VARIATION IN SEGMENT DURATION IN ASL FINGERSPELLING

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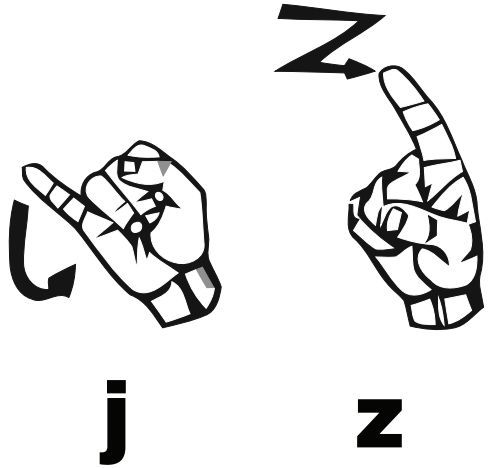
Outline

Background

Fingerspelling

All handshapes are static except for -J- and -Z-.

Fingerspelling makes up anywhere from 12–35% of ASL discourse.
(Padden, 1991; Padden and Gunsauls, 2003)



The phonetics of fingerspelling

Wilcox (1992) looks at about 7 words and describes some of the dynamics of hand motion.

Brentari and Padden (2001); Cormier et al. (2008) both look at the nativization process for fingerspelled words.

Quinto-Pozos (2010) described the rate of fingerspelling for two signers within fluent discourse.

Questions

1. When asked to sign at two different speeds, how much of a difference is there between them?
2. Is there individual variation?
3. Does the type of word affect the speed of fingerspelling?
4. Does the position of a letter in a word affect transition time?
5. Do letters with movement take longer to execute?

Recording Specifications

Signers

2 signers, both are deaf of deaf parents, and native ASL users.

Video

2 video cameras recording at 60 FPS.

We collected 2 sessions for each signer
1 at a normal, conversational speed, and 1 at a careful speed.

There were 100 non-English words, 100 names, 100 nouns.

Each word was fingerspelled twice in each speed.

The video was then post processed and compressed for coding.

Example

staxi.mp4

Figure: T-A-X-I, normal speed.

Example

staxi2.mp4

Figure: T-A-X-I, normal speed, slow motion

Hand coding of apogees

1. 3–4 human coders identified each apogee in every word.
2. The position of each apogee was algorithmically determined.
   Mean absolute deviation:
   27.93 msec for all letters
   62.52 msec for letters with movement
3. A first guess at the letter of each apogee was added using left edge forced alignment.
4. Someone trained in fingerspelling went through and verified the location, and letter of each apogee.

