

Introduction

- The distinction between active subject-extracted and object-extracted relative clauses (RCs) has been studied extensively, but little attention has been paid to passive RCs, which are much more frequent than object-relatives and somewhat more frequent than transitive subject-relatives.
- A number of studies have found that passive sentences are more difficult than active structures in offline measures. (Fodor, Bever, & Garrett, 1974; Caramazza & Zurif, 1976)
- However, Carrithers (1989) found that passive sentences can actually be faster than actives in self-paced reading, suggesting that online and offline measures of sentence complexity may not agree in the case of passives.
- But these results do not bear directly on the processing of relative clauses and are questionable because the semantic plausibility was not carefully balanced across conditions and the results of the offline measure (T/F probe sentences which were all true) were not reported.

More Introduction

- In general, offline comprehension measures have not been taken seriously enough in experiments involving online tasks.
- Probe sentences are usually phrased actively, biasing the results towards active or subject-extracted RC conditions.
- True/false probe items are not particularly sensitive.
- False probe sentences are often created by repeating part of the sentence with a noun or verb changed. These could be answered with a surface-form comparison and may not reflect deeper thematic processing.
 - ▷ The violinist that flattered the sponsor insulted the conductor.
 - ▷ T/F: The violinist flattered the cellist.
- Can offline comprehension scores be dissociated from online reading time and, if so, what implications does this hold for processing theories?

Experimental Design

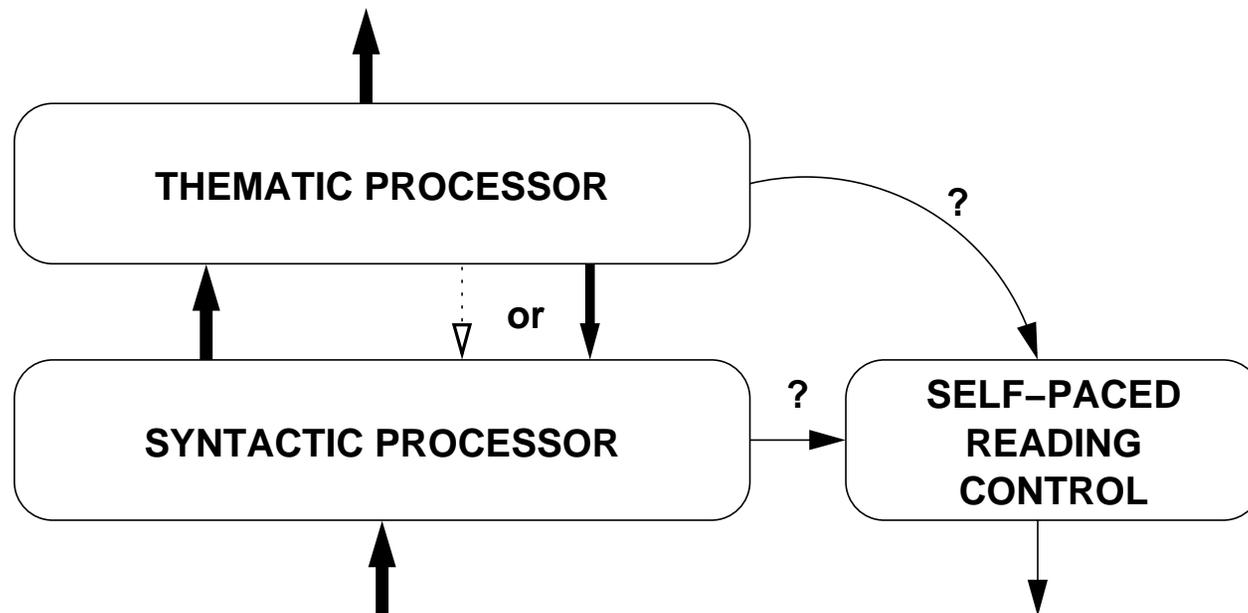
- The goal of this experiment was to accurately assess both the online and offline comprehensibility of sentences in which the matrix subject is modified by various types of relative clause.
- The relative clauses were either active or passive and either subject-extracted or object-extracted.
- The first two noun phrases were fairly neutral with respect to subject- or object-hood of the RC verb, and were swapped to counterbalance the semantic relationships across conditions.
- The online measure was reading time in a self-paced, moving window paradigm.
- The offline measure involved multiple choice (four options), fill-in-the-blank statements.
- The query statements asked about either the main or relative clause and were phrased either actively or passively, and were therefore not always answerable by trivial surface-form comparisons.

