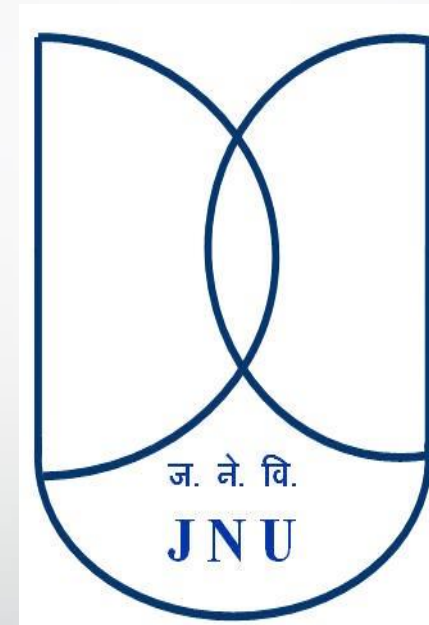
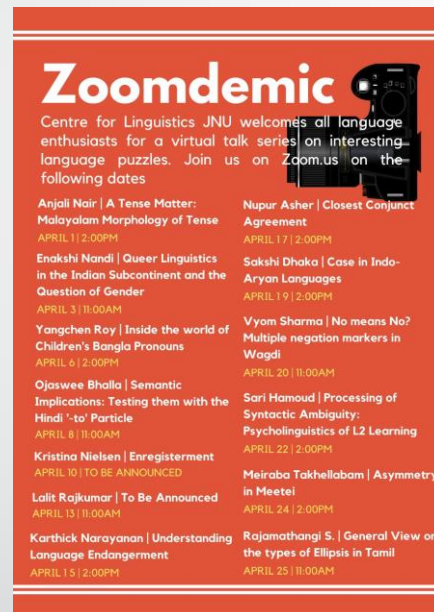


# Processing of Syntactic Ambiguity: Psycholinguistics of L2 Learning



Zoomdemic 2020

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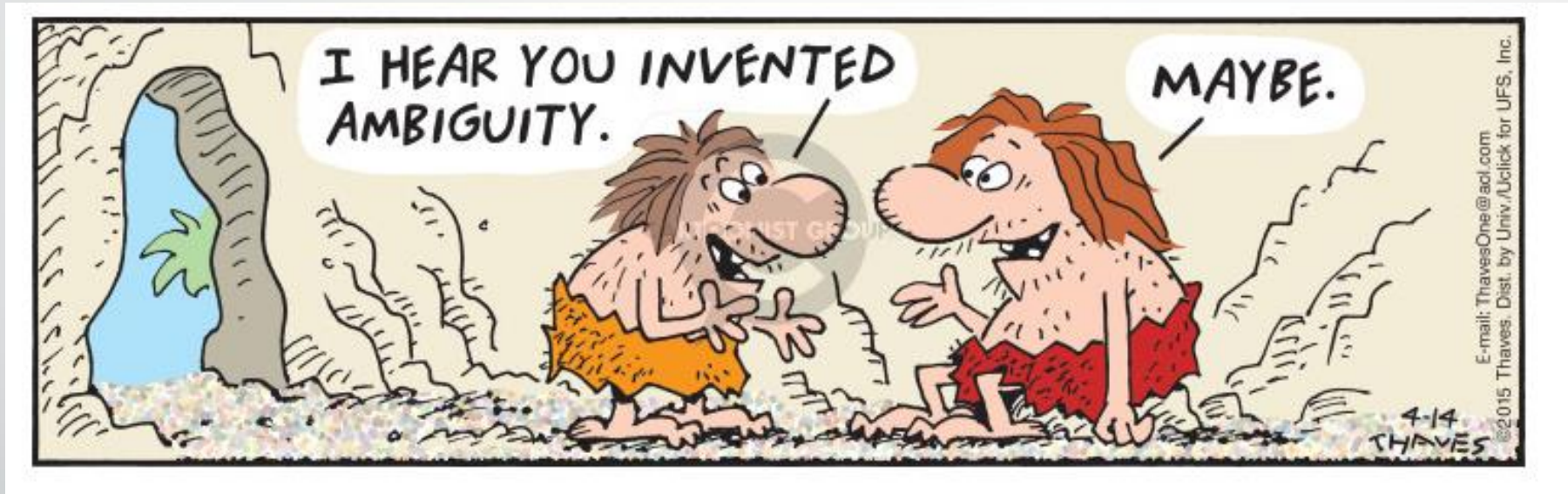
# Contents

1. Important Terms
2. A Closer look at L2 processing and Syntactic Ambiguity
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# Important Terms

- **Psycholinguistics:** the study of how the brain processes and stores language using behavioral (stimulus-response), neurological (brain wave signal), and other types of real time (online) experiments. We study a linguistic phenomenon using **replicable** experiments in order to confirm a hypothesis. The aim is to develop scalable models of language comprehension & production.
- **The Parser:** Parsing is the efficient incremental process of interpreting the meaning of spoken utterances or written sentences.
- This automatic process is based on analysing sentences using the phonological, lexical, syntactic, and pragmatic rules of language.
- However, due to the incremental nature of the human parser, which does not necessarily wait to hear the entire sentence to start building a representation of its meaning, and because of following certain parsing routines, a parsing error could occur at the initial stage of processing due to lexical or syntactic ambiguity. This would lead the parser to go back and reanalyze the sentence to revise initially constructed structures. Why? **Ambiguity!**

# When you think of ambiguity what comes to your mind?



- **Frank and Ernest (Published 2015-04-14 (Image 126015))**
- I went to the bank because I felt like swimming.

