Long-distance coarticulation in American Sign Language

Michael Grosvald

Center for Mind and Brain & Department of Linguistics
University of California at Davis

Thank you: David Corina, Orhan Orgun, Carol Fowler, Patricia Keating, Daniel Recasens, Keith Johnson, Sarah Hafer
and
Martha Tyrone

Agenda

- Background
- Vowel-to-Vowel coarticulation (English)
- Location-to-Location coarticulation (ASL)
- Conclusion

Background

- Sign languages are naturally occurring languages.

- Three main formational parameters:
  - Handshape
  - Movement
  - Location ←

- This sign study focuses on coarticulatory effects related to Location.

Background

"Coarticulation refers to the fact that at any given point during an utterance, the influences of gestures associated with several adjacent or near-adjacent segments can generally be observed in the acoustic or articulatory patterns of speech." *

~ the articulatory influence that phonetic elements have on one another

Relevant for:

- Language change
- Models of language production
- Lexical processing

* Fowler & Saltzman (1993)

Background

- Language change: V-to-V coarticulation --> V harmony? (Ohala)

- Language production: What are the planning units?

- Lexical processing: If perceivers can "see ahead" a few segments, they might be able to narrow the possible range of upcoming words.

- Anticipatory coarticulation should be more relevant from this perspective than carryover coarticulation.

This study focuses on anticipatory coarticulation.

Background

Some previous work that's relevant here:

Öhman (1966): Groundbreaking study on VCV sequences. Different coarticulation patterns associated with different segments & languages.

Magen (1997): Long-distance effects in VCVCV sequences.

Coarticulation studies of ASL investigating:

- Location (Mauk, 2003)
- Handshape (Cheek, 2001)

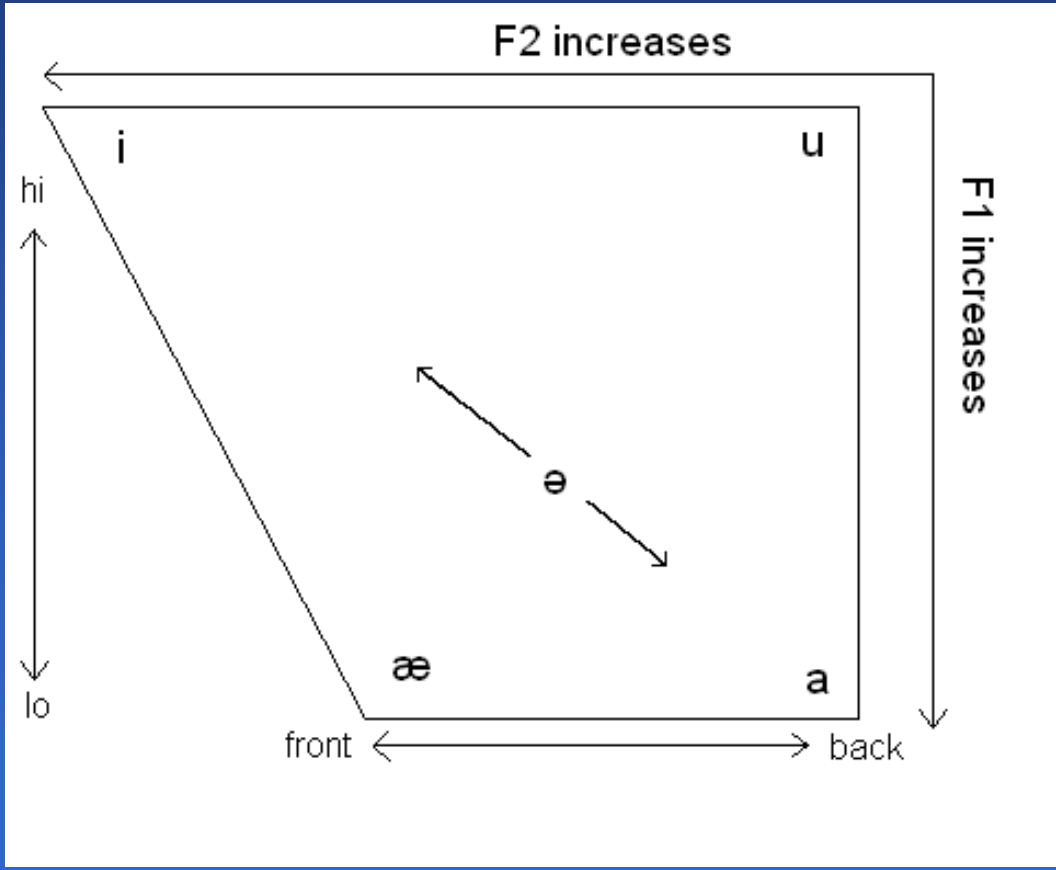
Research Questions

1) How far back can anticipatory effects extend?

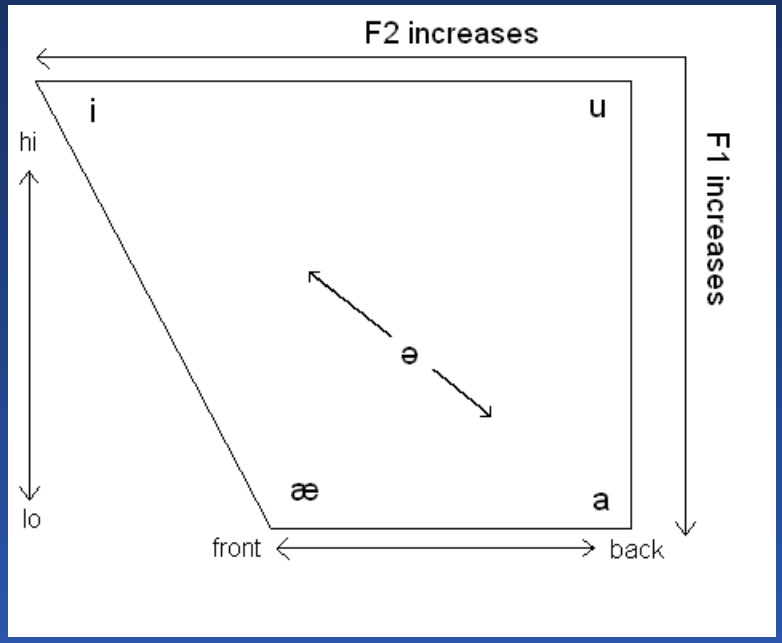
2) How do such effects compare between signed and spoken language?

