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 [ɔ]
- Some use of length in English: "soooooo cool"
- Other languages: vowel length changes meaning
  - Japanese: 木 'tree' vs. 木 'key'
  - Finnish: sää 'snow' vs. tuul 'wind'
  - Andes: ci 'button' vs. ci 'large
  - Thai: ด้า 'to back' vs. ม้า '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: bit, bet
  - Surrounding consonants can affect length too:
    - ee in bead is longer than in ear
      (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 'key'
- Long vowels= 2 moras (μμ)
  - k i i 'key'
- (Syllable final consonants = 1 mora)
  - s o 'tree'
FUN FACT: HAIKU

ran no ka ya
cho no tsubasa ni
kakimono su

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

5 syllables
7 moras
5 moras

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 Zwickowski, 1995; Yamada et al., 1995; Toda, 1997; Oguma, 2000; Tajima et al., 2002, Hirata, 2004b)

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

WHY LENGTH IS HARD TO LEARN: SPEECH RATE


BACKGROUND: GESTURE
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)

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).

\[4 + 5 + 7 = \_ + 7\]

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., Macedon & Dobi, 2017; Nakataoka, 2014)
- Seeing and/or doing gestures helps vocabulary learning (e.g., Lazaraton, 2004; Tellier, 2008; Macedonia & Klimesch, 2014).

GESTURE AND LEARNING OF PRONUNCIATION

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

MANDARIN TONE GESTURES

[Diagram of Mandarin tone gestures]


JAPANESE LENGTH GESTURES

[Diagram of Japanese length gestures]

[Links: Kelly et al (2014)]
BACKGROUND: ATTENTION IN L2 LEARNING

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)

MEASURING ATTENTION

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

EX: ATTENTION IN GERMAN IRREGULAR VERBS

- Sprächen ‘to speak’ (e → i)
  - Ich sprehe
  - Du spreche
- Tragen ‘to carry’ (e → ä)
  - Ich trage
  - Du trägst
- Treatment: reading task
- Attention measured by eye-tracker

EX: ATTENTION IN GERMAN IRREGULAR VERBS

OUR STUDY
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
  - Kare ‘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 measured.

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?

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

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
**SIDE NOTE: BASICS OF JAPANESE PITCH ACCENT**

- Some moras are “accented”—they receive a H tone and following moras receive a L tone
- **Monosyllables:**
  - te ‘hand’
  - se-gs ‘hand, here’
- **Disyllables:**
  - chii ‘emp’
  - chiizu ‘cheese’

**ACCENT CAN CUE LENGTH**

- **Monosyllables**
  - chi ‘social status’
  - shuuto ‘capital’
   - Will accent-cued syllables benefit from gesture to the same degree?
- **Disyllables**
  - chiizu ‘cheese’

**METHODOLOGY: PARTICIPANTS**

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

**METHODOLOGY: MATERIALS**

- Pretest and Posttest: Production Test
- Pretest and Posttest: Perception Test
- 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
METHODOLOGY: MATERIALS

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

• Training: long vowel words (no gesture condition)

METHODOLOGY: MATERIALS

• Training: short vowel words (no gesture condition)

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

METHODOLOGY: TRAINING

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
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

RESULTS

TRAINING DOES PROVIDE LEARNING BENEFIT

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

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.

Where Are Participants Looking?

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)=1.662
  - n.s.
WHERE ARE PARTICIPANTS LOOKING?

<table>
<thead>
<tr>
<th>Area of gaze</th>
<th>See/Do Gesture</th>
<th>No Gesture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Board</td>
<td>7.05%</td>
<td>19.89%</td>
</tr>
<tr>
<td>Face</td>
<td>53.06%</td>
<td>64.96%</td>
</tr>
<tr>
<td>Hands</td>
<td>22.03%</td>
<td>7.6%</td>
</tr>
</tbody>
</table>

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

DOES ATTENTION TO HANDS AID LEARNING?

- Dwell time on hands correlates with increased learning scores (R=0.43; for gesture group only)

DOES ATTENTION TO FACE AID LEARNING?

- Dwell time on face correlates with decreased learning scores (R=-0.46; for gesture group only)

DOES ATTENTION TO BLACKBOARD AID LEARNING?

- Dwell time on blackboard correlates very weakly with decreased learning scores (R=-0.04; 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

FINAL THOUGHTS

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

- Special thanks to:
  - Short Nokumura for recording the Japanese stimuli
  - Guangsheng (Car) Liang for charts, graphs, and data wrangling

REFERENCES


REFERENCES


