

The status of Slavic lexical prefixes in mental grammar

EVIDENCE FROM PRIMING IN BOSNIAN/CROATIAN/MONTENEGRIN/SERBIAN

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THE TALK IN A NUTSHELL

- Our goal was to address the following question:

Do speakers of BCMS treat opaque lexically-prefixed verbs like (1b) as decomposable into two morphemes?

(1)	a. raditi	b. za-raditi novac
	work	LP-work money
	'work'	'earn money'

- To investigate this question, we conducted a morphological priming experiment
- We did not find evidence for genuine morphological priming with opaque lexically-prefixed verbs

ROADMAP

- Context (Slavic prefixes)
- Context (morphological priming)
- Method
- Results
- Discussion

SLAVIC VERBAL PREFIXES (IN GENERATIVE SYNTAX)

- (2) a. raditi → za-raditi novac b. plivati → za-plivati
 work LP-work money swim SLP-swim
 'work' 'earn money' 'swim' 'start swimming'

Lexical prefixes: do not have a stable meaning, can alter the meaning of the verb stem, can alter the telicity/event complexity of the verb stem, ...

Superlexical prefixes: have a stable meaning, cannot alter the meaning of the verb stem, cannot alter the telicity/event complexity of the verb stem, ...

(e.g., Babko-Malaya 1999, Milićević 2004, Svenonius 2004, DiScuillo & Slabakova 2005, Arsenijević 2006, 2007, Ramchand 2008, Łazorczyk 2010, Tatevosov 2008, 2011, to appear, i.a.)

OUR STUDY IN CONTEXT (PREFIXES)

The received view: Verbal prefixes are syntactically decomposable (like in Germanic)

Little is agreed upon beyond this: evidence is usually given for specific (conflicting) analyses of the prefixes' syntax (see Tatevosov to appear for a recent overview)

- roots, functional heads, adjuncts, specifiers, or instances of concord morphology?
- complements of V/root, adjoined to V/root, or in a functional projection outside of VP?

There are comparatively fewer arguments for syntactic decomposition as such, and they remain subject to debate (see Appendix A)

OUR STUDY IN CONTEXT (PREFIXES)

Our study aims to probe the issue experimentally, specifically for non-transparently prefixed verbs

- | | | |
|---------------|----------------------|--------------|
| (3) a. baciti | b. pod-baciti | c. u-baciti |
| throw | LP-throw | LP-throw |
| 'throw' | 'fail' | 'throw into' |

Do BCMS speakers process non-transparent lexical prefixes as morphemes separate from their stems?

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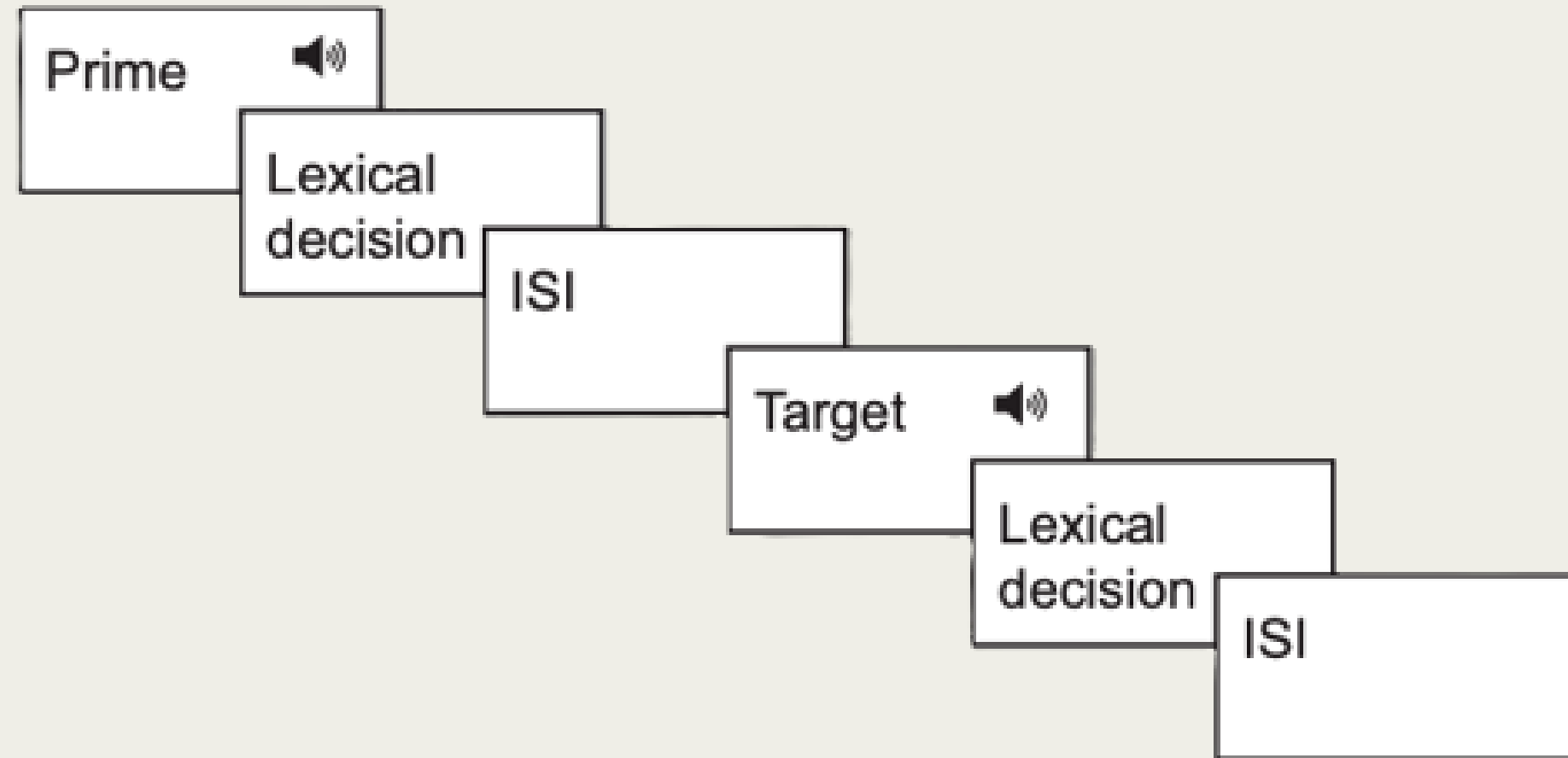
OUR STUDY IN CONTEXT (PRIMING)

Relatedness: *play* and *played* have shared form (partial overlap) and shared meaning

- so do *unbox* and *unplug*
- Do they also share an abstract morphological representation?
- Many (though not all) modern theories agree that they do
 - for all sorts of reasons we do not go into here (e.g., form-meaning mismatches)
- How can we get evidence that *play/played* are related independently of form and meaning?
- One possibility: **morphological priming**

Is word processing modulated (facilitated) by prior exposure to a morphologically related item?