# Examples of Ambiguity

- **Temporary Ambiguity:**
- The young man the ship.
- Why is it ambiguous at first?
- \***[The young man]** [the ship]....
- vs
- [The young] [man] [the ship].
- This is called garden-pathing (i.e. misleading: confusing because the sentence contains a word group which appears to be compatible with more than one **structural** analysis (Frazier & Fodor, 1978) ).

# Puzzle Time!

- Which one is faster to read?
- (1) The horse that raced past the barn fell.

(2) The horse raced past the barn fell.

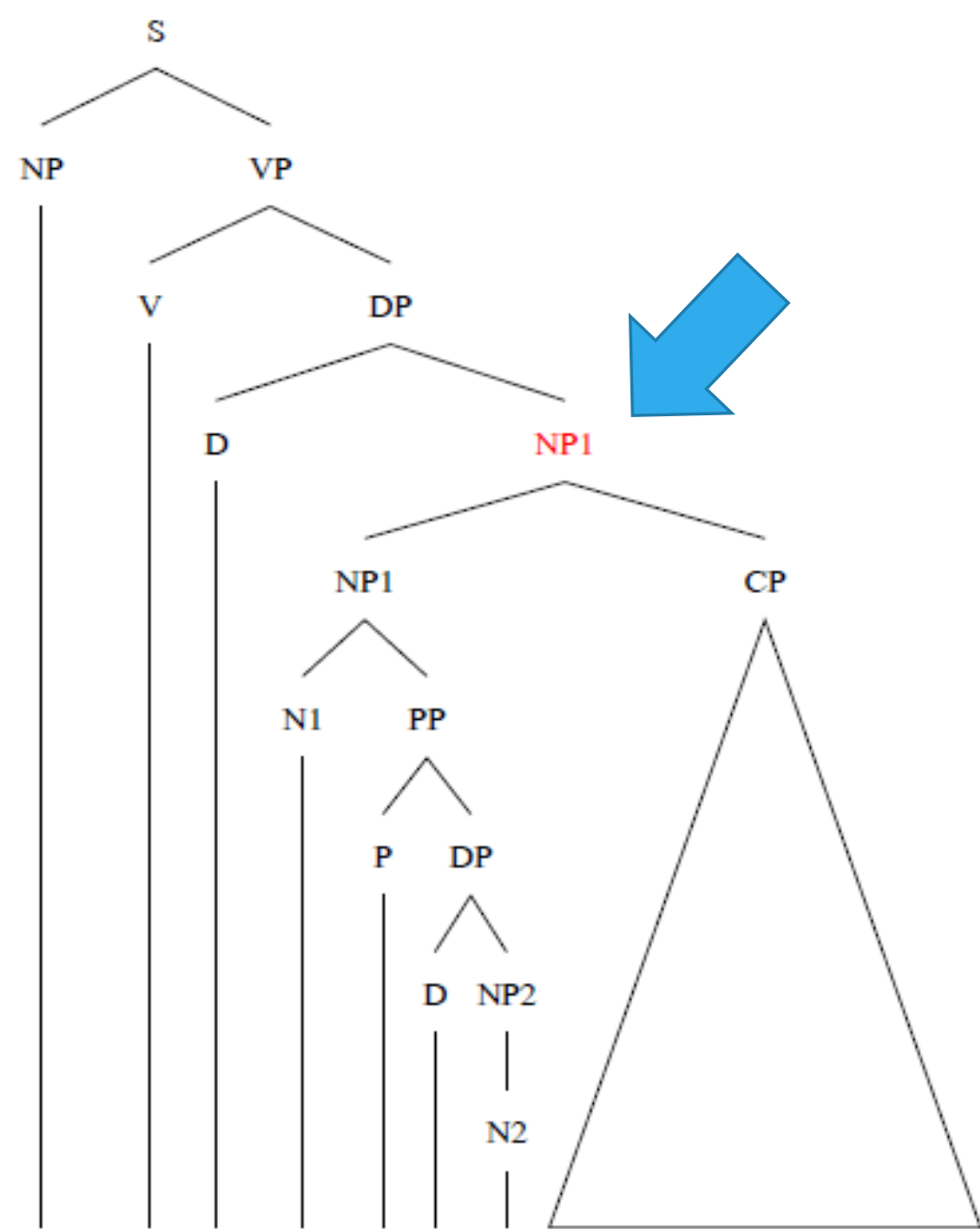
(1) Has more words, but it is faster to read than (2) because the verb **raced** can be interpreted as a finite verb or as a passive participle.

