

# To what extent does the difficulty of processing relative clauses parallel typological complexity?

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# Complexity and language

## ■ Quantity = Complexity?


*(1) Please pick up four tomatoes, a pound of apricots, prune juice, shallots, six apples and a bag of carrots on the way home.*

*(2) The man that the woman that the child hugged kissed laughed.*

 Quantity of information is not the predominant factor of complexity

## ■ Difficulty = Complexity?

– (2) is more difficult to process than (1), the syntactic structure of (2) is more complex than (1)'s.

 Difficulty of processing may be a way to test the language complexity.

# Introduction (1)

## ■ Relativization in general

- RCs are sentential modifiers of nouns.
- The operation of relativization can be marked by different ways, but in any case, the relativized constituent is moved from its canonical position.
- Main idiosyncratic properties in the world languages:
  - The relativizer can be compulsory (French), optional (English, Arabic) or never available (Japanese).
  - Possible morphological variation of the mark according to the relativized position (French vs. Chinese).
  - Possible marking by special verbal morphology (Turkish).
  - In the RC, presence of a resumptive pronoun coindexed with the antecedent (Arabic, Hebrew etc.) or gap (English, French...).

# Introduction (2)

- Relativization in standard French
- Example: center-embedded O RC

(3) *L'homme fume. Le chien chasse l'homme.*

(4) *L'**homme que** le chien chasse fume.*

- The object NP is moved from its canonical postverbal position
- Presence of a relativizer
- The morphology of the relativizer (QUE) indicates the relativized position (Object)
- Main relativizable positions in French: Subject (QUI), Object or Attribute (QUE), Indirect Object (Prep+ Relative pronoun or DONT), Genitive (Prep+ Relative pronoun or DONT)

# Introduction (3)

- Difference between O and S RCS : O RCs (5) more difficult to process than S RCS (6) (Caplan, & Waters, 1999; Ford, 1983; Frazier, 1985; Gibson, 1998, 2000; Gouvea, 2000; King, & Just, 1991; Traxler, Morris, & Seely, 2002; Yngve, 1960)
  - (5) *The reporter that the senator attacked admitted the error.*
  - (6) *The reporter that attacked the senator admitted the error.*
  
- Several theoretical attempts to account for the S O difference
  - Canonical word order
  - Functions parallelism
  - Depth of embedding
  - Working memory cost

# Canonical word order

■ French canonical word order = SVO

■ S RC: SV(O)

*(7) Le sénateur qui attaque le reporter admet l'erreur.  
(The senator that attacked the reporter admitted the error.)*

■ O RC: OSV

*(8) Le sénateur que le reporter attaque admet l'erreur.  
(The senator that the reporter attacked admitted the error.)*

# Function parallelism

- In a language acquisition perspective, Sheldon (1974) claims that (9) is easier to process than (10) and (11), because only in (9), the relativized NP *The singer* has the same function both in the matrix and in the relative clause:

