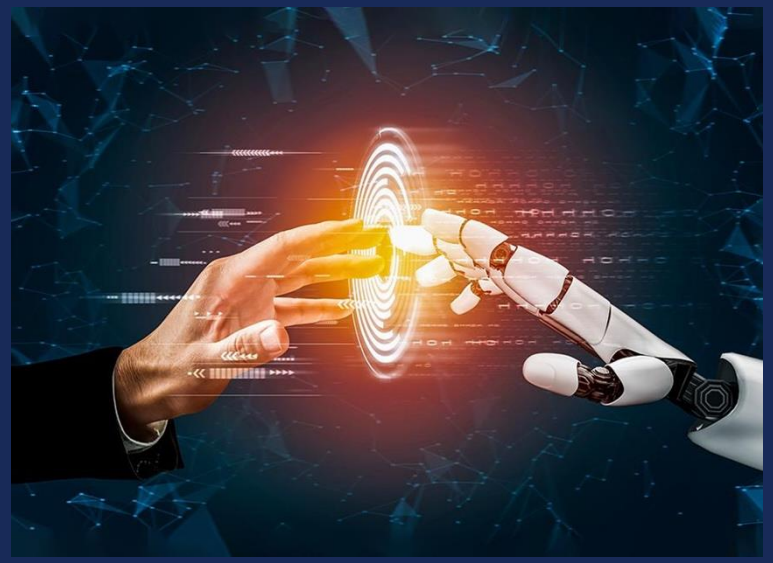
L2 Intelligibility in the Contexts of AI and Globalization



Okim Kang
Northern Arizona University

JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

Tampere University

The Nordic Speech Research Forum
January 26, 2026

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L2 Intelligibility in the Contexts of AI and Globalization

- L2 Speech and constructs
  - Overview of L2 speech technology and AI
- Critical AI in L2 speech
- Intelligibility in global contexts
- Future directions

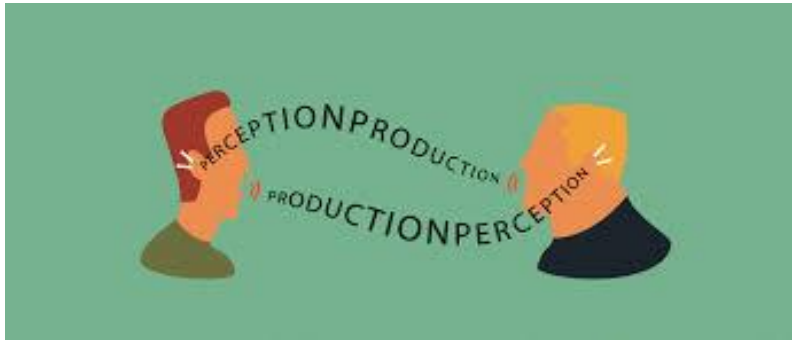
NAU, Flagstaff, Arizona

Altitude: 7,000 feet

A 90-minute Drive from Flagstaff to the Grand Canyon

L2 Speech & Accent

- **L2 speech:** How speakers **perceive**, process, understand, **pronounce** the sounds of an L2 language (Flege, 1995)



- The sound of speech is a critical issue in language assessment because people tend to **immediately judge native/nonnative speaker status on the basis of pronunciation (accent)** (Luoma, 2004).

- **Accent** is "phonological difference from a local norm".
- **Indeed, we all have accents!**
- **Accent is dynamic**: Accent modulates as speakers negotiate social identification or distance with listeners (Giles 1991, Communication Accommodation Theory)