**Someone shot the servant of the actor who was standing on the balcony.**

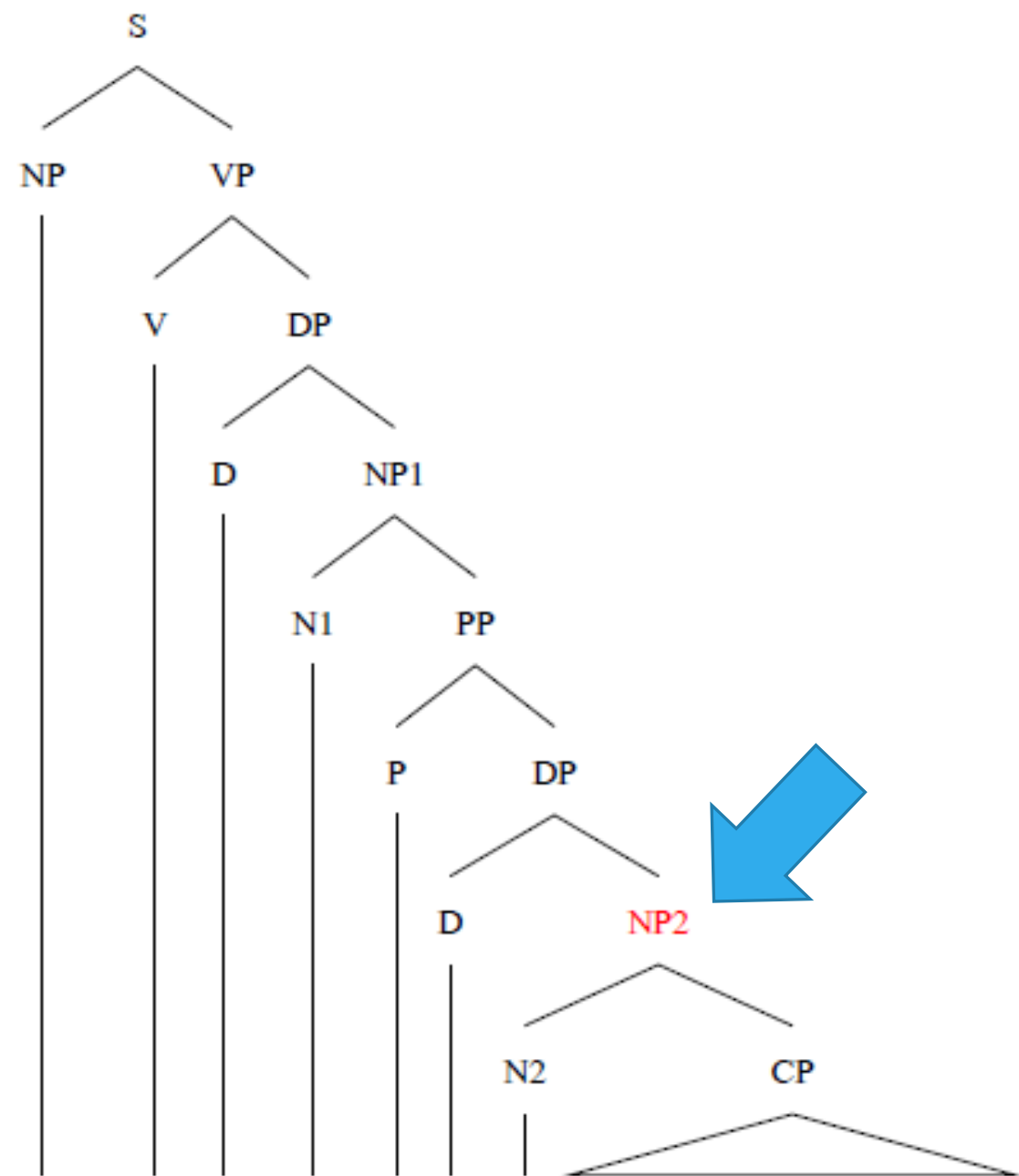
Question is: Who was standing on the balcony?

A. The servant

B. The actor



Someone shot the servant of the actor who was standing on the roof.



Someone shot the servant of the actor who was standing on the roof.



# Important Terms Cont.

- **Memory:** we are dealing with **working memory** (something like RAM in computers)
- **L1ers** Native Speakers
- **L2ers** Late Bilingual Advanced Learners
- **RT** Reading Time in milliseconds.
- **Online:** any experiment that involves measuring the RT
- **Offline:** untimed experiment such as a comprehension questions after a reading text.
- **Shallow Parsing hypothesis:** underuse of syntactic cues by L2ers and overuse of semantic and context information.
- **Parsing Strategies:** quick shortcuts our parser uses to comprehend sentences faster.
- **Examples:** NVN (Bever, 1970), Late Closure (Frazier & Fodor, 1978), Tuning Theory (Brysbaert & Mitchell, 1996; Mitchell, Cuertos, Corley, & Brysbaert, 1995) exemplifies an experience-based universal interactive account..



# My main research question is

- Are advanced Indian L2 learners of Arabic (L2ers) strongly guided by shallow parsing strategies during online comprehension?
- To answer it researchers extensively used (un)ambiguous **Relative Clause Attachment (RCA)** as in (1):

The killer shot the servant of the actor *who was standing on the balcony.*

(1)

NP1

NP2

RC Pro

Aux

V

What is the motivation of this question?

The killer shot the servant of the actor *who was standing on the balcony.*

(1)

NP1

NP2

RC Pro

Aux

V

- ✓ RC is attached high (NP1) or low (NP2) by default depending on language, unless context advises otherwise.
- ✓ Asking : Who was standing on the balcony? The Servant or Actor?  
Contrasts L1ers to L2ers RCA offline preferences.
- ✓ Highlights online (none) native Reading Times (RTs) at the critical regions RCP, Aux V and V.

**There is gap!**

- **Most studies focus on L2ers of European languages.**
- **Few address the influence of contextual cues on processing.**

- **We tested Hindi/Urdu learners of Arabic RCA in biasing contexts to:**
- Add generalizability to the models of L2 processing because Arabic and Hindi/Urdu are:
  - ✓ Opposite in RCA site and directionality: Arabic (VSO) and Hindi/Urdu (SOV).
  - ✓ Spoken by hundreds of millions but almost no studies of similar nature.

## Shallow Structure Hypothesis (SSH)

- Many argue that during most of online processing L2ers employ a **shallow parser**:
  - ✓ They do build hierarchal abstract syntactic structures, **but** are more **sensitive/over-rely** on
  - ✓ Semantic, pragmatic, and surface information more than natives (L1ers) [1,2,3].

## Our Prediction

- We predicted that our L2ers will deep parse RCA both offline and online.
- L2ers' RTs might also be influenced by their L1, the low attaching Hindi/Urdu [4].

## Study 1: Baseline Offline RCA

A Norming study to determine default RCA of Arab L1ers & Hindi/Urdu L2ers of Arabic in different referential contexts.