Example Sentences

- **AS: Active, Subject-extracted (subject relatives)**
 - ▷ The reporter that attacked the senator ignored the president.
 - ▷ The senator that attacked the reporter ignored the president.
- **AO: Active, Object-extracted (object relatives)**
 - ▷ The reporter that the senator attacked ignored the president.
 - ▷ The senator that the reporter attacked ignored the president.
- **PS: Passive, Subject-extracted (passives)**
 - ▷ The reporter that was attacked by the senator ignored the president.
 - ▷ The senator that was attacked by the reporter ignored the president.
- **PO: Passive, Object-extracted**
 - ▷ The reporter that the senator was attacked by ignored the president.
 - ▷ The senator that the reporter was attacked by ignored the president.

Processing Theories

- Presumably the sentence-initial noun phrase is first taken to be an agent (given the animate NPs used in this experiment).
- Subject-extracted passives (PS) and active object relatives (AO) will therefore require a change of thematic role for this NP.
- If a parse-tree is being constructed, a change at the structural level may be required as well.
- Will these changes impair comprehension ability and will they be reflected in online reading times?



Processing Theories

- Structure-first theories suggest that the syntax module makes an initial commitment (to the active reading).
 - ▷ If the syntax module then detects the passive, it presumably must slow down to rearrange the structure.
 - ▷ The thematic module must also change its commitment.
 - ▷ Must the syntactic processor wait for the thematic to be ready before continuing?
 - ▷ Or does it just plow ahead independently?
- Interactionist theories suggest more communication between the thematic processor and lower levels, possibly to the point that there is no clear distinction.
 - ▷ In this case, wouldn't the lower levels find out if the thematic processor is having trouble and slow down?
 - ▷ Alternatively, interactionist theories might hold that the thematic processor does not necessarily commit to a single reading. In this case, the thematic roles could be confused but will not signal this confusion and the rest of the system will happily soldier on.
- Specific versions of either type of theory may or may not predict the possibility of a dissociation between reading rate and thematic clarity.

