

# L2 processing is affected by RAGE: Evidence from reference resolution

Theres Grüter<sup>1</sup> & Hannah Rohde<sup>2</sup>

<sup>1</sup>University of Hawai'i at Mānoa, <sup>2</sup>University of Edinburgh

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# RAGE

Reduced Ability to Generate Expectations

# RAGE

- A working hypothesis for investigating non-native language processing:

*Non-native speakers have reduced ability to generate expectations during language processing.*

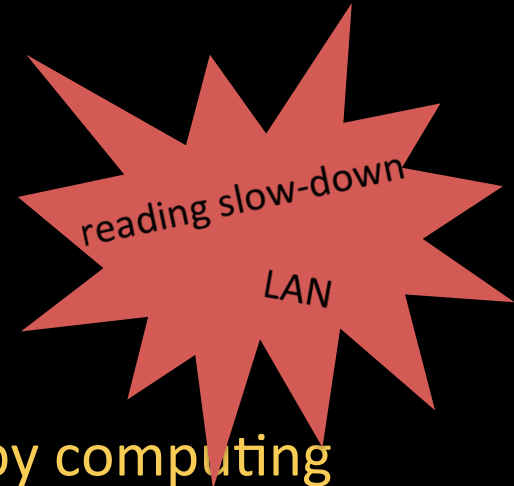
“processing”



integration

integration  
(bottom up, reactive)

The dogs barks



integrate by computing  
subject-verb agreement

# “processing” as integration

“Grammatical structures are built incrementally during comprehension, with each new incoming word or phrase being **integrated** into the current partial representation as soon as possible.”

(Clahsen & Felser, 2006)

# “processing problem” as integration difficulty

“It is possible that the bilinguals’ problem lies in their less-than optimal ability to consistently and efficiently **integrate** different types of information.”

“reduced **integration** ability of bilingual speakers”

(Sorace, 2011)

# “processing”

integration

prediction/  
anticipation/  
expectation



# prediction

(top down, proactive)

The boy will eat



(Altmann & Kamide, 1999)

(Fernald, 2004; Fernald et al., 2008)



# prediction

(top down, proactive)

## Encuentra la

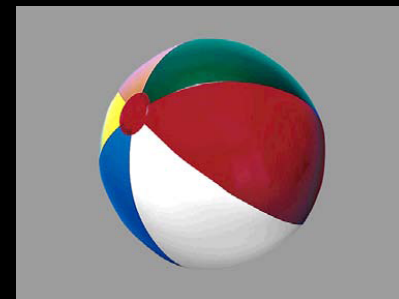
Find

the-FEM



(el zapato)

- ✓ adult native Spanish-speakers
- ✓ and 2-year-olds  
(Lew-Williams & Fernald, 2007)
- ✗ adult L2 learners of Spanish  
(Lew-Williams & Fernald, 2010)
- ✗ even highly proficient ones  
(Grüter, Lew-Williams & Fernald, 2012)



(la pelota)

# “processing” as prediction

“[T]he brain seems to deal with the speed and complexity of language processing by ‘**thinking ahead**’ – that is, generating information about likely upcoming stimuli and preparing ahead of time, at multiple levels, to process them.”

(Federmeier, 2007, *Psychophysiology*)

# “processing” as prediction

“However, such predictive processing entails costs, as well as benefits, and changes in the availability of cognitive and neural resources [...] seem to make prediction more difficult or less likely for many individuals.”

(Federmeier, 2007, *Psychophysiology*)

# “processing problem” as prediction difficulty

“We would like to propose an alternative view of second-language sentence processing, namely that second-language learners build a detailed syntactic representation that is indistinguishable from a native speaker’s, but that they **do not actively predict** syntactic elements during on-line processing.”

(Kaan, Dallas, & Wijnen, 2010)

# “processing problem” as prediction difficulty

## The RAGE hypothesis

- Non-native speakers have reduced ability to generate expectations during language processing.
- RAGE is not confined to prediction at the level of syntax, but affects expectation generation more broadly.

