Processing costs of non-strict versus strict comparison

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Outline

- Semantic/pragmatic analyses of numerically-quantified expressions
- Strict and non-strict comparison as a locus of semantic/pragmatic variation
- Experimental support for the distinction
- Implications for the analyses

Numerically-quantified expressions

- Numerals
- "About", "approximately"
- "More than", "fewer than"
- "At least", "at most"
- "Up to", "maximally", etc.

- Traditional approach – mathematical / set-theoretic semantics

Geurts and Nouwen (2007)

- "At least", "at most" not semantically similar to "more than", "fewer than"
  - Also have a modal component of meaning

- Evidence includes
  - Failure of inference "at most 2" -> "at most 3"
  - Differences in distribution
  - Differences in processing time

Nouwen (2008)

- "No more than", "no less than" not simply the negations of "more than", "less than"
  - Not comparatives, but exact expressions also expressing an attitude

- "This sofa costs no more than £399"
- "John passed no fewer than 5 A-levels"

Nouwen (2009)

- Two classes of modifier?
- Comparison with cardinal ("more than")
- Bound on a degree property ("at most", "up to", "minimally")

  - A triangle has fewer than 6 sides
  - ?A triangle has up to/at most/maximally 6 sides

Interim summary

- Semantics of numerically quantified expressions variable and complex, OR...

- Analyses flawed, as posited semantics implausible, unlearnable

  OR...

- Meaning of these expressions driven by some other underlying consideration

Observation

- All these proposals split quantifiers into two groups, the classical and the non-classical
- All the non-classical cases appear to involve non-strict comparison
  - Definition: Non-strict comparison is of the form "greater than *or equal to*", "less than *or equal to*"
- Could there be something about non-strict comparison causing this? What? How?

Complexity of non-strict comparison

- Idea: Non-strict comparison more complex, at a cognitive level, than strict comparison
  - Not a 'simplex' operation, unlike strict comparison and equality?
  - Does the disjunction in the mathematical description reflect psychological reality?
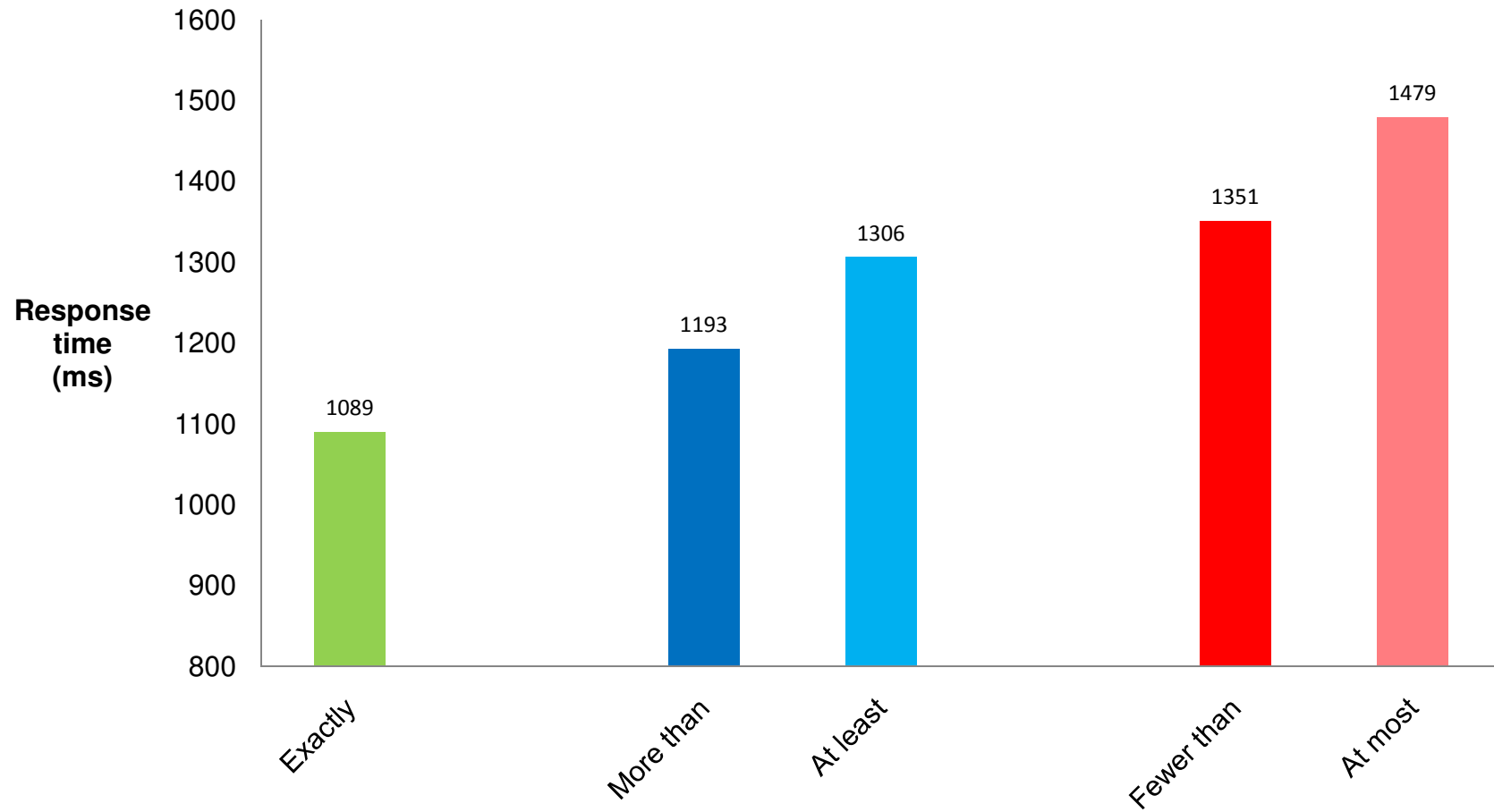 - Is non-strict comparison harder to work with, with regard to drawing inferences?

