



Processing Relative Clauses in Russian



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Background & Motivation

Background

A classic complexity contrast in sentence processing is that between subject- and object-extracted relative clauses (RCs).

Subject-extracted: The dictator that hated the dissident gave a speech.
Object-extracted: The dictator that the dissident hated gave a speech.

A number of sentence-processing theories can account for the object-extracted RCs being more difficult to process:

E.g.

- Resource-based theories:** differences in *integration costs* [integrating head-dependencies] (Ford, 1983; Gibson, 1998, 2000), or *storage costs* [storing incomplete head-dependencies] (Chomsky & Miller, 1963; Warner & Maratsos, 1978; Gibson, 1991, 1998, 2000; Lewis, 1996).
- Word-order theories:** canonical vs. non-canonical word order in the RCs (MacDonald & Christiansen, 2002; cf. Bever, 1970; Mitchell et al., 1995; Tabor, Juliano & Tanenhaus, 1997).
- Accessibility hypothesis:** differences in accessibility of syntactic positions (Keenan & Comrie, 1977; Keenan & Hawkins, 1987; Hale, 2003).
- Perspective Shift Hypothesis:** differences in whether a shift in perspective is required (MacWhinney, 1977, 1982; MacWhinney & Pleh, 1988; cf. Bever, 1970).

Hsiao & Gibson (2003) investigated the processing of RCs in Chinese in an attempt to narrow down the range of possible accounts.

- In Chinese: (1) the canonical word order is SVO, like in English;
(2) the RCs precede the head noun, unlike in English;
(3) the storage and the integration costs are higher in subject-extracted RCs.

Subject-extracted:

e, yaoching fuhao de guanyuan, shinhuaibugui danshi shanyu yintsang
invite tycoon gen official have had intentions but good at hiding
'The official who invited the tycoon has had intentions but is good at hiding them.'

Object-extracted:

fuhao yaoching e de guanyuan, shinhuaibugui danshi shanyu yintsang
tycoon invite gen official have had intentions but good at hiding
'The official who the tycoon invited has had intentions but is good at hiding them.'

Hsiao & Gibson found that subject-extracted RCs are more difficult to process, compared with the object-extracted RCs.

These results are consistent with the predictions of resource-based theories and canonical word-order theories, but not with the predictions of the perspective shift or accessibility hypotheses.

Motivation

This research is aimed at *distinguishing between the resource-based theories and canonical word-order theories*.

Why Russian?

- Like English and Chinese, the canonical word order of Russian is SVO.
- Russian is a flexible word-order language: word order in the RCs can be manipulated.

Experiment

Method

- Participants - 40 subjects (5 removed from the analyses on the basis of low accuracy performance)
- Design - 2 x 2
- Factors:
 - extraction type (subject-extracted relative clauses (RCs), object-extracted RCs)
 - scrambling (non-scrambled, scrambled)

Materials

NonScr-Subj (SVO) Diktator kotoryi nenavidel dissidenta proiznes rech na sobranii
dictator who-Nom hated dissident-Acc gave speech at meeting
'The dictator who hated the dissident gave a speech at the meeting'

NonScr-Obj (OSV) Diktator kotorogo dissident nenavidel proiznes rech na sobranii
dictator who-Acc dissident-Nom hated gave speech at meeting
'The dictator who the dissident hated gave a speech at the meeting'

Ser-Subj (SOV) Diktator kotoryi dissidenta nenavidel proiznes rech na sobranii
dictator who-Nom dissident-Acc hated gave speech at meeting
'The dictator who hated the dissident gave a speech at the meeting'

Ser-Obj (OVS) Diktator kotorogo nenavidel dissident proiznes rech na sobranii
dictator who-Acc hated dissident-Nom gave speech at meeting
'The dictator who the dissident hated gave a speech at the meeting'

Procedure



-self-paced word-by-word reading with a moving window display;

-the critical regions were defined as:
(1) the RC;
(2) the Verb (for possible spill-over effects).