English: V-to-V effects

- Basic idea: create sentences with consecutive schwas, so that lots of V-to-V coarticulation can be expected.



English: V-to-V effects



"It's fun to look up at a key." Context vowel = [i]

"It's fun to look up at a car." Context vowel = [a]

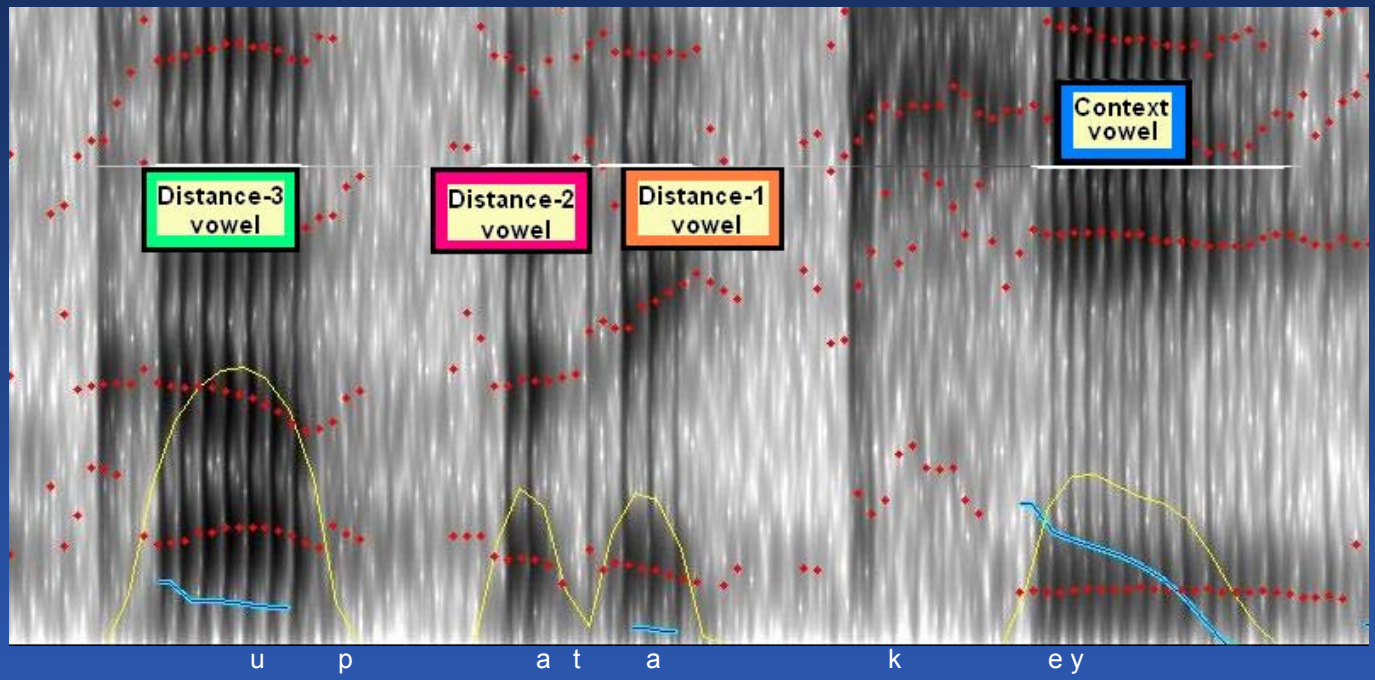
Distance-1 condition: Target V = [ə] as in "a"

Distance-2 condition: Target V = [ə] as in "at" (expected)

Distance-3 condition: Target V = [^] as in "up"

- Each speaker said each sentence six times.

English: V-to-V effects



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Distance-3 condition: Target V = [^] as in "up"

- Each speaker said each sentence six times.

English: V-to-V effects

Results for group of 20 speakers (F2 only):

