GESTURING AVATARS IN COMPUTER-MEDIATED LEARNING OF VOWEL LENGTH CONTRASTS

CALICHE 2018

April 6 2018

Aaron Braver*, TTU

*Based on joint work with Kimi Nakasukatsa, Miranda Scolari, and Tommy Dang. Supported by a TTU Seed Grant for Interdisciplinary Research and a TTU Scholarship Catalyst Program grant

BACKGROUND: LENGTH CONTRASTS

LENGTH CONTRASTS

- English: [o] usually means [o]
- Some use of length in English: "*sooooooo* cool"
- Other languages: vowel length changes meaning
  - Japanese: 木 *ki* 'tree' vs. キー *kii* 'key'
  - Finnish: *tuli* 'fire' vs. *tuuli* 'wind'
  - Arabic زر *zir* 'button' vs. زير *ziir* 'large jar'
  - Thai คัน khan 'to itch' vs. คาน khaan 'to support'
- Exceptional languages: 3 lengths (Mixe, Yavapai, Wichita)

HOW TO DOUBLE YOUR VOWEL INVENTORY

- 5 vowels doesn't give you a lot of possible syllables
- To double possible syllables, contrast vowel lengths
- E.g. Hawaiian has only 5 vowels and only 8 consonants
  - Basic syllables* consist solely of one consonant plus one vowel
  - 5 * 8 = 40 possible syllables—too few!
  - With contrastive vowel length, 80 possible syllables

*Diphthongs are also allowed, adding more possible syllables

AN ASIDE: "VOWEL LENGTH" IN ENGLISH

- Vowel length is not contrastive in English—it never distinguishes two words from one another, but:
- Some vowels happen to be longer than others:
  - Shorter: bit, bet
  - Longer: beet, bait
- Surrounding consonants can affect length too:
  - *ee* in *bead* is longer than *ee* in *beat* (try saying them out loud)
- Since it's not contrastive, English users often don't notice

MORAS: THE UNIT OF LENGTH

- Short vowels = 1 mora (μ)
  - *k i* 'tree'

- Long vowels= 2 moras (μμ)
  - *k i i* 'key'

- (Syllable final consonants = 1 mora)
  - *s o n* 'three'

FUN FACT: HAIKU

ran no ka ya — 5 moras

cho no tsubasa ni — 7 moras

taki mono su — 5 moras

the fragrant orchids
into a butterfly's wings
it breathes the incense

7

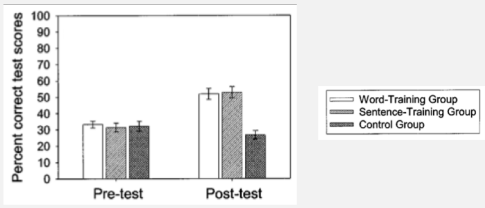
LEARNING L2 JAPANESE VOWEL LENGTH CONTRASTS

- Long vowels are 2–3x longer than short vowels—duration is the primary cue for L1 Japanese speakers (Fujisaki et al., 1975)
- Native English speakers have difficulty acquiring this contrast (Landahl *et al.*, 1992; Han, 1992; Landahl and Ziolkowski, 1995; Yamada *et al.*, 1995; Toda, 1997; Oguma, 2000; Tajima *et al.*, 2002; Hirata, 2004b)

8

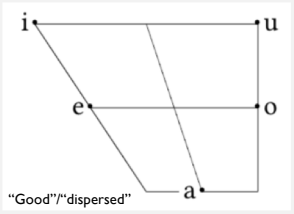
HIRATA ET AL. 2004

- "…the perceptual accuracy even of the trained participants at the post-test was far from perfect"

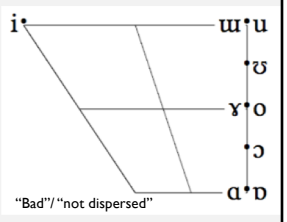


WHY LENGTH IS HARD TO LEARN

- General principle: make vowels as different as possible

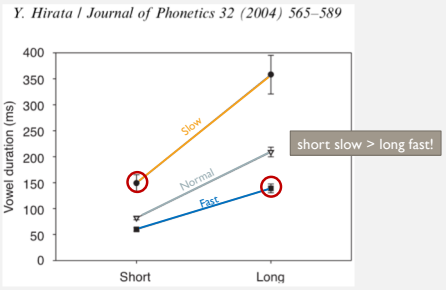


"Good"/"dispersed"



"Bad"/"not dispersed"

WHY LENGTH IS HARD TO LEARN: SPEECH RATE



BACKGROUND: GESTURE

12

WHAT IS GESTURE?