New Perspectives in Global Contexts

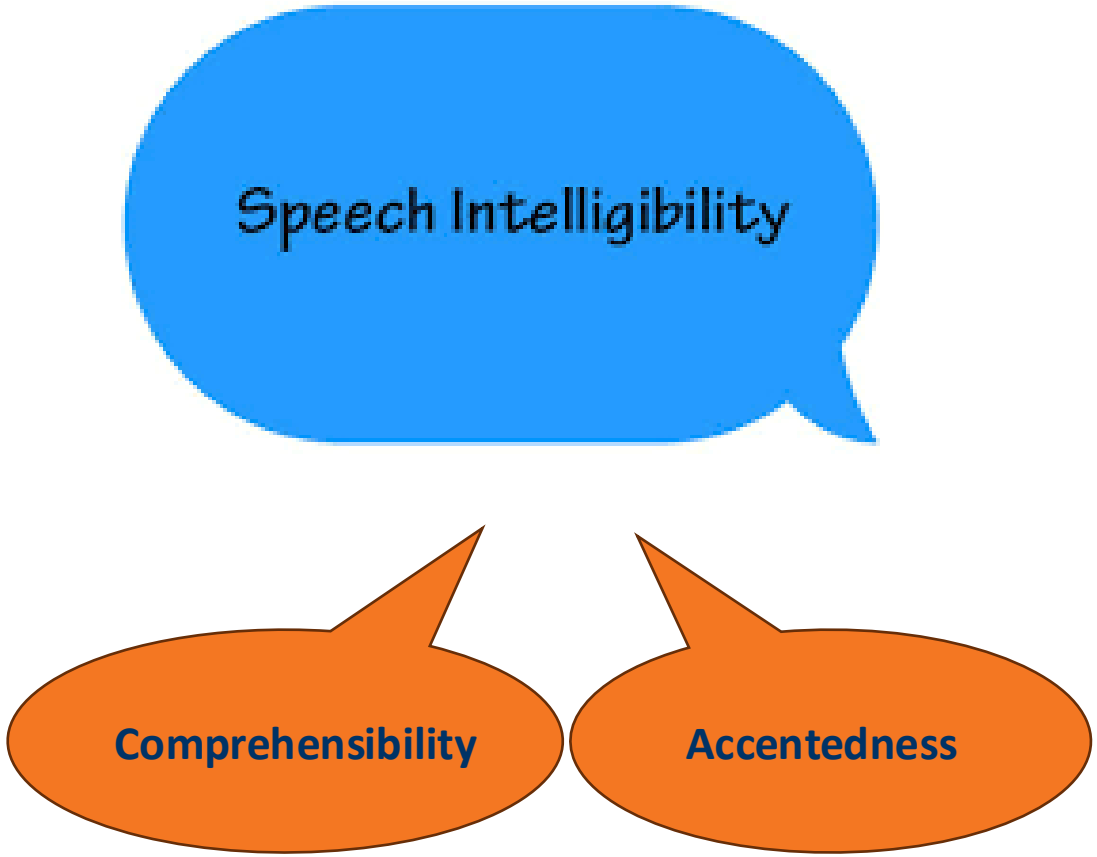
- English has spread all around the world. through globalization (Rose & Galloway, 2019)
- **Ownership of English** no longer belongs just to the inner-circle countries (Kirkpatrick, 2008)

- **Global intelligibility** is a key issue for successful communication in international contexts (Jenkins, 2006)
- **Global Englishes:** Broadly reflecting the use of English across borders and incorporating concepts of WE, ELF, EIL (Galloway & Rose, 2005)

Speech Constructs (Derwing & Munro, 2005)

- **Comprehensibility:** Perception of how easy it is to understand an utterance.
- **Accentedness:** Perception of how different a speaker's accent is from that of L1 community.
- **Intelligibility:** how much the listener actually understands of the intended message.

-Acceptability, appropriateness, familiarity, etc.



What is Intelligibility?

Speech science

- Defined as “the ensemble of properties that allow a native listener of the language to **correctly recognize the linguistic units (such as phonemes, syllables, and words)** in the order that they were produced by the speaker of the utterance” (Gooskens et al., 2010, p. 1022)
- Speech clarity

- Being **intelligible** is not synonymous with being **accent free** (Goodwin, 2014).
- **Mutual intelligibility:** Intelligibility does not reside solely in the speaker or the listener, but rather in the interaction between the two (Kang et al., 2014; Smith & Nelson, 1985).
- Intelligibility can **vary according to audience** (Brown, 1991)
- Intelligibility is **relational, co-constructive, and context-specific** (Kang et al., 2025; Kang et al., CUP, accepted) *(Contemporary Issues in L2 Speech Intelligibility)*

L2 Intelligibility (Kang et al., LT, 2025)

- Global Contexts
  - **Mutual understanding** among speakers of different English varieties
  - Requires both speaker's and listener's ability to comprehend (Gooskens, 2017).
  - What constitutes intelligibility v**aries from context to context** (Kang & Hirschi, 2025)
  - Most intelligibility research focusing on human judgement (Kang et al., 2025)

- AI Contexts
  - A new era in speech intelligibility
  - With the rise of interaction with AI chatbots (Labadze et al., 2023). learners or speakers are now prioritizing intelligible speech in **communication with AI** (Moussalli & Cardoso, 2020).
  - The evolution of ASR capabilities in AI technology has spurred **ASR-based L2 intelligibility** (Inceoglu et al., 2023).