Example, revisited

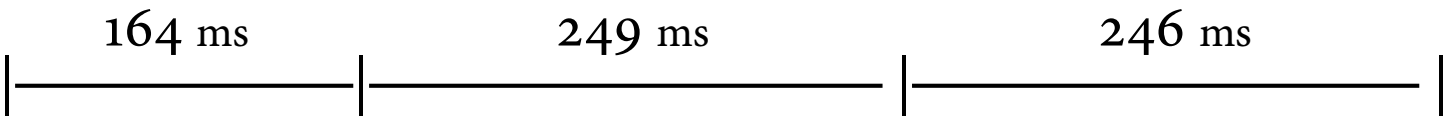


Figure: durations for T-A-X-I

T-A-X-I, L-A-M-B, F-R-E-D, C-A-R-P, and P-U-H-U

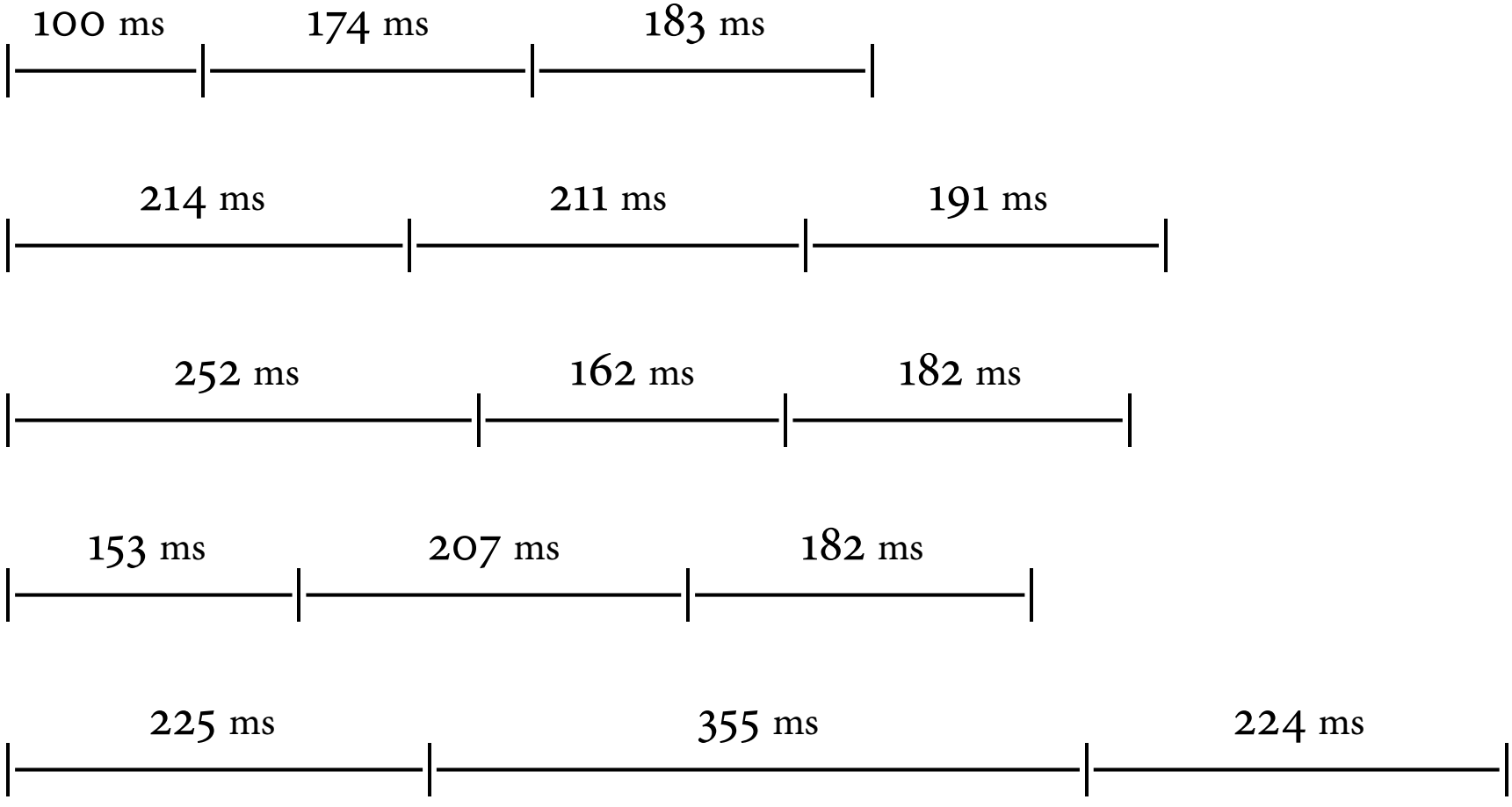


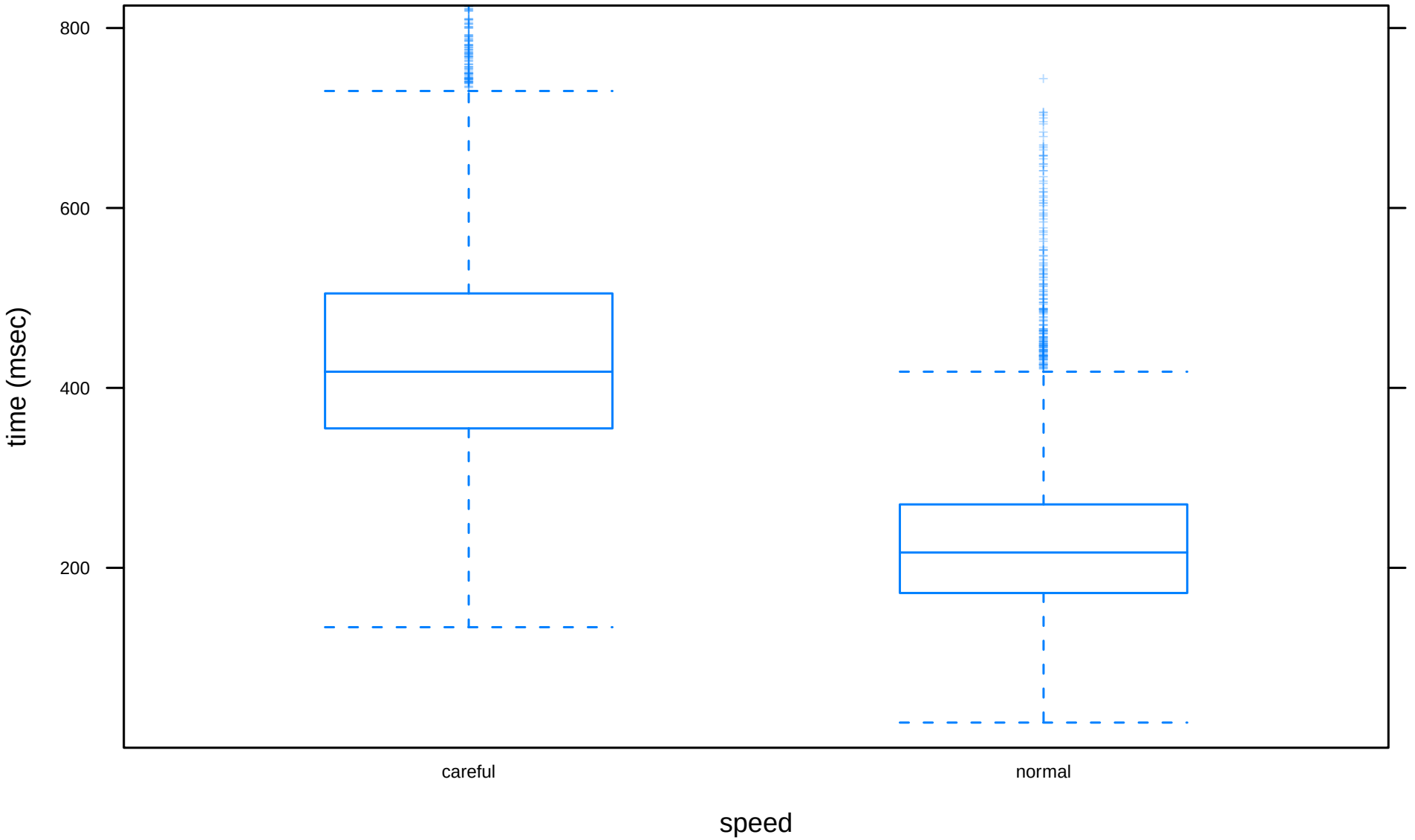
Figure: durations for T-A-X-I, L-A-M-B, F-R-E-D, C-A-R-P, and P-U-H-U (signer: **s1** speed: **normal**)

ANOVA table

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
wordtype	2	33.27	16.64	219.11	0.0000
speed	1	1424.43	1424.43	18760.33	0.0000
signer	1	13.96	13.96	183.82	0.0000
wordtype:speed	2	13.57	6.79	89.38	0.0000
wordtype:signer	2	0.24	0.12	1.60	0.2020
speed:signer	1	234.20	234.20	3084.53	0.0000
Residuals	12356	938.16	0.08		

Table: ANOVA table for log(time)