# Discourse-level expectations & reference resolution

“(...) the idea that language processing involves unconscious hypotheses about where the discourse is going and that these hypotheses influence the activation of discourse referents.”

(Arnold, 2001, *Discourse Processes*)

# Discourse-level expectations & reference resolution

John handed a book to Bob. He . . .

... really wanted Bob to have it.

He = John ('SOURCE-continuation')

... took it and read it right away.

He = Bob ('GOAL-continuation')



# Discourse-level expectations & reference resolution

John **handed** a book to Bob. He . . .

John **was handing** a book to Bob. He . .

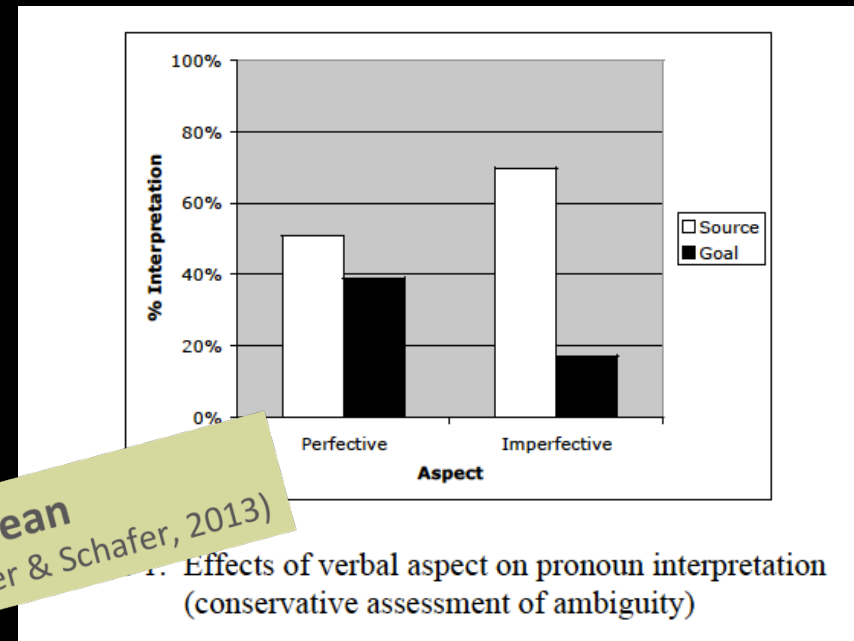
# Discourse-level expectations & reference resolution

Rohde, Kehler & Elman (2006; Kehler et al., 2008)

- native English speakers (n=48)
  - written story continuations
- Participants' interpretations of ambiguous pronouns reflect **event-level expectations.**

effect (partially) replicated in **Japanese**  
(Ueno & Kehler, 2010)

effect (fully) replicated in **Korean**  
(Kim, Grüter & Schafer, 2013)



(Rohde et al., 2006, *CogSciProc*)

# This study



Do event-level biases created by grammatical aspect contribute to **non-native speakers'** discourse expectations and reference resolution?

**RAGE predicts: reduced effect**

# Participants

	<b>Age</b> (in years)	<b>Cloze test<sup>1</sup></b> (proportion acceptable responses)	<b>Versant English Test<sup>2</sup></b> (overall score, range 20-80)	<b>Self-rated English proficiency</b> (out of 10)
L1-English (n=39)	24 (18-66)	0.84 (.60-.98)	--	9.3 (7-10)
L2-English (n=34)	24 (17-51)	0.56 (.26-.80)	51 (34-80)	6.1 (2-9)
L1-Japanese (n=17)	26 (17-51)	0.54 (.36-.68)	48 (40-59)	6.3 (4-9)
L1-Korean (n=17)	23 (20-32)	0.58 (.26-.80)	55 (34-80)	6.0 (2-8)

<sup>1</sup>Brown (1980), <sup>2</sup>Pearson (2011; <http://www.versanttest.com>)

Do learners understand grammatical aspect in English?