- A hand movement that is directly tied to speech. (McNeil, 1992)
- What's not gesture?
  - Pantomime (obligatory absence of speech)
  - Sign language (fully encodes linguistic properties)

13

GESTURE AND LEARNING

- Gestures are very important in communication (McNeil, 1992)
- Gesturing helps cognitive development and learning abstract ideas and mathematical concept (Goldin-Meadow, 2004; Nunez, 2008).

4 + 5 + 7 = __ + 7

14

GESTURE AND FOREIGN LANGUAGE LEARNING

- Seeing speakers' gestures helps second language **comprehension** (e.g., Sueyoshi & Hardison, 2005).
- Seeing teachers' gestures helps second language **grammar** learning (e.g., Matsumoto & Dobs, 2017; Nakatsukasa, 2016)
- Seeing and/or doing gestures helps **vocabulary** learning (e.g., Lazaraton, 2004; Tellier, 2008; Macedonia & Klimesch, 2014).

15

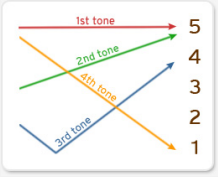
GESTURE AND LEARNING OF PRONUNCIATION

- Seeing and/or doing gestures helps **pronunciation** learning – but results are mixed.
  - Metaphoric pitch gestures to teach Chinese pitch → **Effective** (Morett & Chang, 2014)
  - Metaphoric gestures to teach Japanese short vs. long vowel → **Not effective** (Kelly, Bailey, and Hirata, 2017)

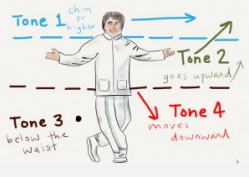
Why mixed results? Participants' background? Are non-learners of Japanese ready to learn this difficult phonological feature?

16

MANDARIN TONE GESTURES



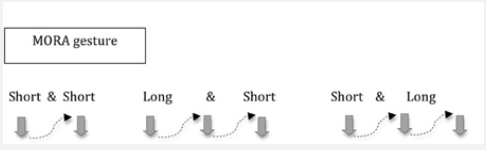
http://quora.com



http://terrywaltz.com

17

JAPANESE LENGTH GESTURES



se ki
'seat'

see ki
'century'

go kee
'word form'

18

Kelly et al (2014)

BACKGROUND: ATTENTION IN L2 LEARNING

19

THE NOTICING HYPOTHESIS

- Conscious learning is necessary/helpful for L2 acquisition—subconscious processes aren't enough (Schmidt 1990, 2001)
- "Conscious registration of the concurrence of some event" (Schmidt 1995)

20

MEASURING ATTENTION

- "Think alouds"
- Underlining (parts of) words necessary for later production
- Stimulated recall
- Eye tracking

21

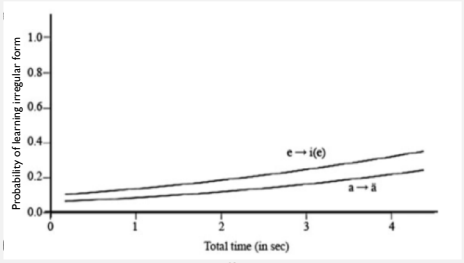
EX: ATTENTION IN GERMAN IRREGULAR VERBS

- *Sprechen* 'to speak' (e → i)
  - *Ich spreche*
  - *Du sprichst*
- *Tragen* 'to carry' (a → ä)
  - *Ich trage*
  - *Du trägst*
- Treatment: reading task
- Attention measured by eye-tracker

22

(Godfroid and Uggen 2013)

EX: ATTENTION IN GERMAN IRREGULAR VERBS



23

(Godfroid and Uggen 2013)