between speeds



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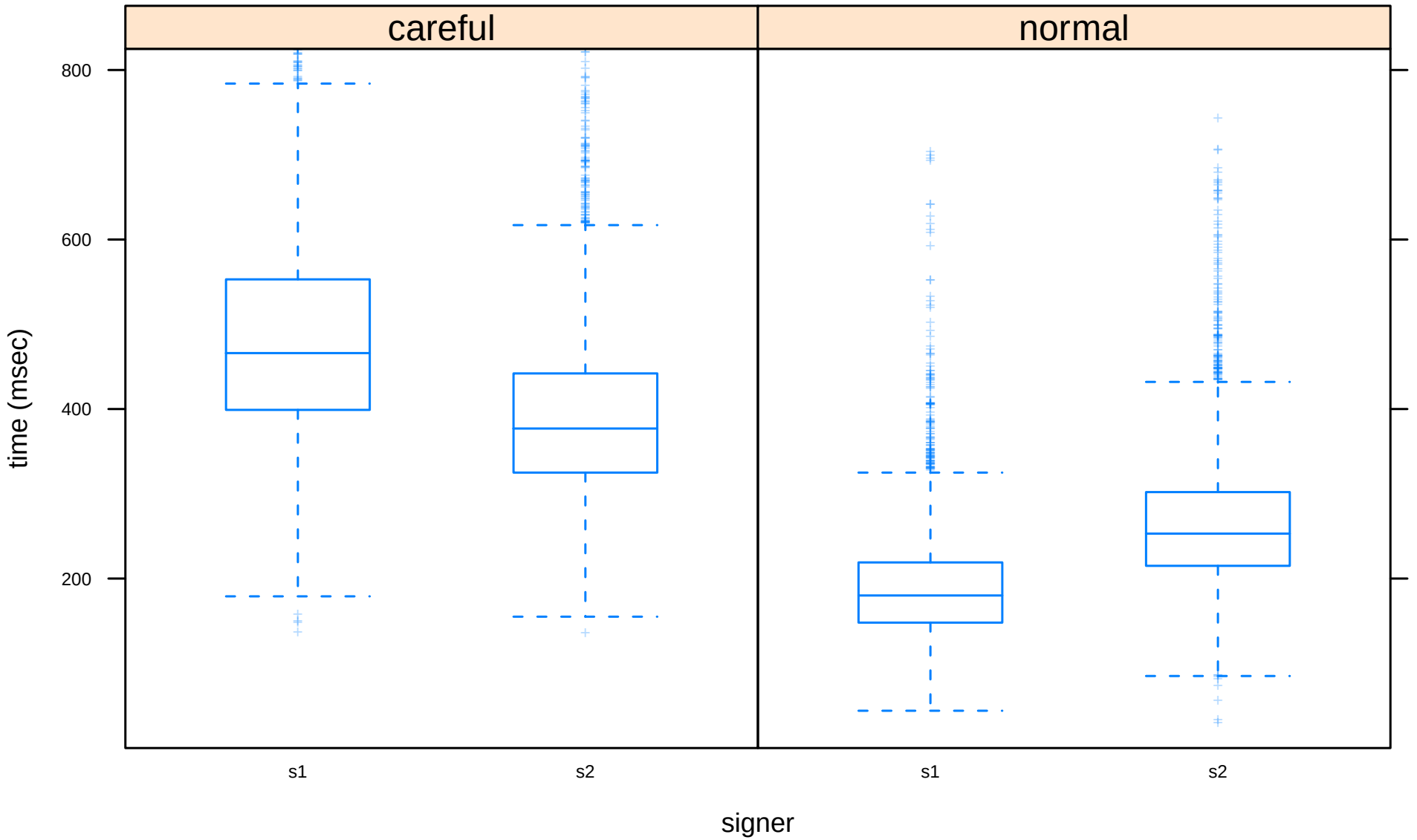
between signers, by speed



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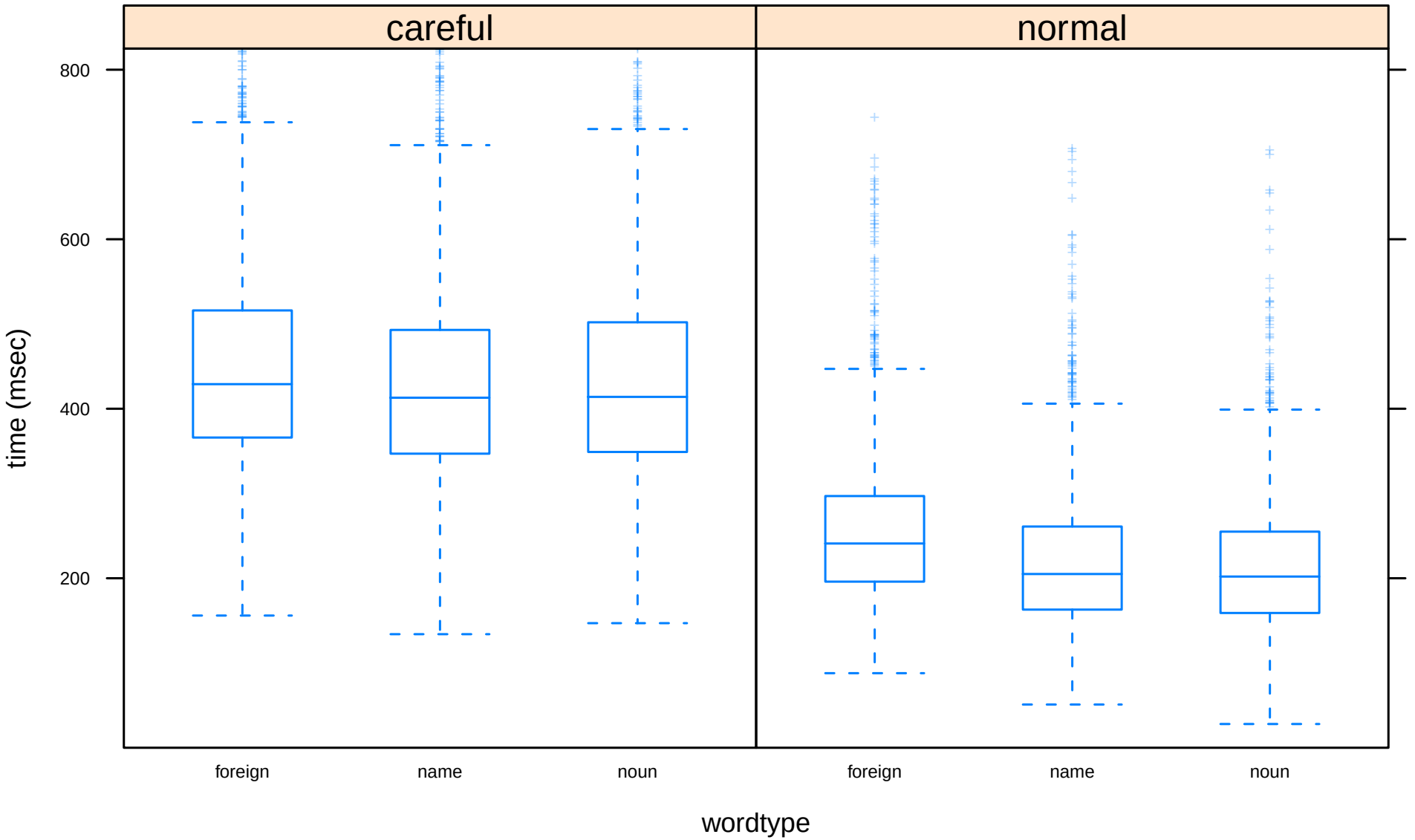