- Task 1 (Truth value judgments)

Do learners use grammatical aspect to create discourse expectations?

- Task 2 (Story continuations)

# Task 1: Truth value judgments

- adapted from Gabriele's (2005, 2009, etc) story compatibility task
- Do learners know that (transfer-of-possession) verbs with progressive marking
  - i) denote an incomplete event,
  - ii) cannot have a resultative reading?

Patrick is giving a towel to Ron.

**TRUE** when Ron has not yet received the towel.

**FALSE** after Ron has received the towel.



Patrick and Ron are at the pool together. This is the towel that Patrick will give to Ron. At 4:00, Ron is done swimming and ready to shower. At 4:05, Patrick grabs the towel for Ron and walks over to Ron's side of the pool.

---

At 4:05, Pikachu says:

**Patrick is giving the towel to Ron**



- 
- TRUE
  - FALSE
  - I am not sure

Submit



Patrick and Ron are at the pool together. This is the towel that Patrick will give to Ron. At 4:00, Ron is done swimming and ready to shower. At 4:05, Ron disappears into the showers with the towel in his hand.

---

At 4:05, Pikachu says:

**Patrick is giving the towel to Ron**



- 
- TRUE
  - FALSE
  
  - I am not sure

Submit



# Task 1: Truth value judgments

Conditions:

	aspect	verb	event	truth value	k
1	progressive	transfer-of-possession	incomplete	true	5
2	progressive	transfer-of-possession	complete	false	5
3	perfective	other achievement	incomplete	false	4
4	perfective	other achievement	complete	true	4
5	progressive	accomplishment	complete	false	4

## 2 (group: L1, L2) x 5 (condition) ANOVA

- main effect of condition (F(4,284)=402.1, p<.001)
- no effect of group (F(1,71)<1)
- interaction n.s. (F(4,284)=2.16, p=.07)