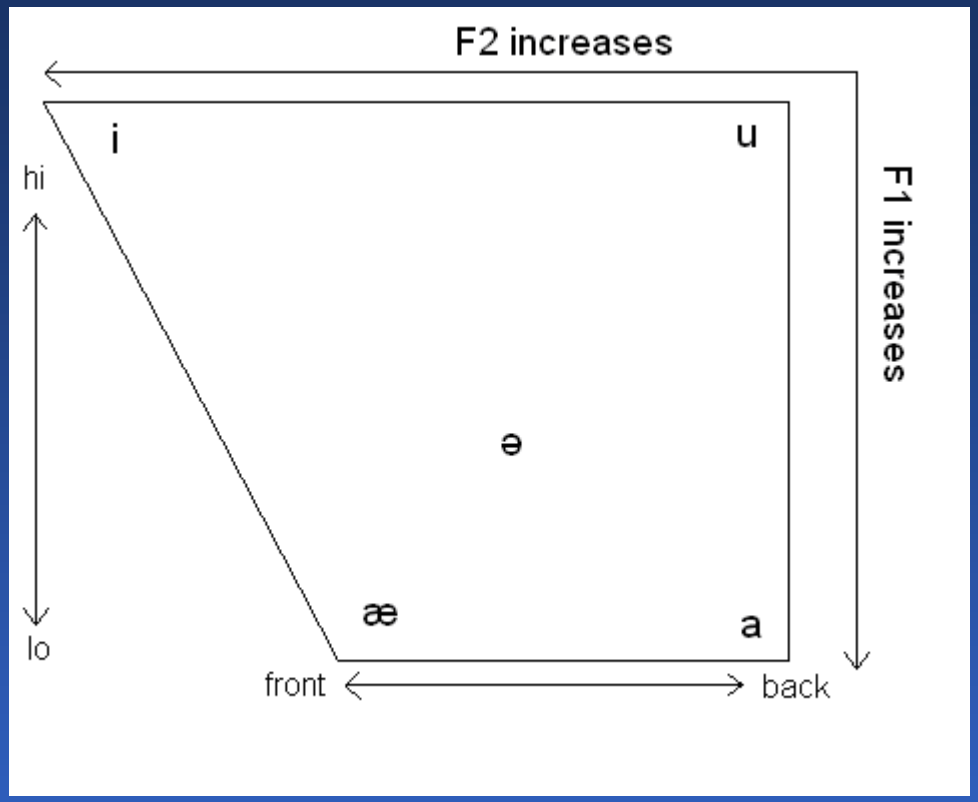
	up	at	a	key/car
Distance:	3	2	1	(no effects)
- By % of subjects:	10%	55%	25%	10%

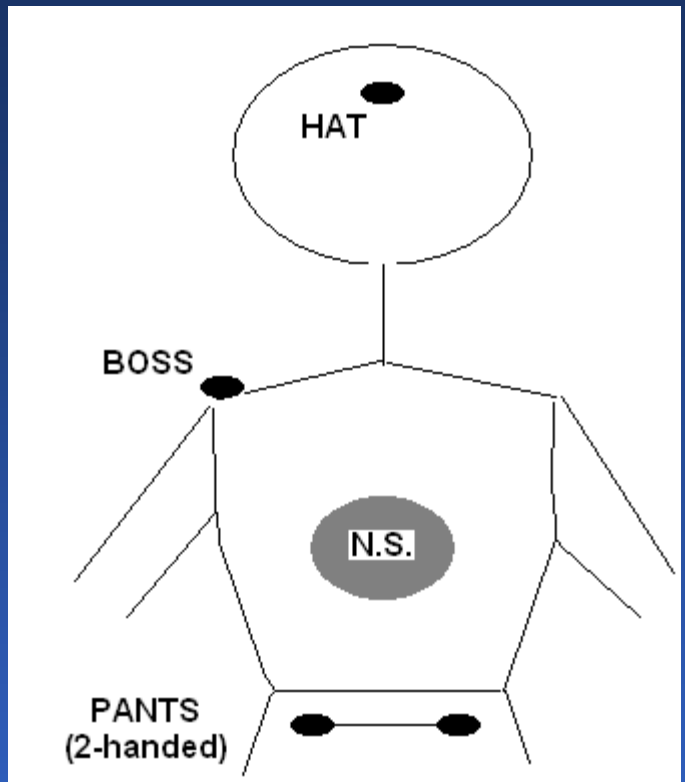
American Sign Language

- Three main formational parameters:
  - Handshape
  - Movement
  - Location ←

- Focus on Location-to-Location effects:
  - Motion capture technology
  - Visualization similar to that for V-to-V effects
    (e.g. high-low, side-to-side)