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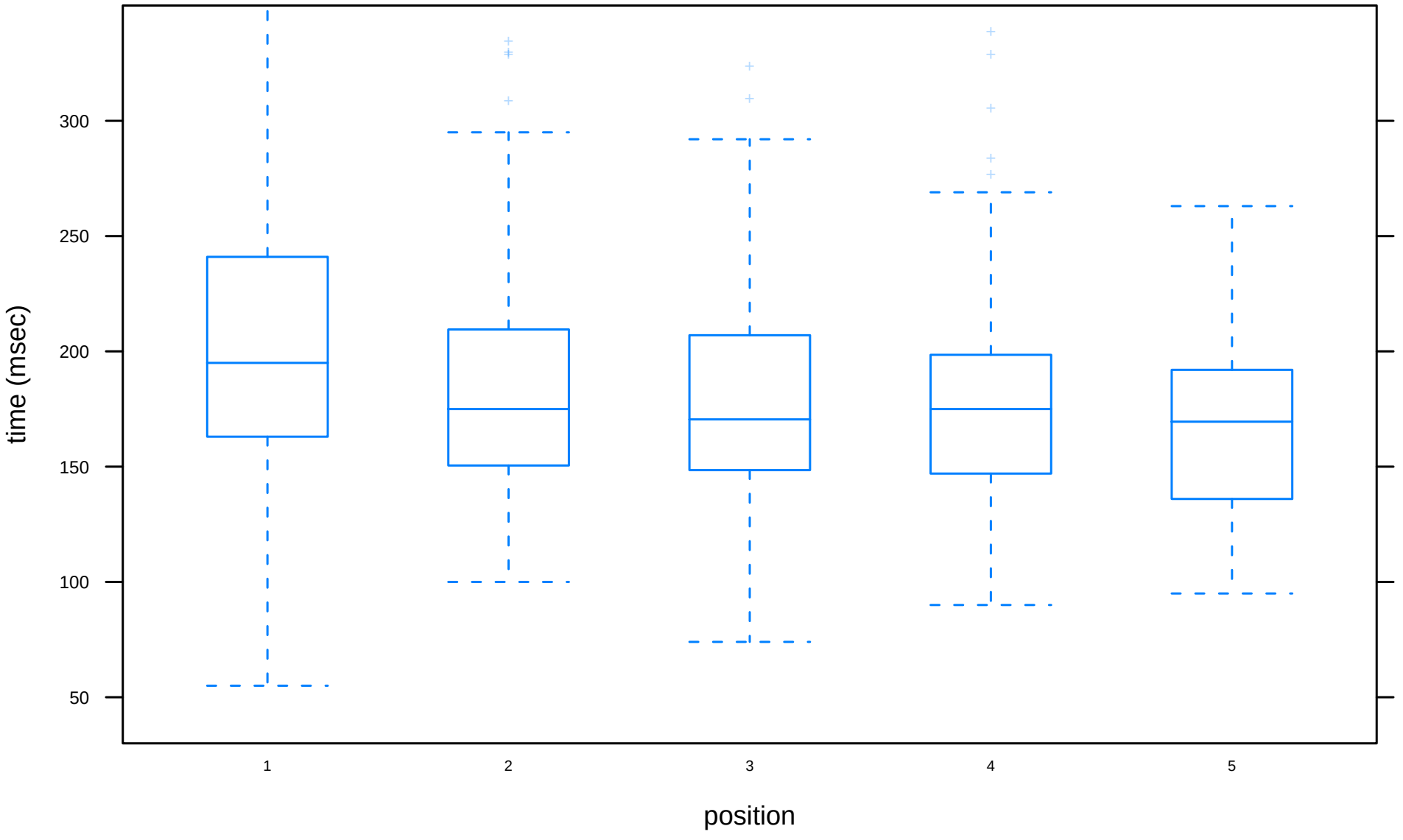
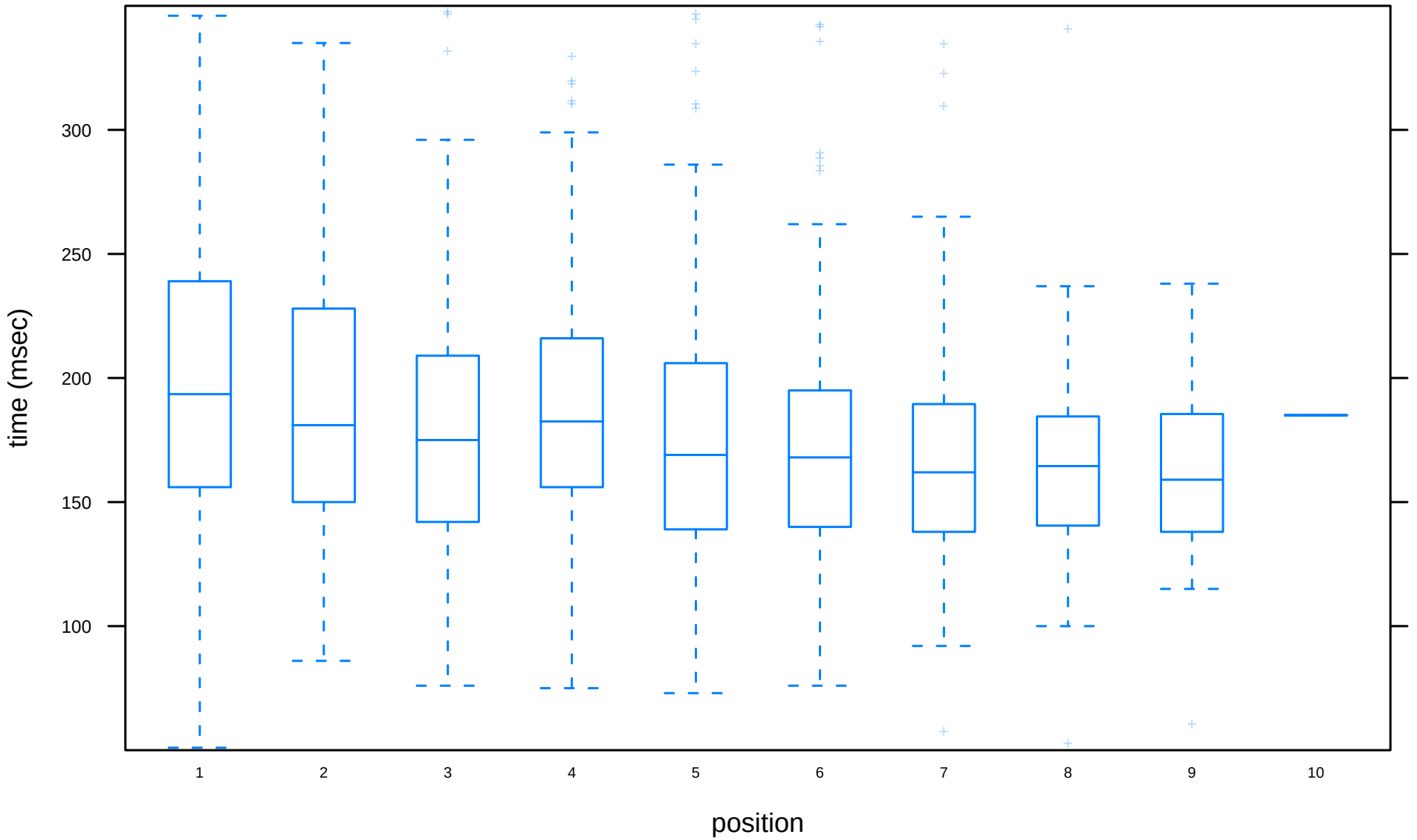
Short words (3 – 6 letters) – s1, normal