Testing the ease of processing

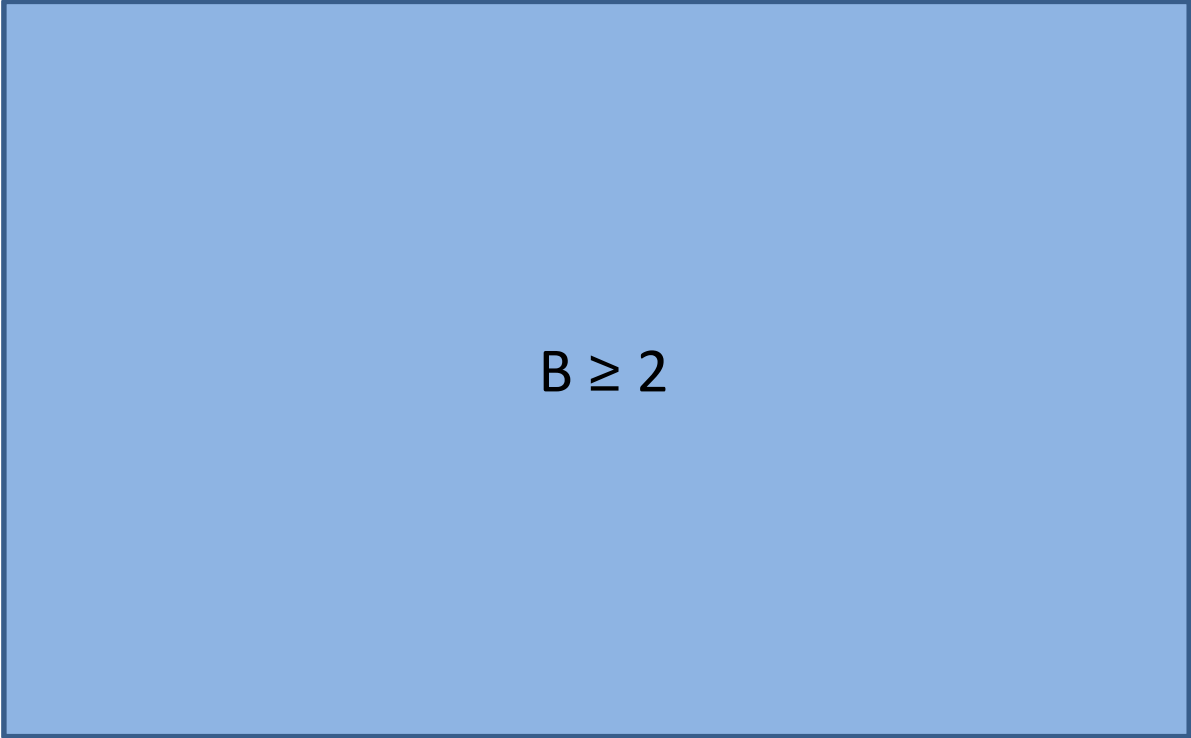There are [   ] Bs

Testing the ease of processing