American Sign Language





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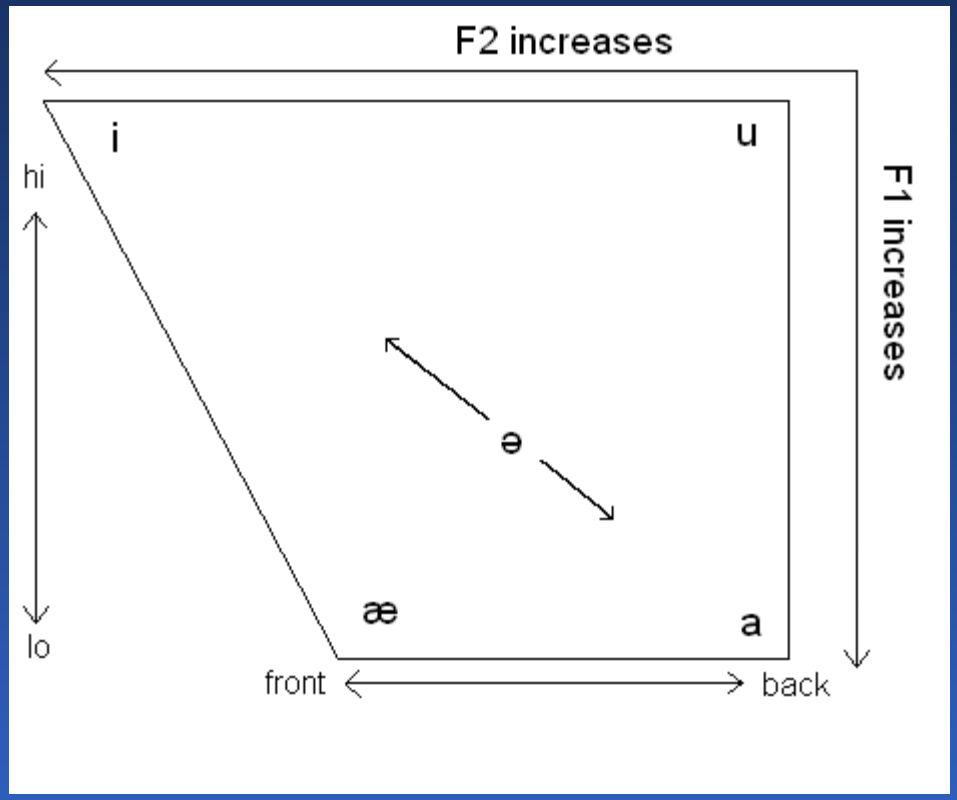
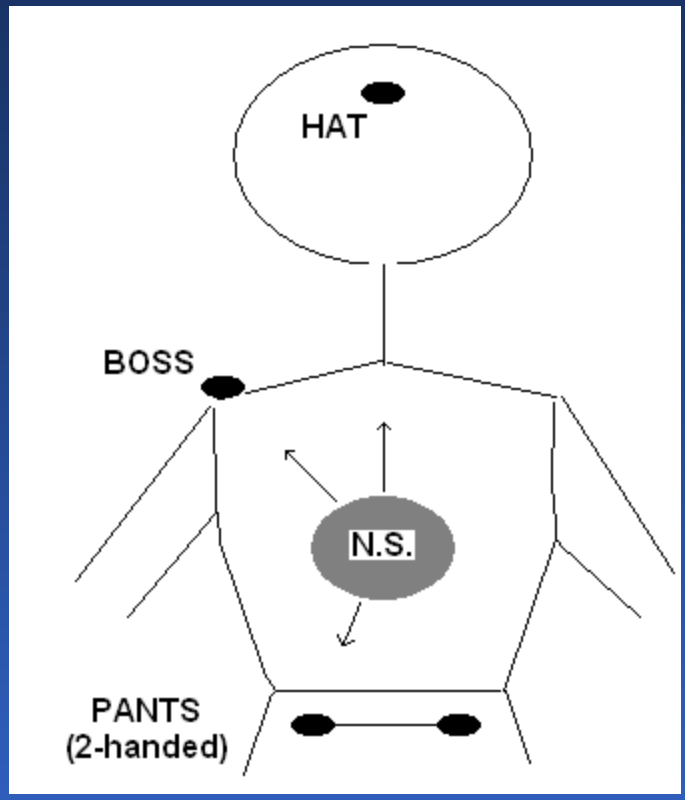
American Sign Language



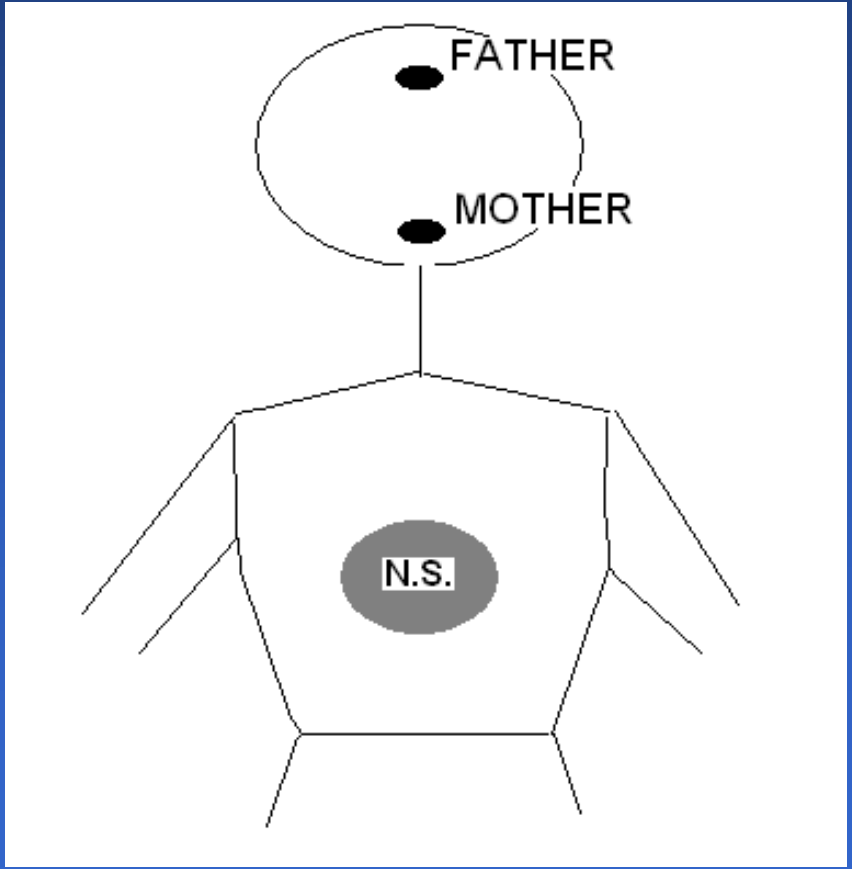


Q: In a quest for long-distance coarticulation, what sign location might be most analogous to schwa?

A: Neutral signing space? [... but with a caveat]

ASL: L-to-L effects

- Basic idea: create sentences with consecutive neutral-space signs, so that lots of L-to-L coarticulation can be expected.



