Trilingual reading: The effect of cognates, 'false friends', and language proficiency

Lectura trilingüe: El efecto de cognados, 'falsos amigos' y la competencia ligüística. Leitura Trilíngue: O efeito de cognatos, 'falsos amigos' e a competência lingüística.

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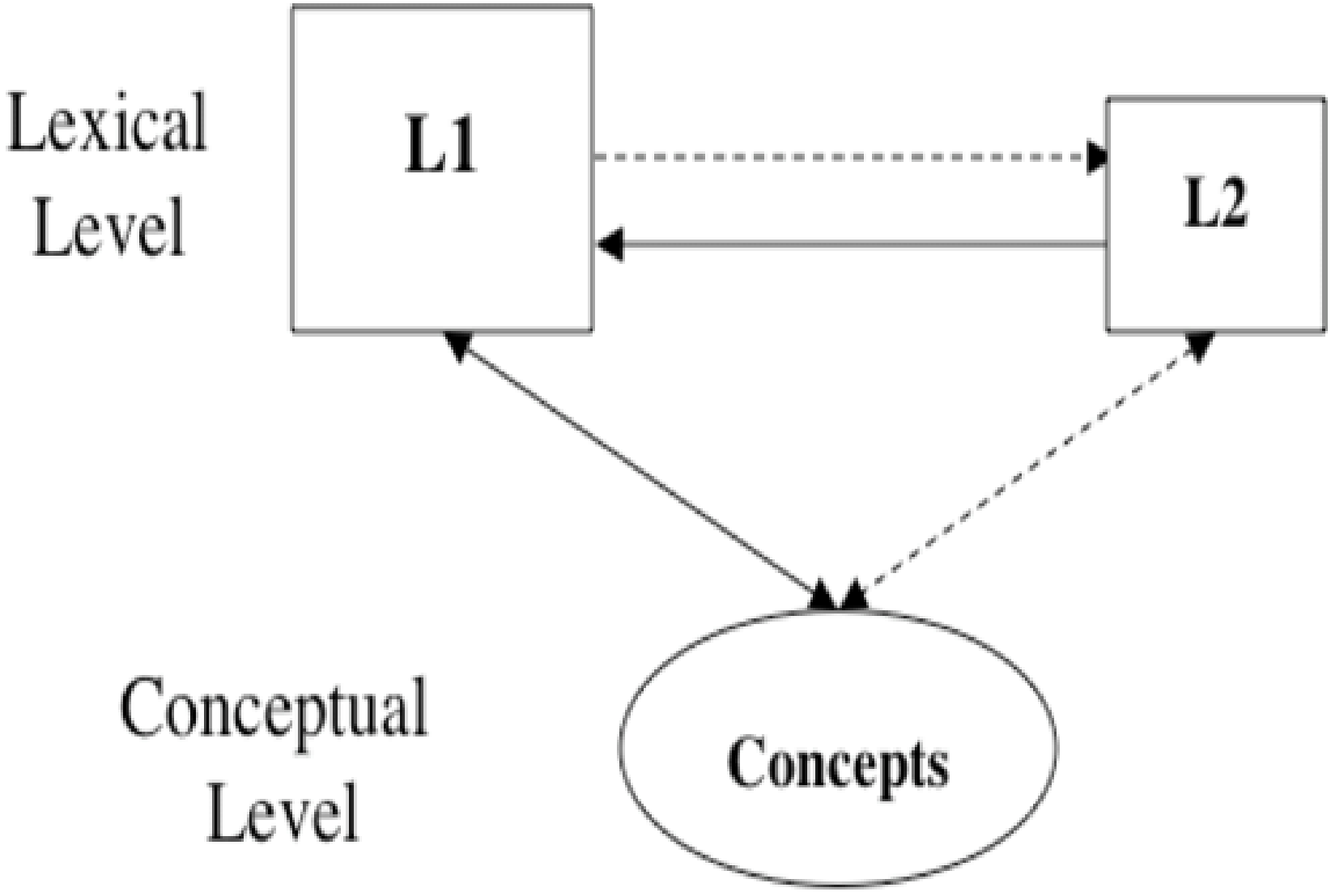
- Question: How do bilinguals represent the words they know in all their languages?
  - One possibility: Two separate lexicons; bilinguals (mostly) access meaning by accessing their L1 (Revised Hierarchical Model, Kroll & Stewart, 1994)