BBB
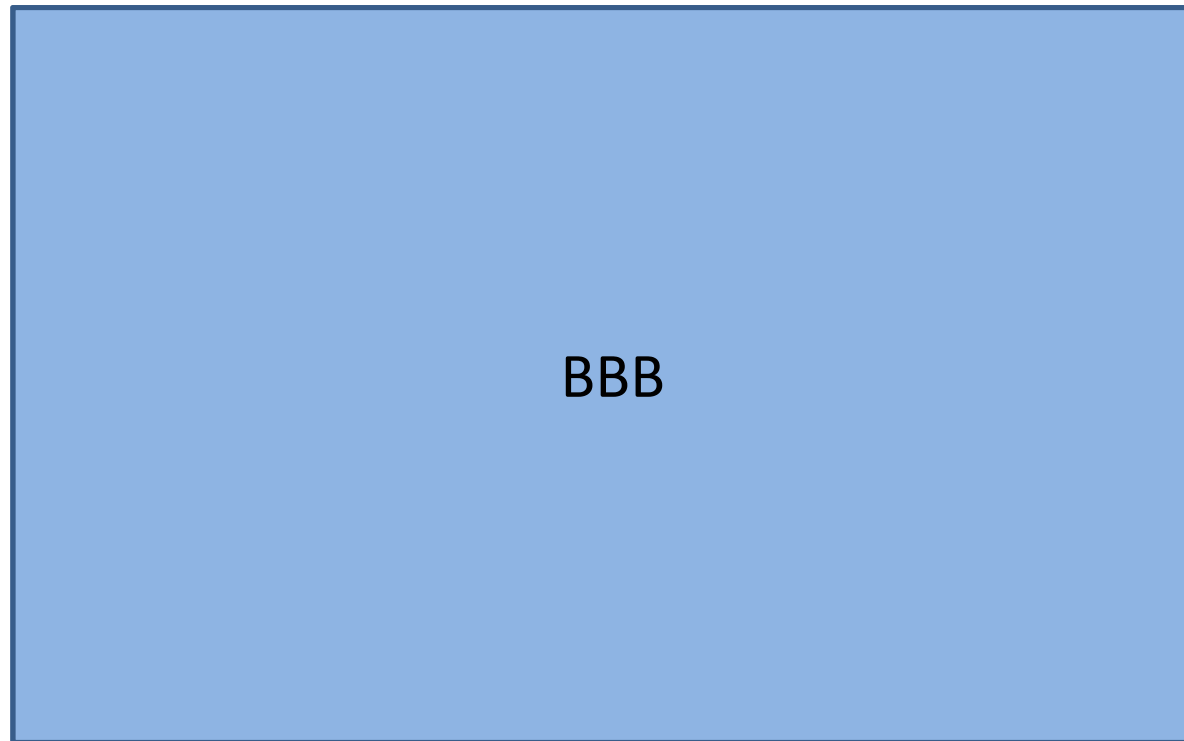
Testing the ease of processing

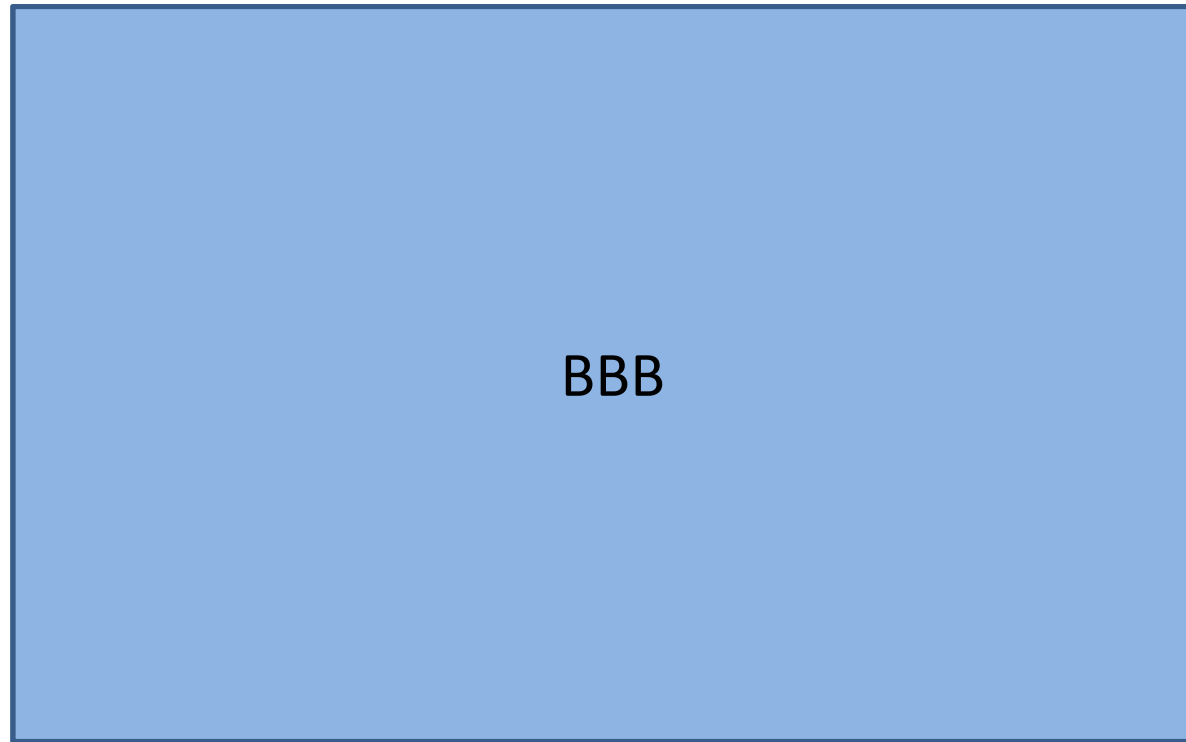