OUR STUDY

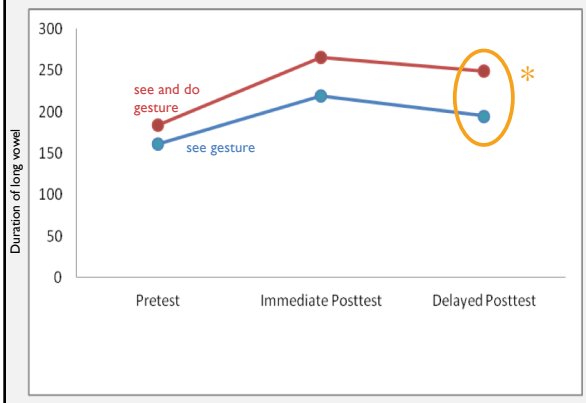
24

GESTURE AND FOREIGN LANGUAGE LEARNING

Pilot Classroom Study (Iizuka, Nakatsukasa, Braver, & Farley, 2016)

- 31 Learners of Japanese (2nd semester)
- Gesture: Handclapping indicating the number of moras.
  - *Kare* 'boyfriend': (Ka Re) 2 claps
  - *Karee* 'curry': (Ka Re E) 3 claps
- See Gesture (n=15): Learners only saw the instructor's gesture.
- See & Do Gesture (n=16): Learners saw and repeated the instructor's gestures.
- Students' vowel durations were then measure

25



RESEARCH QUESTIONS

- Do seeing and repeating *computer avatar's* gestures help Japanese learn acquire a skill to distinguish short and long vowel in Japanese?
- Does learners' level of attention correlate with their learning?

27

MOTIVATION OF THE STUDY

- Test the effectiveness of gestures on pronunciation learning with current L2 students of Japanese
- Increase attention paid to gestures by participants—previous studies show attention primarily focused on faces
  - Pedagogical, rather than spontaneous co-speech gestures
  - In see/do condition, participants will need to repeat gestures
  - Digital vs. real-life faces differ

28

STIMULI

- 37 short/long pairs of Japanese words
- Variables:
  - Syllables in word (1 or 2)
  - Pitch accent placement (syllable 1 or 2)—can be a clue about length!

29

STIMULI

木 *ki* 'tree' vs. キー *kii* 'key'

30

SIDE NOTE: BASICS OF JAPANESE PITCH ACCENT

- Some moras are "accented"—they receive a H tone and following moras receives a L tone
- Monosyllables:
  - te 'hand' — te (H)
  - te-ga 'hand.NOM' — te-ga (H L)
- Disyllables
  - chizu 'map' — chi zu (H L)
  - chiizu 'cheese' — chi i zu (H L L)

31

ACCENT CAN CUE LENGTH

- Monosyllables
  - chii 'social status' — chi i (H L) — Two tones in one syllable → must be a long syllable
- Disyllables
  - shuuto 'capital' — shu u to (H L L) — Two tones in one syllable → must be a long syllable
- Will accent-cued syllables benefit from gesture to the same degree?

32

METHODOLOGY: PARTICIPANTS

- 16 learners of Japanese from JPN2302 and 4300 (2nd semester and above)
- L1 English/L2 Japanese

33

METHODOLOGY: MATERIALS

- Pretest and Posttest: Production Test

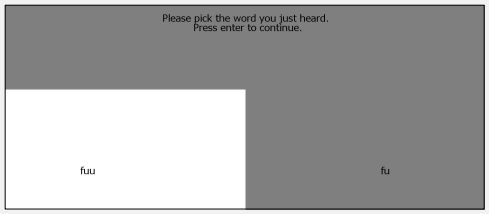
S1 pretest

34

S1 posttest

METHODOLOGY: MATERIALS

- Pretest and Posttest: Perception Test



35

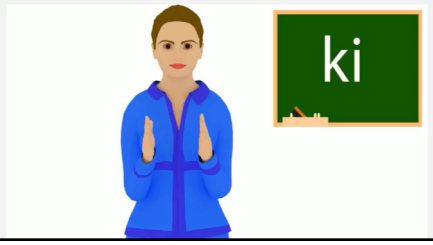
METHODOLOGY: TRAINING

- After pretest, participants receive training
- See avatar reading a word and gesturing (1 clap per mora)
- Condition 1: repeat word while copying gesture (n=8)
- Condition 2: repeat word with no gesture (n=8)
- Head positioned on chin rest
- Eye gaze tracked—hands/face/elsewhere
- Audio and video recorded to verify gestures