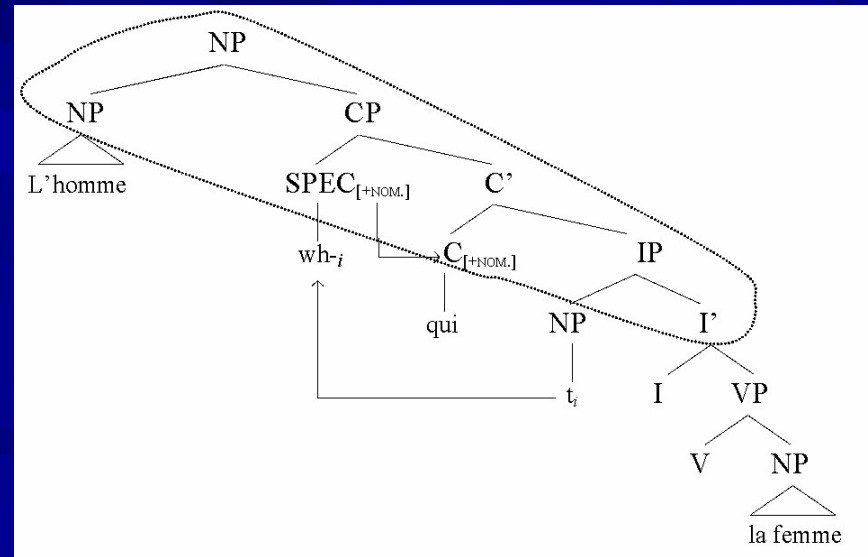
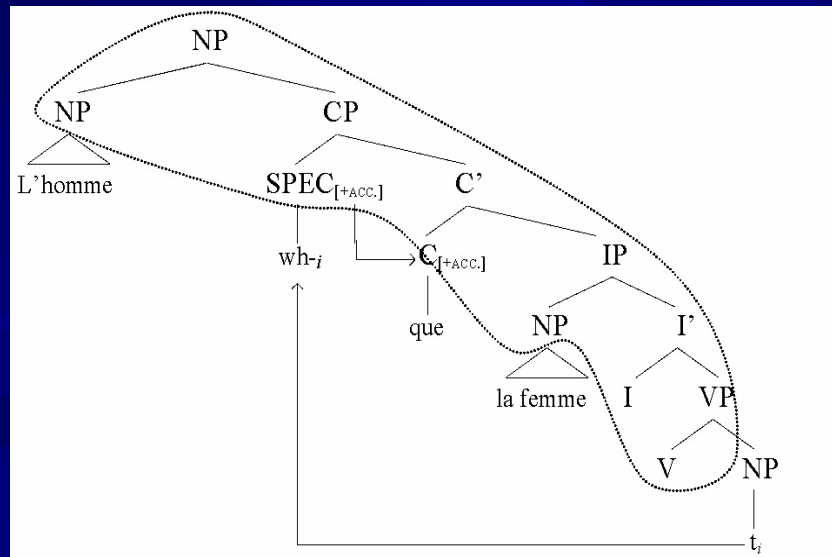
(9) *She despises the singer that you admire.*

(10) *The singer that you admire is on stage tonight.*

(11) *She despises the singer that is on stage.*

# Depth of embedding

- Hawkins (1994) : in a language such as French, a S RC is predicted to be less complex to process than a O RC.
- The reason is the following : in O RCs, the size of the portion of the tree involved in the coindexation between  $t$  and the head noun is larger.





# Working memory accounts of RC processing

- Working memory accounts of RC processing:
  - King, & Just (1991)
  - Caplan, & Waters (1999)
  - Gibson (1998, 2000): the DLT, a computational approach

# The DLTheory

■ Two processing costs: memory and integration costs

■ Predictions

(8) O RC: *Le sénateur que le reporter attaque admet l'erreur.*  
1+2 3

(7) S RC: *Le sénateur qui attaque le reporter admet l'erreur.*  
1 1 3

■ Extended predictions

(12) OG RC: *Le sénateur dont le reporter attaque le parti admet l'erreur.*  
>1 1(+3) 5

*(The senator whose party the reporter attacked admitted the error.)*

# A typological approach

## ■ The Accessibility Hierarchy (Keenan, & Comrie, 1987):

S > O > IO > OBL > G > OComp

## ■ Principles:

- « A language must be able to relativize [S position].
- [Strategies apply] on a contiguous segment of the AH.
- Strategies can that apply at one point of the AH may cease to apply at any lower levels. » (Keenan, & Comrie, 1987, p. 6)

## ■ Examples:

- S only: Malagasy
- S-G: French
- S-OComp: English

# The AH and comprehension

- Keenan, & Hawkins (1987): repetition procedure
- Materials: 36 sentences (9 different positions in the AH)
  - (13) S: *I know that the girl who got the answer right is clever.*
  - (14) O: *He remembered that the sweets which Dave gave Sally were a treat.*
  - (15) OG: *The fact that the sailor whose ship Jim took had one leg is important.*
  - (16) OComp: *He remembered that the girl who Jane is older than could read.*
- Results: the AH is supported by adult and children's data
- Comments:
  - S, IO, Obl: one animate noun; SG, OG, OComp...: two animate nouns
  - The procedure mixes production and comprehension