Corpus Frequency

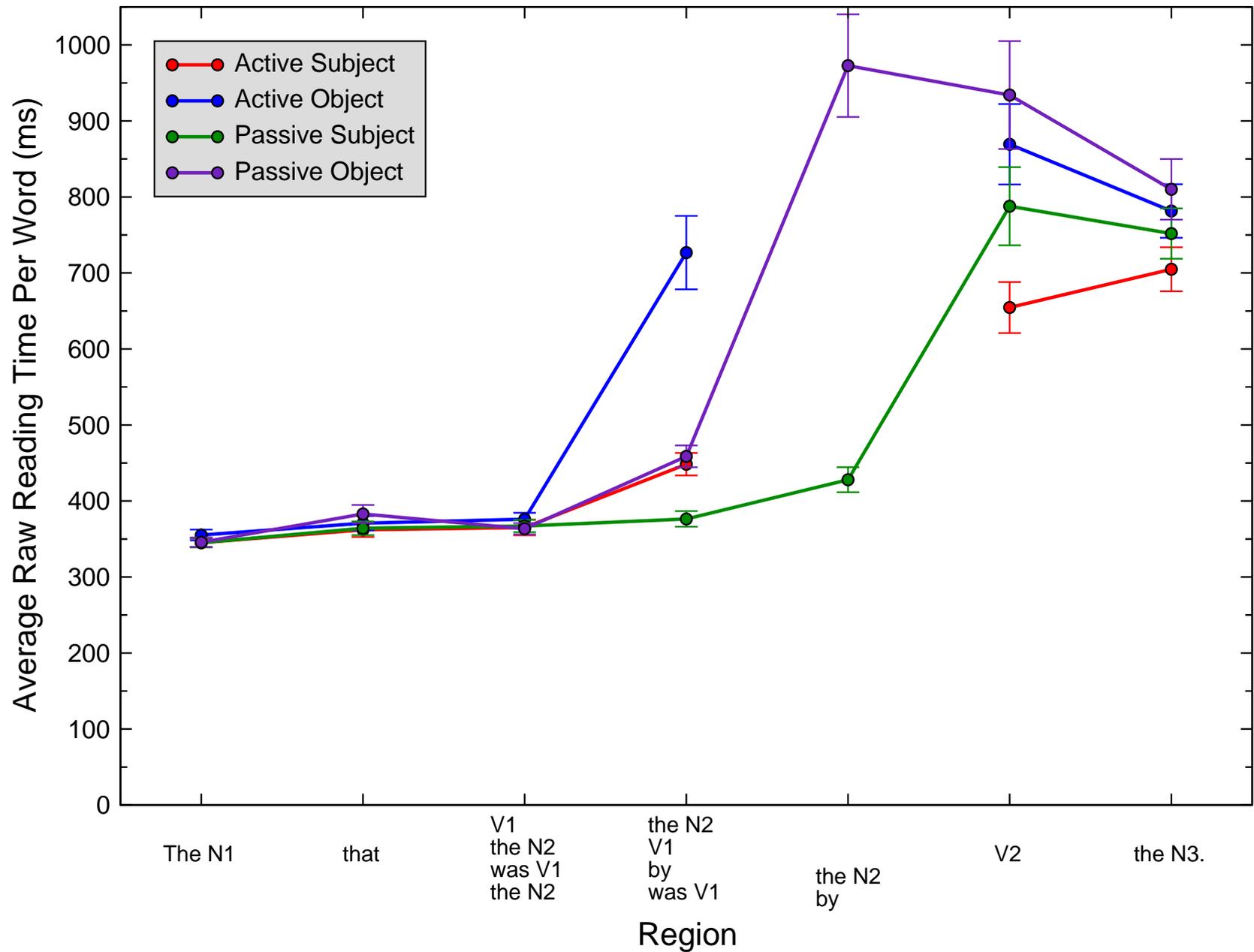
- Frequency counts in the Penn Treebank (Brown and WSJ):

RC Type	All RCs		Modifying the Matrix Subject		Modifying the Matrix Object	
Unreduced RCs						
Active transitive	3143	36.3%	1046	43.5%	442	29.8%
Active intransitive	2623	30.3%	690	28.7%	513	34.6%
Object extracted	1106	12.8%	234	9.7%	211	14.3%
Passive	993	11.5%	214	8.9%	155	10.5%
Reduced RCs						
Active transitive	1297	13.5%	353	14.7%	278	19.5%
Active intransitive	1066	11.1%	290	12.1%	185	13.0%
Object extracted	1544	16.1%	323	13.5%	227	15.9%
Passive	5671	59.2%	1430	59.7%	736	51.6%
Reduced and Unreduced RCs						
Active transitive	4440	24.3%	1399	29.1%	720	24.8%
Active intransitive	3689	20.2%	980	20.4%	698	24.0%
Object extracted	2650	14.5%	557	11.6%	438	15.1%
Passive	6664	36.5%	1644	34.2%	891	30.7%

