



APPLIED RESEARCH LABORATORY FOR
**INTELLIGENCE
AND SECURITY**

Leveraging Spanish knowledge to facilitate *ab initio* L3 Portuguese learning: Investigating instructional techniques and cognitive aptitude

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Role of the L2 in L3 acquisition

Previous language learning experience facilitates learning an additional language

- Metalinguistic awareness
- Familiarity and use of multiple learning strategies

(e.g., Kaushanskaya & Marian, 2009; Papagno & Vallar, 1995; Van Hell & Mahn, 1997)

Related languages further facilitated

- Provide a 'jump start' on the L3 lexicon and/or grammar
- Positive(/Negative) cross-linguistic influence

(see Linck, Michael, Golonka, Twist & Schwieter, 2015 for a review)

Role of the L2 in L3 acquisition

Cross-training: utilizing previous language learning experience to facilitate learning an additional language

- Metalinguistic awareness
- Familiarity and use of multiple learning strategies

Role of the L2 in L3 acquisition

Conversion training: utilizing a known language to facilitate learning a related additional language

- Role of the donor language in conversion training (see Linck, Michael, Golonka, Twist & Schwieter, 2015 for a review):
 - facilitation (positive cross-linguistic influence)
 - interference (negative cross-linguistic influence)

Two Instructional Techniques

Glosses

- L1 and/or L2 Definitions in the margins of an L3 text for key terms

Parallel texts

- Original L3 text side-by-side a translation in L1 and/or L2

Glosses as an instructional technique

- Glosses more effective than no glosses for vocabulary learning, retention, and reading (Azari et al., 2012; Ko, 2012; Palmer, 2003; Rouhi & Mohebbi, 2012; Salehi & Nasarieh, 2013; Samian et al., 2016)
 - No difference (Guidi, 2009; Cheng & Good, 2009; Jacobs et al., 1994)
 - Mixed results for the effect of L1 vs. L2 glosses
 - L1 better than L2 for reading, listening, and productive knowledge (Hashemian & Fadaei, 2013; Palmer, 2003; Dabaghi & Rafiee, 2012)
 - L2 better than L1 for reading, vocabulary, and receptive knowledge (Ko, 2005; Miyasako, 2002; Dabaghi & Rafiee, 2012)
 - No difference (Rouhi & Mohebbi, 2012, Yoshii, 2006)
 - Mixed results for bilingual glosses (Azari et al., 2012; Salehi & Naserieh, 2013; Xu, 2010)
-

Parallel texts as an instructional technique

- Parallel texts more effective than glosses for reading comprehension, grammar (Parent & Belasco, 1970; Jarvis & Jensen, 1982)
- Better than control for vocabulary learning, grammar, translation, reading comprehension (Wong & Lee, 2016; Chujo et al., 2009; Ciobanu & Hartley, 2006; Xu & Kawecki, 2005)
- Most PT studies only looked at L2 learning from an unrelated L1
- Few studies have looked at related languages (Wong & Lee, 2016); some only in a trilingual context (Xu & Kawecki, 2005; Ciobanu & Hartley, 2006; Harper & Hamer, 2006)

Techniques for conversion-training

- **Bilingual glosses**

- L1 and L2 translations of key terms in the margins of an L3 text

- Previous results are mostly on L2 and mixed
- No clear advantage for either L1 or L2 glosses

(Bonilla et al., 2016 Hashemian & Fadaei, 2013; Palmer, 2003; Dabaghi & Rafiee, 2012; Ko, 2005; Miyasako, 2002; Rouhi & Mohebbi, 2012, Yoshii, 2006; Azari et al., 2012; Salehi & Naserieh, 2013; Xu, 2010)

- **Parallel texts**

- Original L3 text side-by-side a translation in L2 (and/or L1)

- Scarce, mostly on L2 (not L3) learning

(Parent & Belasco, 1970; Jarvis & Jensen, 1982; Wong & Lee, 2016; Xu & Kawecky, 2005; Ciobanu & Hartley, 2006; Harper & Hamer, 2006)

Outcomes

Measures of success

1. L3 reading comprehension
2. L3 vocabulary learning and retention
3. L3 spelling rules generalization and retention

Example:

Spanish: verb+ción = noun; nominalización

Portuguese: verb+ção = noun; nominalização

Research Questions

Are glosses or parallel texts more effective instructional techniques for...

1. ...enhancing reading comprehension in L3?
2. ...promoting initial vocabulary learning and/or retention in L3?
 - a) Do patterns of learning and retention differ for cognates, false cognates, and non-cognates?
3. ...promoting the initial noticing and/or retention of generalized L2-to-L3 spelling rules?

Research Questions

4. What is the role of L2 proficiency for L3 reading comprehension, vocabulary learning, and spelling rules generalization?

Method

Participants

- N = 74 (54 female)
- Age 18-34 (*M*: 20.8; *SD*: 2.6)
- Native English advanced learners of Spanish
 - At least two years of Spanish study (*M*: 6.4; *SD*: 2.3)
 - Minimum score of 5 on a Spanish cloze test (0-20) (*M*: 9.8; *SD*: 3.0)
 - No prior exposure to Portuguese or other Romance languages

Experimental Treatment

Two texts with 14 target words each

Authentic newspaper articles (BBC Brasil)

- Shortened and counterbalanced
- One text presented as control (no instruction)
- One text presented in either the glosses or parallel texts condition with highlighted target words

Texts targeted to included cognates, false cognates, and non-cognates

Experimental Treatment

Text 1: Glosses Condition

Azeite, milho ou canola?

Quando o assunto é gorduras e óleos, temos dezenas de opções disponíveis e é complicado saber qual delas será a "mais saudável". As prateleiras dos supermercados têm de tudo.

Portuguese – Spanish – English

gordura – grasa – fat
óleo – aceite – cooking oil
ter – tener – to have
opção – opción – option
prateleira – estante – shelf

Text 1: Parallel Texts Condition

Azeite, milho ou canola?

Quando o assunto é gorduras e óleos, temos dezenas de opções disponíveis e é complicado saber qual delas será a "mais saudável". As prateleiras dos supermercados têm de tudo.

¿El aceite de oliva, de maíz o de canola?

Quando se trata de grasas y aceites, tenemos decenas de opciones disponibles y es difícil saber cuál será la "más saludable". Los estantes de los supermercados tienen todo.

Experimental Treatment

Text 2: Glosses Condition

O papel do sono

Portuguese – Spanish – English

O **sono** é um recurso estratégico que muitas empresas estão ignorando, de acordo com um estudo preparado pelo professor Christopher Barnes.

sono – sueño – sleep

Text 2: Parallel Texts Condition

O papel do sono

O **sono** é um recurso estratégico que muitas empresas estão ignorando, de acordo com um estudo preparado pelo professor Christopher Barnes.

El papel del sueño

El **sueño** es un recurso estratégico que muchas empresas están ignorando, según un estudio preparado por el profesor Christopher Barnes.

Outcomes

Measures of success

1. L3 reading comprehension
10 MC, 4 option questions
2. L3 vocabulary learning and retention
Cognates, false cognates, non-cognates
Vocabulary Knowledge Scale (VKS) Assessment
(Wesche & Paribakht, 1996)
3. L3 spelling rules generalization and retention
15 MC, 4 option questions
Example:
Spanish: verb+ción = noun; nominalización
Portuguese: verb+ção = noun; nominalização

Outcomes

Which of the following statements best represents the main idea of the passage?