# Testing the ease of processing, again
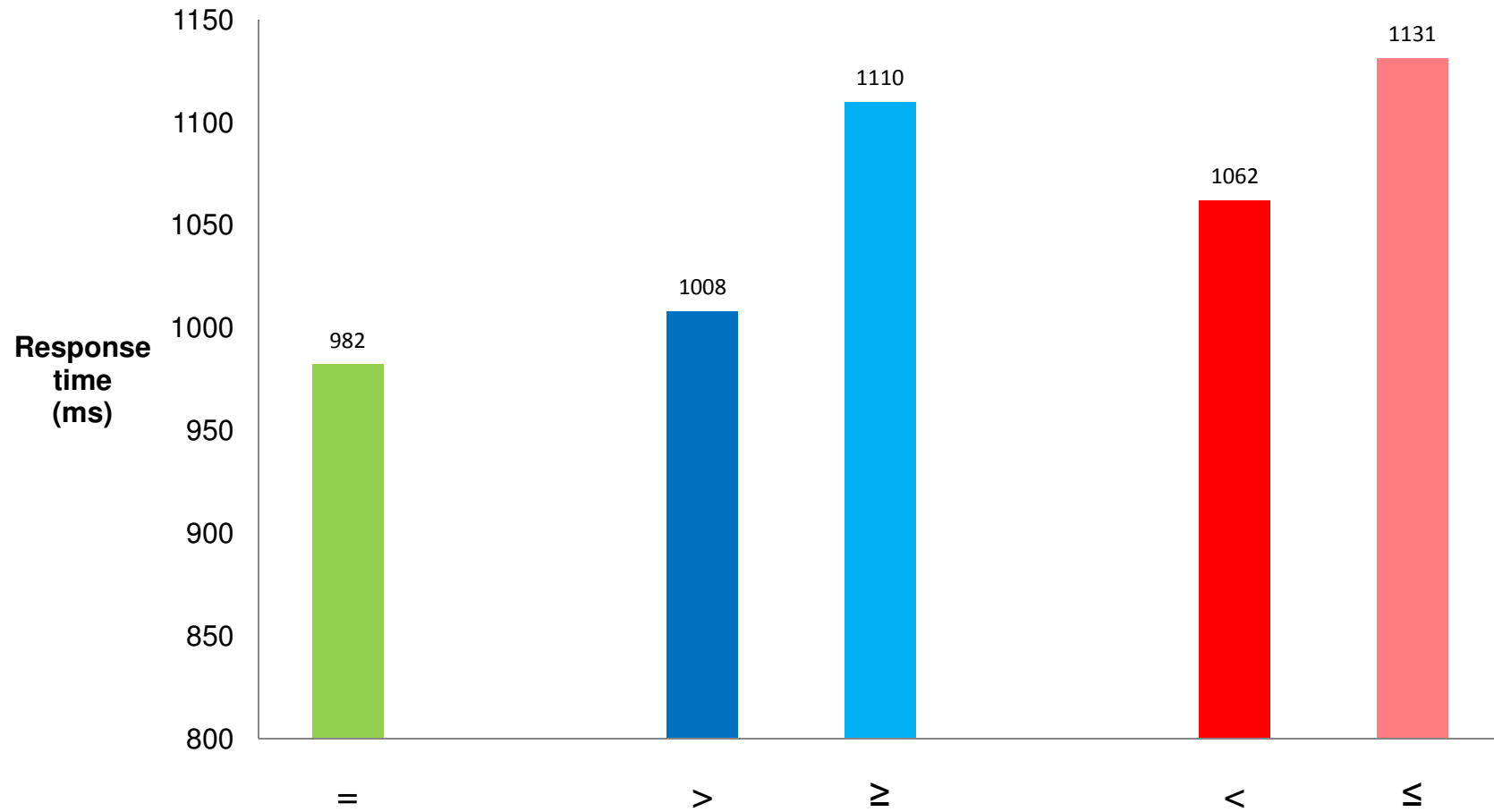
There are [   ] Bs

