An asymmetry of agreement attraction provides evidence for self-organized parsing

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Introduction

- The label on the bottles... is (~95%), are (~5%)... vs. The label on the bottle... is (~99%), are (~1%)... (Bock & Miller, 1991)
- Possible explanations:
  - Incorrect controller retrieval (Lewis & Vasishth, 2005; see also Franck, in press)
  - Dynamical formation of different structures (Tabor & Hutchins, 2004; Vosse & Kempen, 2009)
- Acceptability judgement materials:
  - A box of apples (Containment)
  - A pile of apples (Collection)
  - A number of apples (Measure)
  - Many apples (Quantifier)
- Semantic norming: N1 topicality decreases box to many (N = 20, χ²(4) = 198.6, p < .001)
- Acceptability judgment results:
  - 1-7 Likert scale, N = 46
  - Significant 3-way interaction (χ²(3) = 8.196, p < .05)
  - Agreement attraction gives way to grammatical agreement

Subject Viability

- Number match to verb and topicality were combined into a single subject viability score
- Free parameter values:
  - N1 Topicality parameter = 2 * (0.48125, 0.35, 0.1125, 0.05)
  - N2 Topicality parameter = 0.5 in long condition, 0 in short condition
- Controller retrieval
  - Subject viability = 0.5 * (topicality + number match)
  - Linear model: Pr(N1 retrieved) = N1 viability / (N1 viability + N2 viability)
  - Nonlinear model: Pr(N1 retrieved) = N1 viability³ / (N1 viability³ + N2 viability³)
- Self-organized parser
  - Subject viability = 0.25 * topicality + 0.75 * number match
  - Other parameters held constant
  - Subject viability plus feedback dynamics lead to left- or right-headed parse
  - Monte Carlo simulations provide probabilities of each parse forming

Fig. 2: Linear controller retrieval model results

Fig. 3: Nonlinear controller retrieval model results

Fig. 4: Self-organizing parser, also showing the interaction from the acceptability data.

Fig. 5: SOPARSE structure formation. Blue lines indicate developing structural links.

Discussion

- The linear controller retrieval model produced a different type of interaction than was observed in the acceptability judgment experiment
- Adding the nonlinear skewing provided much better fit to the data
- The self-organizing model predicts the correct form of the interaction from independently motivated assumptions: it is the central mechanism for forming structure at all

Self-organized parsing

- The current model can be thought of as an approximation of a more complete parsing model, SOPARSE (Tabor & Hutchins, 2004)
- In SOPARSE (Fig.5), lexically anchored treelets compete to form a parse, with positive feedback connections between compatible treelets
- Predicts: digging-in (Tabor & Hutchins, 2004) and local coherence effects (Bicknell, Levy, Dembert, 2009; Konieczny et al., 2010; Tabor, Galantucci, & Richardson, 2004)
- Low-level feedback dynamics (e.g., between attachment sites for individual words, blue lines) combine, creating feedback dynamics at the level of whole phrases
- Current model approximates these phrase-level feedback dynamics
- Feedback-based, self-organized parsing may provide a principled framework for explaining agreement attraction and other effects

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