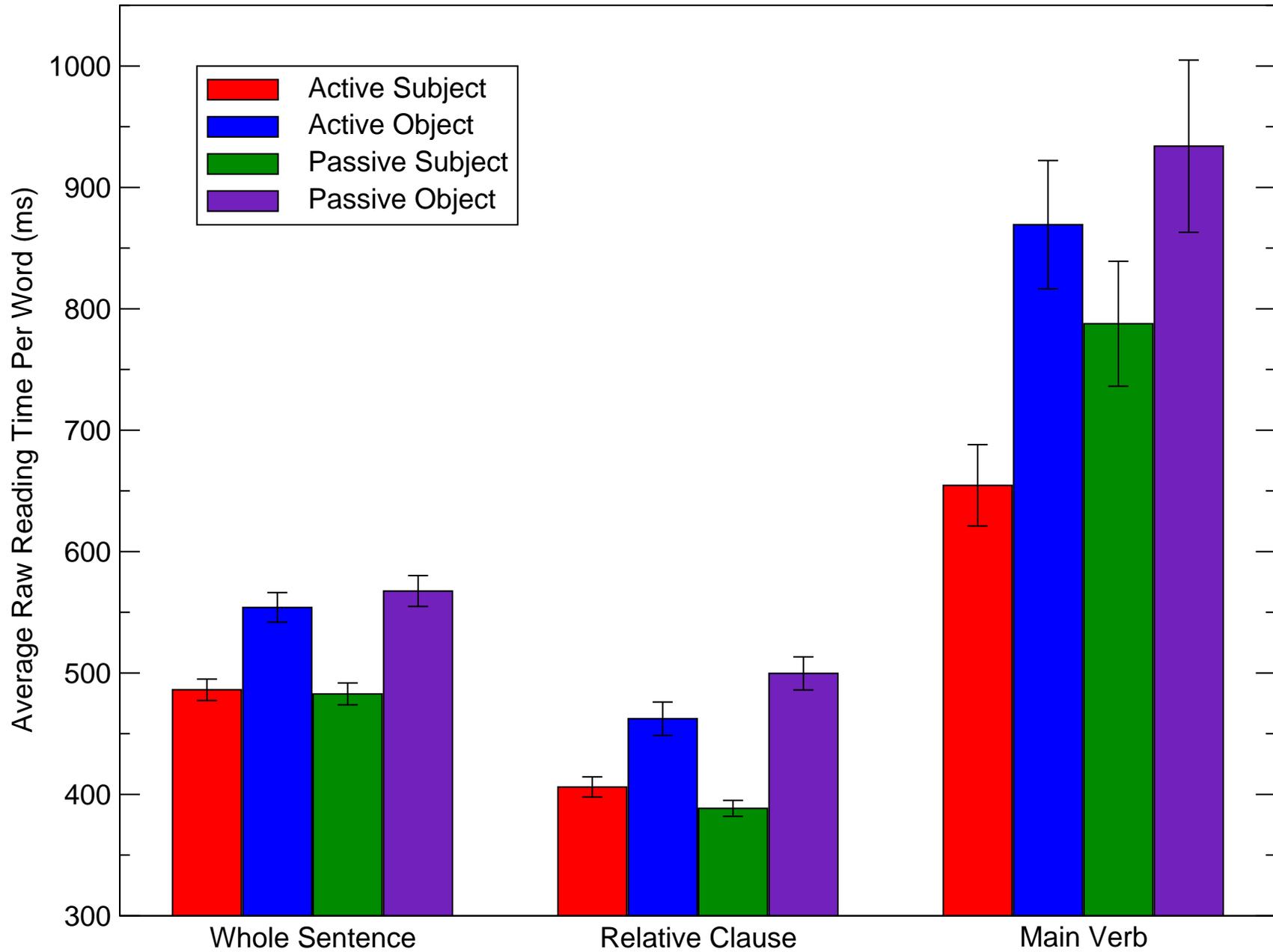
Methods

- 24 experimental items. 36 fillers. 48 participants.
- Five additional participants were replaced because of excessively bad comprehension (4) or slow reading (1) on the filler items.
- Sentences were presented with masked, moving-window, self-paced reading.
- Two questions followed each experimental item; one or two followed each filler.
- For each participant, a linear regression equation was computed to predict the reading time as a function of word length. This prediction was subtracted from the raw times to obtain residual reading times.

