Syntactic complexity effects in Jabberwocky sentences

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BACKGROUND AND MOTIVATION

Background:
Jabberwocky materials have been commonly used for investigating syntactic processing in fMRI studies (e.g., Friederici et al., 2000; Friederici, 2001; Indefrey et al., 2001; Moro et al., 2001; Hickock et al., 2003) and ERP studies (e.g., Hahne & Jescheniak, 2001; Sanders & Neville, 2003; Silva-Pereyra, 2007; Yamada & Neville, 2007) (see also Marslen-Wilson & Tyler, 1980 for earlier behavioral work).

Theoretical motivation:
- to investigate syntactic processing independent from lexical and referential semantics

Practical motivation:
- to obtain more reliable measures of syntactic working memory (Experiment 2) in individual participants by eliminating the variance associated with particular lexical items and plausibility factors (e.g., Gibson, Fedorenko & Ishizuka, submitted)
  - for use in individual-differences behavioral paradigms
  - for potential use in functional localization in fMRI investigations

Research question:
Do people process Jabberwocky sentences in a similar fashion to normal sentences?

Approach:
To investigate well-established syntactic complexity phenomena in Jabberwocky sentences, in order to see whether similar effects obtain:
- main verb / reduced relative ambiguity
- subject- vs. object-extracted relative clauses

EXPERIMENT 1 (MV-RR ambiguity)

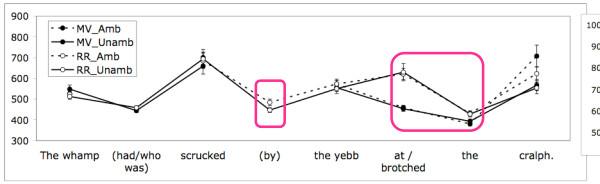
Design: 2 x 2, crossing ambiguity (ambiguous / unambiguous) and resolution (main verb / reduced relative clause)
Materials: Monosyllabic pronounceable non-words (ARC Nonword Database, http://www.maccs.mq.edu.au/~nwdb/)
Paradigm: Self-paced moving-window word-by-word reading (Just, Carpenter & Wolley, 1982)

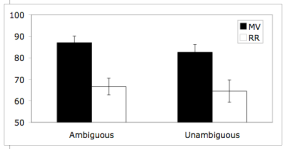
32 participants, 24 items (also, 24 items from Experiment 2 and 24 random fillers)

Sample item:
Main verb resolution: The **whamp** (had) **scrucked** the **yebb** at the **cralph**.
Reduced relative resolution: The **whamp** (who was) **scrucked** by the **yebb brotched** the **cralph**.
Comprehension questions always concerned the dependency structure of the sentence (e.g., Did the whamp scruck the yebb?)

Results:

Criterion for inclusion in the analyses: overall accuracy for each experiment is at or above 55%





Reading times
Effect of ambiguity at "*by*": F1(1,31)=2.53, p=.12; F2(1,23)=4.36, p<.05
Effect of resolution at "*at/brotched*" (hard to interpret) and "*the*": Fs>12, p<.002
Effect of ambiguity at the last region: F1(1,31)=6.82, p<.02; F2(1,23)=5.22, p<.05

Accuracies
Effect of resolution:
F1(1,31)=22.3, p<001;
F2(1,23)=25.7, p<.001

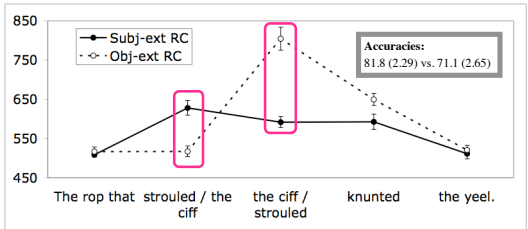
EXPERIMENT 2 (RCs)

Design: A two-way manipulation: subject- vs. object-extracted relative clauses
Materials: Same as Experiment 1.
Paradigm: Same as Experiment 1.

32 participants, 24 items (also, 24 items from Experiment 2 and 24 random fillers)

Sample item:
Subject-extracted: The **rop** that **strouled** the **ciff knunted** the **yeel**. / The **ciff** that **strouled** the **rop knunted** the **yeel**.
Object-extracted: The **rop** that the **ciff strouled knunted** the **yeel**. / The **ciff** that the **rop strouled knunted** the **yeel**.
Comprehension questions always concerned the dependency structure of the sentence
4 types: RC-Yes (Did the rop stroul the ciff?) RC-No (Did the ciff stroul the rop?)
MV-Yes (Did the rop knunt the yeel?) MV-No (Did the ciff knunt the yeel?)

Results:



Reading times

Embedded verb:
F1(1,31)=10.7, p<.005; F2(1,23)=30.4, p<.001

Main verb (spill-over):
F1(1,31)=9.15, p<01; F2(1,23)=4.75, p<.05

Accuracies

F1(1,31)=9.78, p<005; F2(1,23)=10.3, p<.005

NB: There was large variability across individual participants in overall accuracies. There was a correlation (r=.43) in performance on the two experiments (collapsing across conditions in each experiment), suggesting that overall motivation / amount of effort determined performance.

SUMMARY & IMPLICATIONS

Summary:

- (Most) participants can extract propositional content from Jabberwocky sentences as evidenced by above-chance comprehension accuracies.
- Well-established syntactic complexity effects were obtained in Jabberwocky materials.

Theoretical implications:
- People process novel words in a similar way to words stored in long-term memory (e.g., spontaneously assigning thematic roles to nouns, recognizing the ambiguity in morphologically-ambiguous word-forms).
- Syntactic-category frequency effects (e.g., MV reading of an -ed form being more frequent than the participle reading) are not specific to particular lexical items.

Practical implications:
- Whereas syntactic complexity effects emerge very clearly in Jabberwocky materials, these materials are not ideally suited for individual-differences behavioral paradigms or imaging studies because of the variability present in the participants' ability to process these kinds of sentences.
- Investigating the sources of this variability may, however, prove an interesting enterprise with potential implications for research on first and second language learning.