OUR STUDY IN CONTEXT (PRIMING)



Unmasked **auditory** continuous
lexical decision task

auditory processing = incremental

visual processing = beginning and end
of word processed from the start

- Auditory presentation mitigates pre-lexical morpho-orthographic decomposition effects (cf. Feldman, Barac-Cikoja & Kostić 2002, Nikolova & Jarema 2002, Kazanina 2011)

OUR STUDY IN CONTEXT (PRIMING)

Ex. Creemers et al. 2020, morphological priming in Dutch prefixed verbs

Target	MS prime	M prime	Ph prime	C prime
<i>bieden</i> 'offer'	<i>aanbieden</i> 'offer'	<i>verbieden</i> 'forbid'	<i>bespieden</i> 'spy'	<i>opjagen</i> 'hurry, rush'
<i>schieten</i> 'shoot'	<i>beschieten</i> 'fire on/at'	<i>opschieten</i> 'hurry up'	<i>begieten</i> 'pour over'	<i>bezoeken</i> 'visit'
<i>werpen</i> 'throw'	<i>afwerpen</i> 'throw off'	<i>ontwerpen</i> 'design'	<i>aanscherpen</i> 'sharpen'	<i>uitdraaien</i> 'print out'

MS = morpho-semantic (transparent)

M = morphological (opaque)

P = phonological (rhyme prime)

C = control (unrelated)

- **Relevant finding:** significant priming in the MS and M (but not P) conditions compared to C
- **Their conclusion:** priming in M is driven by morphological relatedness of M prime and target stem

OUR STUDY IN CONTEXT (PRIMING)

- Along with trying to better understand the status of lexical prefixes in BCMS, we had a few additional goals aimed at improving experimental control
 - cleaner phonological controls = full overlap with phonological material of the stem (rather than rhyme prime)
 - pseudo-morphological condition = apparent prefix+stem combination, but there is independent evidence to the contrary
- Previous work on auditory processing has found differences in priming between genuinely affixed words and pseudo-affixed words (Creemers et al. 2023)
- If the priming effect is larger for lexically prefixed verbs than for pseudo-prefixed items, we can be confident that it reflects a genuine morphological relationship rather than other confounding factors

ROADMAP

- Context (Slavic prefixes)
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EXPERIMENTAL ITEMS

Prime-target relations:

i) Morphologically and semantically related (MS) :	<i>u-bacio</i> 'threw into'	<i>bacio</i> 'threw'
ii) Morphologically related, semantically opaque (M) :	<i>za-činio</i> 'spiced up'	<i>činio</i> 'did'
iii) Pseudo-morphologically related (PM) :	<i>po-mogao</i> 'helped'	<i>mogao</i> 'could'
iv) Phonologically related (P) :	<i>ugradio</i> 'installed'	<i>radio</i> 'worked'
v) Controls (C):	<i>iskočio</i> 'jumped out'	<i>radio</i> 'worked'

EXPERIMENTAL ITEMS

iii) Pseudo-morphologically related (PM) :

po-mogao
'helped'

mogao
'could'

(4) a. *pomogn-em*
help-1SG.PRES
'I help'

b. *mog-u*
can-1SG.PRES
'I can'

(cf. **pomog-u*/**mogn-em*)

EXPERIMENTAL ITEMS

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v) Controls (C):	<i>iskočio</i> 'jumped out'	<i>radio</i> 'worked'

METHOD

Balanced incomplete block design

Target	MS	M	PM	P	C
stao	zastao	pristao		blistao	preterao
našao	pronašao	snašao	ponašao		zabranio
radio	uradio	zaradio		ugradio	iskočio
dao			nadao	vladao	izmerio

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-
-

METHOD

- N = 138
- (Unmasked) auditory continuous lexical decision task
- 4 lists, 30 critical item pairs per list (5 per critical condition + 10 controls)
- 200 filler pairs (50% real words and 50% non-words)

DATA CLEANING

- Exclusion (18.4%):
 - 3 Participants whose filler accuracy lower than 80% were excluded
 - 3 Primes and 1 Target whose overall accuracy across participants lower than 50% were excluded
 - Target RTs shorter than 250 ms and longer than 2500ms were excluded

ANALYSIS

- Bayesian linear mixed-effect model fitted to RT assuming lognormal distribution using STAN
- Predictors:
 - Prime Condition (treatment-coded, reference: Control)
 - Continuous Control predictors: Trial Number, Prime Duration, Target Duration, Prime RT, ISI
 - all centered and logged
- Maximal random effects: all slopes by participant and item
- Informed priors by Creemers et al. (2020)
- Effects reported in milliseconds (smaller number=faster)

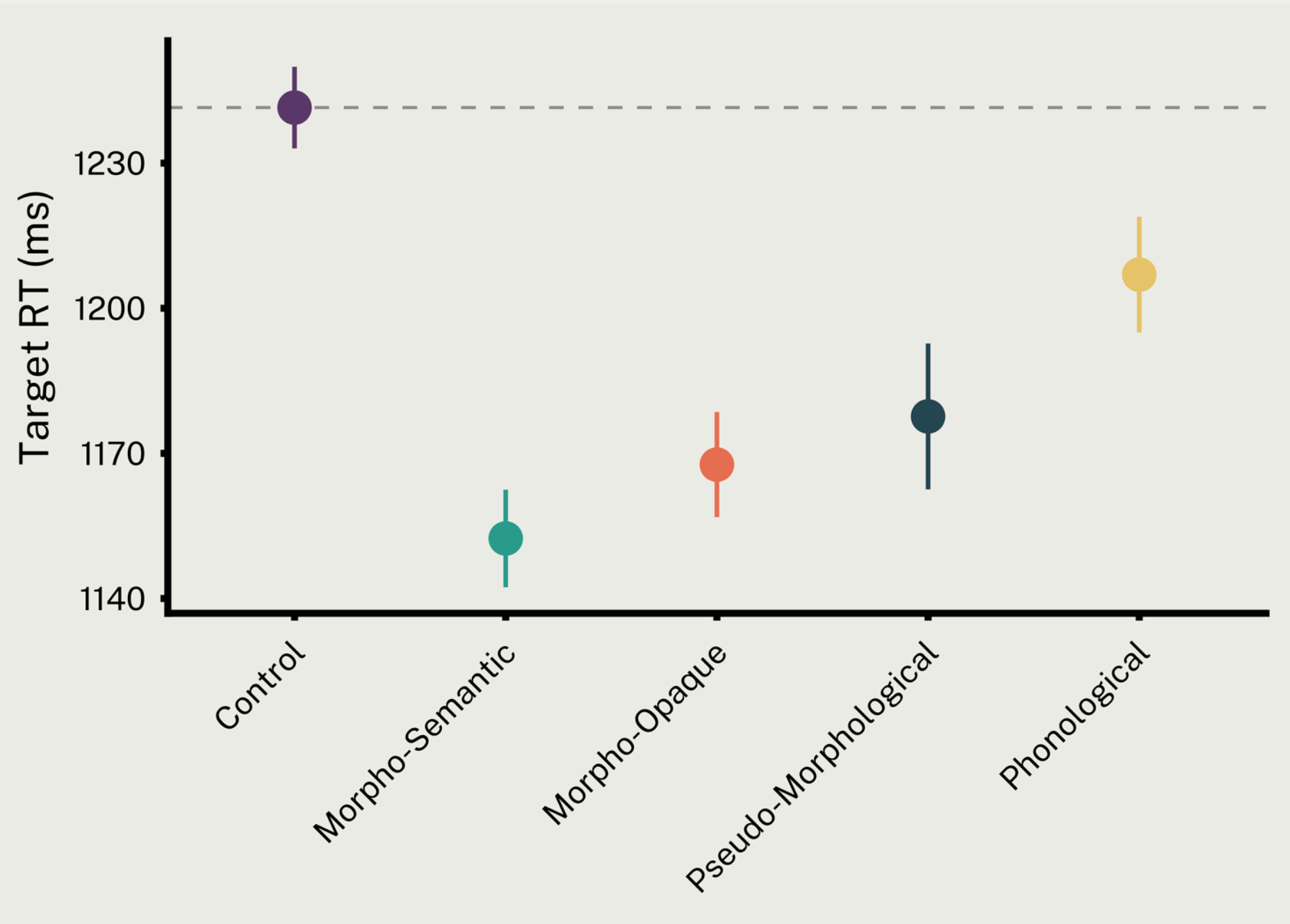
ANALYSIS

- We report our confidence that the effect goes in the claimed direction ($P(\beta < 0)$)
 - **Important:** Bayesian analysis does not report whether an effect exist, it estimates its distribution
 - Since our models are conservative, effects with >89% posterior probability are treated as credible