- Research shows that sunflower oil is the healthiest out of all of the oils
 - Scientists do not agree on which types of oil are best for cooking
 - Scientists identify health benefits of different oils and fats
 - Research identifies healthier oils and fats for cooking
-

What do the quotation marks in the word “healthiest” in the first sentence imply about the author? He or she is using...

- Sarcasm
 - Emphasis
 - An imprecise term
 - Somebody else's words
-

Outcomes

Pesquisa

Please select and provide information accordingly

- I. I don't remember having seen this word before.
- II. I have seen this word before, but I'm not sure what it means.
- III. I have seen this word before and I think it means (synonym, translation, brief explanation in English or Spanish):

- IV. I know this word. It means (synonym, translation, or brief explanation in English or Spanish):

horrible (Spanish); horrible (English)

- horribel
- horrivle
- horrible
- horrivel

vive (Spanish); (he/she) lives (English)

- vivoe
- vivõe
- vive
- vivi

Procedure

Prescreen: Spanish cloze test Session 1

Text A: Control (no training)

1. Read L3 Portuguese text
2. Immediate tests (RC, VKS, SRG)
3. Cognate Status Study

Text B: Training (bilingual glosses or parallel texts)

1. Pre-reading activities
2. Reading L3 Portuguese text
3. Post-reading activities
4. Immediate tests (RC, VKS, SRG)

LHQ & End-of-Session Questionnaire

Session 2, 2 weeks later

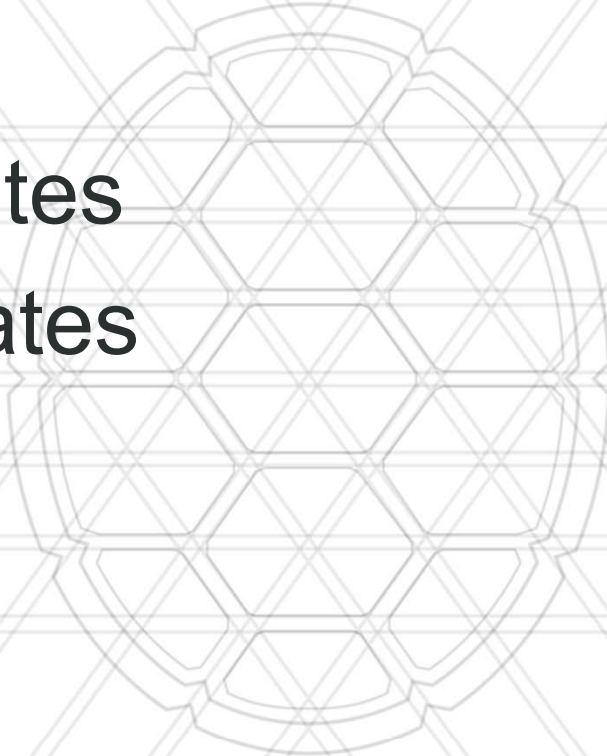
Text 1 and 2 Delayed tests (VKS, SRG)

Target Words

6 cognates

8 false cognates

12 non-cognates



Results

Cross-classified logistic mixed-effects models (lme4 package in R)

DV

- Accuracy (0,1)

IVs

- Condition (control, glosses, parallel texts)
- L2 Proficiency (centered)
- Cognate status (for VKS only;
cognate, false cognate, non-cognate)

Forward testing of random effects, backward testing of fixed effects (a la Raudenbush & Bryk, 2002; Snijders & Bosker, 2012)

Reading Comp. Results

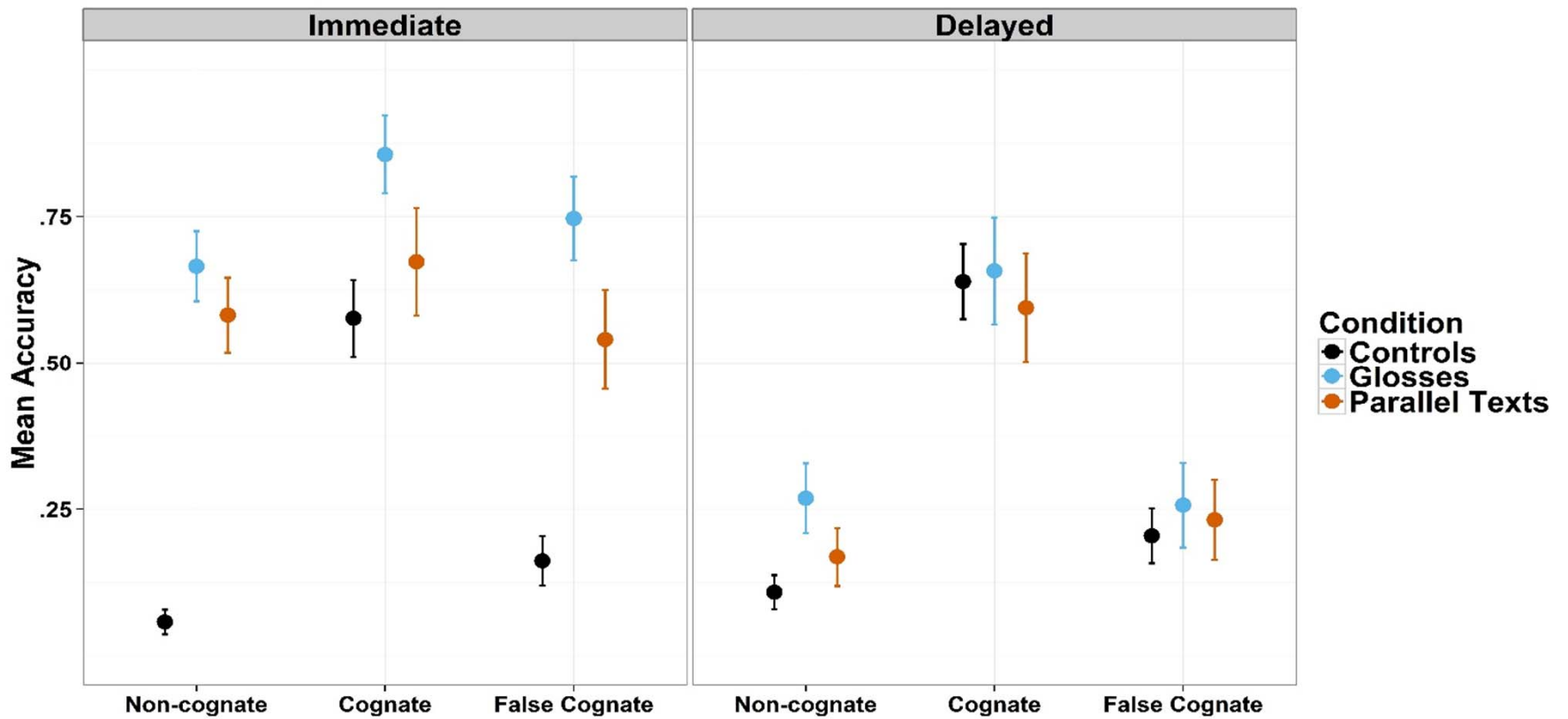
Bilingual Glosses > Control, Parallel texts