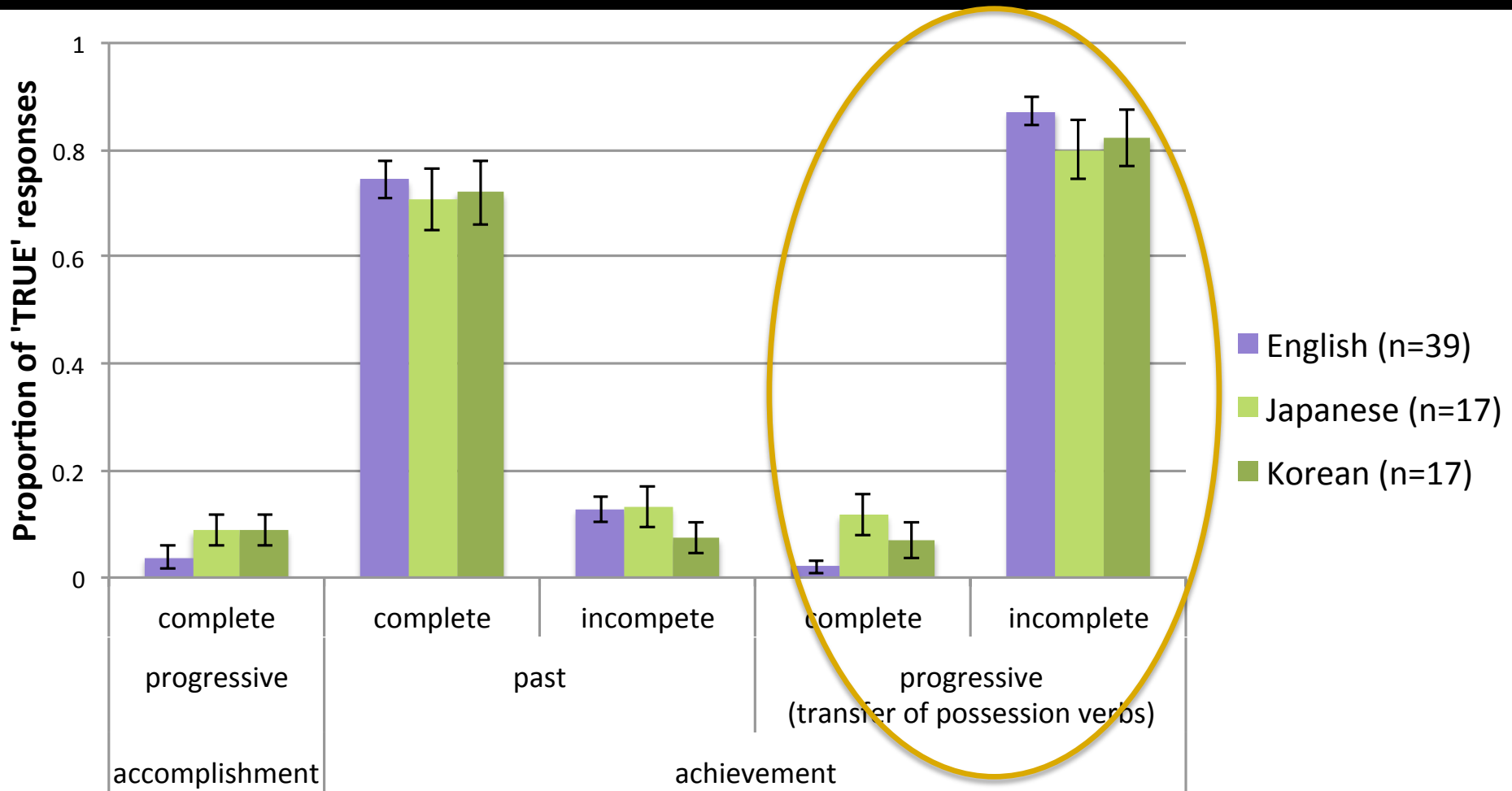


Fig. 1. % TRUE responses by language.

Do learners understand grammatical aspect in English?

- Task 1 (Truth value judgments)



Do they use grammatical aspect to create discourse expectations?

- Task 2 (Story continuations)

# Task 2: Story continuations

2 (aspect) x 2 (prompt type) design

COMPLETED EVENT (PERFECTIVE)

Patrick **gave** a towel to Ron. He \_\_\_\_\_

Patrick **gave** a towel to Ron. \_\_\_\_\_

INCOMPLETE EVENT (IMPERFECTIVE)

Patrick **was giving** a towel to Ron. He \_\_\_\_\_

Patrick **was giving** a towel to Ron. \_\_\_\_\_

Latin square design, 5 items/condition + 20 fillers  
(10 verbs: *bring, feed, give, mail, pass, push, roll, serve, take, throw*)

## Task 2: Story continuations

- data annotated for co-reference

Patrick gave/was giving a towel to Ron. (He) \_\_\_\_\_

He made sure to give him a clean dry one.

(SOURCE-continuation)

He said "Thank you."

(GOAL-continuation)

He did not notice the puddle of water on the floor.

(ambiguous: 8/12% of L1/L2 data)

The towel was still warm from the drying machine.

(other: 12/11% of L1/L2 data)

## 2 (aspect) x 2 (prompt type) x 2 (group) ANOVA

- main effect of aspect ( $F_1(1,70)=12.2, p<.001, F_2(1,19)=12.2, p<.001$ )
- main effect of prompt type ( $F_1(1,70)=101.2, p<.001, F_2(1,19)=191.5, p<.001$ )
- main effect of group ( $F_1(1,70)=8.0, p<.01; F_2(1,19)=20.6, p<.001$ )
- aspect x group interaction ( $F_1(1,70)=4.6, p<.01; F_2(1,19)=3.7, p=0.07^*$ )