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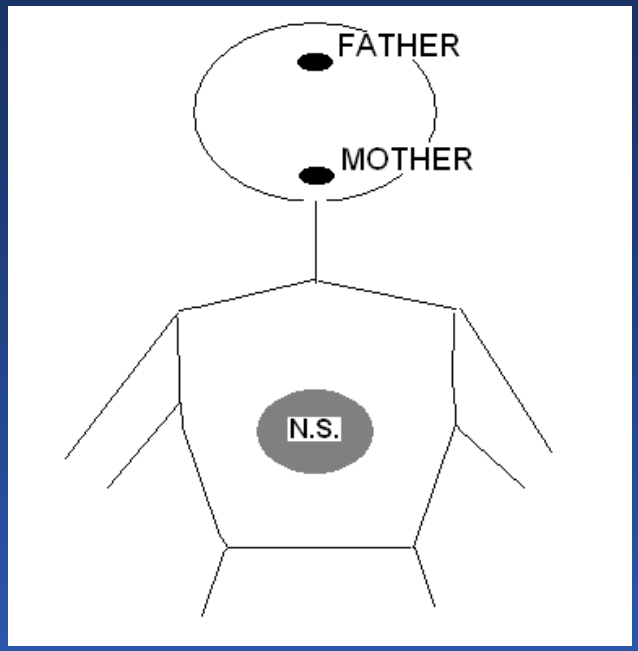
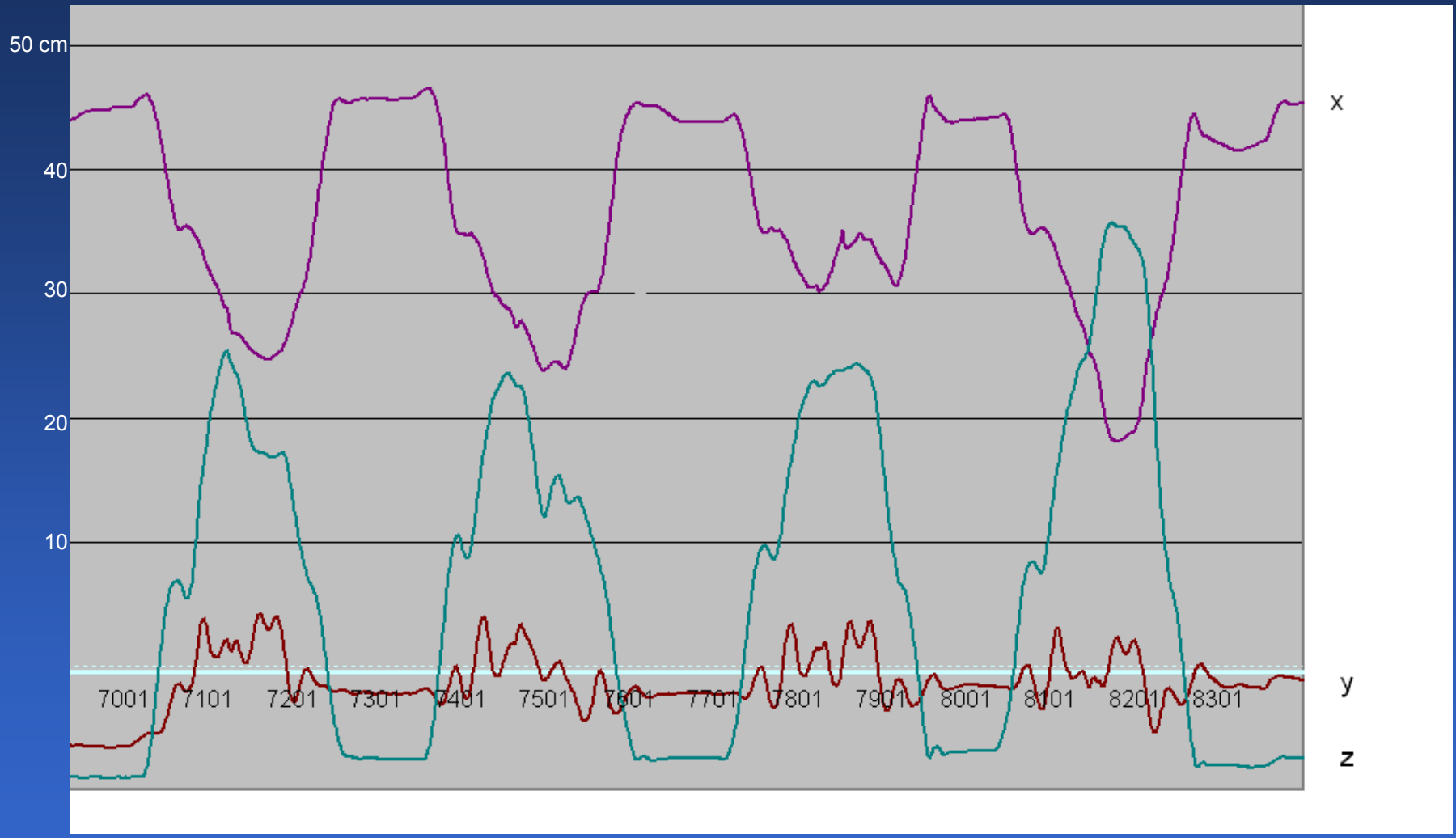


"I WANT GO FIND FATHER I." Context = forehead
"I WANT GO FIND MOTHER I." Context = chin

Distance-3 condition: Target sign = WANT

- Each sentence repeated five times.