Testing the ease of processing, again
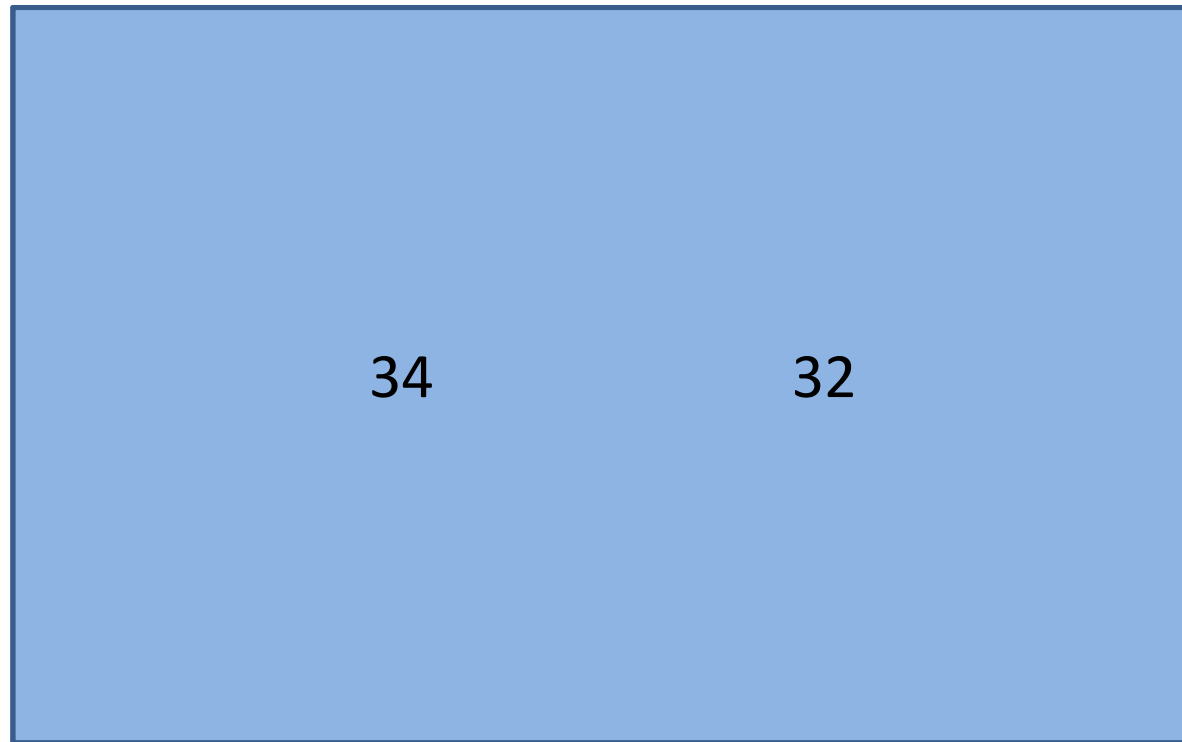
$$B \geq 2$$