Revised Hierarchical Model

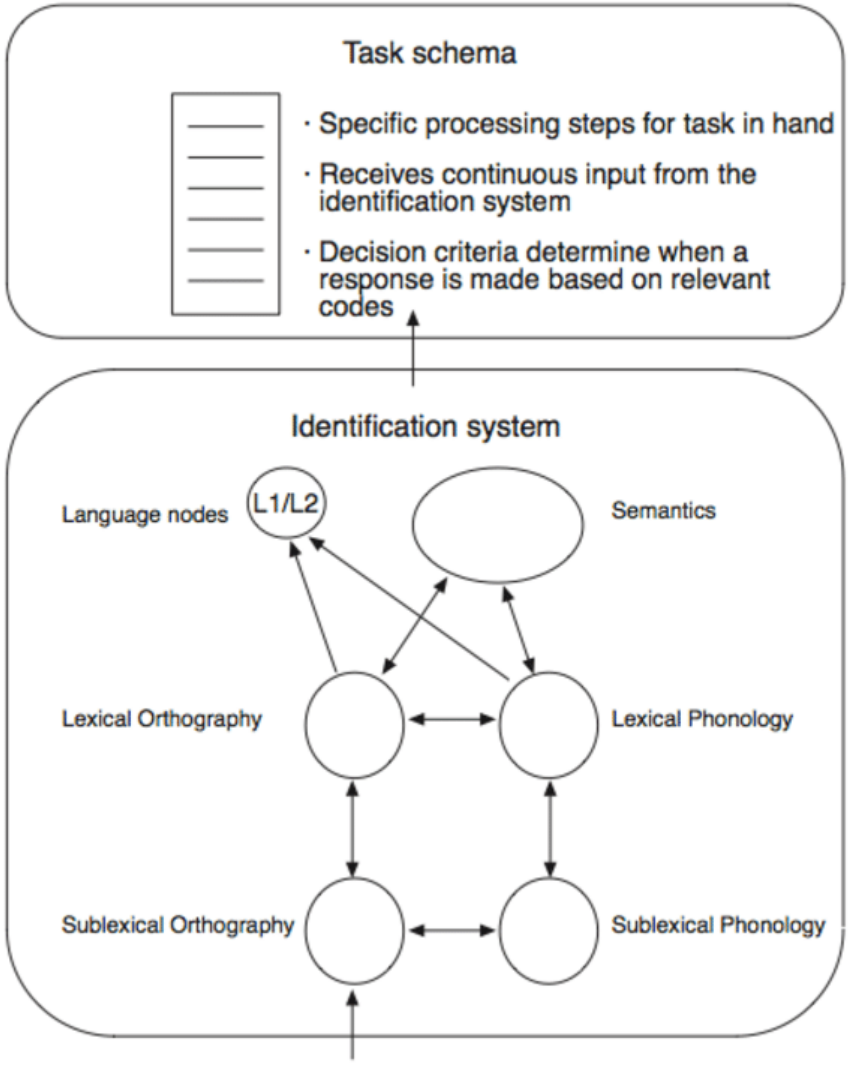


(figure from Basnight-Brown, 2014)

Introduction

- Alternative: Lexicons are not separate. Bilinguals can activate all their lexical representations at any time. Task demands determine which words are responded to (BIA+, Dijkstra and van Heuven, 2002)

Bilingual interactive activation model+



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    - Interlingual homographs (“false friends”) cause interference: e.g. “sensible” vs. “sensitive” for EN and ES/PT speakers
  - This suggests there are more direct connections between L2 words and meaning than there should be according to the Revised Hierarchical Model

Past eye movement results

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  - Libben & Titone (2009): Cognates facilitate processing and interlingual homographs (false friends) interfere with processing in both early and late L2 reading measures compared to control words

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  - Libben & Titone (2009): Cognates facilitate processing and interlingual homographs (false friends) interfere with processing in both early and late L2 reading measures compared to control words
  - Cognates processed faster in L2 reading (Cop, Dirix, Van Assche, Drieghe, Duyck, 2017) compared to control words

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- In many parts of the world, multilingualism is the norm!
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- The Revised Hierarchical Model cannot properly account for multilingualism
  - How would it work? L3 -> L2 -> L1 -> Concepts?
- The BIA+ could be extended more easily: just add more words and additional language nodes

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Predictions from an extended BIA+ model

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- Multilingual "false friends" (i.e. a letter string that is a cognate in two languages but not in the third, e.g. "sensible" in ES/PT vs. EN) should generate more interference than bilingual "false friends".
- ECEM 2017: Toassi, Mota, & Teixera (2017): Effect of triple cognates (Portuguese/Italian/German). Trilinguals process triple cognates faster than double cognates

Current study

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  - Is the cognate effect stronger in the presence of visual noise (more top-down processing?)
    - In other words, is it easier to process a cognate in the presence of visual noise than a control word?
  - For triple cognates, does it help you if you are good at all three languages or are two sufficient for the cognate effect?

Method

- Participants: 41 Portuguese-Spanish-English trilinguals in Ceará, Brazil reading 100 *English* (L3) sentences with embedded cognates/false friends or control words

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- Visual noise manipulation

Example cognates and controls

English	Portuguese	Spanish	English word frequency (per million)	False friend
actor	ator	actor	22.0	no
cereal	cereal	cereal	4.7	no
error	erro	error	41.2	no
piano	piano	piano	20.3	no
origin	origem	origen	31.9	no
security	segurança	seguridad	148.5	no
lecture	leitura	lectura	17.8	yes
advertising	advertência	advertencia	45.0	yes
computer	computador	computadora	144.5	yes
support	suporte	soporte	309.6	yes
date	data	dato	171.6	yes