ASL: L-to-L effects



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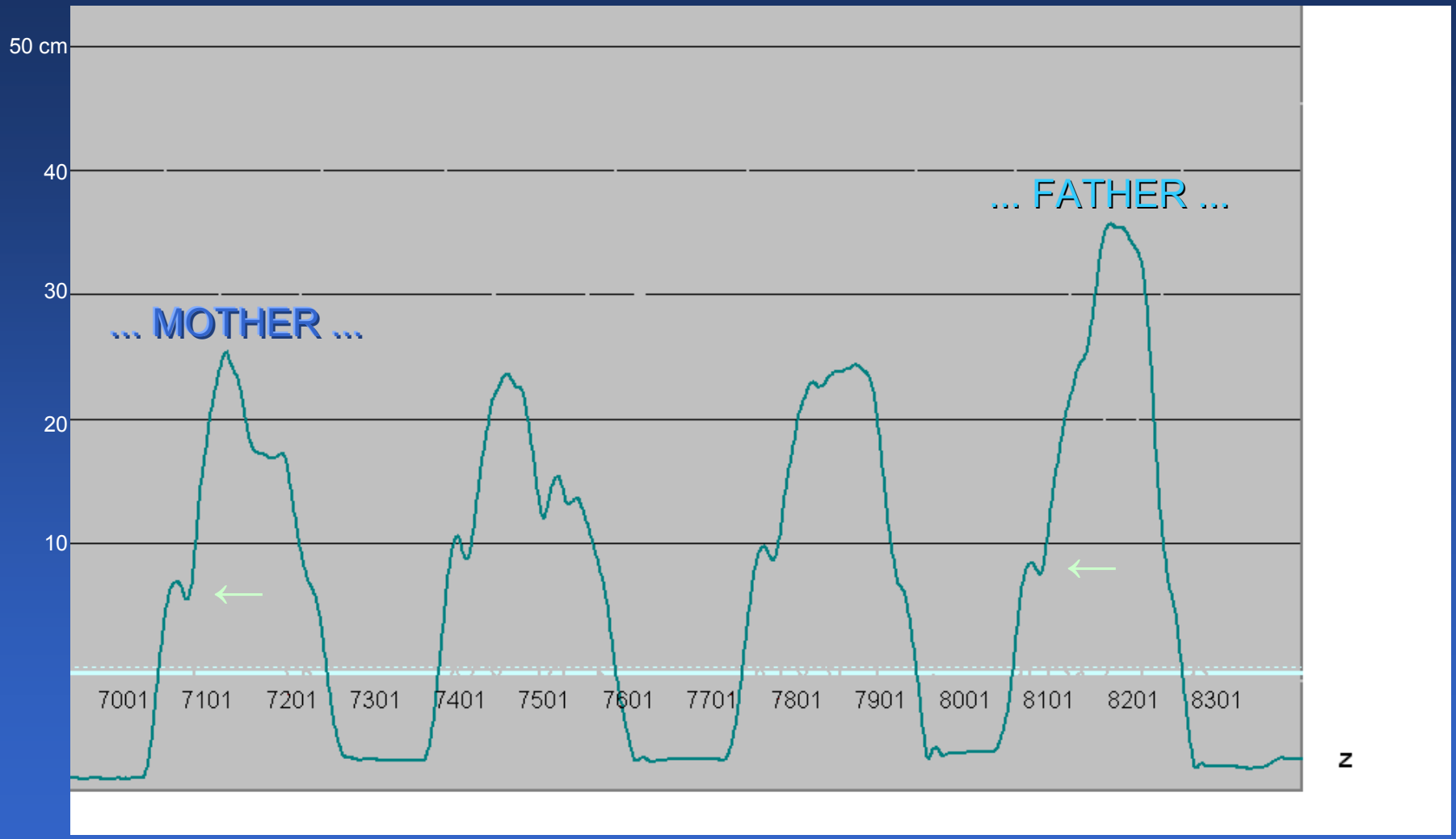

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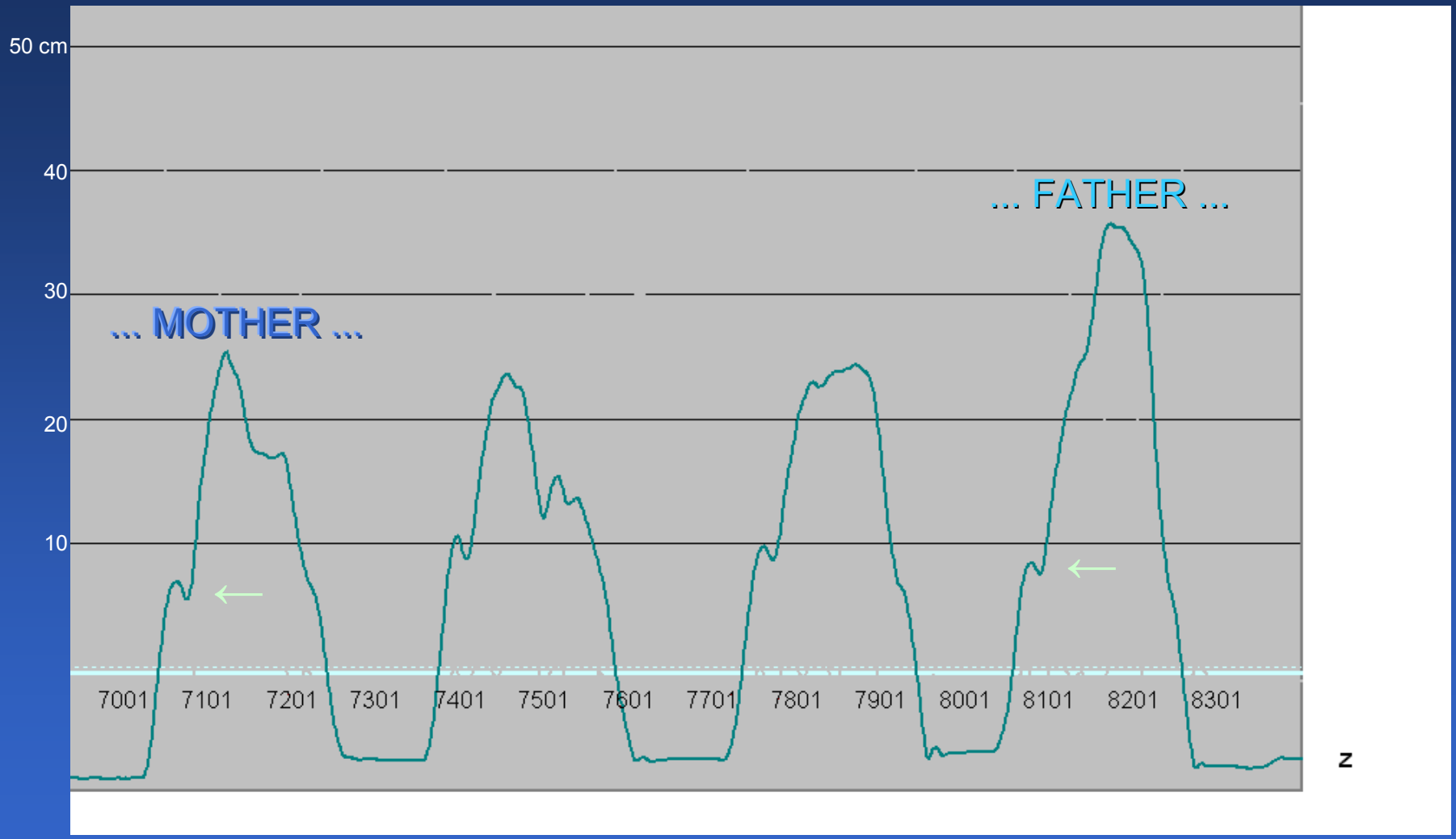