# Predictions

- Canonical word order
- Functions parallelism



$S > O, IO, OBL, G$

- Depth of embedding
- Working memory cost



$S > O > IO > OBL > G$

# Our experiment

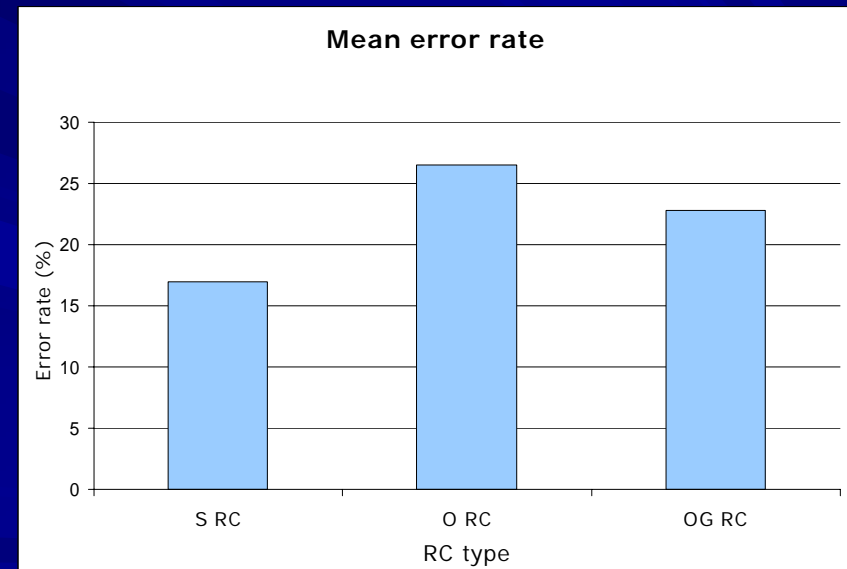
## ■ Method

- Participants: 30 native speakers of French (21.26, s.d. 2.49)
- Materials: 36 experimental sentences, 3 conditions (S, O, OG)
  - (17) S: *La danseuse qui regarde le chanteur appelle le studio (The dancer that is looking at the singer is calling the studio)*
  - (18) O: *La danseuse que le chanteur regarde appelle le studio (The dancer that the singer is looking at is calling the studio)*
  - (19) OG: *La danseuse dont le chanteur regarde les jambes appelle le studio (The dancer whose legs the singer is looking at is calling the studio)*
- Procedure: Self-paced word-by-word, moving window display  
Comprehension question after each trial, no feedback

# Results

■ Participants with more than 35% of extreme reading times (<100ms or >1500ms) were discarded, thus leaving 27 for statistical analysis

■ Comprehension errors:  
Significant effect of RC type



# Reading times (1)

## Regions of interest:

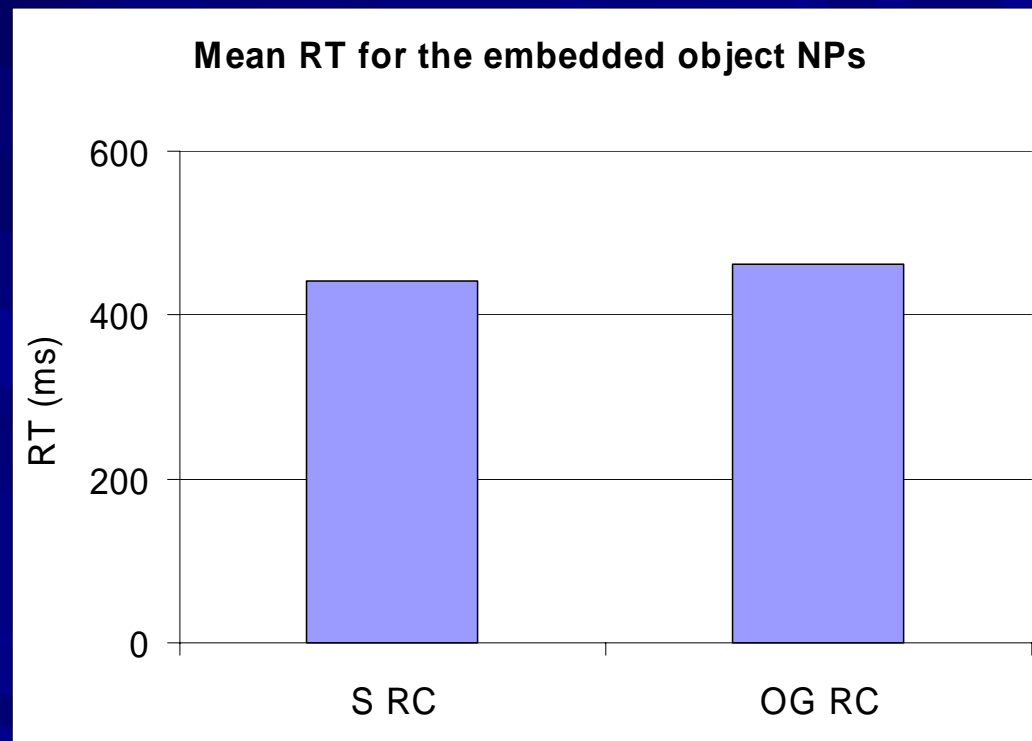
- Object NP of the S and OG RCs
- Embedded verb
- Main clause verb