Example stimuli

Cognate/False friend condition	Control condition	False friend?
Carl argued that his father's error was similar to his own.	Carl argued that his father's laugh was similar to his own.	FALSE
Bob saw that the piano was beautiful.	Bob saw that the bench was beautiful.	FALSE
They said that the origin could not be determined.	They said that the winner could not be determined.	FALSE
The neighbors said that the destruction came as a complete surprise.	The neighbors said that the improvement came as a complete surprise.	FALSE
They thought that their assumption would never be questioned.	They thought that their friendship would never be questioned.	FALSE
They said that the inspector was nervous during the trial.	They said that the plaintiff was nervous during the trial.	FALSE
Dan needed to call the qualified physician in order to solve his problem.	Dan needed to call the qualified gardeners in order to solve his problem.	TRUE
John said that the initial lecture helped with the rest of the research.	John said that the initial choices helped with the rest of the research.	TRUE
The boy's finger was hurt after the incident.	The boy's throat was hurt after the incident.	TRUE
An old ship carrying a bomb sank deep into the sea.	An old ship carrying a gift sank deep into the sea.	TRUE
While he was out with Jane, John worried about his actual girlfriend showing up.	While he was out with Jane, John worried about his lovely girlfriend showing up.	TRUE
The missionaries gave alms to the villagers so they could open a workshop.	The missionaries gave saws to the villagers so they could open a workshop.	TRUE

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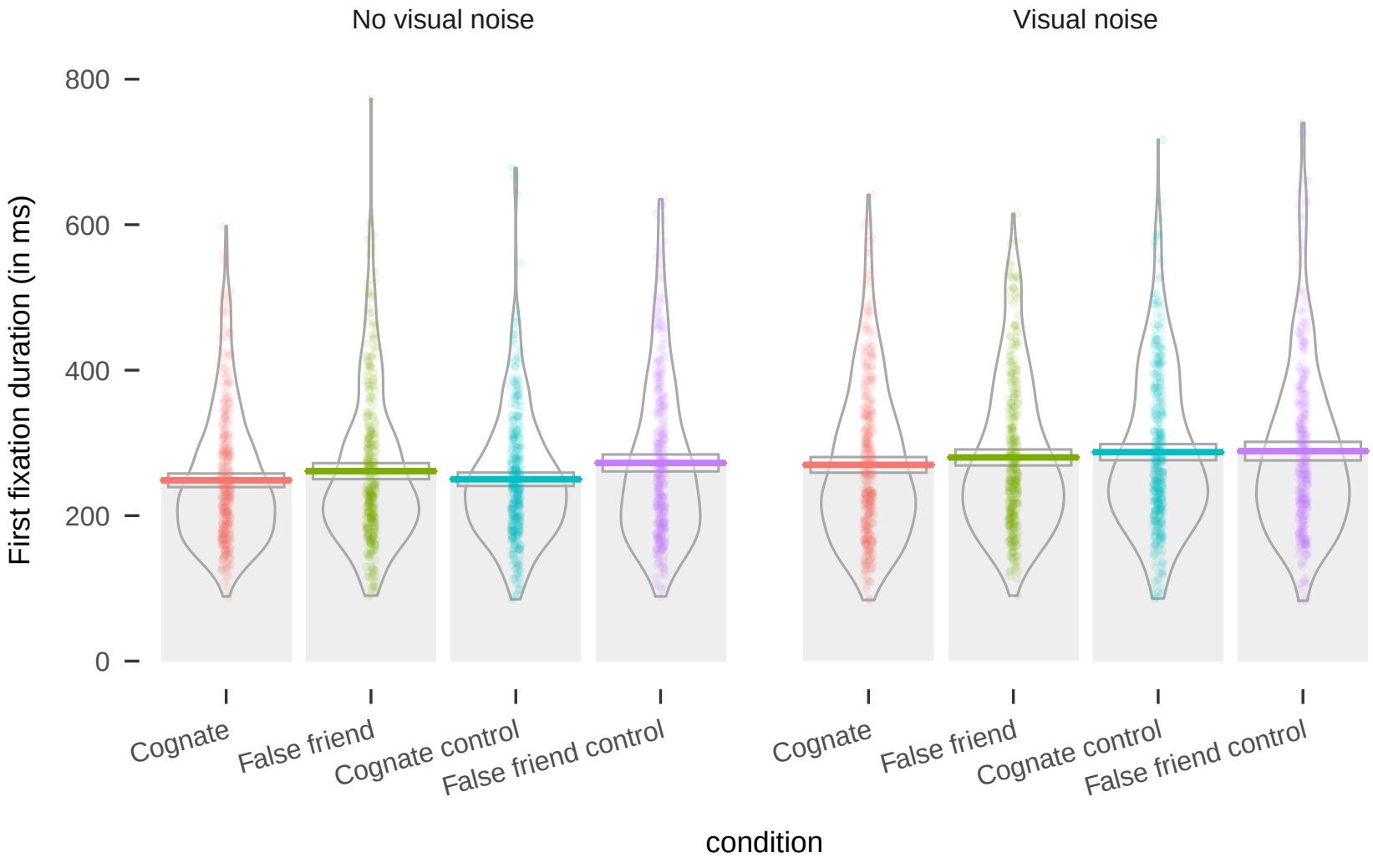
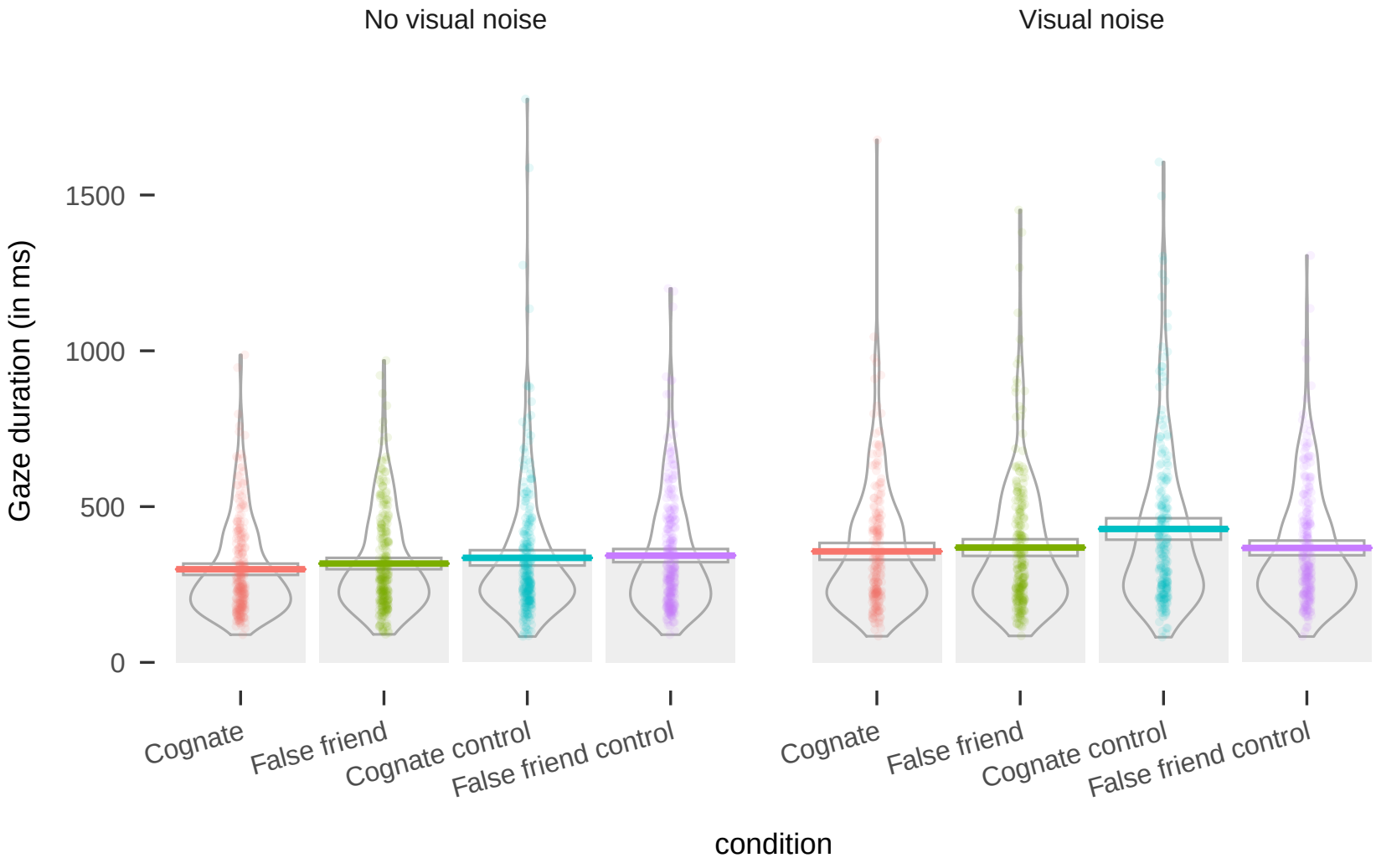
  - The effects of visual familiarity and of semantic overlap should be stronger in the presence of visual noise.
- If there is a greater advantage for triple cognates and a greater disadvantage for "double false friends":
  - Participants who are strong in all three languages should show a greater advantage for cognates and a greater disadvantage for false friends than those who are strong in only one of the languages