FATHER (forehead): Avg z value: 8.65 cm

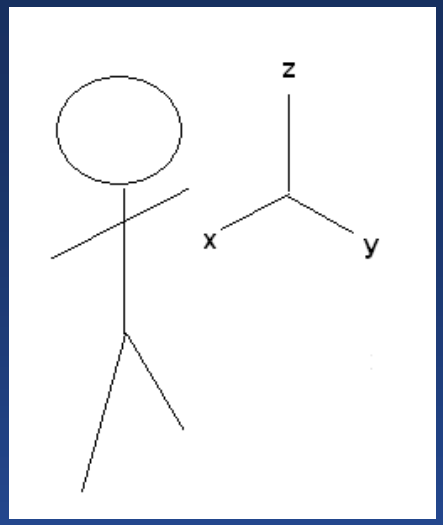
MOTHER (chin): Avg z value: 7.12 cm

**p<0.01

ASL: L-to-L effects

Distance-3: “I WANT GO FIND (X) I.”

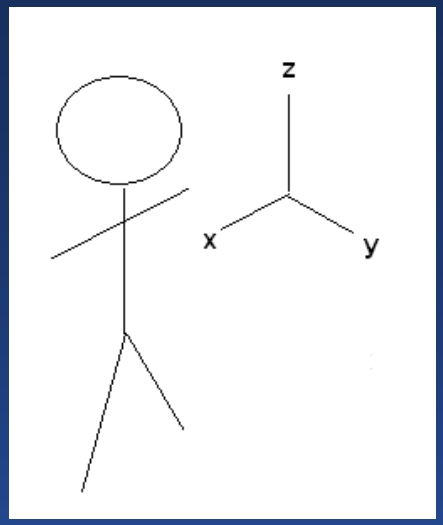
FATHER (forehead):	Avg z value: 8.65 cm	**p<0.01
MOTHER (chin):	Avg z value: 7.12 cm	
HAT (head):	Avg z value: 17.06 cm	p=0.102
PANTS (waist):	Avg z value: 15.97 cm	
DEER (head):	Avg z value: 16.74 cm	p=0.104
RUSSIA (waist):	Avg z value: 15.43 cm	



ASL: L-to-L effects

Distance-1: “I WANT (X) I.”

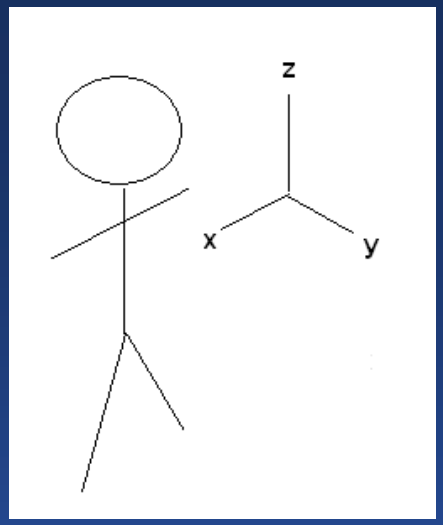
z (up/down)	x (right/left)	y (front/back)		Context
17.76 cm			p=0.08	HAT
15.65				PANTS



ASL: L-to-L effects

Distance-1: “I WANT (X) I.”

z (up/down)	x (right/left)	y (front/back)		Context
17.76 cm			p=0.08	HAT
15.65				PANTS
16.27 cm			*p<0.05	DEER
14.51				RUSSIA



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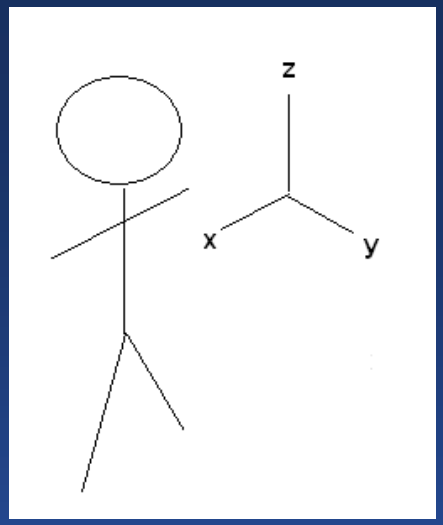
Distance-1: “I WANT (X) I.”