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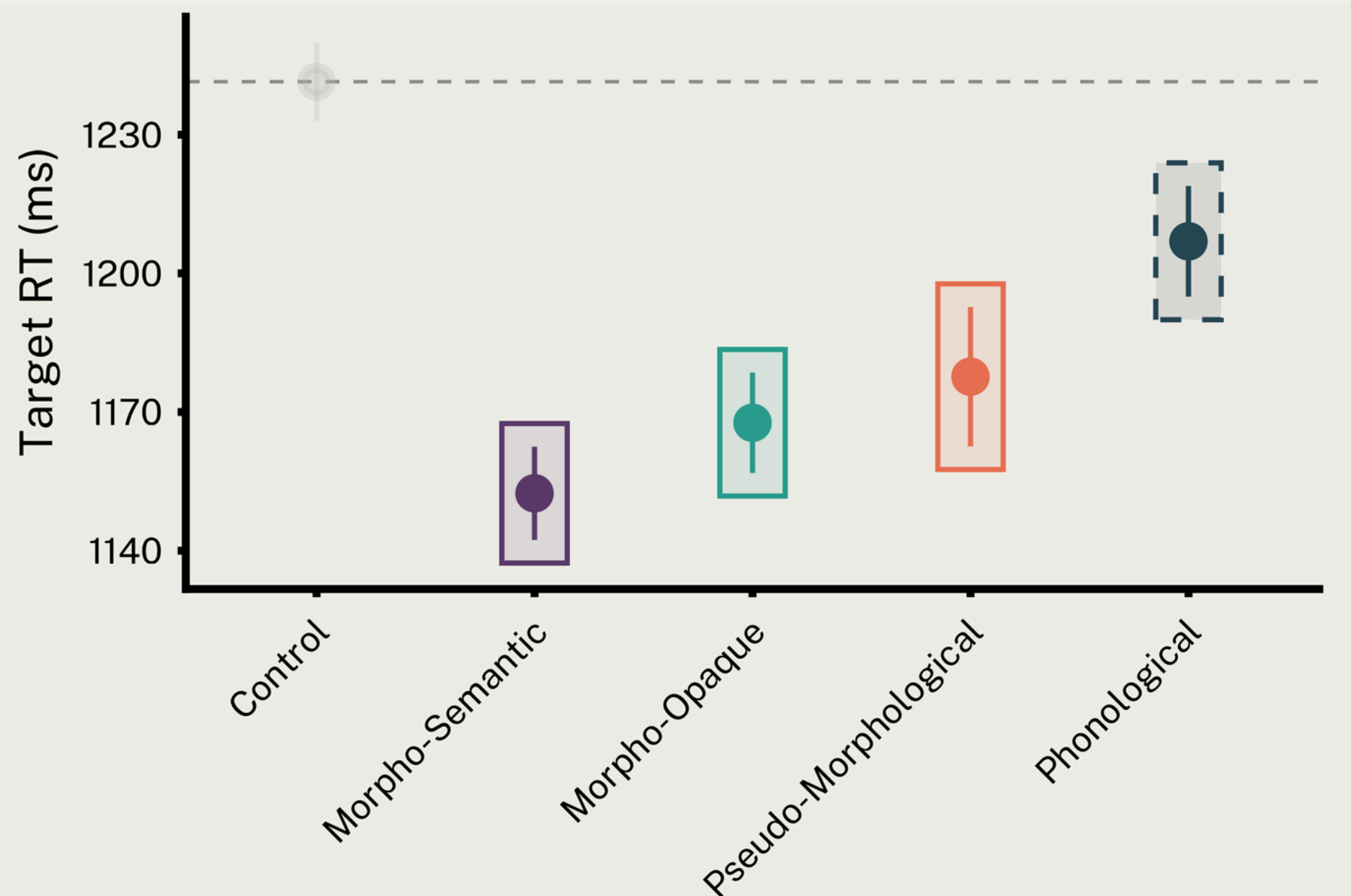
RESULTS: COMPARISON AGAINST CONTROL



Mean ± 1 SE

- ✓ P: $\beta = -51.2 \text{ ms}$, $CI[-101.6, 4.1]$, $P(\beta < 0) = 0.967$
- ✓ PM: $\beta = -68.4 \text{ ms}$, $CI[-122.3, -10.0]$, $P(\beta < 0) = 0.986$
- ✓ MO: $\beta = -87.6 \text{ ms}$, $CI[-121.0, -54.8]$, $P(\beta < 0) = > .999$
- ✓ MS: $\beta = -110.0 \text{ ms}$, $CI[-143.2, -75.6]$, $P(\beta < 0) = > .999$