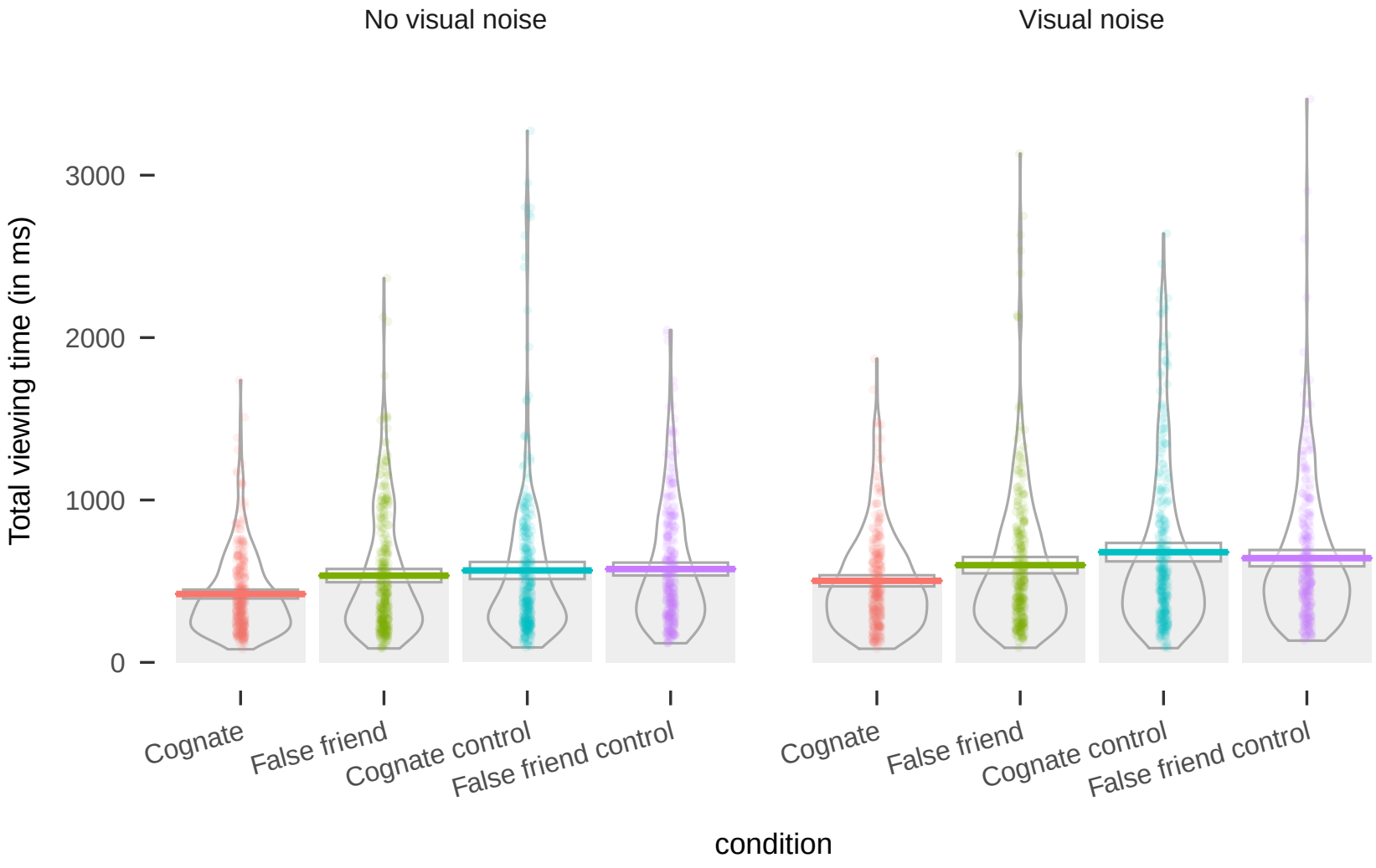
Results: First fixation duration



Results: Gaze duration



Results: Total viewing time



Effect of cognate condition and noise: First fixation duration (target word)

Effect	b	SE	t	df	p
Intercept	5.53	0.03	177.47	37.87	$< .001$
ConditionCognate vs Control	0.04	0.02	2.19	2,734.01	.029
ConditionControl vs False Friend Control	-0.03	0.02	-1.78	275.92	.075
ConditionTrue Cognate vs False Friend	0.00	0.01	0.24	2,733.92	.812
Noise	0.04	0.01	6.98	2,713.80	$< .001$
ConditionCognate vs Control by Noise	0.03	0.02	1.63	2,723.48	.103
ConditionControl vs False Friend Control by Noise	0.03	0.02	1.79	2,715.25	.073
ConditionTrue Cognate vs False Friend by Noise	0.02	0.01	1.71	2,716.95	.088

Effect of cognate condition and noise: Gaze duration (target word)

Effect	b	SE	t	df	p
Intercept	5.77	0.05	128.14	43.71	$< .001$
ConditionCognate vs Control	0.12	0.03	4.34	2,003.57	$< .001$
ConditionControl vs False Friend Control	0.06	0.04	1.51	164.80	.133
ConditionTrue Cognate vs False Friend	0.04	0.02	2.03	1,998.68	.043
Noise	0.09	0.01	9.11	2,005.86	$< .001$
ConditionCognate vs Control by Noise	0.02	0.03	0.89	1,997.10	.376
ConditionControl vs False Friend Control by Noise	0.06	0.03	2.42	1,999.27	.016
ConditionTrue Cognate vs False Friend by Noise	0.02	0.02	1.17	1,995.47	.240

Effect of cognate condition and noise: Total viewing time (target word)

Effect	b	SE	t	df	p
Intercept	6.18	0.06	103.73	47.33	$< .001$
ConditionCognate vs Control	0.20	0.03	7.05	2,397.40	$< .001$
ConditionControl vs False Friend Control	-0.04	0.05	-0.72	133.42	.470
ConditionTrue Cognate vs False Friend	0.04	0.02	2.11	2,400.37	.035
Noise	0.09	0.01	8.45	2,398.75	$< .001$
ConditionCognate vs Control by Noise	0.00	0.03	-0.02	2,396.56	.987
ConditionControl vs False Friend Control by Noise	0.03	0.03	1.01	2,393.98	.312
ConditionTrue Cognate vs False Friend by Noise	0.00	0.02	0.08	2,396.56	.937

Hypotheses revisited: Part 1

- Target words that are visually familiar (cognates/false friends) *are indeed* processed faster than those that are unfamiliar (control words) in both early and late measures