Parallel Texts = Control

Reading Comprehension

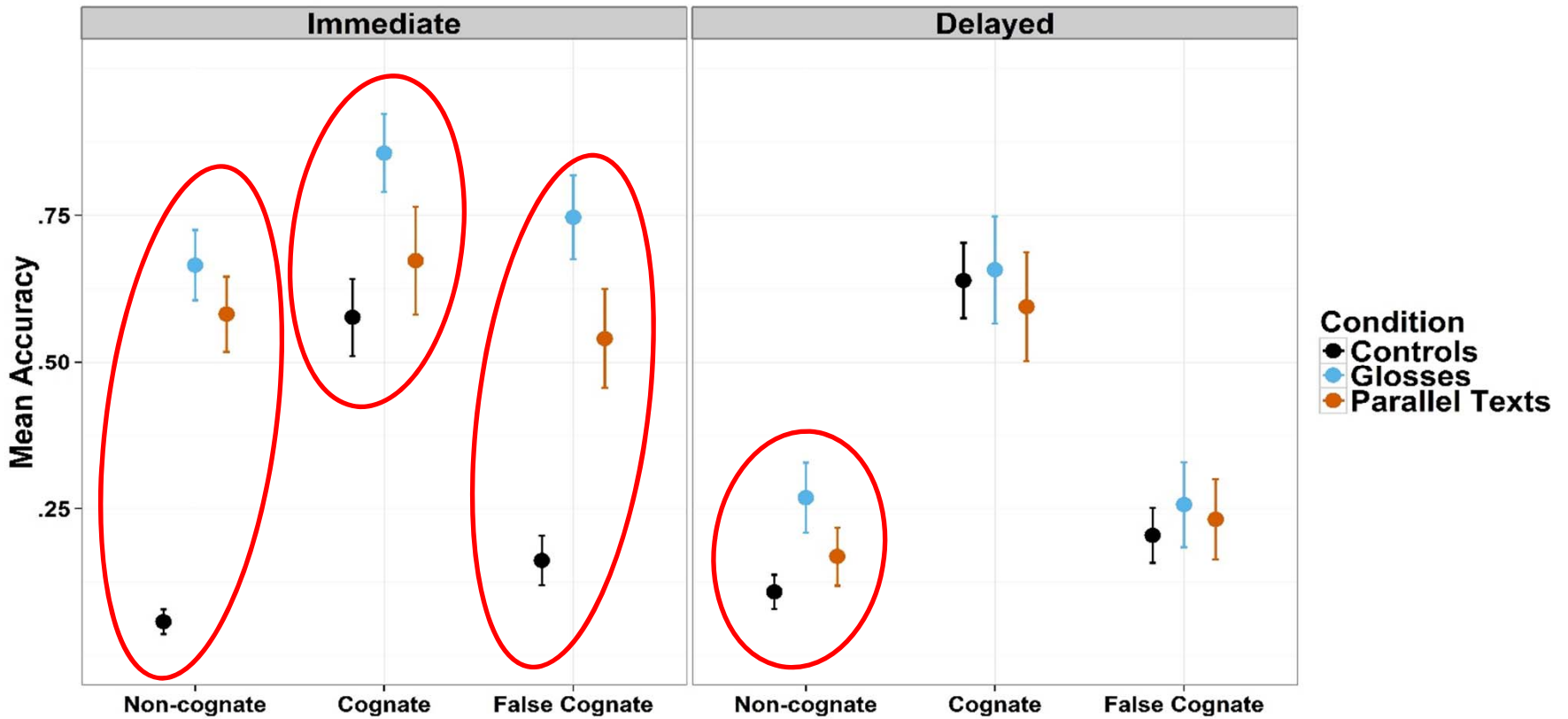
Condition	Immediate Test
Control	.58 (.49)
Glosses	.64 (.48) *
Parallel Texts	.56 (.50)