RESULTS: COMPARISON AGAINST PHONOLOGICAL

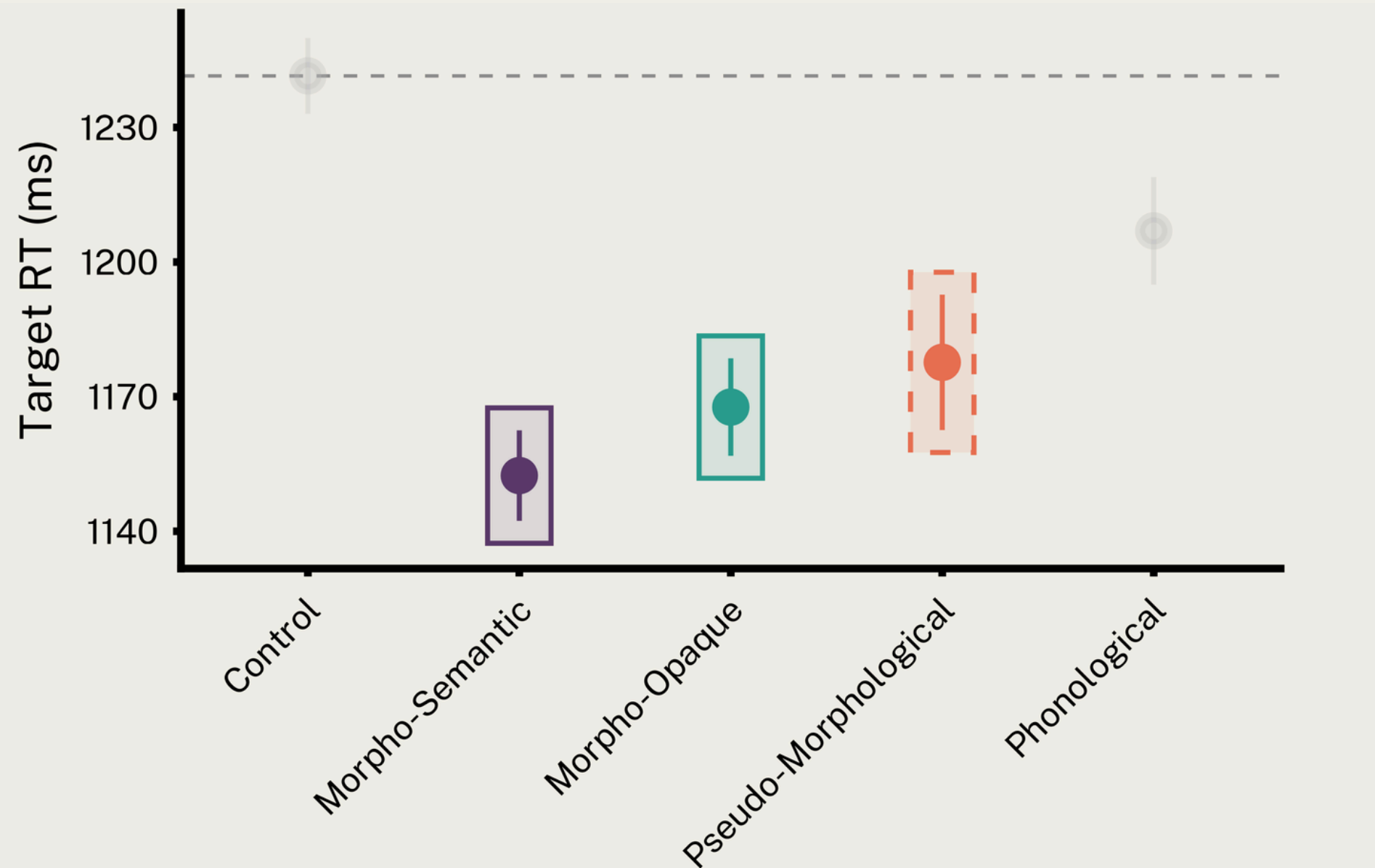


✓ **MS** $\Delta = -58.8 \text{ ms}$, $CI[-119.8, -2.2]$, $P(\Delta < 0) = 0.979$