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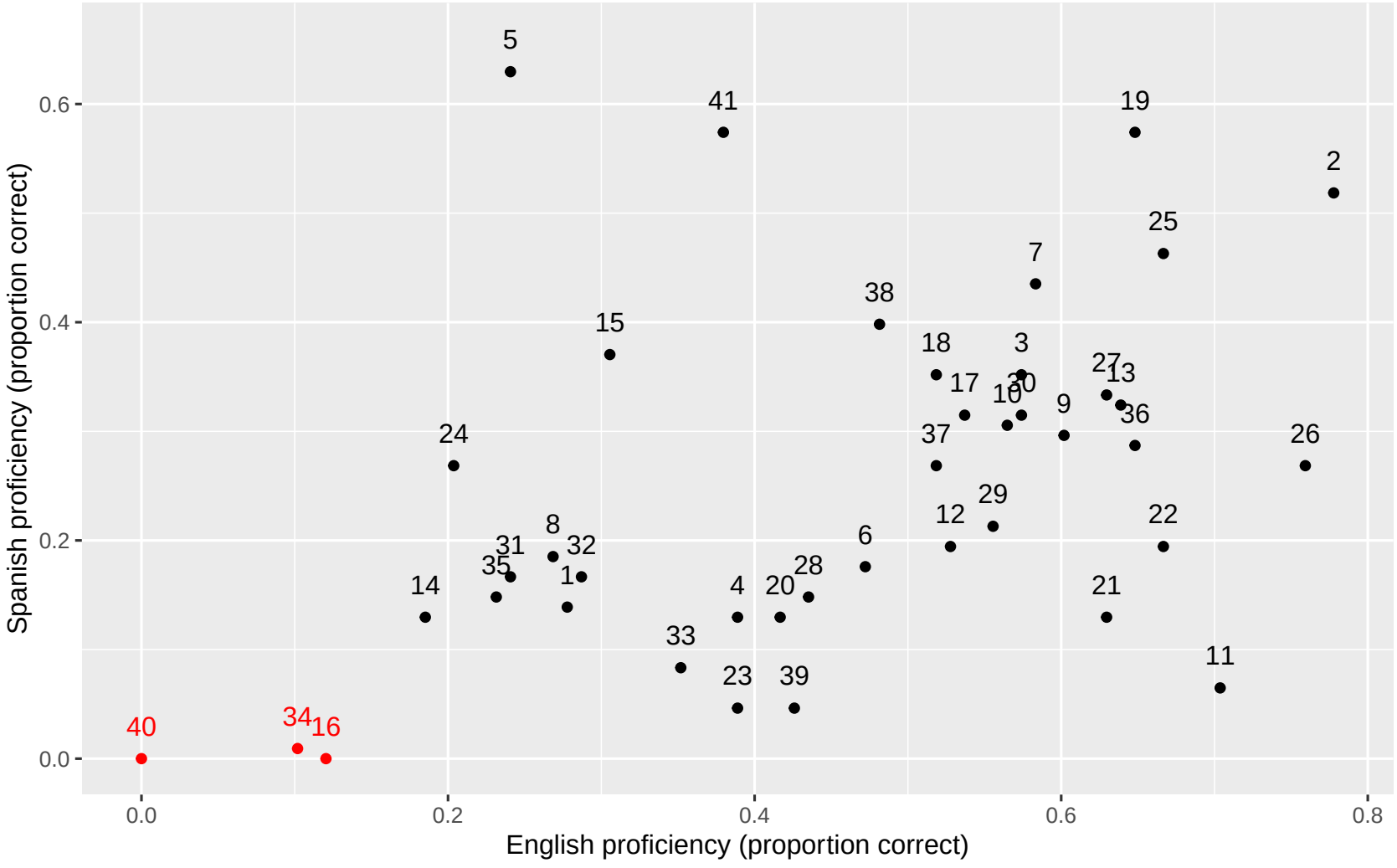
- Target words that are visually familiar (cognates/false friends) *are indeed* processed faster than those that are unfamiliar (control words) in both early and late measures
- Semantic overlap effects (false friend interference) *only occur* in late measures (TVT)
- Visual noise slows down processing in general, but it doesn't see to increase top-down reliance on lexical memory

Participant proficiency



We excluded participants 16, 34, 40 because of very low English and Spanish proficiency

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- Since all the target words are true cognates between Portuguese and Spanish, participants with high Spanish proficiency should process the target words faster (but not the control words)
- Semantic overlap effects (false friend interference) should be stronger for participants who are highly proficient in Spanish

Proficiency effects: First fixation duration (target word)

Effect	b	SE	t	df	p
Intercept	5.53	0.03	195.12	35.34	< .001
ConditionCognate vs Control	0.03	0.02	1.93	2,744.53	.054
ConditionControl vs False Friend Control	-0.03	0.02	-1.67	308.90	.095
ConditionTrue Cognate vs False Friend	0.00	0.01	0.16	2,741.93	.876
English	-0.60	0.17	-3.50	34.00	.001
Spanish	0.19	0.19	1.01	34.20	.319
Noise	0.04	0.01	6.81	2,700.10	< .001
ConditionCognate vs Control by English	0.08	0.11	0.72	2,700.13	.471
ConditionControl vs False Friend Control by English	0.13	0.11	1.19	2,705.56	.233
ConditionTrue Cognate vs False Friend by English	-0.02	0.08	-0.31	2,707.37	.754
ConditionCognate vs Control by Spanish	0.11	0.12	0.91	2,698.21	.364
ConditionControl vs False Friend Control by Spanish	0.05	0.13	0.37	2,700.53	.708
ConditionTrue Cognate vs False Friend by Spanish	0.08	0.09	0.84	2,708.38	.402
English by Spanish	-0.81	1.06	-0.76	34.48	.450
ConditionCognate vs Control by Noise	0.03	0.02	1.41	2,708.53	.160
ConditionControl vs False Friend Control by Noise	0.03	0.02	1.72	2,700.23	.086
ConditionTrue Cognate vs False Friend by Noise	0.02	0.01	1.23	2,700.60	.218
English by Noise	-0.02	0.04	-0.45	2,762.73	.652
Spanish by Noise	0.04	0.05	0.90	2,740.06	.369
ConditionCognate vs Control by English by Spanish	0.32	0.68	0.47	2,761.99	.638
ConditionControl vs False Friend Control by English by Spanish	-0.19	0.73	-0.25	2,746.48	.800
ConditionTrue Cognate vs False Friend by English by Spanish	0.05	0.51	0.09	2,763.90	.926
ConditionCognate vs Control by English by Noise	-0.07	0.11	-0.65	2,763.37	.514
ConditionControl vs False Friend Control by English by Noise	-0.26	0.11	-2.33	2,761.60	.020
ConditionTrue Cognate vs False Friend by English by Noise	-0.03	0.08	-0.37	2,762.48	.710
ConditionCognate vs Control by Spanish by Noise	0.09	0.12	0.77	2,745.54	.439
ConditionControl vs False Friend Control by Spanish by Noise	0.15	0.13	1.15	2,737.97	.249