Vocabulary Results



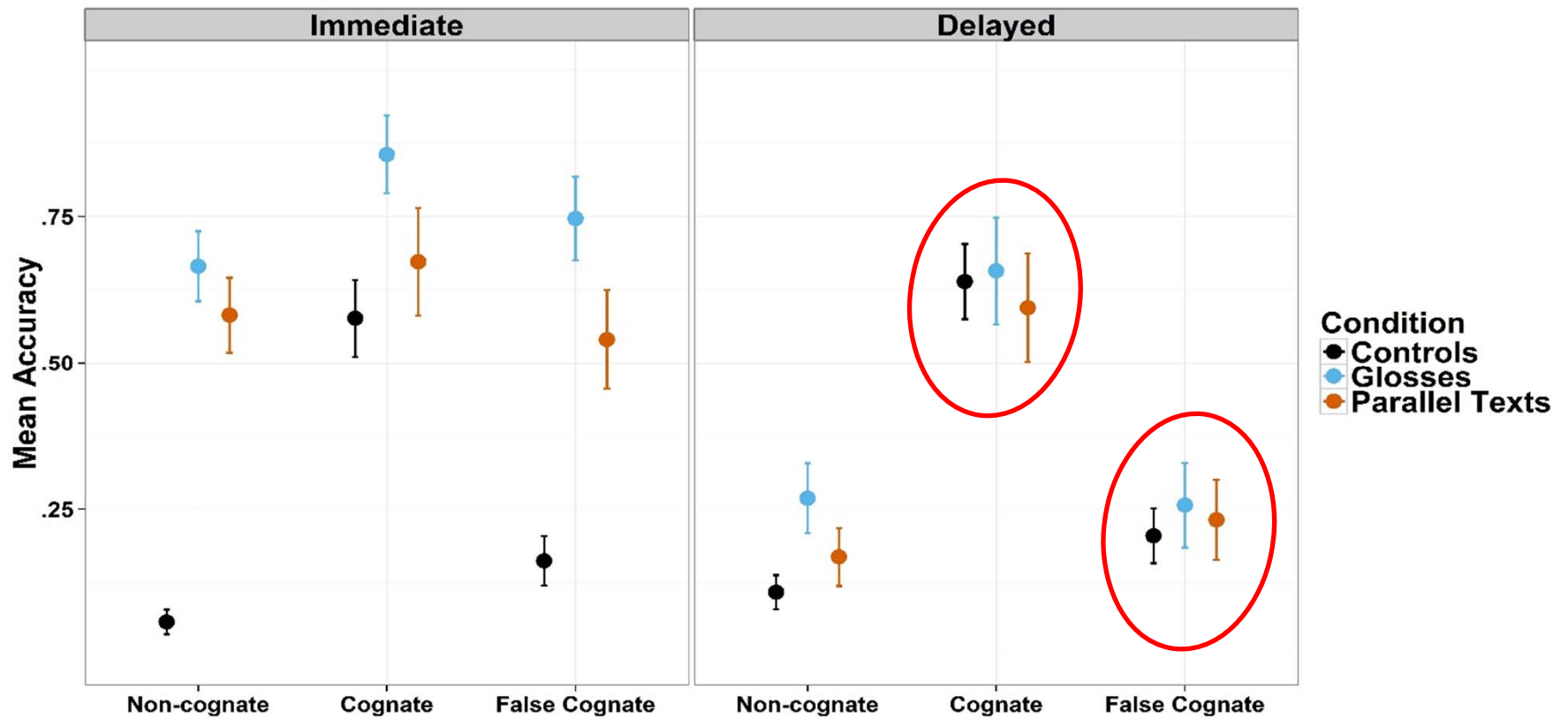
Vocabulary Results

Bilingual glosses > Parallel texts > Control



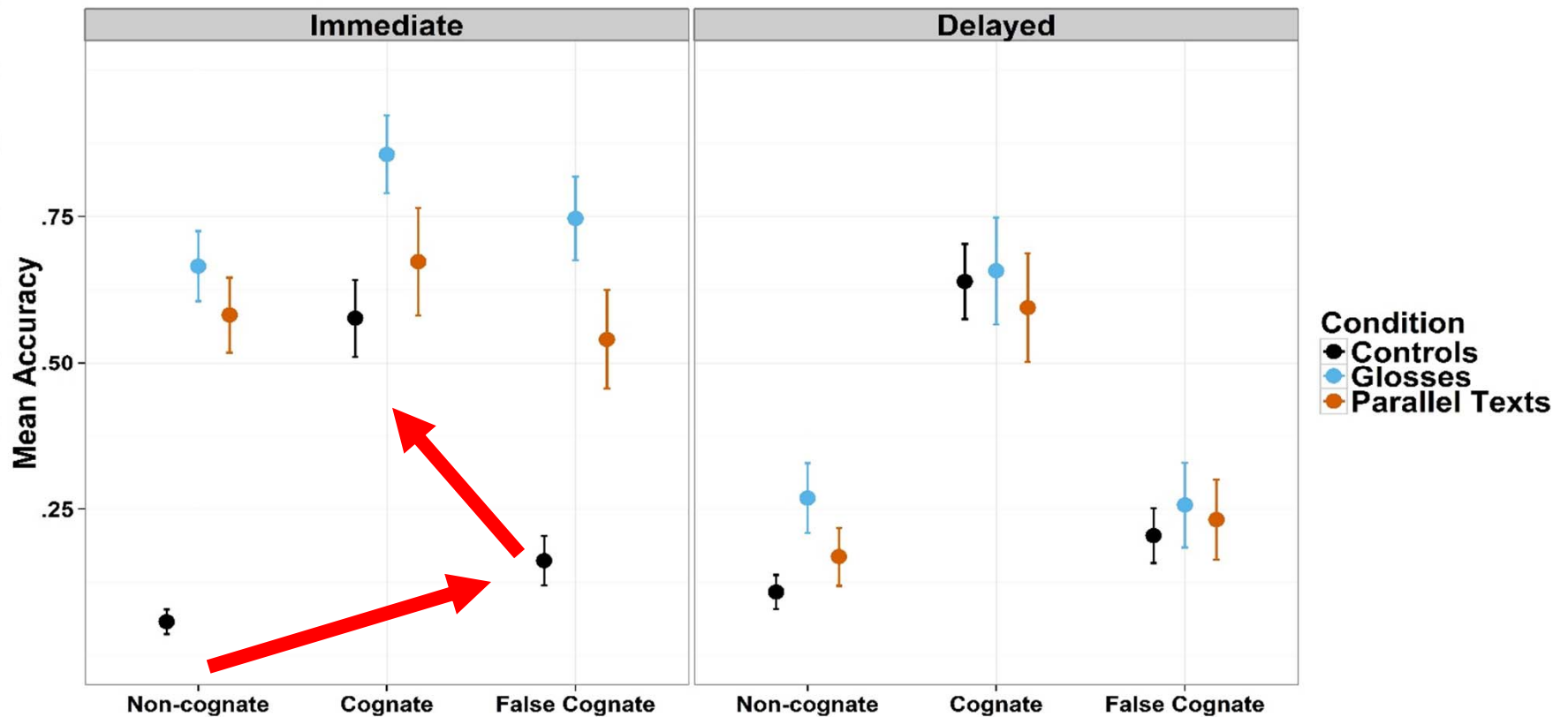
Vocabulary Results

Bilingual glosses = Parallel texts = Control



Vocabulary Results

Cognates > False Cognates > Non-Cognates



Spelling Rules Gen. Results

Control > Bilingual Glosses, Parallel texts

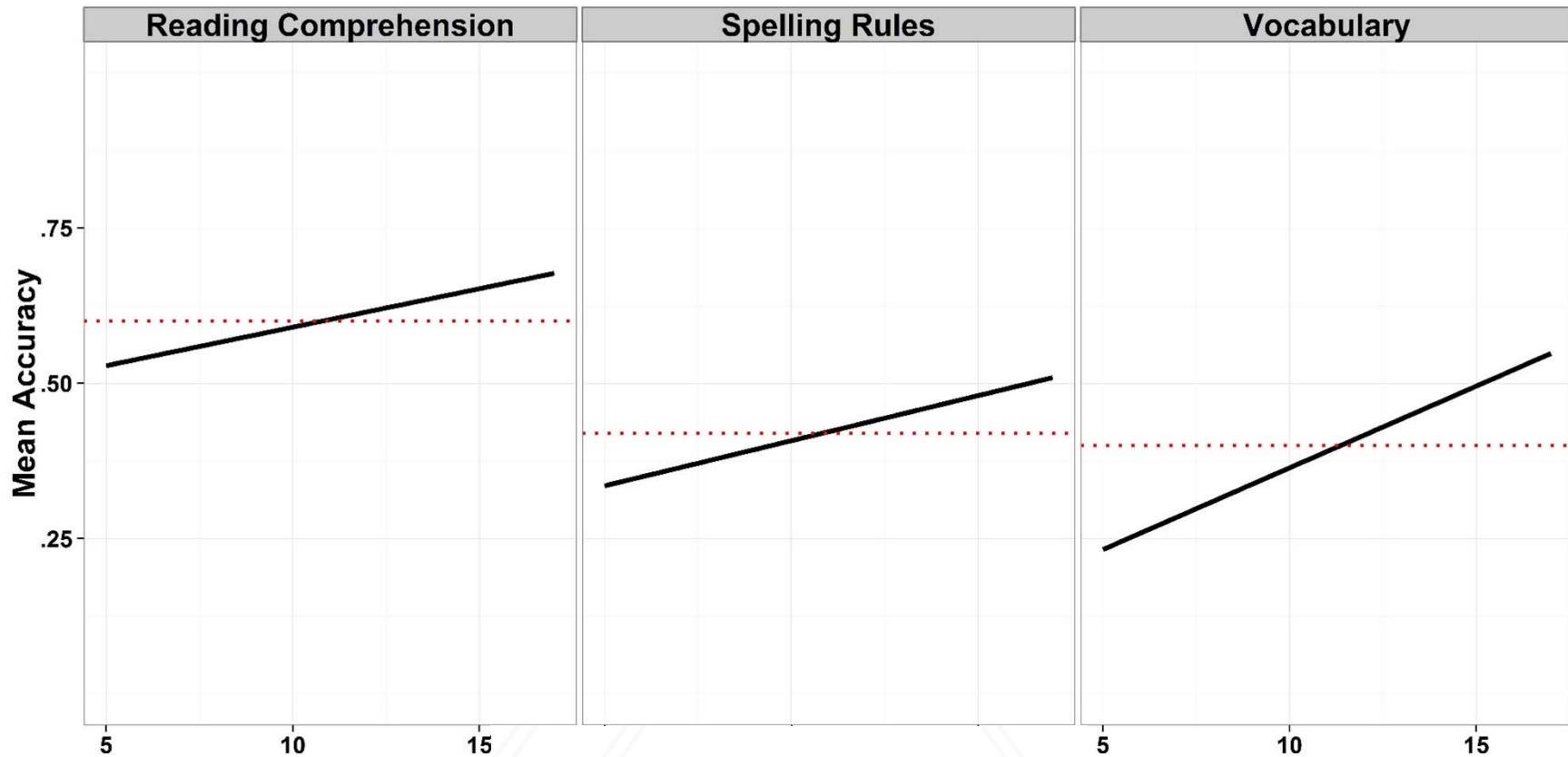
Bilingual Glosses = Parallel Texts

immediate = delayed

Spelling Rules			
Condition	Immediate Test	Delayed Test	Mean across test times
Control	.43 (.49)	.43 (.49)	.43 (.49) *
Glosses	.39 (.49)	.36 (.48)	.38 (.48)
Parallel Texts	.40 (.49)	.39 (.49)	.39 (.49)

Role of L2 Proficiency

Significant effect of L2 Proficiency across all conditions and cognate status



Research Questions Revisited

1. Are glosses or parallel texts more effective for enhancing reading comprehension in L3?

Bilingual glosses > Parallel texts, Control

Research Questions Revisited

2. Are glosses or parallel texts more effective for...

...promoting vocabulary learning?

