Class A / Class B distinction

**ENGLISH**

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<thead>
<tr>
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Nouwen (2010) Class A / Class B distinction

Class A : comparison between definite amounts
Nouwen (2010) Class A / Class B distinction

Class A: comparison between definite amounts

Context: I bought a laptop yesterday and I know it has 2Gb of internal memory
Nouwen (2010) Class A / Class B distinction

Class A: comparison between definite amounts

**Context:** I bought a laptop yesterday and I know it has 2Gb of internal memory.

- ✓ My laptop has more than/over 1Gb of internal memory.
- # My laptop has at least 1Gb of internal memory.
Nouwen (2010) Class A / Class B distinction

Class A: comparison between definite amounts

Context: I bought a laptop yesterday and I know it has 2Gb of internal memory

✓ My laptop has more than/over 1Gb of internal memory.

# My laptop has at least 1Gb of internal memory.

Class B: relate to ranges of values, not definite values (ignorance)
EXPERIMENT

- Participants: 16 native speakers of American English aged 19-28

- Method: visually presented with a quantified expression “Q 15”

- $Q = \text{Locative (over/under), Comparative (more than/fewer than), Superlative (at most, at least)}$
EXPERIMENT

- Participants: 16 native speakers of American English aged 19-28
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more than 15
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- The statement was replaced by a number ranging from 11 to 19 for 1000 ms
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- Participants were asked to verify whether the statement was true wrt the quantified expression they saw before by pressing two keys for YES and NO
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T

V
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- SNARC effect (Dehane et al., 1993)
  - smaller numbers  – faster responses with left hand
  - larger numbers   – faster responses with right hand
EXPERIMENT

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- Spatial – Numerical Association Response Effect
  - smaller numbers  – faster responses with left hand
  - larger numbers  – faster responses with right hand
EXPERIMENT

- Participants: 16 native speakers of American English aged 19-28

- Method: visually presented with a quantified expression “Q 15”

- Q = Locative (over/under), Comparative (more than/fewer than), Superlative (at most, at least)

  - 40 statements per Q = 240 critical items (6 Qs x 40 trials each)

  - 240 filler trials of the form “it is X” where X would be a shape or a color
more than 15
fewer than 15
it is green
at most 15
under 15
<table>
<thead>
<tr>
<th>Experiment 1</th>
<th>Accuracy</th>
<th>RTs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vertical</td>
<td>Horizontal</td>
</tr>
<tr>
<td>Comparative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>more than N</td>
<td>0.96</td>
<td>0.98</td>
</tr>
<tr>
<td>fewer than N</td>
<td>0.93</td>
<td>0.97</td>
</tr>
<tr>
<td>Locative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>over N</td>
<td>0.95</td>
<td>0.97</td>
</tr>
<tr>
<td>under N</td>
<td>0.92</td>
<td>0.95</td>
</tr>
<tr>
<td>Superlative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>at least N</td>
<td>0.82</td>
<td>0.91</td>
</tr>
<tr>
<td>at most N</td>
<td>0.77</td>
<td>0.86</td>
</tr>
<tr>
<td>Average</td>
<td>0.89</td>
<td>0.94</td>
</tr>
</tbody>
</table>

3 (Quantifier) x 2 (Direction of Entailment) x 2 (Orientation) ANOVA on RTs:
Locative – Comparative – Superlative
Upward – Downward
Horizontal – Vertical
3 (Quantifier) x 2 (Direction of Entailment) x 2 (Orientation) ANOVA on RTs:

- Quantifier (F(2) = 19.659, p < .001), with locatives faster than comparatives (F(1) = 10.383, p < .006), comparatives faster than superlatives (F(1) = 22.587, p < .001)
- Direction of Entailment (F(1) = 6.890, p < .034), with upward-entailing faster than downward-entailing
Conclusions: Exp 1

- **RTs:**
  - Replicated widely reported effect of direction of entailment.
  - Obtained a difference in RTs between one more pair of Class A quantifiers (locatives) and Class B quantifiers (superlatives)
  - Evidence in favour of Nouwen’s classification
  - The difference between the two Class A pairs (locatives vs comparatives) suggests that Nouwen’s classes is not the only factor implicated

- **Accuracy:** ceiling effects
• In all cases the NDH serves as a reference point and the DH always moves on the vertical axis.
• FEWER-THAN the DH moves away from the NDH/reference point towards unbounded space,
• While for AT-MOST the DH moves towards and stops right below the NDH/reference point which works as a boundary (it caps the DH, preventing any further upward movement).
This suggests that

- Independently: evidence for a vertical quantifier mental line (compare with horizontal cardinal mental line)
Thank you ...