**Method:** Two offline experiments in the form of paper questionnaires + linguistic background.

### 1<sup>st</sup> Experiment

- Had 24 **items** similar to (2) + 48 fillers.
- No context and RC was globally ambiguous.
- Binary questions determined RCA.

### Participants:

- Monolingual Arab L1ers (N=48), all Syrian students at ABU, Homs.
- Multilingual Indian L2ers (N=24), all from Indian Hindi Belt regions and from Islamic madrasas from JNU and JMI, Delhi.

### Result:

- High RCA overall among in L1ers & L2ers.

2<sup>st</sup> Experiment (2X1)

- Items of similar design to 1<sup>st</sup>, L1ers (N=44) and L2ers (N=42).
- All items are preceded by either NP1/ NP2 basing context (C1/C2) as in (3, 4):

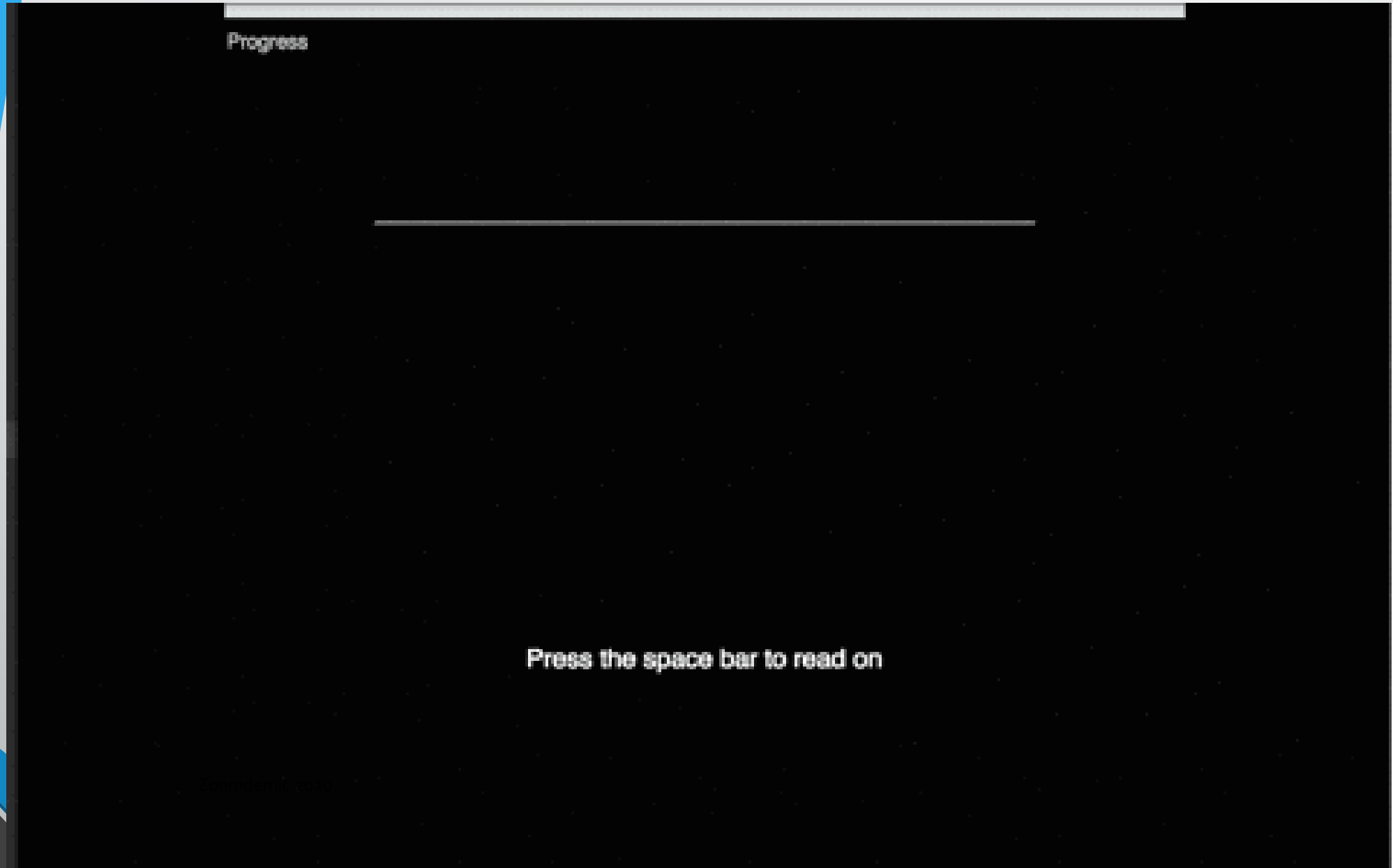
(2)	الشرفة	على	واقفاً	كان	الذي	الممثل	خادم	اللص	ضرب
	ʔalfurfati	ʕala	waqifan	kana	ʔalaði	ʔalmumaθili	xadima	ʔalisʕu	dʕaraba
	the balcony	on	standing	was.	who.	the actor	the servant	the thief	hit
			-S.M	-S.M	-S.M	-S.M	-S.M		
			V	Aux	RC Pro	NP2	NP1		↔↔↔
“The thief hit the servant of the actor who was standing on the balcony.”									

(3)	كان للممثل الموهوب بيوت في الغابة وكان المُمثل المشهور يدعو أصدقائه لزيارته فيها.
NP1 Biasing	The gifted actor had houses in the forest, and this actor always invited friends to visit.

(4)	كان الخادم الفقير رجلاً صالحاً ولكن نهايته كانت مأساوية.
NP2 Biasing	The poor servant was a good man, but this servant’s life ended tragically.