Bilingual glosses > Parallel texts > Control,
regardless of cognate status

...promoting retention of learned vocabulary?

Bilingual glosses > Parallel texts > Control,
for non-cognates

Research Questions Revisited

2.

- a. Do patterns of learning and retention differ for cognates, false cognates, and non-cognates?

Yes;

cognates > false cognates > non-cognates

Research Questions Revisited

3. Are glosses or parallel texts more effective for...

...promoting spelling rules generalization?

Control > Bilingual glosses, Parallel texts

Possibly due to more focus on the text without instructional aids in the margins

...for promoting retention of spelling rules generalization?

There was no change at delayed

Research Questions Revisited

4. What is the role of L2 proficiency for L3 reading comprehension, vocabulary learning, and spelling rules generalization?

L2 proficiency ↑ L3 reading comprehension ↑
L2 proficiency ↑ L3 vocabulary learning ↑
L2 proficiency ↑ L3 spelling rules ↑
No interactions with condition or cognate status

Conclusions

- Bilingual glosses can be effective in enhancing L3 comprehension and vocabulary learning
- Not all words are learned equally
- Reinforcement is needed for successful retention of vocabulary
- L2 proficiency is crucial for success in conversion training

Next step

- What about individual differences?
- Are people with different strengths better suited to learning in different instructional conditions?
- Cognitive language aptitude

Aptitude by treatment interactions (ATIs) in L3 learning

- Growing literature of aptitude and ATI research in L2 (e.g., Li, 2014)
- Fewer studies on the role of aptitude in L3 (Bonilla et al., forthcoming; Maimone, 2017; Thompson, 2008)
- No ATI studies found on L3 learning

- This study is a first exploratory look at the differential role of cognitive aptitude across different instructional techniques in L3 learning

Research Questions

1. Does cognitive aptitude **broadly** predict *ab initio* L3 outcomes in learning a related L3 for...
2. Does cognitive aptitude **interact with instructional treatment** to predict *ab initio* L3 outcomes in learning a related L3 for...
 - a) ...reading comprehension?
 - b) ...vocabulary learning?
 - c) ...noticing and generalization of L2-to-L3 spelling rules?

Method

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 - No prior exposure to Portuguese or other Romance languages

Method

Treatment Outcomes

Measures of success

1. L3 reading comprehension
 - 10 MC, 4 option questions
2. L3 vocabulary learning
 - Cognates, false cognates, non-cognates
 - Vocabulary Knowledge Scale (VKS) Assessment
(Wesche & Paribakht, 1996)
3. L3 spelling rules generalization
 - 15 MC, 4 option questions
 - Example:
Spanish: verb+ción = noun; nominalización
Portuguese: verb+ção = noun; nominalização

Aptitude Measures

Hi-LAB (Doughty et al., 2007; Linck et al., 2013)

- **Rote Memory (RM)**
 - Recalling new associations
- **Explicit Induction (EI)**
 - Consciously deriving patterns and rules
- **Implicit Learning (IL)**
 - Adapting to process stimuli with increasing practice
- **WM Updating (U)**
 - Keeping info in memory and revising it continuously
- **Inhibitory Control (IC)**
 - Inhibiting interference (from known languages)
- **Processing Speed (PS)**
 - General processing speed

Aptitude Measures

Hi-LAB (Doughty et al., 2007; Linck et al., 2013)

- **Rote Memory (RM)**
 - Paired Associates Task
- **Explicit Induction (EI)**
 - Letter Sets Task
- **Implicit Learning (IL)**
 - Serial Reaction Time Task
- **WM Updating (U)**
 - Running Memory Span Task
- **Inhibitory Control (IC)**
 - Antisaccade Task
- **Processing Speed (PS)**
 - Random block of Serial Reaction Time Task

Procedure

- Prescreen: Spanish cloze test
- Session 1
 - Text A: Control (no training)
 1. Read L3 Portuguese text
 2. Immediate tests (RC, VKS, SRG)
 - Cognate Status Study
 - Text B: Training (bilingual glosses or parallel texts)
 1. Pre-reading activities
 2. Reading L3 Portuguese text
 3. Post-reading activities
 4. Immediate tests (RC, VKS, SRG)
 - Language History & End-of-Session Questionnaire
 - **Running Memory Span Task**
- Session 2 (2 weeks later)
 - Text 1 and 2 Delayed tests (VKS, SRG)
 - **Remaining aptitude measures**

Analysis Procedure

- **Cross-classified logistic mixed-effects models**
 - Forward testing of random effects, backward testing of fixed effects
(a la Raudenbush & Bryk, 2002; Snijders & Bosker, 2012)
- **DV: Accuracy (0,1)**
- **First step IVs:**
(started with above instructional technique models)
 - Condition (control, bilingual glosses, parallel texts)
 - L2 Proficiency (centered)
 - Time (SR/VKS only; immediate, delayed)
 - Cognate status (VKS only; cognate, false cognate, non-cognate)
- **Second step IVs:**
 - Aptitude measure
 - Aptitude interactions with remaining first step variables

Summary of Aptitude Effects

	Rote Memory	Explicit Induction	Implicit Learning	WM Updating	Inhibitory Control	Processing Speed
Reading Comp.	√	√		√+	√√	√
Vocab.	√	√√		√√	√+	√+
Spelling Rules			√√			

- √ (RQ1) Significant main effect of Aptitude and/or Aptitude x L2 Proficiency interaction ('+')
- √√ (RQ2) Significant Aptitude x Instructional Condition interaction