36

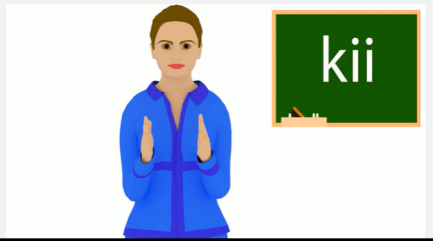
METHODOLOGY: MATERIALS

- Training: short vowel words (see/do gesture condition)



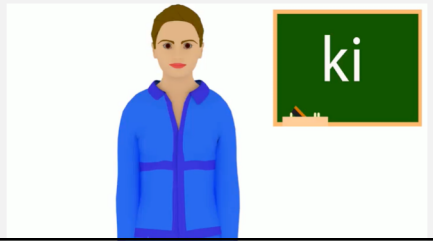
METHODOLOGY: MATERIALS

- Training: long vowel words (no gesture condition)



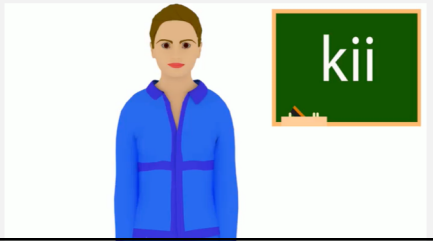
METHODOLOGY: MATERIALS

- Training: short vowel words (no gesture condition)



METHODOLOGY: MATERIALS

- Training: long vowel words (see/do gesture condition)



METHODOLOGY: TRAINING

ki

kii

METHODOLOGY: PROCEDURE

Pretest
- Perception
- Production

Training
- **Condition 1**: See and repeat avatar's gestures and word
- **Condition 2:** Repeat avatar's word

Posttest
- Perception
- Production

Delayed posttest (1 week)
- Perception
- Production

42

METHODOLOGY: EYE TRACKING

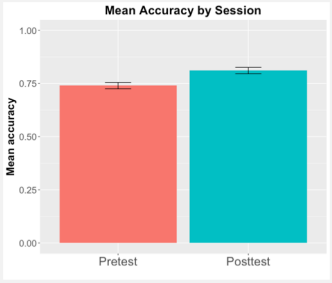
- Overt attention: Locus of attentional focus is consistent with eye position
  - *Where someone is looking is where they are attending*
- Do subjects who attend to the gestures during training exhibit larger learning scores?
  - Measured with eye tracking: real-time recording of eye movements/fixations at a sampling rate of 2000 Hz
  - *Correlate proportion of fixation time on avatar's hands with learning score*

43

RESULTS

44

TRAINING DOES PROVIDE LEARNING BENEFIT



- Overall means:
  - Pretest: 0.74
  - Posttest: 0.81
  - Δ: .07
- Anova:
  - F(1,15)=11.35
  - p < 0.05 *

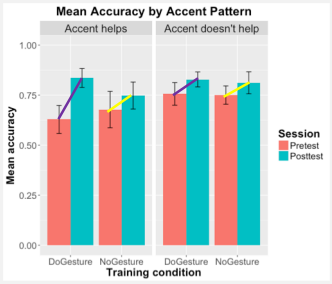
(accuracy ~ session)

TRAINING BENEFIT DOES NOT VARY BY CONDITION

- Mean learning by condition:
  - DoGesture: 0.09
  - NoGesture: 0.05
- Anova:
  - F(1,14) = 0.92
  - *n.s.*

(accuracy ~ group * session)

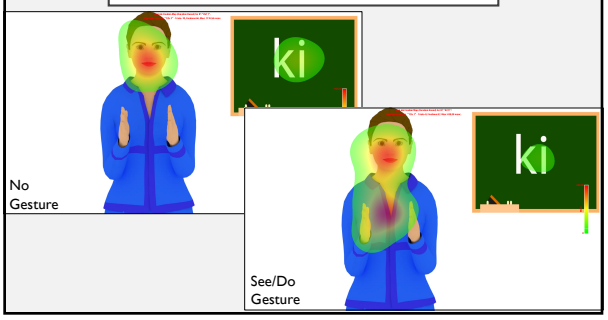
ACCENT AS A CUE TO LENGTH?