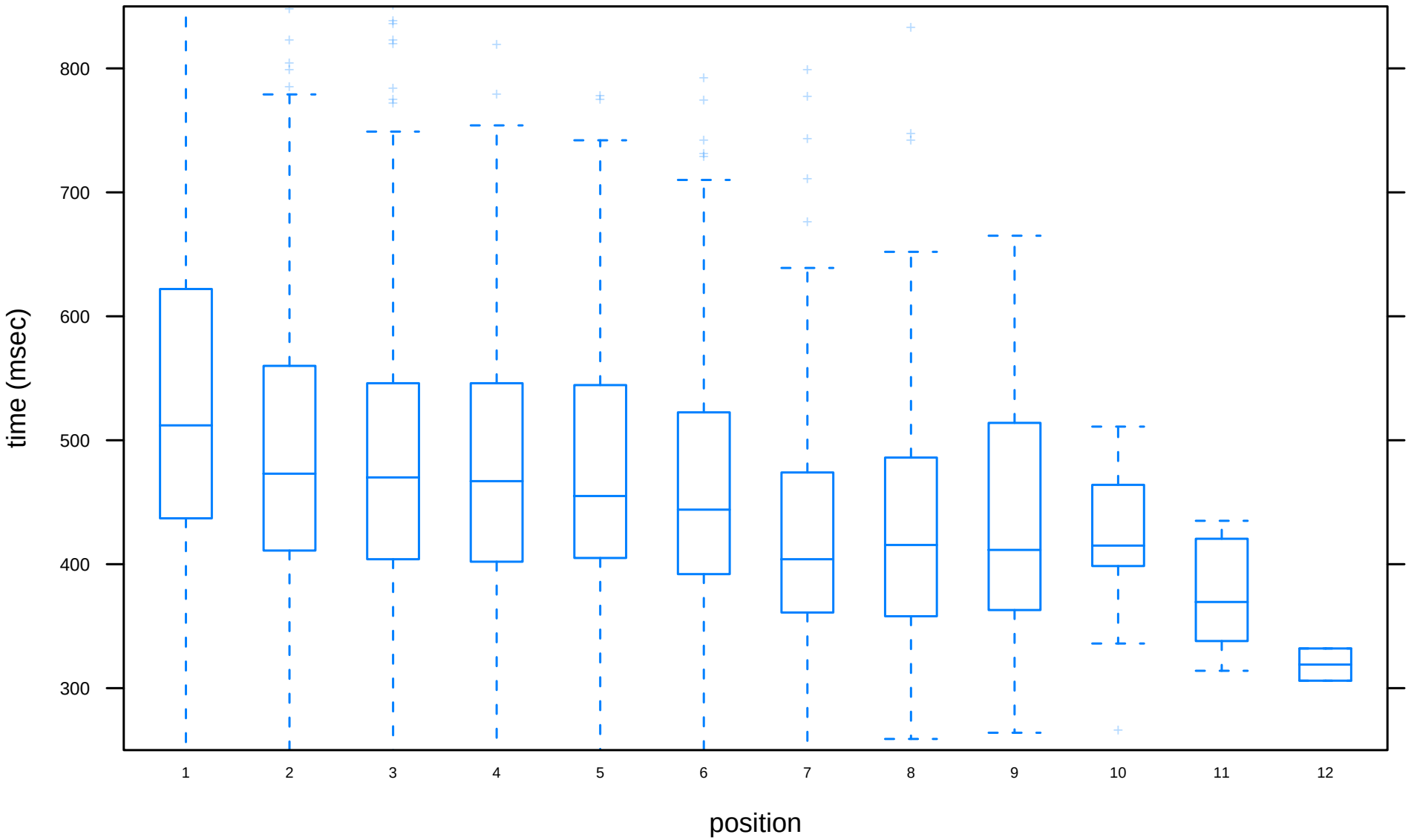
Long words (8 – 10 letters) – s1, normal