- **Result:** NP2 biasing context was not strong to alter default RCA & final parsing decisions for both L1ers and L2ers, as predicted by all models, since L2ers had ample time to weigh different information.

# Online Reading Experiment (SPR)





- **Weaknesses**

1. The unnatural button presses causes fatigue
2. The experiment design might induce artifact reading strategies (learners only focusing on specific parts of the sentence (RC in our case))
3. Longer reading times do not always mean higher cognitive cost (confounds!!!!!!)
4. Effective reading span differs between langs especially, right to left which is usually more denser than English (segmentation might produced unnatural results).

# Strengths and Weaknesses of SPR

- **Strengths**

1. Reliable and consistent results if experiment is well designed and piloted.
2. Cheap and mobile. Do not need a laboratory.
3. Very strong community
4. Robust reading tasks that caters for cross-language or bilingual effects (e.g., code-switching, grammatical gender, homograph, and cognate), as well as other effects (e.g., word frequency, and context effects) found in the mainstream psycholinguistic

### Why?

- To determine online parsing and initial interpretation of RCA among and L1ers/L2ers
- To test the predictions of SSH: L2ers shallow parse & strongly guided by referential context.

### Design (2X2):

- Contrasted NP1/ NP2 **basing contexts (C1/C2)**
- C1 was a paragraph of two sentences in which NP1 was [+TOPIC, +SUBJECT] similar to (3)
- C2 was a paragraph of two sentences in which NP2 was [+TOPIC, +SUBJECT] similar to (4).
- High or low RCA (**N1/N2**) was indicated by
- Number morphemes (**Singular/Plural**;) at the RC Pro, Aux V, and V as in (5,6).
- Items were counter balanced to make either NP1/NP2 plural or singular.
- Centered self-paced reading. 24 Latin-squared items, 48 fillers.
- Pre-registered on AsPredicted.com. L1ers (N=52) and L2ers (N=52).

**Conditions:** (a) C1N1 (b) C1N2 (c) C2N1 (d) C2N2

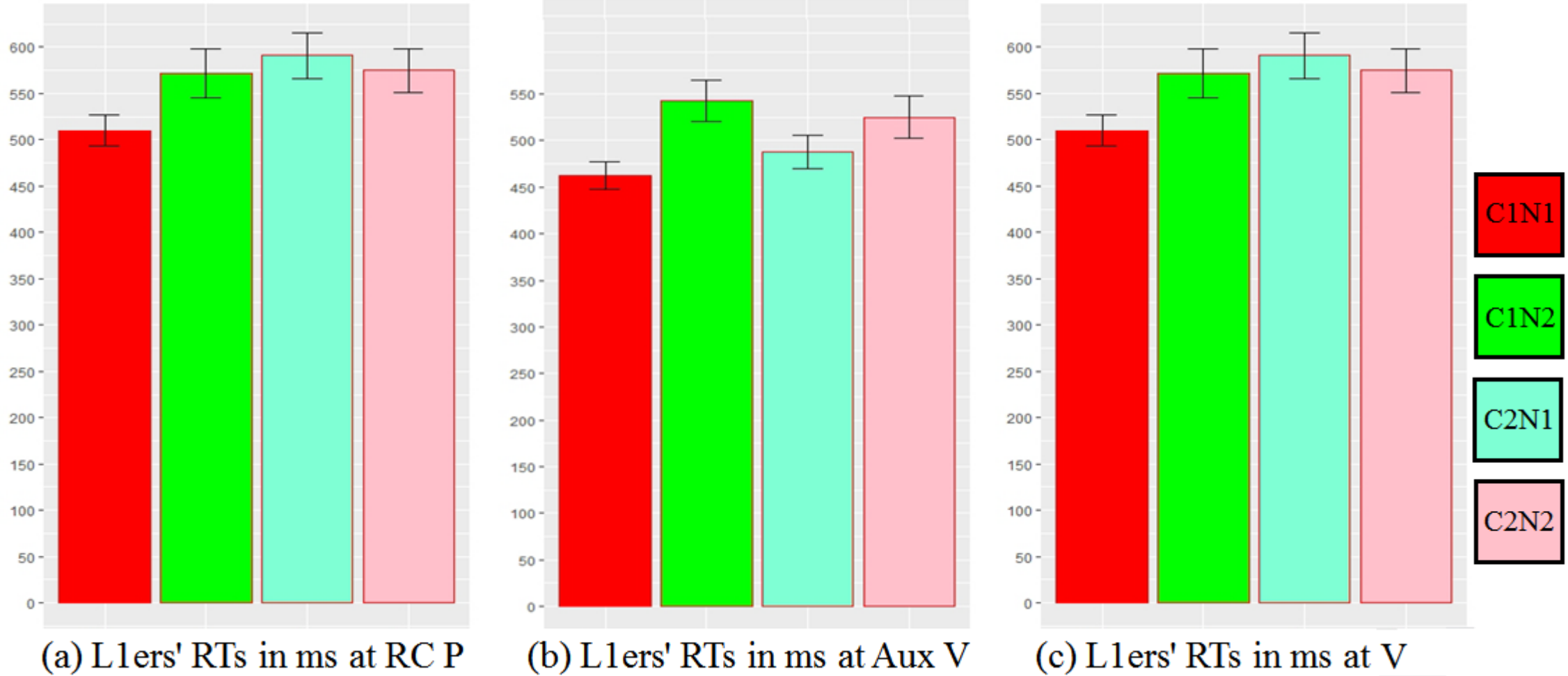
### • Predictions

SSH predicts main effect of referential context on attachment on L2ers [5]& that L1 transfer does not happen online [3].