Reading Comp. Results

Bilingual Glosses > Control, Parallel texts

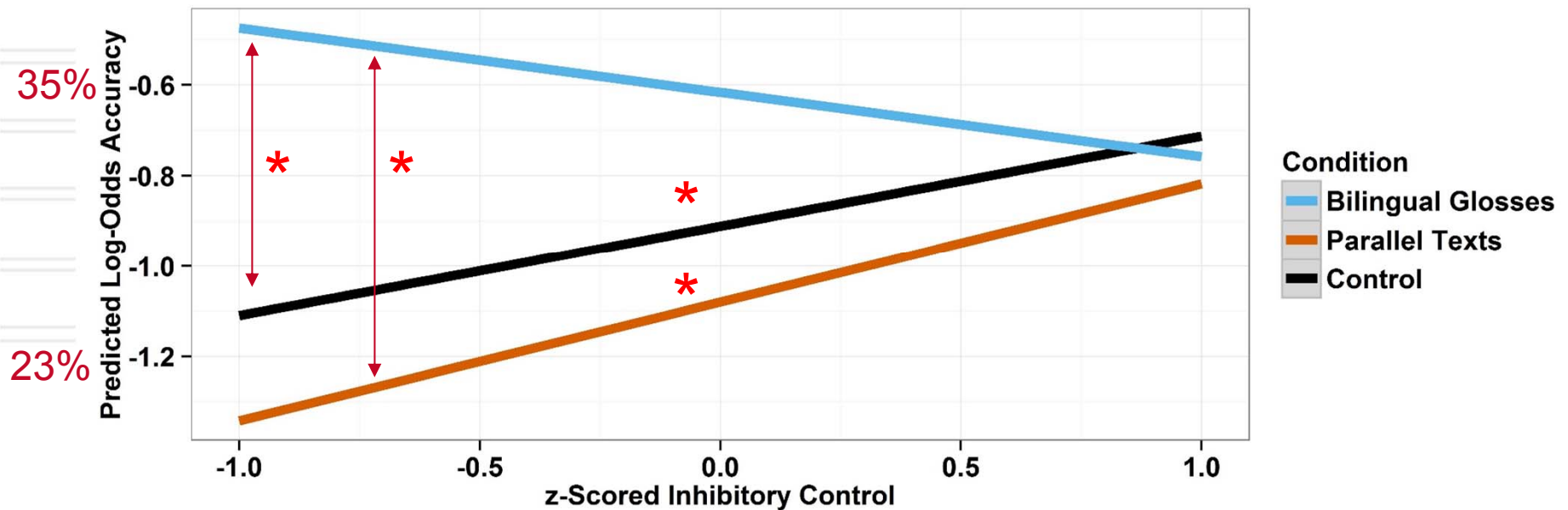
Parallel Texts = Control

Reading Comprehension

Condition	Immediate Test
Control	.58 (.49)
Glosses	.64 (.48) *
Parallel Texts	.56 (.50)

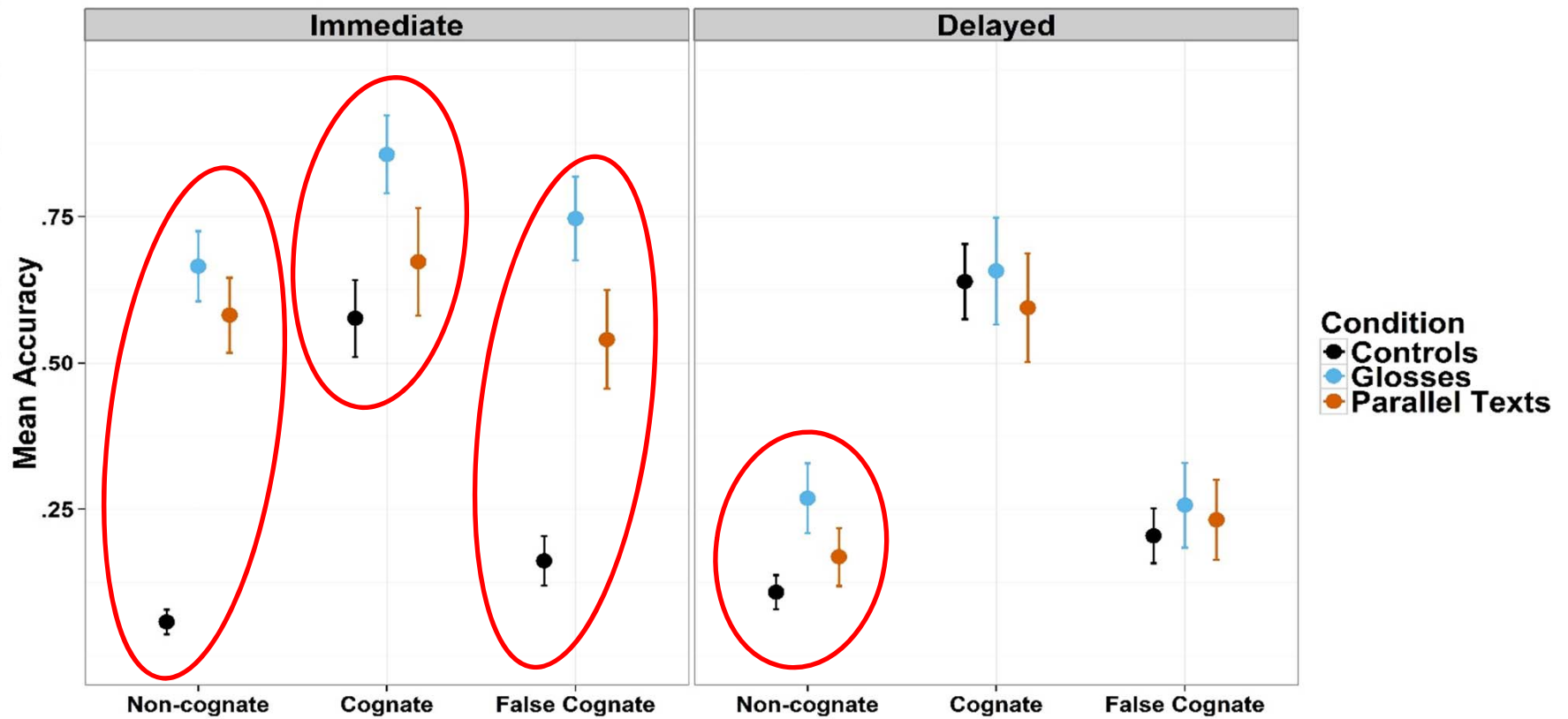
Reading Comp. Results ATI: Inhibitory Control (IC)

Significant effects of IC for **Parallel Texts** and **Control** conditions



Vocabulary Results

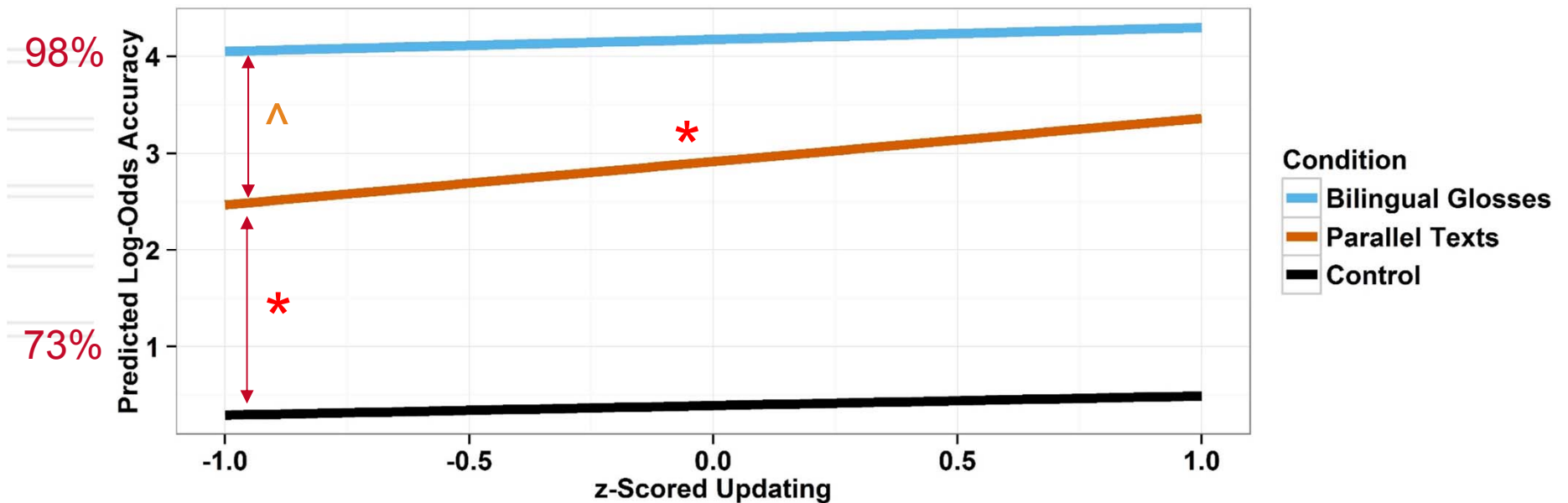
Bilingual Glosses > Parallel Texts > Control