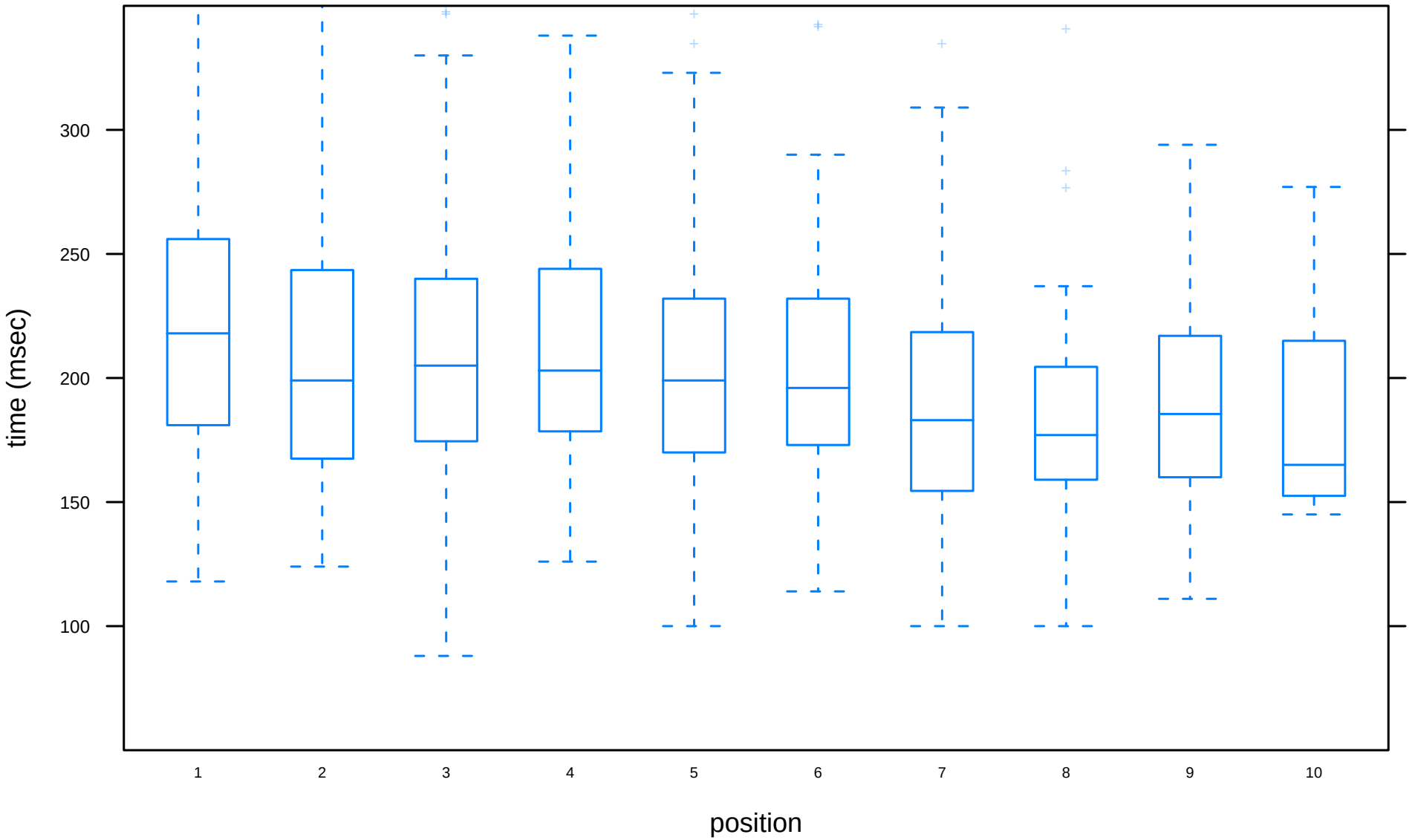
Possible explanations

1. memory limitations
2. articulation limitations
3. phonological chunking
   4 letters ~= 3 movements ~= 1 ASL sign

careful is different



non-english is different



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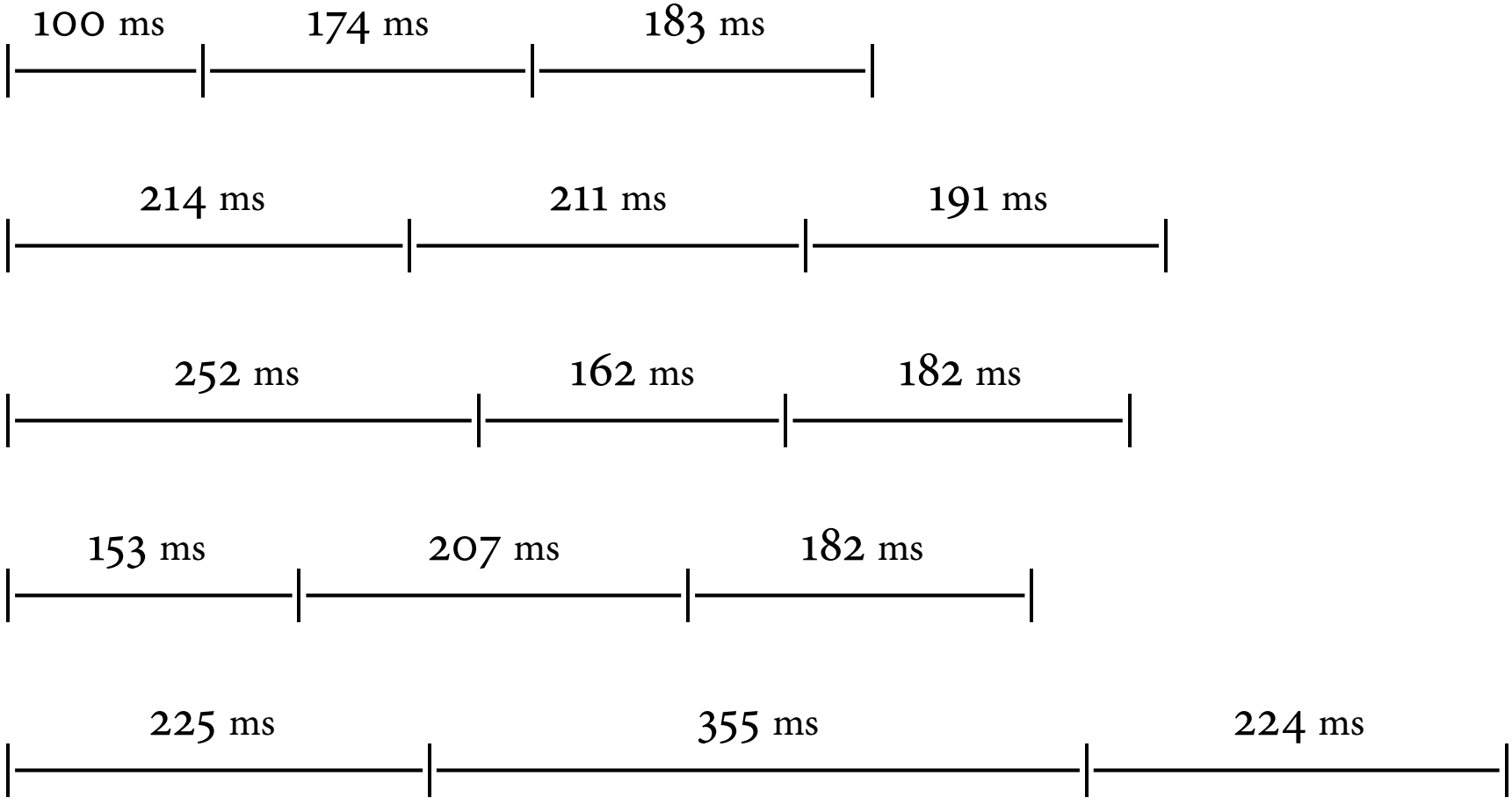