## Examples of our online items

(5)	الشرفة	على	واقفين	كانوا	الذين	الممثل	خدم	اللص	ضرب
	ʔalfurfati	ʕala	waqifina	kanu	ʔalaðina	ʔalmumaθili	Xadama	ʔalisʕu	dʕaraba
	the balcony	on	standing -P.M	were -P.M	Who -P.M	the actor -S.M	the servants -P.M	the thief	hit
			V	Aux	RC Pro	NP2	NP1		↔↔↔
“The thief hit the servants of the actor who were standing on the balcony.”									

(6)	الشرفة	على	واقفين	كانوا	الذين	الممثلين	خادم	اللص	ضرب
	ʔalfurfati	ʕala	waqifina	kanu	ʔalaðina	ʔalmumaθili	xadima	ʔalisʕu	dʕaraba
	the balcony	on	standing -P.M	were -P.M	Who -P.M	the actors -P.M	the servant -S.M	the thief	hit
			V	Aux	RC Pro	NP2	NP1		↔↔↔
“The thief hit the servant of the actors who were standing on the balcony.”									



The killer shot the servant of the actor *who was standing on the balcony.*

(1)

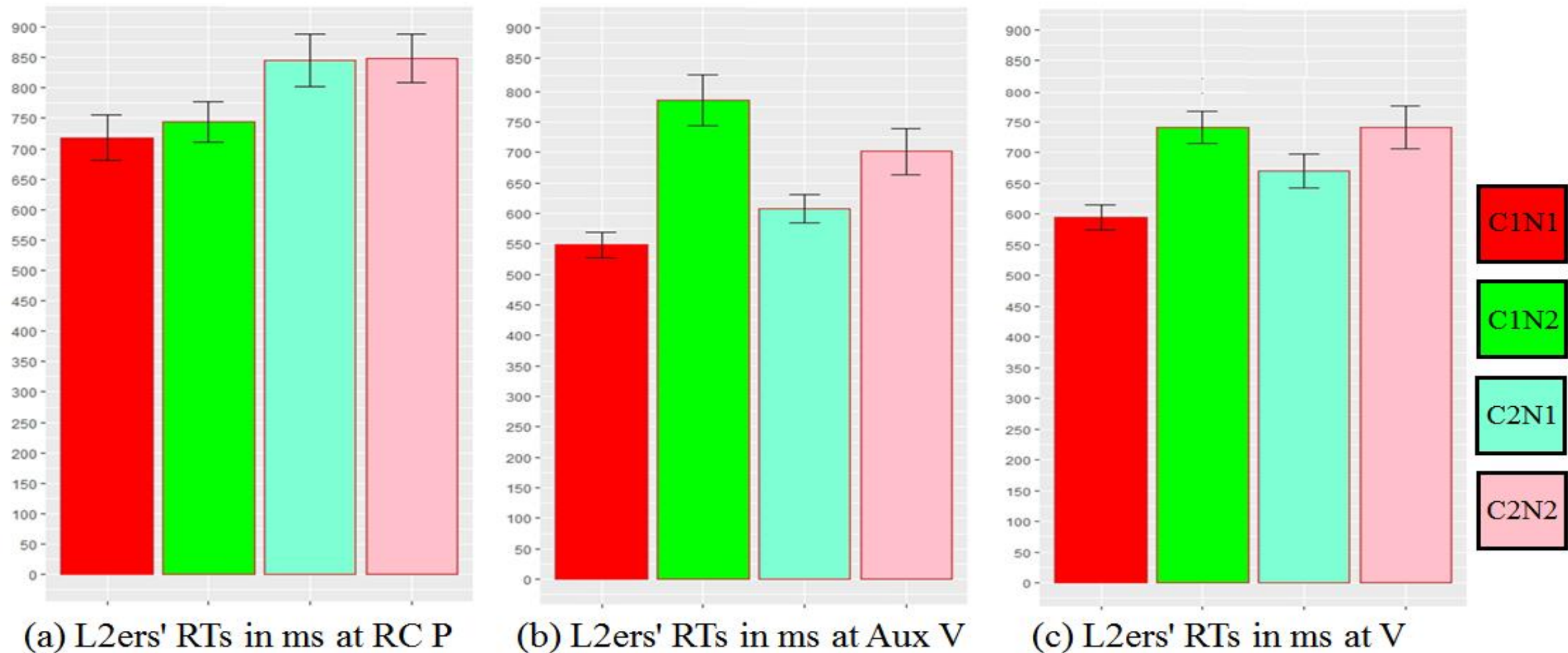
NP1

NP2

RC Pro

Aux

V



The killer shot the servant of the actor *who was standing on the balcony.*

(1)