✓ **MO** $\Delta = -36.4 \text{ ms}$, $CI[-96.9, 19.8]$, $P(\Delta < 0) = 0.896$

✗ **PM** $\Delta = -17.2 \text{ ms}$, $CI[-88.8, 57.6]$, $P(\Delta < 0) = 0.688$

RESULTS: COMPARISON AGAINST PSEUDO-MORPH

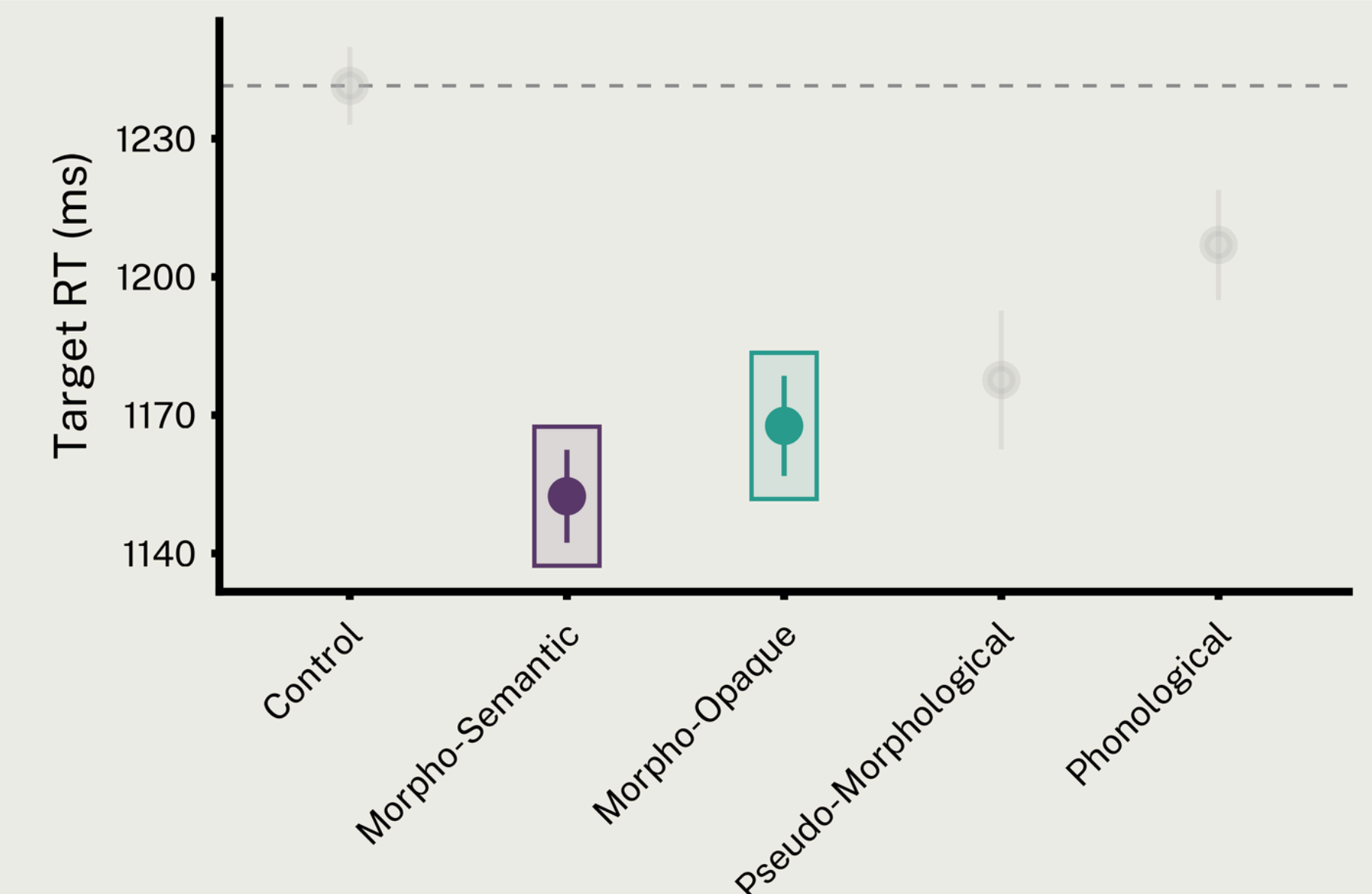


✗ P $\Delta = -17.2 \text{ ms}$, $CI[-88.8, 57.6]$, $P(\Delta < 0) = 0.688$

✓ MS $\Delta = -41.6 \text{ ms}$, $CI[-107.0, 20.3]$, $P(\Delta < 0) = 0.91$

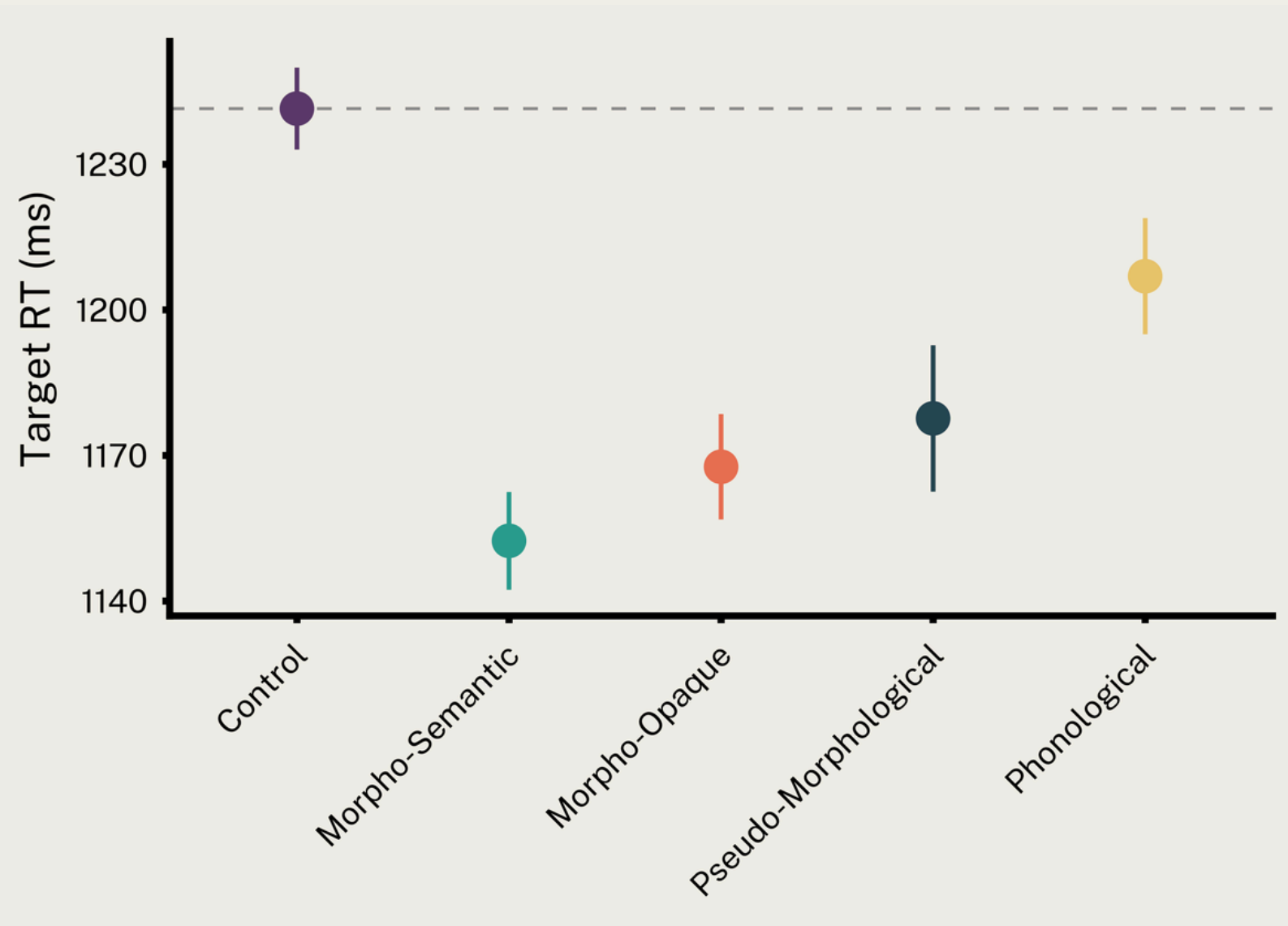
✗ MO $\Delta = -19.3 \text{ ms}$, $CI[-86.3, 41.9]$, $P(\Delta < 0) = 0.731$

RESULTS: MORPHO-SEMANTIC VS. MORPHO-OPAQUE



MS
vs. **MO**
 $\Delta = -22.4 \text{ ms}, CI[-64.5, 20.2], P(\Delta < 0) = 0.858$

RESULTS

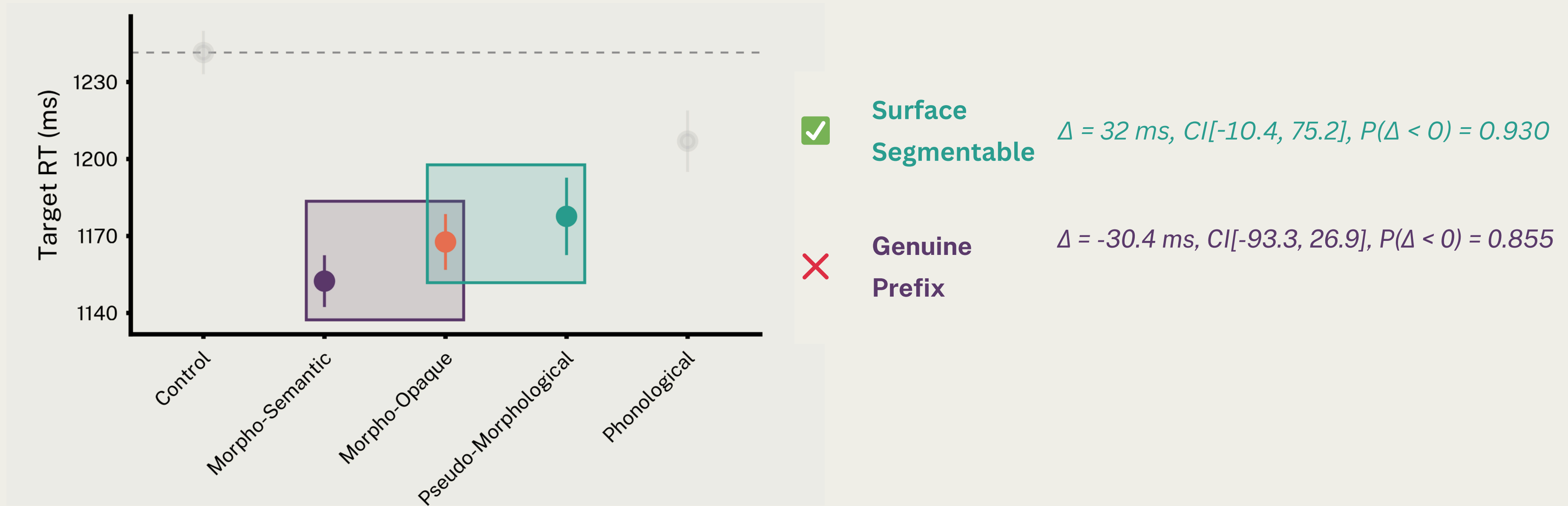


Comparison

Comparison	P(D < 0)
Morpho-Semantic vs. Phonological	0.979
Morpho-Semantic vs. Pseudo-Morphological	0.910
Morpho-Opaque vs. Phonological	0.896
Morpho-Semantic vs. Morpho-Opaque	0.858
Morpho-Opaque vs. Pseudo-Morphological	0.731
Pseudo-Morphological vs. Phonological	0.688

- Qualitatively MO looks indistinguishable from either MS or PM
- Do we have any quantitative evidence for distinguishing MO from PM or MS?

RESULTS: EVIDENCE FOR MO+PM VS. MS



ROADMAP

- Context (Slavic prefixes)
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RESULTS: SUMMARY

- Answering our main question: We do not see LPs being processed differently than pseudo-prefixes
 - Morpho-Opaque and Pseudo-Morphological conditions are not credibly distinguishable
- All manipulations including Phonological Primes facilitate target recognition vs. Control
- **Upshot: The facilitatory effect tracks apparent morphological structure**
 - not semantic relatedness or phonological overlap alone
 - likely not only genuine morphological structure

DISCUSSION

- Our results potentially pose significant questions for the study of lexical prefixes, priming studies, and models of spoken word recognition:
- **Prefixes:**
 - What is the analytical evidence for decomposition of opaque lexical prefixes evidence for?
 - Do we have sufficient additional (syntactic) evidence for the decomposition of transparent prefixes?

DISCUSSION

- Our results potentially pose significant questions for the study of lexical prefixes, priming studies, and models of spoken word recognition:
- **Priming studies:**
 - What evidence do studies of morphological priming give for genuine morphological decomposition?
 - Might they be revealing the effects of surface decomposability (+semantics) instead?

DISCUSSION

- Our results potentially pose significant questions for the study of lexical prefixes, priming studies, and models of spoken word recognition:
- **Models of spoken word recognition:**
 - Our results show significant priming in the PM and P conditions
 - How can we reconcile this with models like TRACE (McClelland & Elman, 1986) and Short-list (Norris, 1994) which state that disfavoured competing lexical items should be inhibited?