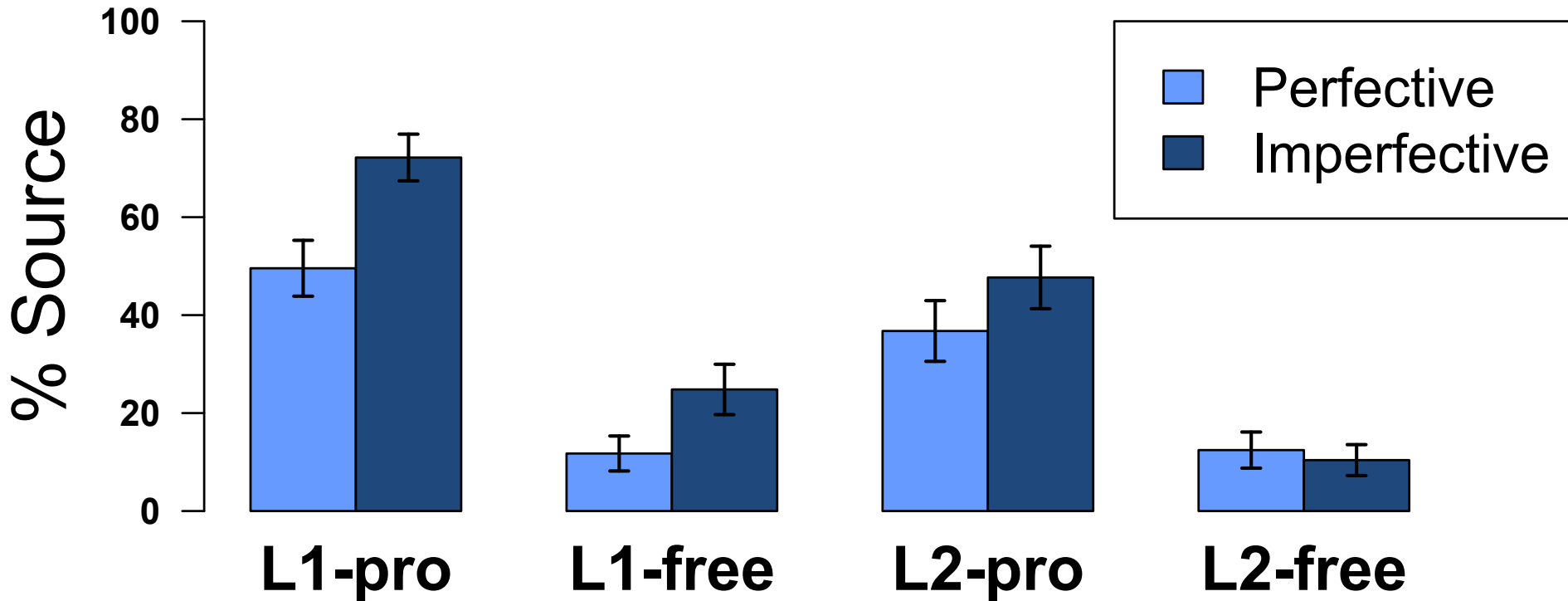


Fig. 2. % Source-continuations by language group and prompt type.

- replication of aspect effect  
(more SOURCE-continuations with imperfectives)
- interaction of aspect with group  
(aspect effect is stronger for L1 group)

✧ consistent with the RAGE hypothesis

Non-native speakers *know* the meaning of aspect (task 1), but they do not seem to *use* this knowledge *as much* to generate discourse-level expectations (task 2).

- main effect of group  
(fewer SOURCE-continuations in L2 group)

→ recency bias?

(see Kehler et al., 2011, for similar findings from native-speaking *children*)

→ indication of resource limitations affecting  
information *integration*



“processing”

integration

prediction

# in-progress & future work

- look at effect of aspect on *coherence relations*
- *aural* (instead of written) story continuations
  - manipulate prosodic focus (with Amy J. Schafer)
- *online* measure of anticipatory co-reference processing (Visual World)

# Thank you

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theres@hawaii.edu

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