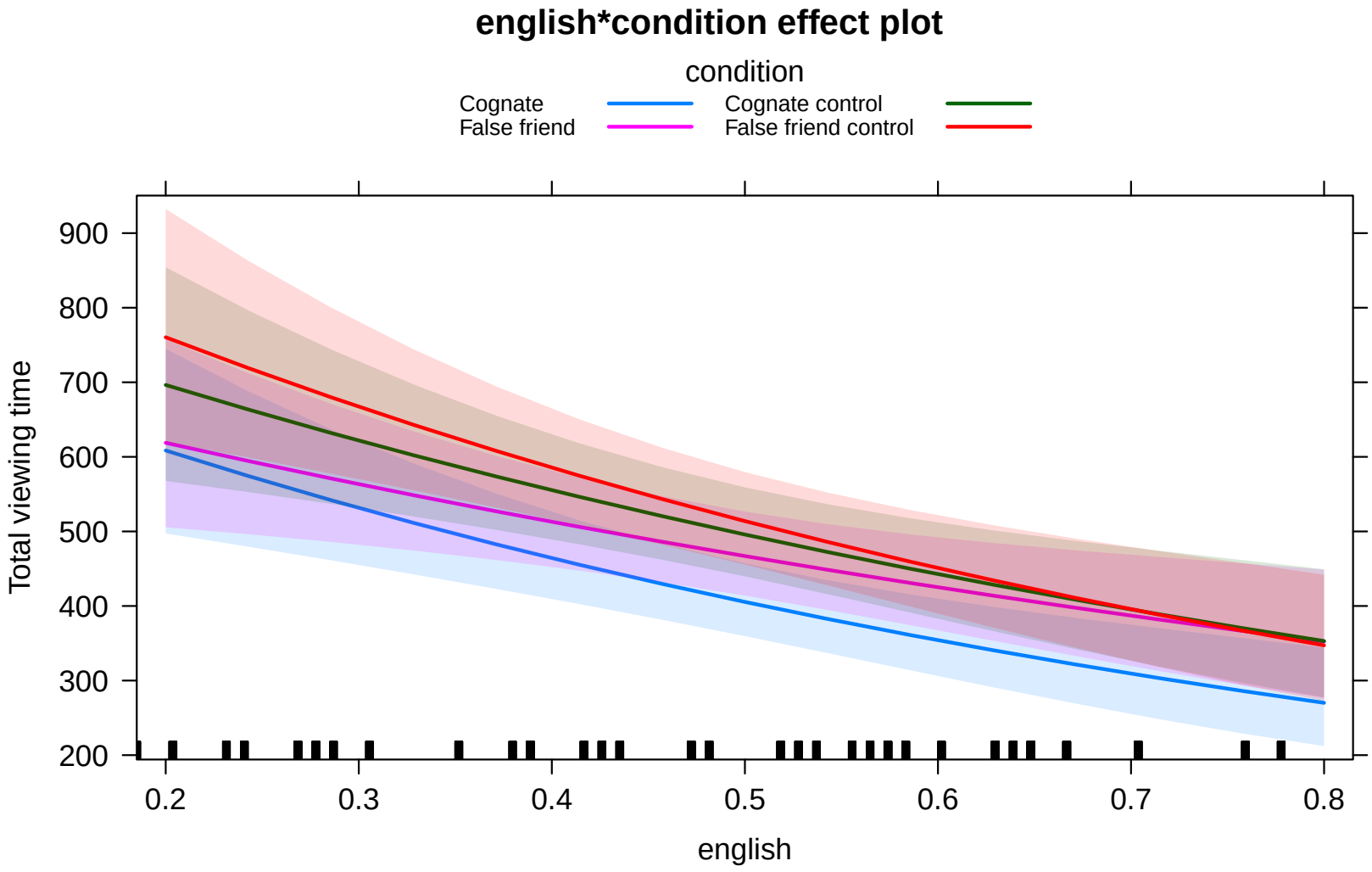
Effect of proficiency: Gaze duration (target word)