WRAPPING UP

- We conducted an auditory priming study asking whether opaquely-prefixed verbs in BCMS prime their corresponding stems more than pseudo-prefixed verbs
- We did not find evidence that opaquely- and pseudo-prefixed verbs are processed differently
- Our results have potential implications for our understanding of lexical prefixes, priming studies, and models of spoken word recognition

SPECIAL THANKS



David Embick



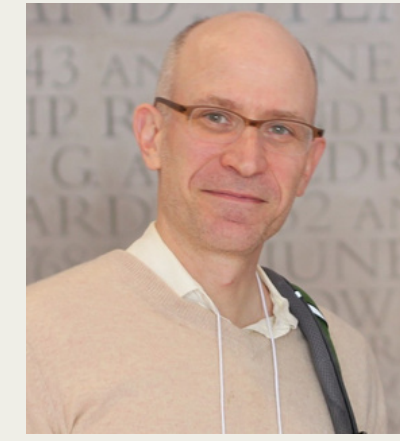
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APPENDIX A: ANALYTICAL EVIDENCE FOR DECOMPOSITION

(arguments that can be applied to opaque prefixation)

I. ARGUMENT REALIZATION: Obligatoriness of the syntactic realization of the object is induced by the prefix, which introduces a result state description (Babko-Malaya 1999, Dimitrova-Vulchanova 1999, Biskup 2019, Tatevosov to appear; see also Rappaport Hovav & Levin 1998 on English *sweep* vs. *break*)

While this is a tendency, it is far from generalizable: the opposite is also attested, cf (Xa-b)

Generally, the less determinate the verb is as to the kind of object it takes, the less able it is to drop the object, even with unprefixated verbs (X)

- (5) a. pisati (nešto) → za-pisati *(nešto)
write something LP-write something
'write (something)' 'write down something'
- b. baciti *(nešto) → pod-baciti (*nešto)
throw something LP-throw something
'throw something' 'fail'
- (6) činiti *(nešto) → u-činiti *(nešto)
do something LP-do something
'do something' 'do something'

APPENDIX A: ANALYTICAL EVIDENCE FOR DECOMPOSITION

II. SCOPE OF ADVERBIALS LIKE ‘ALMOST’ & ‘AGAIN’: If an event is decomposed into subevents, one should expect to find semantic operations that can target some of the subevents, but not the others (Morgan 1969, McCawley 1971, Dowty 1979, von Stechow 1996, Rapp & von Stechow 1999, Beck and Johnson 2004, a.o.)

- (7) a. Skoro je na-pisala pismo (ali se predomisli).
almost AUX LP-wrote letter but SE reconsidered
‘She almost wrote the letter (but she changed her mind).’
- b. Skoro je na-pisala pismo (ali joj treba još dva minuta).
almost AUX LP-write letter but CL need more two minutes
‘She almost wrote the letter (but she needs two more minutes).’

Not conclusive evidence for syntactic decomposition (nor even for complex even structural representations)

An adverb may describe a proper part of the event denoted by the expression it modifies, just as the adjective *blond* in *blond child* describes a proper part of the child (namely, its hair)

We do not assume decomposition (syntactic or semantic) to be responsible for the fact that *blond* can modify a proper part of the child (see Williams 2015: ch. 10)

APPENDIX A: ANALYTICAL EVIDENCE FOR DECOMPOSITION

III. INTERPRETATION UNDER NEGATION. Ambiguity under negation is taken as evidence for decomposition of pre-fixed verbs (Xa); the same ambiguity is possible with verbs that can denote accomplishments without taking LPs (Xb)

(8) a. Nije o-pisala situaciju.
NEG-AUX LP-wrote situation
'She didn't describe the situation.'
1. No describing activity performed.
2. No describing activity completed.

b. Ni-je večerala.
NEG-AUX dined
'She didn't have dinner.'
1. No dining activity performed.
2. No dining activity completed.

In (8a) there was no situation-describing, and this can be true either because there wasn't a whole situation-describing, or because there wasn't even a part (like saying that there's no house on the lot, either because they didn't start building it, or because they didn't finish)

Also, if (8a) had an LF equivalent to "She started but hasn't finished describing the situation", one might expect (9a) to have a parse synonymous to (9c), contrary to fact

(9) a. Porekao je da Marija ni-je o-pisala situaciju.
denied AUX that Mary NEG-AUX LP-wrote situation
'He denied that Mary has not described the situation.'

b. He claimed that she finished describing the situation ✓
c. He claimed that she hasn't started describing the situation. ✗