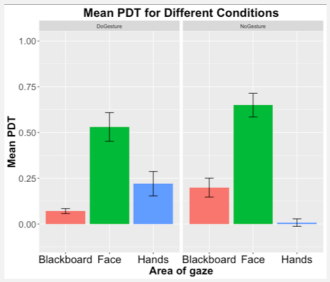
- Accent seems to trend toward helping accuracy in the gesture condition but not no gesture
- ANOVA
  - F(1,14)=.662
  - *n.s.*

(improvement ~ group * session * accent)

WHERE ARE PARTICIPANTS LOOKING?



WHERE ARE PARTICIPANTS LOOKING?

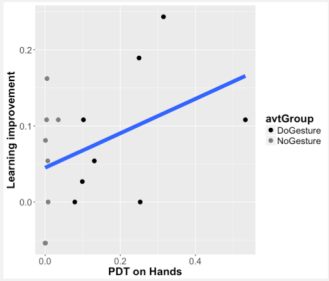


	See/Do Gesture	No Gesture
Board	7.05%	19.89%
Face	53.06%	64.96%
Hands	22.03%	.76%

- Anova:
  - F(2,28) = 6.26
  - p < 0.01 *

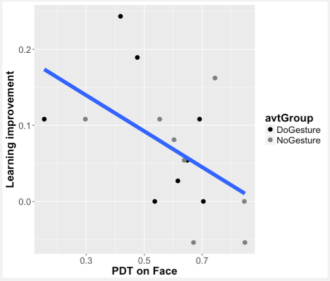
(pdt ~ location * group)

DOES ATTENTION TO HANDS AID LEARNING? ✓



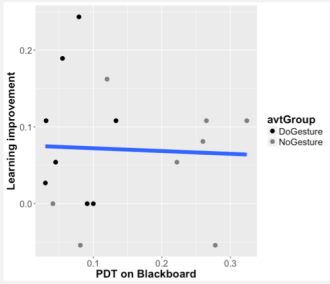
- Dwell time on hands correlates with increased learning scores (R=.43; for gesture group only)

DOES ATTENTION TO FACE AID LEARNING? ✗



- Dwell time on face correlates with decreased learning scores (R=.-46; for gesture group only)

DOES ATTENTION TO BLACKBOARD AID LEARNING? ✗



- Dwell time on blackboard correlates very weakly with decreased learning scores (R=-.04; for gesture group only)

SUMMARY

- Training—with or without gestures—improves performance on perception/identification task
- Participants don't use accent as a cue to length
- Participants attend to hand gestures of computer avatars
- No significant difference between gesture and no gesture groups, but:
- Attending to hands correlates with better performance, while attending to blackboard or face correlates with worse performance

53

FINAL THOUGHTS

- Next steps:
  - Analyze production data
  - Add more participants
  - Complete and analyze delayed posttest
  - See but don't do gesture condition
  - Current Japanese students vs. complete novices

54

THANK YOU

- Special thanks to:
  - Shiori Nakamura for recording the Japanese stimuli
  - Guangsheng (Carl) Liang for charts, graphs, and data-wrangling

REFERENCES

Goldin-Meadow, S. Gestures role in the learning process. Theory into Practice, 2004, 43, 314-321

Fujisaki, H., Nakamura, K., and Imoto, T. 1975. "Auditory perception of duration of speech and non-speech stimuli," in *Auditory analysis and perception of speech*, edited by G. Fant and M.A.A. Tatham Academic Press, London, pp. 197–219.

Godfroid, A., & Uggen, M. S. (2013). Attention to irregular verbs by beginning learners of German. Studies in Second Language Acquisition, 35(2), 291-322.

Hirata, Y. 2004b. "Training native English speakers to perceive Japanese length contrasts in word versus sentence contexts," J. Acoust. Soc. Am. 116, 2384–2394.

Iizuka, Nakatsukasa, Braver, & Farley, 2016. Bridge between syllabic and moraic languages: Does gesture help pronunciation learning?. Second Language Research Forum (SLRF) 35. Columbia University.