Vocabulary Results

ATI: WM Updating (U)

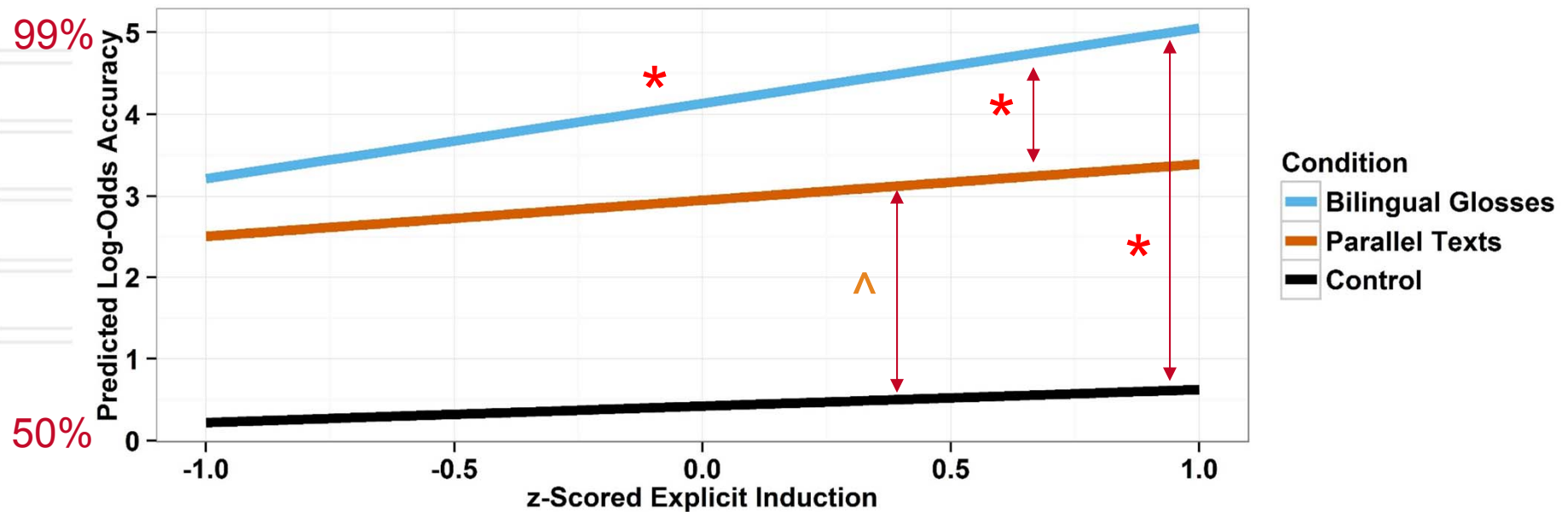
Significant effect of U for **Parallel Texts**



Vocabulary Results

ATI: Explicit Induction (EI)

Significant effect of EI for **Bilingual Glosses**



Spelling Rules Gen. Results

Control > Bilingual Glosses, Parallel texts

Bilingual Glosses = Parallel Texts

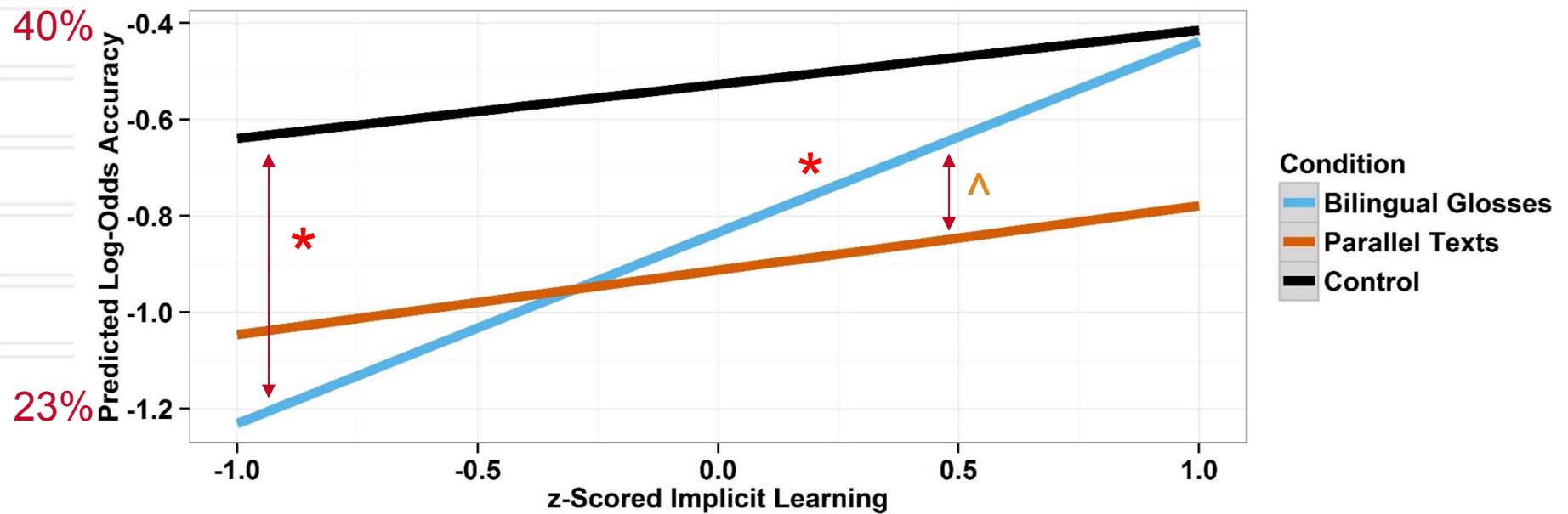
immediate = delayed

Spelling Rules			
Condition	Immediate Test	Delayed Test	Mean across test times
Control	.43 (.49)	.43 (.49)	.43 (.49) *
Glosses	.39 (.49)	.36 (.48)	.38 (.48)
Parallel Texts	.40 (.49)	.39 (.49)	.39 (.49)

Spelling Rules Gen. Results

ATI: Implicit Learning (IL)

Significant effect of IL for **Bilingual Glosses**



Research Questions Revisited

1. Does cognitive aptitude **broadly** predict *ab initio* L3 outcomes in learning a related L3 for...
2. Does cognitive aptitude **interact with instructional treatment** to predict *ab initio* L3 outcomes in learning a related L3 for...
 - a) ...reading comprehension?
 - a) (1) Yes; (2) Yes
 - b) ...vocabulary learning?
 - a) (1) Yes; (2) Yes
 - c) ...noticing and generalization of L2-to-L3 spelling rules?
 - a) (1) No; (2) Yes

Research Questions Revisited

	Rote Memory	Explicit Induction	Implicit Learning	WM Updating	Inhibitory Control	Processing Speed
Reading Comp.	√	√		√+	√√	√
Vocab.	√	√√		√√	√+	√+
Spelling Rules			√√			

- √ (RQ1) Significant main effect of Aptitude and/or Aptitude x L2 Proficiency interaction ('+')
- √√ (RQ2) Significant Aptitude x Instructional Condition interaction

Conclusions

- Cognitive aptitude is factor in *ab initio* L3...
 - Reading comprehension
 - Rote memory
 - Explicit induction
 - Working memory updating
 - Processing speed
 - Vocabulary learning
 - Rote memory
 - Inhibitory control
 - Processing speed
- regardless of instructional condition

Conclusions

Different facets of aptitude are relevant for different instructional conditions in *ab initio* L3...