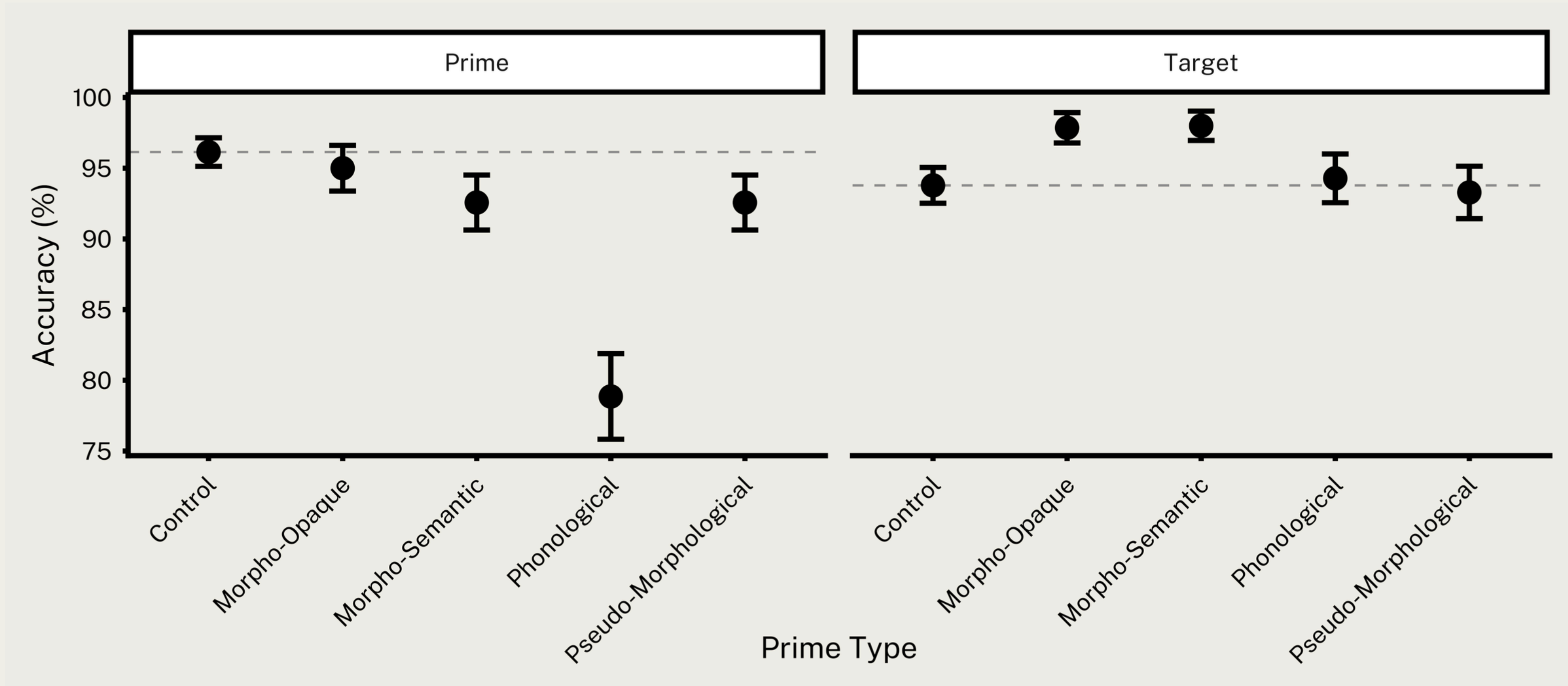
APPENDIX B: OUR EXPERIMENTAL STIMULI AT A GLANCE

1	target	MS prime	M prime	PM prime	P prime	Control
2	radio	uradio	zaradio		ugradio	iskočio
3	dao			nadao	padao	izmerio
4	dao				vladao	
5	vikao			navikao		olakšao
6	vikao			odvikao		
7	bavio			nabavio	labavio	pokazao
8	bavio			zabavio		
9	mogao			pomogao		naveo
10	mogao			domogao		
11	rekao			urekao		uživao
12	rekao			porekao		
13	išao			obišao		sadržao
14	išao			naišao	utišao	
15	hteo			prohteo		izneo
16	znao	saznao		poznao		izborio
17	bacio	ubacio	podbacio			objavio
18	pio		napio		postupio	ostvario
19	pio				zakrpio	
20	oštrio	izoštrio				uvideo
21	sitnio	presitnio				preneo
22	sisao	isisao	presisao			omogućio
23	pisao	dopisao	pripisao			promenio

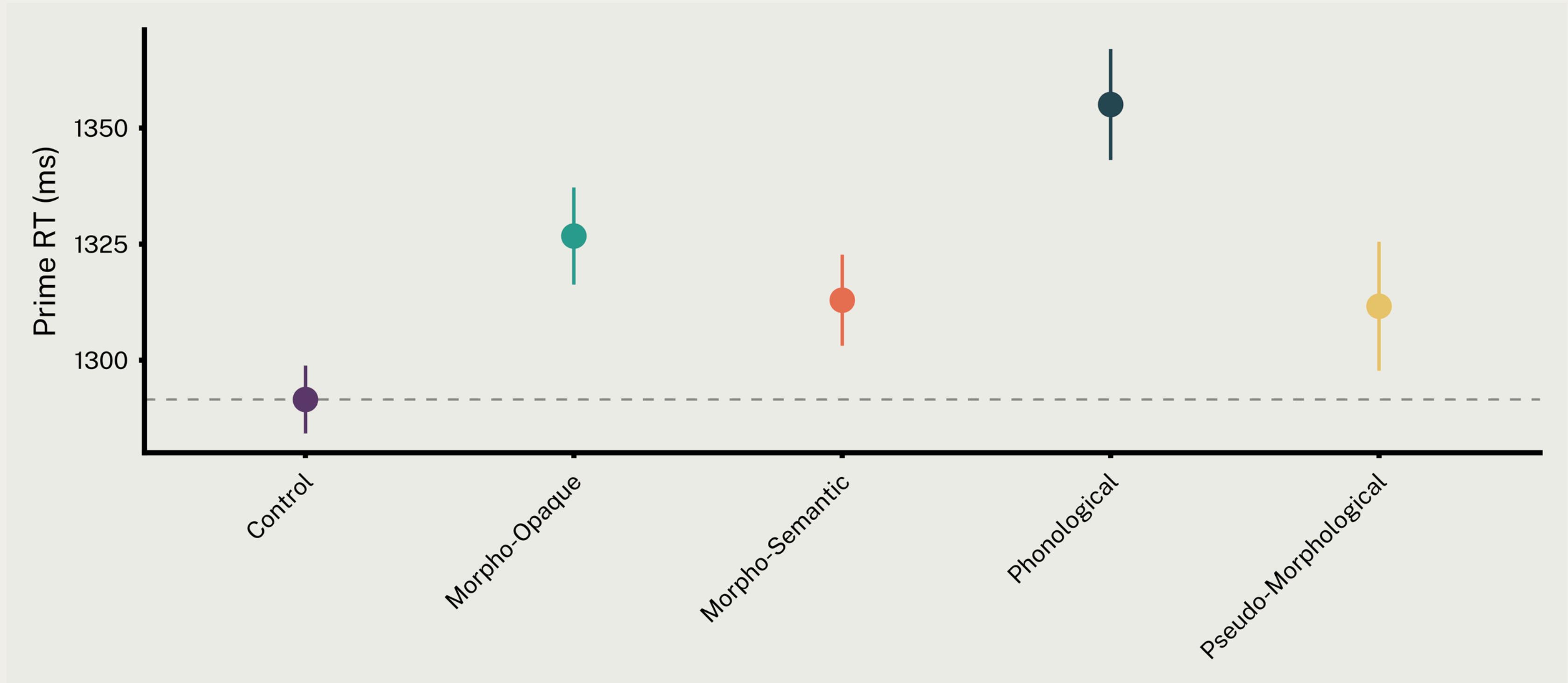
APPENDIX B: OUR EXPERIMENTAL STIMULI AT A GLANCE

23	target	MS prime	M prime	PM prime	P prime	Control
24	mislio	razmislio	izmislio			prosipao
25	digao	podigao				otvarao
26	stigao	pristigao	postigao			pomagao
27	voleo	zavoleo				ponudio
28	našao	pronašao	snašao	ponašao		zabranio
29	kuupio		iskuupio	sakupio		naterao
30	kuupio			prikupio		
31	dobio	zadobio	pridobio			ismejao
32	stao	zastao	pristao		blistao	preterao
33	činio	učinio	začinio			isprosio
34	igrao		izigrao			odvalio
35	odao				navodao	
36	odao				prohodao	ofarbao
37	krao	pokrao	pikrao			prenosio
38	vodio		zavodio			boravio
39	vratio		povratio			prevario
40	ticao			preticao	spoticao	pretvarao
41	ticao			sticao		
42	lućio	izlućio			kulućio	sanjao
43	stavio		predstavio		obustavio	prekucao
44	sećao	prisećao	osećao			otvorio
45	orao	preorao			naborao	priućio