Figure: durations for T-A-X-I, L-A-M-B, F-R-E-D, C-A-R-P, and P-U-H-U (signer: **s1** speed: **normal**)

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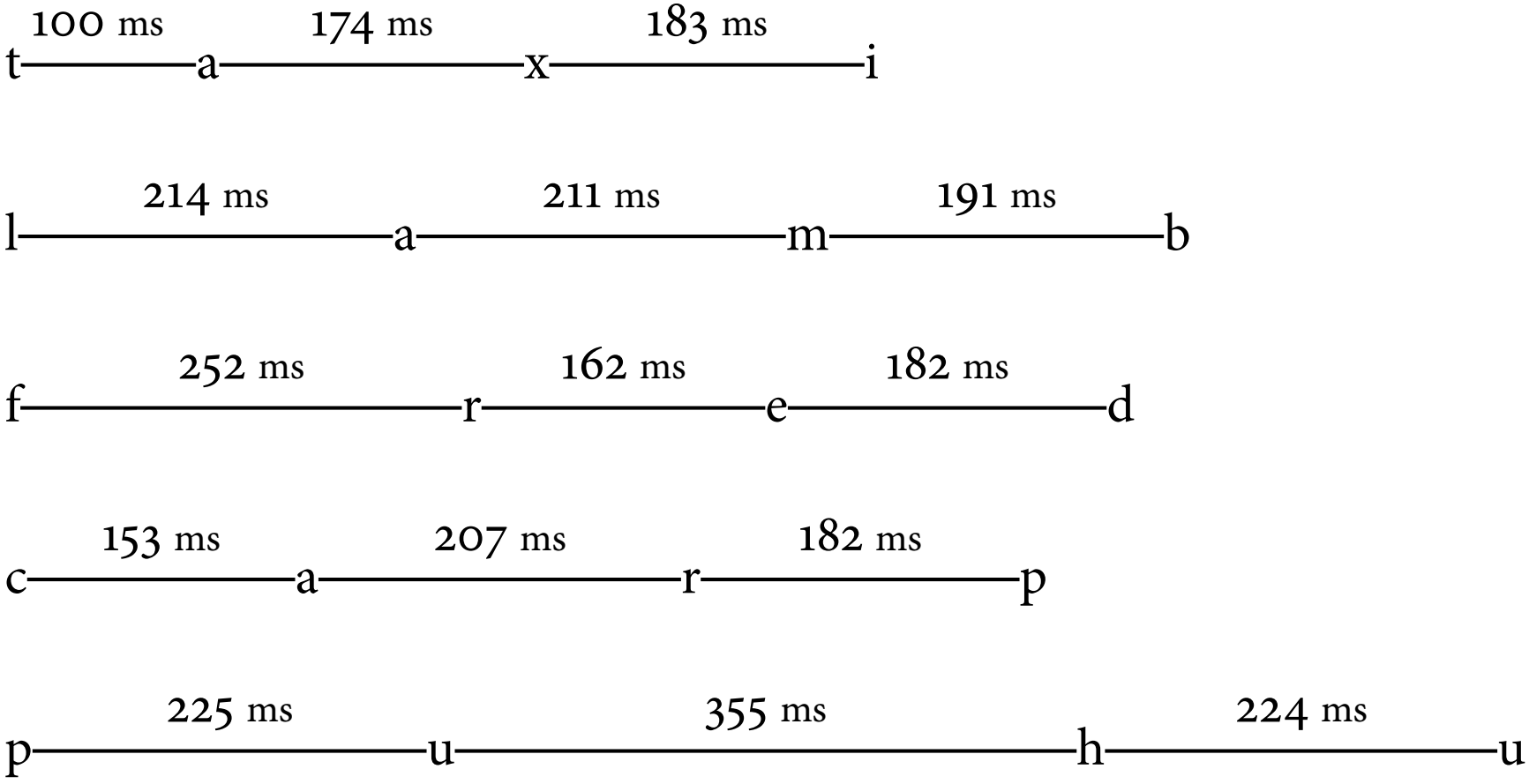