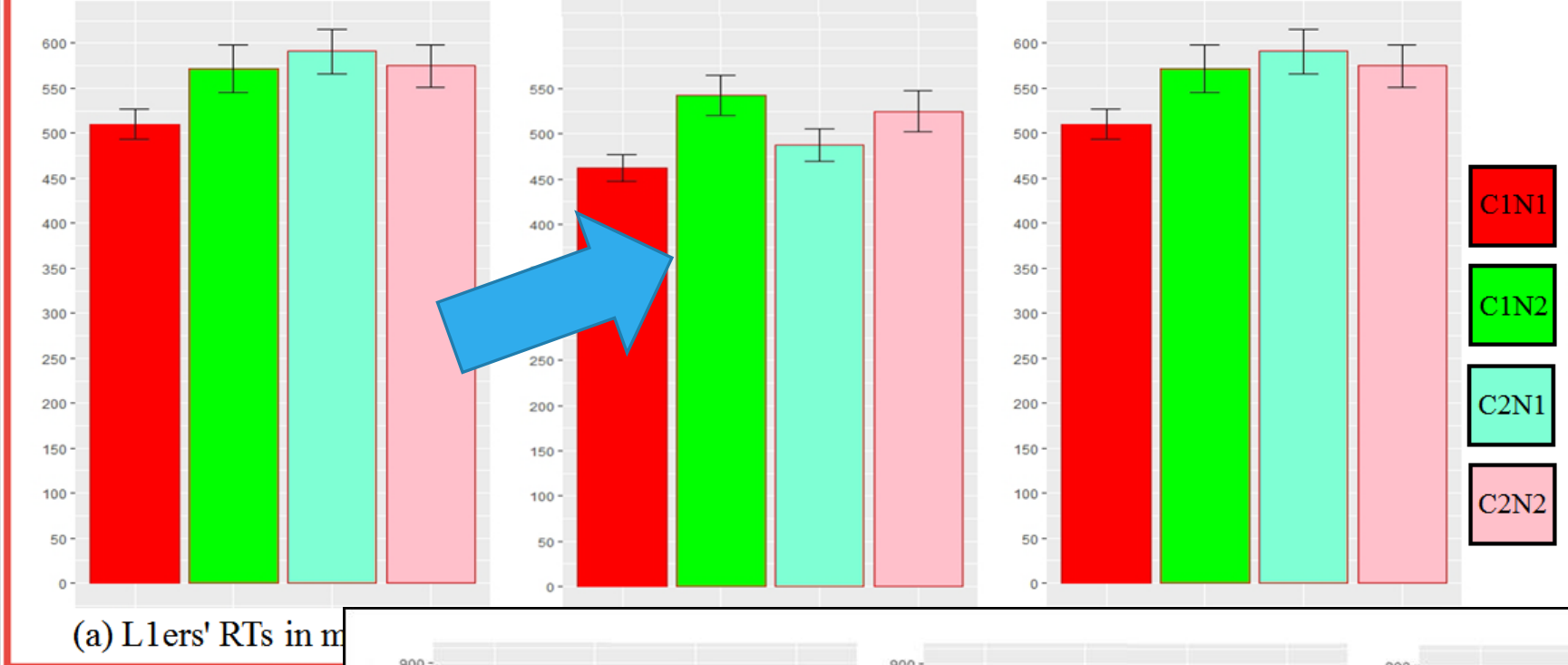
NP1

NP2

RC Pro

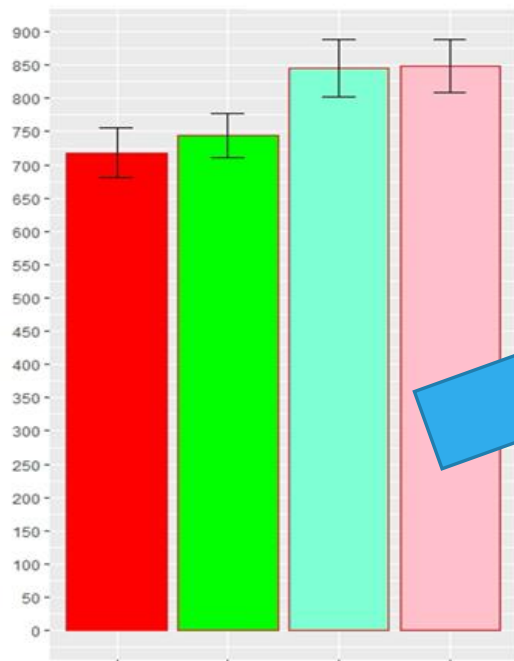
Aux

V

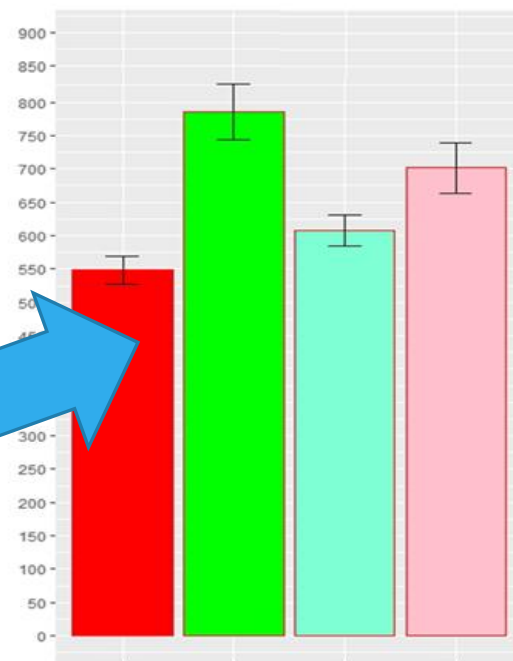


(a) L1ers' RTs in ms

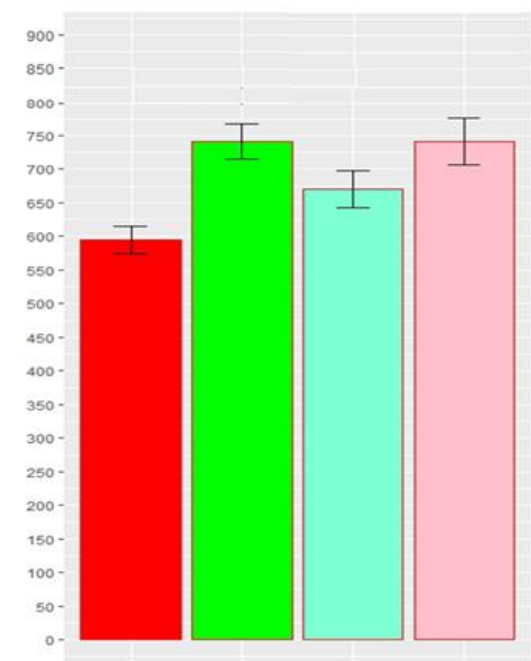
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(a) L2ers' RTs in ms at RC P