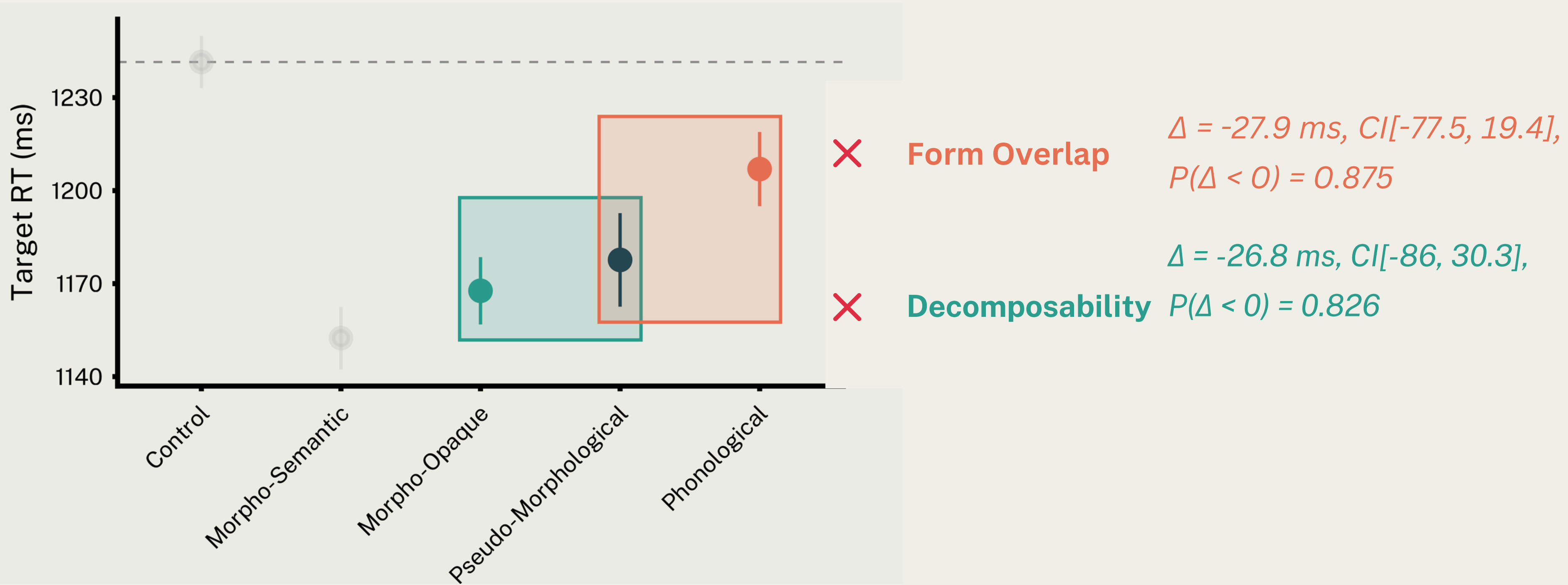
APPENDIX C: ACCURACY



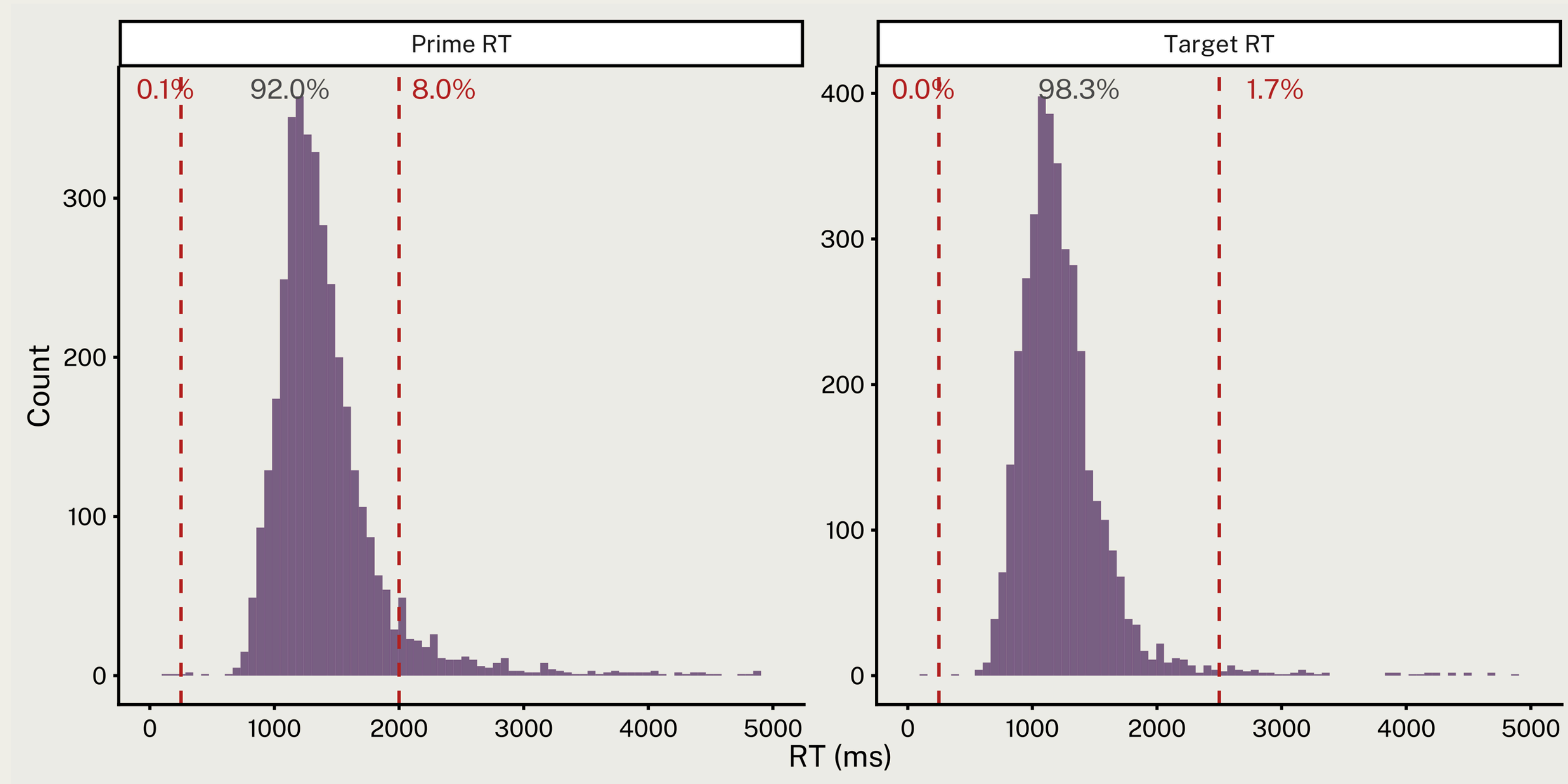
APPENDIX D: PRIME RT



APPENDIX E: RESPONSE RT DISTRIBUTIONS



APPENDIX E: RESPONSE RT DISTRIBUTIONS



APPENDIX F: OTHER PREDICTORS

Parameter	Estimate	SE	95% CI	P(b > 0)
Intercept	7.103	0.015	[7.075, 7.132]	> .999
Morpho-Semantic vs Control	-0.095	0.015	[-0.124, -0.065]	< .001
Morpho-Opaque vs Control	-0.075	0.015	[-0.104, -0.046]	< .001
Pseudo-Morphological vs Control	-0.058	0.025	[-0.106, -0.008]	0.014
Phonological vs Control	-0.043	0.023	[-0.087, 0.003]	0.033
Trial number	0.011	0.008	[-0.004, 0.026]	0.930
Prime duration	-0.018	0.009	[-0.037, 0.000]	0.025
Target duration	0.034	0.010	[0.015, 0.055]	> .999
Prime RT	0.082	0.006	[0.071, 0.095]	> .999
ISI	-0.002	0.003	[-0.009, 0.005]	0.286

APPENDIX F: OTHER PREDICTORS

Comparison	Diff (ms)	SE	95% CI	P(D dir)
Morpho-Semantic vs. Phonological	-58.78	29.66	[-119.78, -2.23]	P(D < 0) = 0.979
Morpho-Semantic vs. Pseudo-Morphological	-41.62	31.95	[-106.96, 20.34]	P(D < 0) = 0.910
Morpho-Opaque vs. Phonological	-36.43	29.52	[-96.90, 19.78]	P(D < 0) = 0.896
Morpho-Semantic vs. Morpho-Opaque	-22.35	21.25	[-64.51, 20.20]	P(D < 0) = 0.858
Morpho-Opaque vs. Pseudo-Morphological	-19.27	32.15	[-86.25, 41.86]	P(D < 0) = 0.731
Pseudo-Morphological vs. Phonological	-17.16	37.01	[-88.82, 57.61]	P(D < 0) = 0.688

APPENDIX G: MCMC CHAINS, ALL HEALTHY