# Reading times (2)

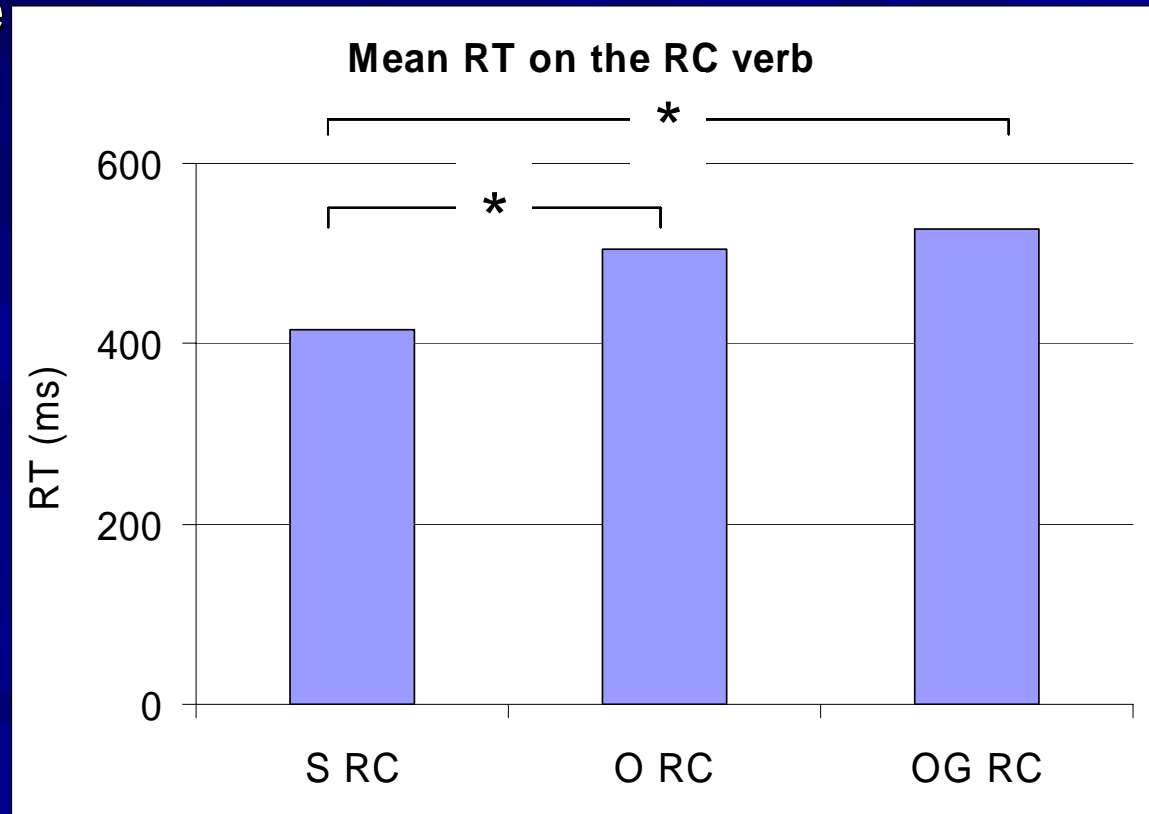
- Object NP of the S and OG RCs
  - No difference