Effect	b	SE	t	df	p
Intercept	5.76	0.04	140.66	41.77	< .001
ConditionCognate vs Control	0.12	0.03	4.19	1,985.52	< .001
ConditionControl vs False Friend Control	0.06	0.04	1.46	179.91	.145
ConditionTrue Cognate vs False Friend	0.03	0.02	1.60	1,982.16	.110
English	-0.89	0.23	-3.80	33.55	.001
Spanish	0.05	0.27	0.17	33.80	.864
Noise	0.09	0.01	8.90	1,987.90	< .001
ConditionCognate vs Control by English	-0.18	0.17	-1.06	1,972.90	.288
ConditionControl vs False Friend Control by English	-0.09	0.17	-0.56	1,991.30	.574
ConditionTrue Cognate vs False Friend by English	-0.01	0.12	-0.06	1,970.74	.952
ConditionCognate vs Control by Spanish	0.31	0.19	1.60	1,969.34	.110
ConditionControl vs False Friend Control by Spanish	-0.19	0.19	-0.98	1,969.42	.329
ConditionTrue Cognate vs False Friend by Spanish	-0.08	0.14	-0.56	1,968.58	.575
English by Spanish	-1.41	1.45	-0.98	34.39	.335
ConditionCognate vs Control by Noise	0.03	0.03	1.05	1,979.78	.296
ConditionControl vs False Friend Control by Noise	0.06	0.03	2.04	1,979.43	.042
ConditionTrue Cognate vs False Friend by Noise	0.01	0.02	0.72	1,978.33	.469
English by Noise	-0.04	0.06	-0.64	2,012.40	.524
Spanish by Noise	-0.04	0.07	-0.57	2,004.05	.571
ConditionCognate vs Control by English by Spanish	0.06	1.09	0.05	2,004.42	.959
ConditionControl vs False Friend Control by English by Spanish	0.10	1.11	0.09	1,983.79	.930
ConditionTrue Cognate vs False Friend by English by Spanish	0.49	0.79	0.62	1,999.26	.535
ConditionCognate vs Control by English by Noise	-0.13	0.17	-0.74	2,026.23	.459
ConditionControl vs False Friend Control by English by Noise	-0.22	0.17	-1.30	2,011.83	.194
ConditionTrue Cognate vs False Friend by English by Noise	0.06	0.12	0.49	2,017.64	.625
ConditionCognate vs Control by Spanish by Noise	0.17	0.20	0.88	1,995.50	.380
ConditionControl vs False Friend Control by Spanish by Noise	-0.06	0.19	-0.32	1,992.92	.752

Effect of proficiency: Total viewing time (target word)

Effect	b	SE	t	df	p
Intercept	6.18	0.05	116.78	49.19	< .001
ConditionCognate vs Control	0.20	0.03	6.14	2,388.19	< .001
ConditionControl vs False Friend Control	-0.04	0.05	-0.71	152.46	.482
ConditionTrue Cognate vs False Friend	0.05	0.02	2.06	2,387.31	.040
English	-1.18	0.30	-4.00	35.33	< .001
Spanish	0.41	0.33	1.24	36.20	.224
Noise	0.09	0.01	7.68	2,384.25	< .001
ConditionCognate vs Control by English	0.22	0.20	1.12	2,378.60	.264
ConditionControl vs False Friend Control by English	0.17	0.20	0.85	2,378.86	.395
ConditionTrue Cognate vs False Friend by English	0.30	0.14	2.15	2,376.11	.032
ConditionCognate vs Control by Spanish	-0.26	0.24	-1.07	2,390.46	.283
ConditionControl vs False Friend Control by Spanish	-0.32	0.25	-1.30	2,381.61	.193
ConditionTrue Cognate vs False Friend by Spanish	-0.30	0.17	-1.75	2,386.01	.080
English by Spanish	-2.52	1.83	-1.38	38.11	.177
ConditionCognate vs Control by Noise	0.00	0.03	-0.10	2,387.44	.923
ConditionControl vs False Friend Control by Noise	0.03	0.03	0.84	2,375.62	.399
ConditionTrue Cognate vs False Friend by Noise	0.00	0.02	-0.12	2,386.14	.905
English by Noise	-0.01	0.07	-0.15	2,416.92	.881
Spanish by Noise	-0.13	0.09	-1.55	2,391.27	.122
ConditionCognate vs Control by English by Spanish	0.63	1.39	0.45	2,388.14	.652
ConditionControl vs False Friend Control by English by Spanish	-0.02	1.43	-0.02	2,377.54	.986
ConditionTrue Cognate vs False Friend by English by Spanish	-0.45	0.99	-0.45	2,384.57	.649
ConditionCognate vs Control by English by Noise	0.02	0.20	0.11	2,429.64	.909
ConditionControl vs False Friend Control by English by Noise	-0.11	0.20	-0.57	2,416.79	.572
ConditionTrue Cognate vs False Friend by English by Noise	0.15	0.14	1.06	2,427.10	.290
ConditionCognate vs Control by Spanish by Noise	-0.11	0.25	-0.46	2,406.22	.646
ConditionControl vs False Friend Control by Spanish by Noise	-0.07	0.25	-0.28	2,378.01	.778

Effect of English proficiency: Total viewing time



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Conclusions

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- For highly proficient readers, the semantic overlap between the visually familiar words becomes much more important in later processing
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- Are trilinguals better people?

Thank you very much.

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- Questions? Preguntas? Perguntas?