z (up/down)	x (right/left)	y (front/back)		Context
17.76 cm			p=0.08	HAT
15.65				PANTS
16.27 cm			*p<0.05	DEER
14.51				RUSSIA
	36.55 cm		**p<0.01	BOSS
	35.61			CUPCAKE
	34.54			CLOWN



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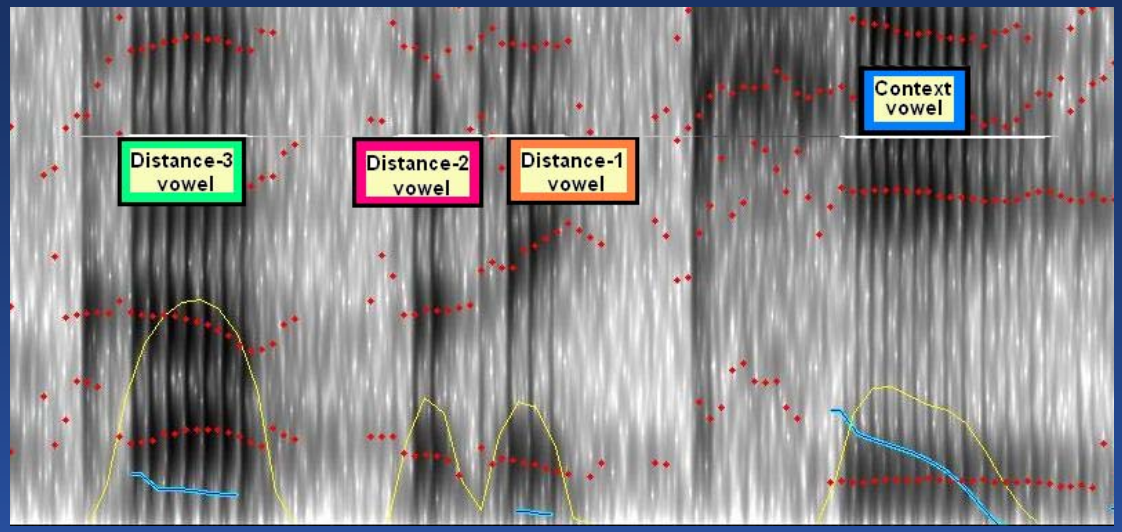
Distance-1: “I WANT (X) I.”

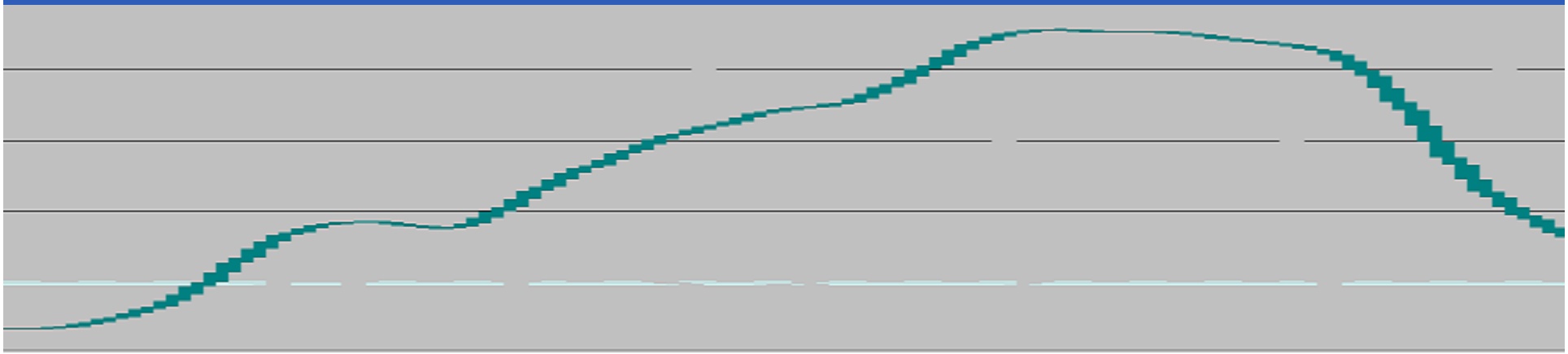
z (up/down)	x (right/left)	y (front/back)		Context
17.76 cm			p=0.08	HAT
15.65				PANTS
16.27 cm			*p<0.05	DEER
14.51				RUSSIA
	36.55 cm	0.20 cm	*p<0.05	BOSS
	34.54	1.43		CUPCAKE
	35.61	1.41		CLOWN

Cross-modality comparison



^ ------- ~300-500 ms ------- ^

v ---------- ~500-800 ms ---------- v



Conclusion: Implications

- Speech production

Coproduction (Fowler) & Window (Keating) models

e.g. Fowler & Saltzman (1993): 200-250 ms as estimate of gesture's anticipatory range of influence.

- Sign production

If confirmed, long-distance effects in sign language must be recognized in any viable model of sign production.

- Language in general

The time range of planning for linguistic production may be dissimilar between modalities.

Conclusion: Ongoing research …

- Perception:

  This project on English V-to-V coarticulation has found some listeners are sensitive even to the longest-distance effects.

  Will we see similar results for sign?

  Also in progress: use of ERP methodology

- More sign subjects:

  The English study has recruited many subjects and has found substantial variability among speakers and listeners. What about inter-signer variation?

- Non-linguistic "coarticulation":

  Are the effects we're seeing here exclusively language-based?

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Contact information:

Michael Grosvald
Center for Mind and Brain
267 Cousteau Place
Davis, CA 95618

E-mail: mgrosvald@ucdavis.edu
Phone: (530) 297-4427