Kelly, S., Bailey, A., & Hirata, Y. (2017). Metaphoric Gestures Facilitate Perception of Intonation More than Length in Auditory Judgments of Non-Native Phonemic Contrasts. *Collabra: Psychology*, *3*(1), 7.

Kelly, Spencer D., et al. "Exploring the role of hand gestures in learning novel phoneme contrasts and vocabulary in a second language." *Frontiers in psychology* 5 (2014): 673.

Landahl, K., and Ziolkowski, M. 1995. "Discovering phonetic units: Is a picture worth a thousand words?" Papers from the 31st Regional Meeting of the Chicago Linguistic Society 1, 294–316.

REFERENCES

Landahl, K., Ziollkowski, M., Usami, M., and Tunnock, B. 1992. "Interactive articulation: Improving accent through visual feedback," in *The Proceedings of the Second International Conference on Foreign Language Education and Technology*, edited by I. Shinjo *et al.* The Language Laboratory Association of Japan, Kasugai, Aichi, Japan, pp. 283–292.

Lazaraton, Anne. "Gesture and speech in the vocabulary explanations of one ESL teacher: A microanalytic inquiry." *Language learning* 54.1 (2004): 79-117.

Macedonia, Manuela, and Wolfgang Klimesch. "Long-term effects of gestures on memory for foreign language words trained in the classroom." *Mind, Brain, and Education* 8.2 (2014): 74-88.

Matsumoto, Yumi, and Abby Mueller Dobs. "Pedagogical gestures as interactional resources for teaching and learning tense and aspect in the ESL grammar classroom." *Language Learning* 67.1 (2017): 7-42.

McNeill, David. *Hand and mind: What gestures reveal about thought*. University of Chicago press, 1992.

Morett, L. M., & Chang, L.-Y. (2014). Emphasising sound and meaning: Pitch gestures enhance Mandarin lexical tone acquisition. Language, Cognition and Neuroscience, 30(3), 347–353.

Nakatsukasa, Kimi. "Efficacy of recasts and gestures on the acquisition of locative prepositions." *Studies in Second Language Acquisition* 38.4 (2016): 771-799.

Nunez, Rafael. "A fresh look at the foundations of mathematics: Gesture and the psychological reality of conceptual metaphor." *Metaphor and gesture* (2008): 93-114.

REFERENCES

Oguma, R. 2000. "Perception of Japanese long vowels and short vowels by English speaking learners," Japanese-Language Education Around the Globe 10, 43–55.

Schmidt, R. (1990). The Role of Consciousness in Second Language Learning. *Applied Linguistics, 11*, 129-158.

Schmidt, R. (1995). Consciousness and foreign language learning: A tutorial on the role of attention and awareness in learning. In R. Schmidt (Ed.), *Attention and awareness in foreign language learning* (pp. 1-63). Honolulu, HI: University of Hawaii, Second Language Teaching & Curriculum Center.

Schmidt, R. (2001). Attention. In P. Robinson (Ed.), *Cognition and second language instruction* (pp. 3-32). Cambridge: Cambridge University Press.

Sueyoshi, Ayano, and Debra M. Hardison. "The role of gestures and facial cues in second language listening comprehension." *Language Learning* 55.4 (2005): 661-699.

Tajima, K., Rothwell, A., and Munhall, K. G. 2002. "Native and non- native perception of phonemic length contrasts in Japanese: Effect of identification training and exposure," J. Acoust. Soc. Am. 112, 2387.

Tellier, Marion. "The effect of gestures on second language memorisation by young children." *Gesture* 8.2 (2008): 219-235.

Toda, T. 1997. "Strategies for producing mora timing by non-native speak- ers of Japanese," in *Acquisition of Japanese as a Second Language*, edited by Daini Gengo Shuutoku Kenkyuukai Bonjinsha, Tokyo, pp. 157–197.

Yamada, T., Yamada, R. A., and Strange, W. 1995. "Perceptual learning of Japanese mora syllables by native speakers of American English: Effects of training stimulus sets and initial states," *Proceedings of the 14th International Congress of Phonetic Sciences* 1, 322–325.