Predictions

Resource-based theories (specifically, DLT (Gibson, 1998, 2000)):

The non-scrambled subject-extracted (SVO) and the scrambled object-extracted (OVS) conditions should be easier to process than the non-scrambled object-extracted (OSV) and the scrambled subject-extracted (SOV).

Word-order theories:

- (1) The non-scrambled subject-extracted (SVO) condition should be the easiest to process.

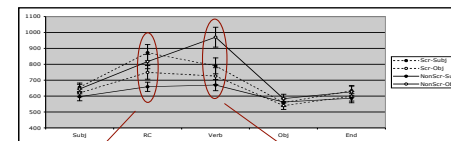
The predictions with regard to the difficulty of processing of the other three conditions vary, depending on how the theory is formalized.

For example, one version of Word-order theory may postulate that the processing complexity increases with the increased number of displacements (moved elements) from the canonical word order. Such a theory would then have the following predictions:

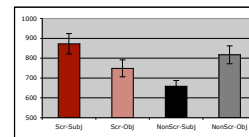
- (2) The non-scrambled object-extracted (OSV) and the scrambled subject-extracted (SOV) conditions should be the next most complex (one displacement each).
- (3) The scrambled object-extracted (OVS) should be the most difficult to process (two displacements).

Results & Conclusions

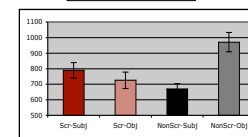
Reading Times



Reading Times - RC



Reading Times - Verb



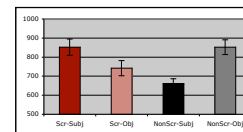
-Main effect of **scrambling**: scrambled sentences slower (F(1,34)=4.89; p < .05; F2(1,29)=5.87; p < .05).

-Significant **crossover interaction**: for the non-scrambled conditions, the object-extracted RCs are slower, but for the scrambled conditions, the subject-extracted RCs are slower (F(1,34)=24.91; p < .0001; F2(1,29)=15.08; p < .001).

-Main effect of **extraction**: object-extracted RCs slower (F(1,34)=5.57; p < .05; F2(1,29)=6.55; p < .05).

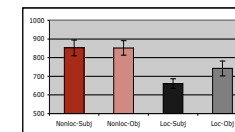
-Significant **crossover interaction**: for the non-scrambled conditions, the object-extracted RCs are slower, but for the scrambled conditions, the subject-extracted RCs are slower (F(1,34)=22.02; p < .0001; F2(1,29)=18.65; p < .0005).

Reading Times - RC + Verb



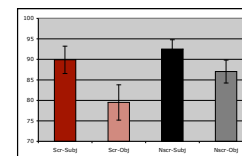
-Significant **crossover interaction**: for the non-scrambled conditions, the object-extracted RCs are slower, but for the scrambled conditions, the subject-extracted RCs are slower (F(1,34)=51.61; p < .0001; F2(1,29)=29.22; p < .0001).

Reading Times - RC + Verb (Factors: Locality x Extraction)



-Main effect of **locality**: local conditions faster (F(1,34)=51.61; p < .0001; F2(1,29)=29.22; p < .0001).

Comprehension Performance



In comprehension data, we observed a main effect of extraction.

-Main effect of **extraction**: subject-extracted RCs more accurate (F(1,34)=8.53; p < .01; F2(1,29)=9.31; p < .005).

Discussion

The non-scrambled subject-extraction (SVO) was processed the fastest of the four conditions, as predicted by the Word-order theories. But other predictions of the Word-Order theories were not supported.

For example, the Word-order theories predict that the scrambled object-extracted condition (OVS) should be the slowest of the four, whereas it is numerically the second fastest, significantly faster than the SOV or the OSV conditions.

The pattern of results support the resource-based theories of sentence comprehension. In particular, local integration conditions were faster to process than non-local integration conditions, independent of scrambling and extraction type.