# Reading times (3)

## ■ RC verb

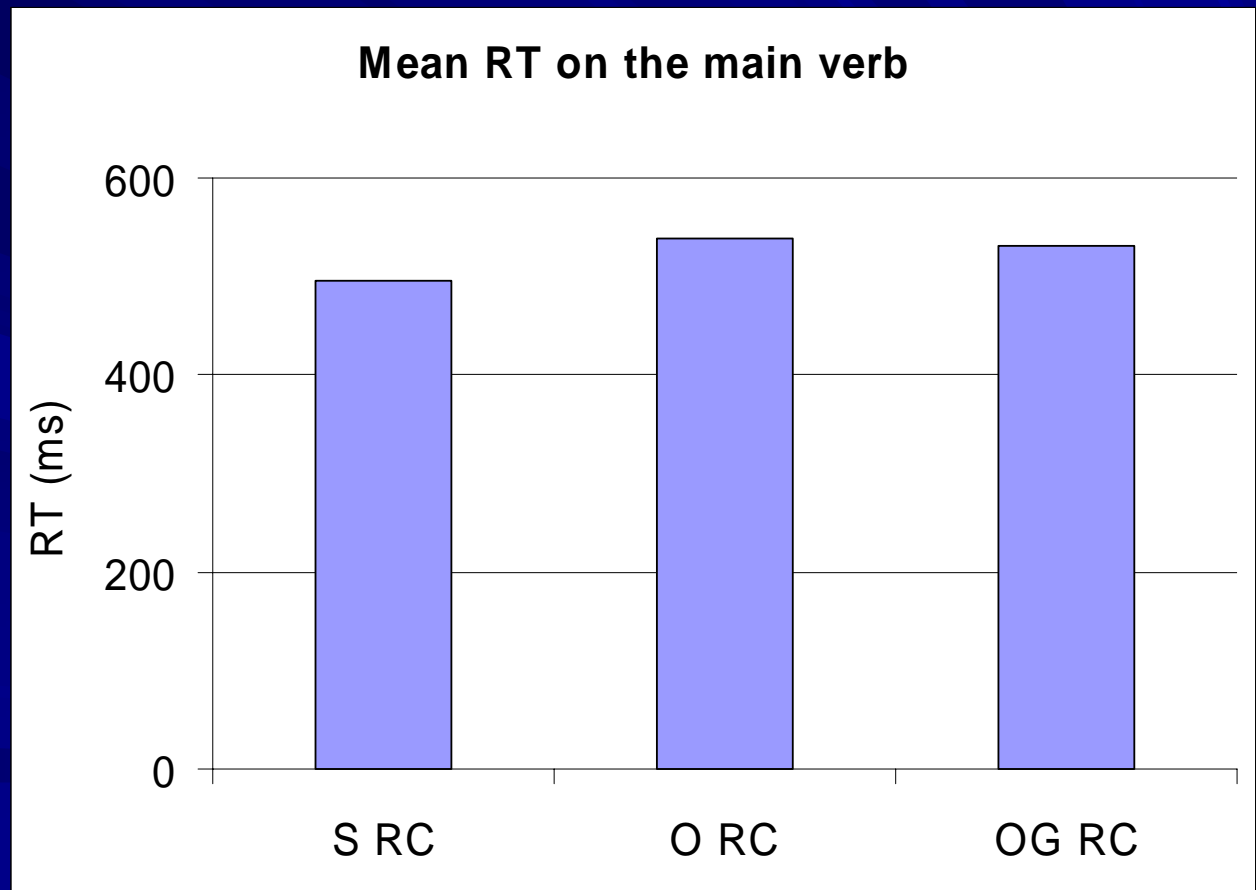
– Effect of RC type



# Reading times (4)

## ■ Main verb

- No significant difference



# Discussion (1)

- S RCs are faster to read and generate less errors than the other types (O, OG)
- Different from previous findings
- Different from what is predicted by the depth of embedding and DL theories
- Compatible with canonical word order and functions parallelism theories

# Discussion (2)

- On theories of language processing:
  - Memory cost is not infirmed by canonical word order nor functions parallelism theories
  - Necessity to disentangle canonical word order from functions parallelism

# Further experiment

	Canonical +	Canonical -
Parallel +	<i>L'homme qui regarde la femme promène le chien.</i>	<i>La femme regarde le chien que l'homme promène.</i>
Parallel-	L'homme regarde la femme qui promène le chien.	<i>L'homme que la femme regarde promène le chien.</i>

# Discussion (3)

- Complexity = Difficulty ?
- Structural complexity (depth of embedding, number of syntactic nodes, long distance dependencies) does not automatically trigger processing difficulty
- Nevertheless it does not mean that complex sentences are easy to process

*The lion that the gorilla that the tiger bit chased died*



Difficulty is not equivalent to complexity

# Why?

	Complex structure	Simple structure
Processing difficulty	<b>YES</b> $S RC < O RC$	?
Processing ease	<b>Possible</b> $O RC = OG RC$	<b>YES</b> $S RC < O RC$