(b) L2ers' RTs in ms at Aux V



(c) L2ers' RTs in ms at V





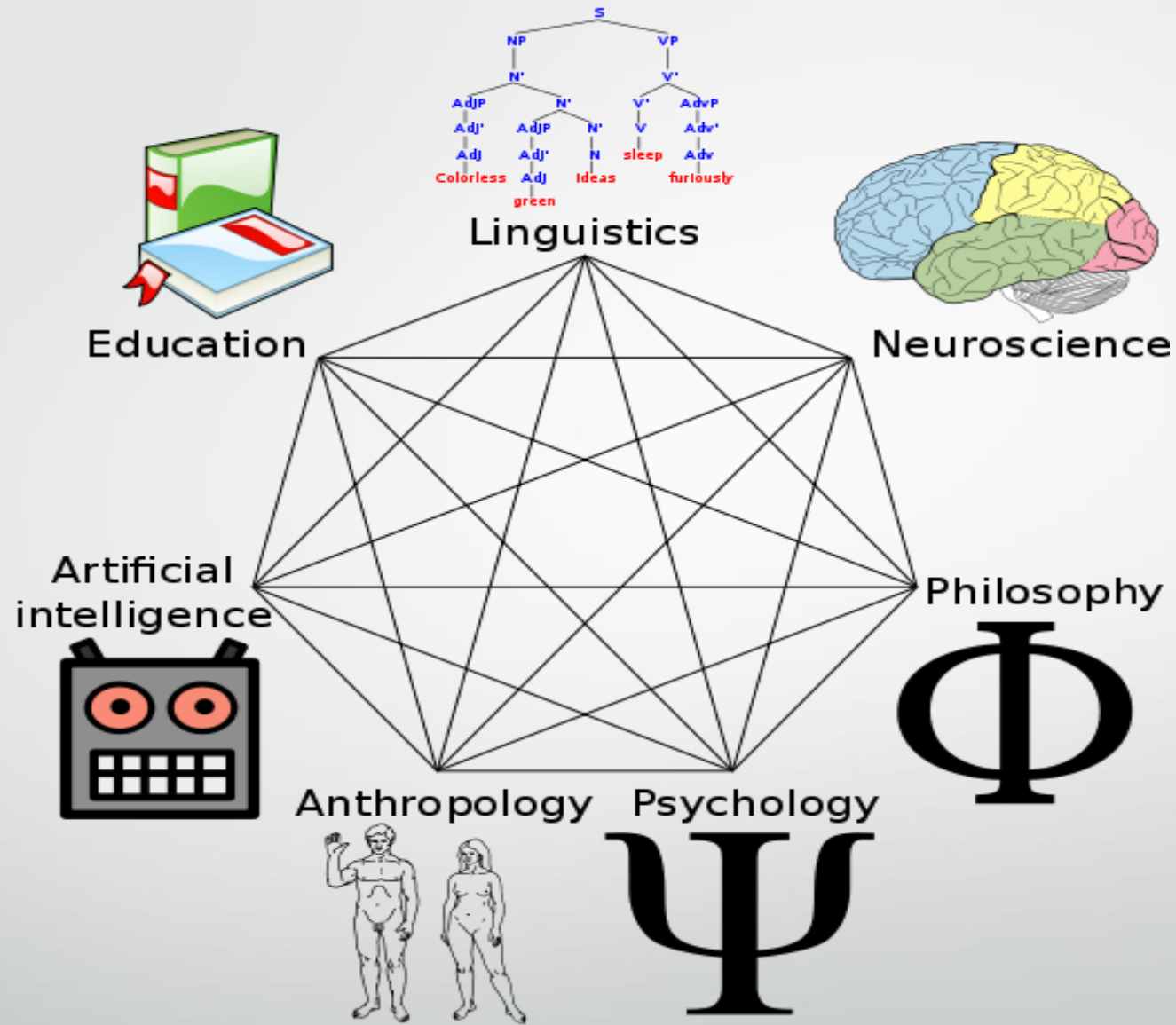
## Results and conclusion

- **All analyses done using linear mixed models on log RTs**
  - Fig.1: average L1ers RTs at the critical regions & default RCA (C1N1&C2N1) driving the effect, 2ed figure shows L2ers nativelike parsing (Fig.2: (b&c)) despite the initial delay (Fig.2 : (a)).
- At the RC, we found marginal effect of context for the L1ers ( $t = 1.7$ ), and significant effect on L2ers ( $t = 2.9$ ), but **SSH predictions did not hold at AUX and VP**. Despite initial sensitivity to context, L2ers do employ deep parsing. It could be argued that the L2ers, who mostly come from Madrasa background, are so advanced in Arabic that they can parse like L1ers.
- This possibility seems to be weak because in our norming study where we used pen and paper questionnaires the L2ers were much slower than the L1ers.

- **Other models and explanations:**
- Both L1ers and L2ers utilize the same parser, but!
- Memory cue retrieval interference could cause non-native parsing and slow down [6,7].
- The architecture of the bilingual mental lexicon slows down L2 processing [8,9,10].

# Possible Benefit of the Study

- Understand how multilinguals process a learned language.
- This will enable us to improve teaching methods to make them more efficient.
- It will also help build better computer language models that enhance artificial intelligence (ACT-R).



Cognitive Science  
Heptagram  
(The Endless Knot  
Blog by Dr.Mark  
Sundaram)

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# Thank You for Listening!