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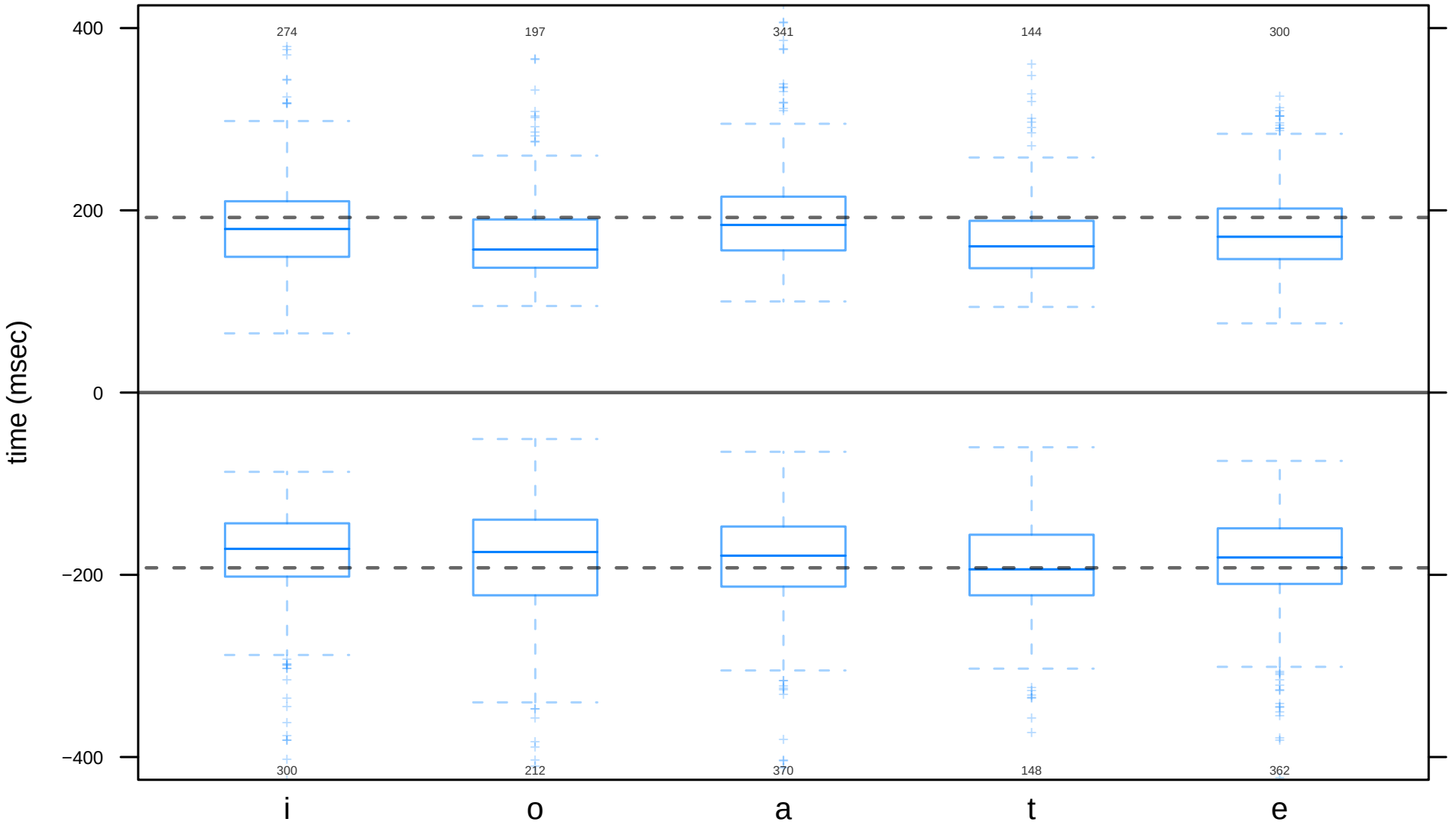
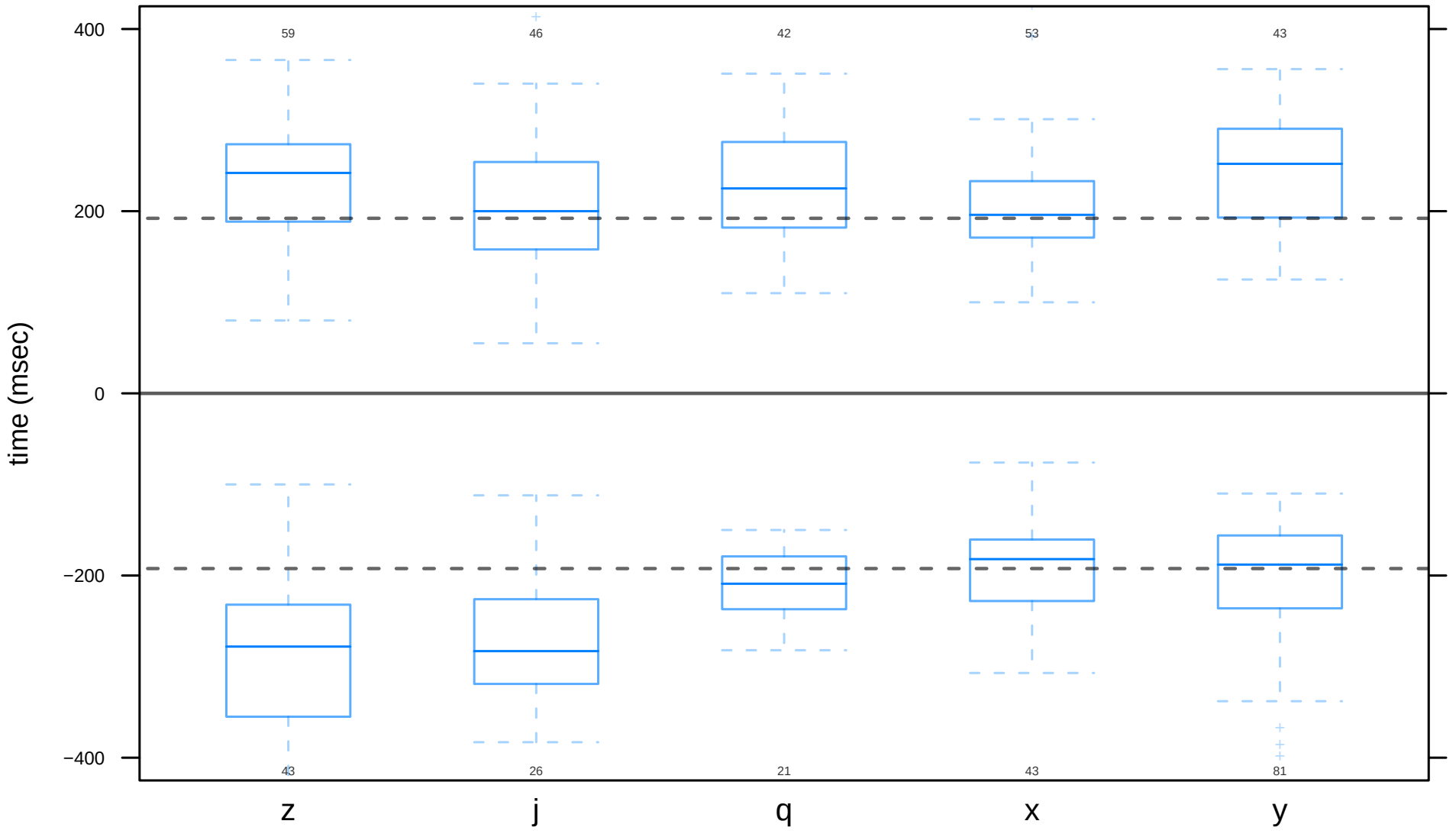
transitions for high frequency letters



transitions for for low frequency letters



Movement in -ʏ-

Figure: The first 10 instances of -ʏ- – not at the end of the word

Conclusions

1. When asked to fingerspell at different speeds, the spread is significant.
2. There is individual variation overall and in speed, but not wordtype.
3. Signers fingerspell slower on non-English words.
4. Signers seem to chunk their production into 3-4 letter chunks with longer words.
5. Letters with movement take longer to execute.
6. The class of letters that have movement might need redefining: -Y- and possibly -Q-.

Future directions

1. More sophisticated modeling
2. Quantification of other articulatory features
3. Recognition related tasks
4. More signers (in progress!)

Thank you for coming.

I must also acknowledge the contributions of many who contributed in ways big and small:

Fingerspelling data

Drucie Ronchen and Andy Gabel

Main advisors

Jason Riggle and Diane Brentari

Other researchers

Susan Rizzo, Karen Livescu, Greg Shakhnarovich, Raquel Urtasun, and Katie Henry.

Interpreters

Selected bibliography

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between wordtypes, by speed and by signer