Testing the ease of processing, again

BBB

Testing the ease of processing, again

Testing the speed of comparison directly (pilot)

- "Press a key if the number on the left is..."

34   32

Testing the speed of comparison directly (pilot)

- Numerical trend towards slower verification of "or equal to" relation
  - Counterbalanced by rapid determination of the equality case
- However, some interpretive issues:
  - Instructions requiring disjunctive process?
  - Reverse distance effect makes analysis tricky
- Remain in search of a better protocol

The complexity-based account

- Complexity of non-strict comparison leads to markedness of corresponding forms
  - which can therefore give rise to implicatures

e.g.   "John has at most three cars"   vs.
       "John has fewer than four cars"

- Pragmatic enrichment towards Geurts and Nouwen's 'semantic' meaning

The complexity-based account

- coheres with observations not satisfactorily dealt with by existing accounts

- unifies various *ad hoc* proposals into a single coherent account

- does not stipulate meanings and thus increase the burden of acquisition

Conclusion

- Some evidence that non-strict comparison more complex than strict comparison

- This may have linguistic consequences and thus explain puzzling behaviours of numerically quantified expressions

Thank you!

References

Geurts, B. and Nouwen, R. (2007). "At least" et al.: the semantics of scalar modifiers. *Language*, 83: 533-59.

Nouwen, R. (2008). Upper-bounded *no more*: the exhaustive interpretation of non-strict comparison. *Natural Language Semantics*, 16: 271-95.

Nouwen, R. (2009). Two kinds of modified numerals. In Solstad, T. & Riester, A. (eds.), *Proceedings of Sinn und Bedeutung 13*.