- Reading comprehension
 - Inhibitory control (**control** & **parallel texts**)
- Vocabulary learning
 - Explicit Induction (**bilingual glosses**)
 - Working memory updating (**parallel texts**)
- Spelling rules
 - Implicit learning (**bilingual glosses**)

and can provide insight into what the learners are doing differently in the respective learning environments

Conclusions

Results of both sets of research questions show that it's important to consider...

1. the context of learning (instructional method),
 2. the context of the learner (individual differences),
 3. and the interaction of learning and learner context
- in order to best leverage existing knowledge for conversion training outcomes.
-

Future Directions

Do these effects of aptitude persist over time (more than one learning session)?

- e.g., Would effects persist if we track Spanish learners of Portuguese in a longitudinal study?

Investigate effect of L1 in glosses to test glosses superiority over L2-only parallel texts

- Do ATIs for glosses persist for an L2-only glosses condition?

Concordances instructional condition

Compare results to another related language pair (Russian → Ukrainian)

Thank you for listening!

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Marrie Bonilla (GMU)

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End of study survey

Survey question

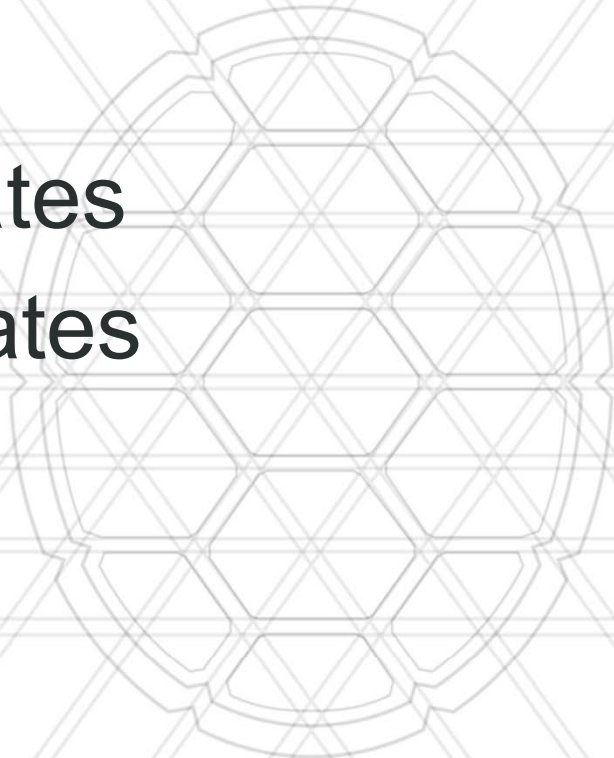
	Glosses	Parallel texts	Control
How much of the passage were you able to understand?	4.4	3.9	3.0
How confident were you answering reading comprehension questions?	4.2	3.7	3.0
How confident were you answering vocabulary questions?	4.1	3.7	2.6
How confident were you answering spelling rules questions?	2.9	3.1	2.0
To what extent did you rely on your Spanish while reading in Portuguese?	4.4	4.1	4.3
What effect did Spanish have on your comprehension of the passage?	4.6	4.3	3.9
How helpful were pre- and post-reading activities for reading comprehension?	4.3	3.9	N/A
How helpful were pre- and post-reading activities for vocabulary learning?	4.5	4.0	N/A
How helpful were pre- and post-reading activities for figuring out grammar rules?	3.2	3.2	N/A

Target Words

cognates

false cognates

2 non-cognates



Target Words

Cognate Status	Portuguese Word	Spanish Word	English Word	Average Similarity Rating Between Portuguese and Spanish Word
Cognate (6)	amostra	muestra	sample	3.30
	consumo	consumo	consumption	4.97
	inovação	innovación	innovation	3.84
	nível	nivel	level	4.41
	relógio	reloj	clock	3.95
	trabalhador	trabajador	worker	4.31
Pseudo cognate (8)	criança	niño	child	1.54
	escala	horario	schedule	1.31
	escritório	oficina	office	1.89
	funcionário	empleado	employee	1.68
	gordura	grasa	fat	2.38
	mudança	cambio	change	1.35
	óleo	aceite	cooking oil	1.81
	privação	privación	deprivation	3.69
Non-cognate (12)	aula	clase	class	1.57
	banha	manteca	lard	1.32
	doença	enfermedad	illness	1.19
	hoje	hoy	today	3.54
	jornada	jornada	workday	4.75
	milho	maíz	corn	2.68
	morador	habitante	resident	1.30
	opção	opción	option	3.24
	pesquisa	investigación	research	1.28
	prateleira	estante	shelf	1.22

Reading Comprehension

Effects	<i>b</i>	<i>exp(b)</i>	<i>SE</i>	<i>p-value</i>
cept (Parallel)	0.236	1.27	0.27	.383
tion: Control	0.113	1.12	0.15	.440
tion: Glosses	0.418	1.52	0.18	.020*
ency	0.059	1.06	0.02	.009*
om Effects	Variance		<i>SD</i>	
cepts Subject	0.105		0.32	
cepts Text	<0.001		<0.001	
cepts Text\Item Type	0.162		0.40	
cepts Text\Item Type\Item Number	0.717		0.85	

KS

Effects	<i>b</i>	<i>exp(b)</i>	<i>SE</i>	<i>p-value</i>
pt (Parallel/Non-Cognate/Immediate)	0.456	1.58	0.42	.281
on: Control	-4.156	0.02	0.29	<.001*
on: Glosses	0.605	1.83	0.26	.022*
ency	0.231	1.26	0.04	<.001*
te Status: Cognate	0.746	2.11	0.71	.296
Condition: Control	3.408	30.22	0.43	<.001*
Condition: Glosses	1.286	3.62	0.51	.011*
te Status: False Cognate	-0.262	0.77	0.65	.684
Condition: Control	1.497	4.47	0.41	<.001*
Condition: Glosses	0.665	1.94	0.40	.096^
me: Delayed	-2.723	0.07	0.27	<.001*
Condition: Control	3.506	33.31	0.38	<.001*
Condition: Glosses	0.399	1.49	0.36	.268
cognate Status: Cognate	1.978	7.23	0.46	<.001*
< Condition: Control	-2.326	0.10	0.59	<.001*
< Condition: Glosses	-1.651	0.19	0.68	.016*
cognate Status: False Cognate	0.603	1.83	0.42	.147
< Condition: Control	-0.980	0.38	0.56	.079^
< Condition: Glosses	-1.378	0.25	0.58	.017*
om Effects	Variance		<i>SD</i>	
pts Subject	0.951		0.98	
pts Portuguese Word	1.631		1.28	

Spelling Rules Generalization

Effects	<i>b</i>	<i>exp(b)</i>	<i>SE</i>	<i>p-value</i>
cept (Parallel)	-0.520	0.59	0.21	.011*
tion: Control	0.190	1.21	0.10	.047*
tion: Glosses	-0.076	0.93	0.13	.559
ency	0.082	1.09	0.03	.002*
om Effects	Variance		<i>SD</i>	
cepts Subject	0.403		0.63	
cepts Item Number	0.905		0.95	