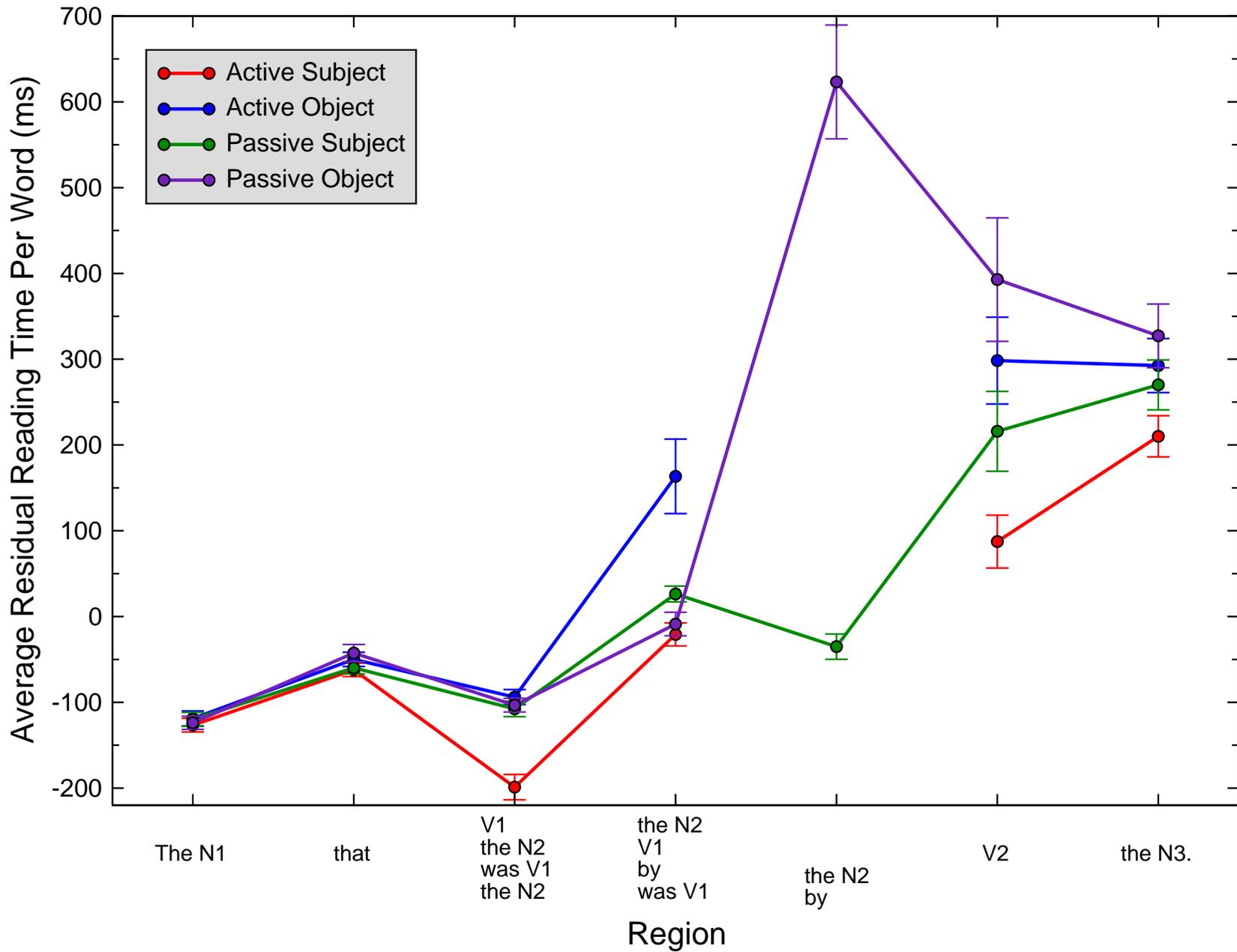
Raw Reading Times



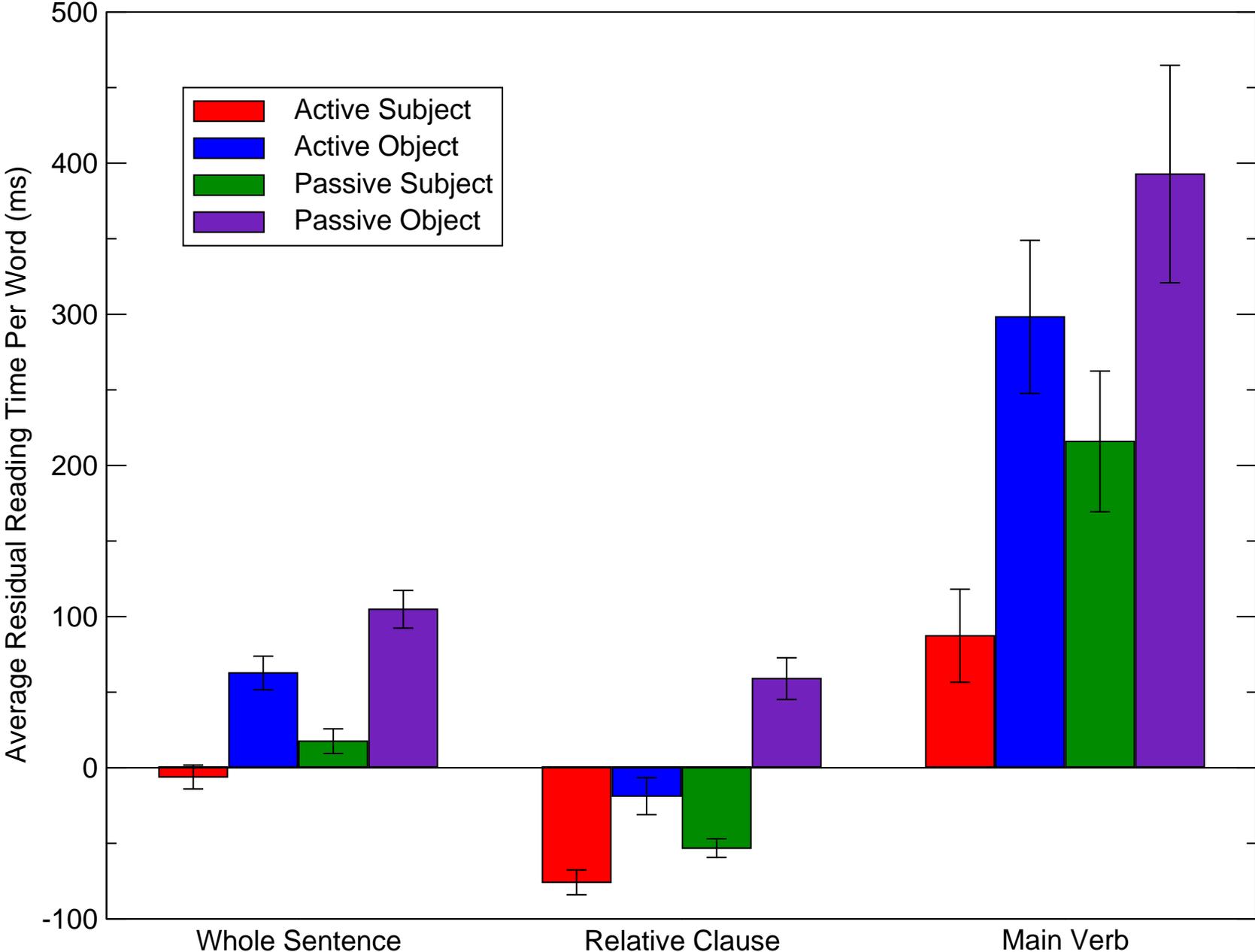
Raw Reading Times



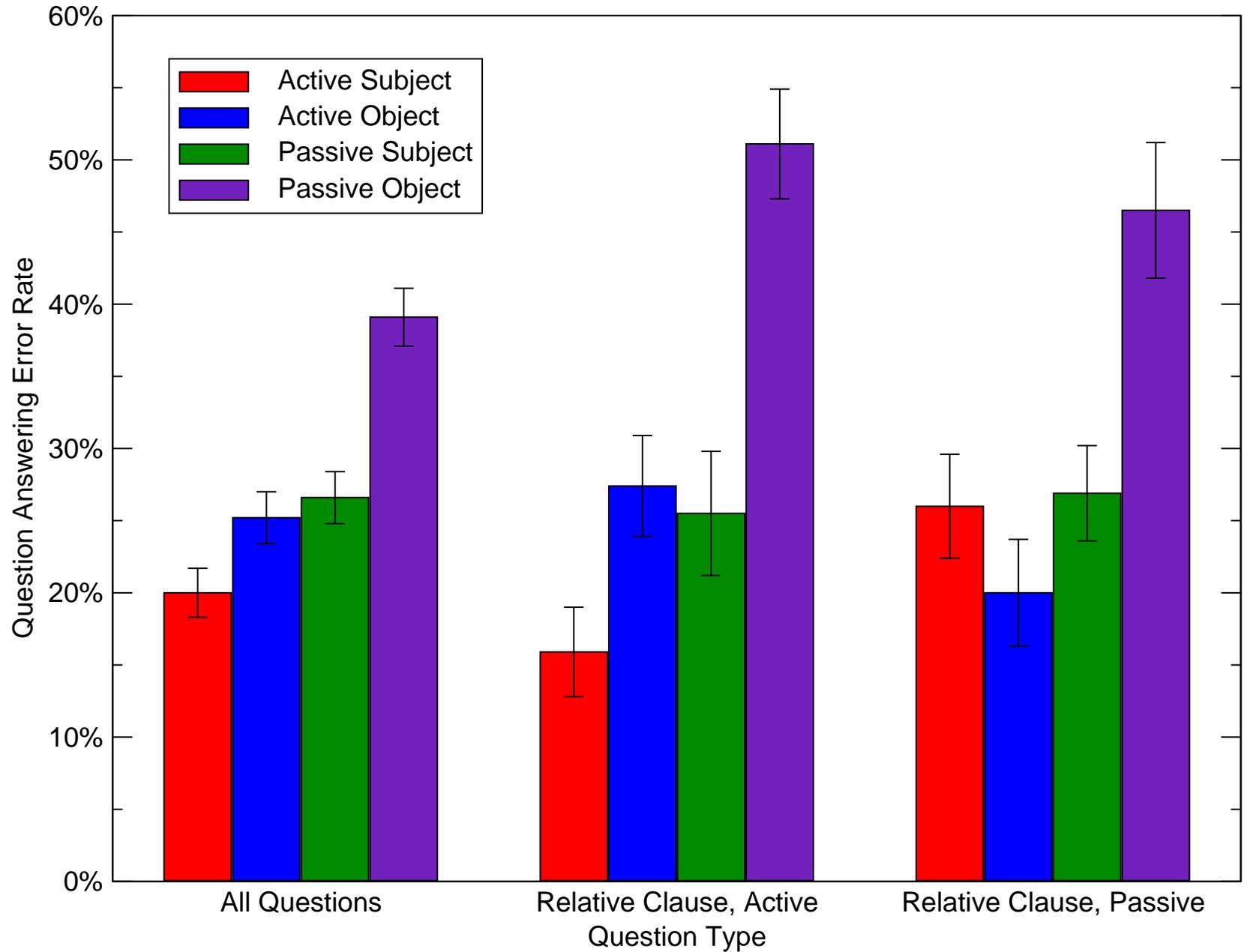
Residual Reading Times



Residual Reading Times



Question Answering



Conclusions

- Passive sentences and object relatives are not comprehended as well as active subject relative RCs.
- Passives are read more quickly than object relatives.
- Raw reading times for passives are as fast or faster than those for active subject relatives.
- Residual reading times for passives are somewhat slower than those for subject relatives on the relative clause and main verb, but not overall.
- Reading rates are in line with frequency data, comprehension scores are not.
- These results suggest that the online sentence reading control mechanism is not necessarily sensitive to processing difficulty at the thematic level.
- In general, what types of thematic errors or difficulties cause us to slow down when reading and which are ignored indefinitely?