Overview of L2 Speech Technology and AI

(Dentaa, Bae, & Kang, forthcoming)

- Automatic speech recognition (ASR): Recognizing isolated spoken digits of **one individual's speech** (Bell Laboratory, 1950s; Davis et al., 1952) => the recognition to vowels and phonemes
- Large-vocabulary continuous speech recognition systems (LVCSR) + Hidden Markov Models (HMMs) => recognized more **natural speech** (Witt & Young, 1997).
- In late 1980s and early 1990s, applying speech recognition technologies to **language learning**
  - Computer-assisted pronunciation training (**CAPT**) systems
- In early 2010s, technological advances in machine learning, including deep neural networks (DNNs), recognizing **other English accents**.
  - ASR systems became available on personal devices (e.g., **smartphones and computers**)
- In early 2020s, advances in end-to-end neural ASR and self-supervised speech recognition stable for large-scale use on **mobile platforms and in classrooms** (Prabhavalkar et al., 2024).
- Between 2020 and 2026, ASR systems have been integrated with **Gen AI** based on LLMs, enabling feedback in the form of explanations, prompts, and **conversational responses** (Hono et al., 2024).

L2 Speech and AI Tools

- In 2020s, mobile technologies and **intelligent personal assistants** (IPAs).
- In ASR-LLM models, speech recognition output combines with GenAI systems to provide explanatory and **dialogic responses in natural language** (Goh & Aryadoust, 2025).
  - Voice-enabled assistants (e.g., Google Assistant, Amazon Alexa) and speech-to-text systems (e.g., Google Voice Typing).
- **Conversational agents** to improve fluency, i.e., chatbots to rehearse low-stakes speaking opportunities
  - OpenAI's ChatGPT voice mode, ELSA AI Tutor, Duolingo Max, etc.
- Lower-cost and widely available tools for formative feedback
  - Google Voice Typing, Google Assistant, Microsoft Dictate, and Whisper-based transcription tools
  - **Word error rate => intelligibility**

Human vs. AI: Linguistic Variation

In comparison to human/human, when speakers communicate with an AI agent, they make…

- Comparable IC features (Karatay & Xu, 2025)
- Louder with AI than human (Siegert & Kruger, 2022)
- Timpe-Laughlin et al. (2022)
  - Fewer turns with AI (half)
  - Longer speaking time with AI
  - Fewer backchannelling with AI
- Longer pauses between turns or different **intonation patterns** (Kang et al., in process)

Intonation (Human vs. AI)

- Prosodically, speakers often signal agreement with **pitch concord** (or matching) and disagreement with breaking (Brazil, 1998; Pickering et al., 2012)

A: It wasn't my fault, was it?
B: No, of course, it wasn't. Definitely not.

Disagreement mitigation with concord (Pickering, 2018, p. 65)

Pickering (2018)

Human

Lily

2025 version

Critical AI in L2 Speech

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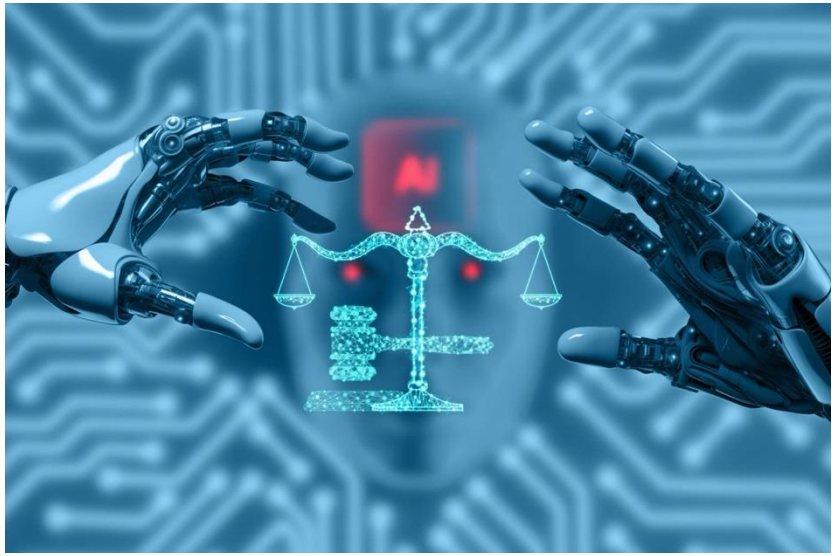
Kang, O., & Hirschi, K. (2025). AI-based bias and second language speech technology. *Annual Review of Applied Linguistics*.

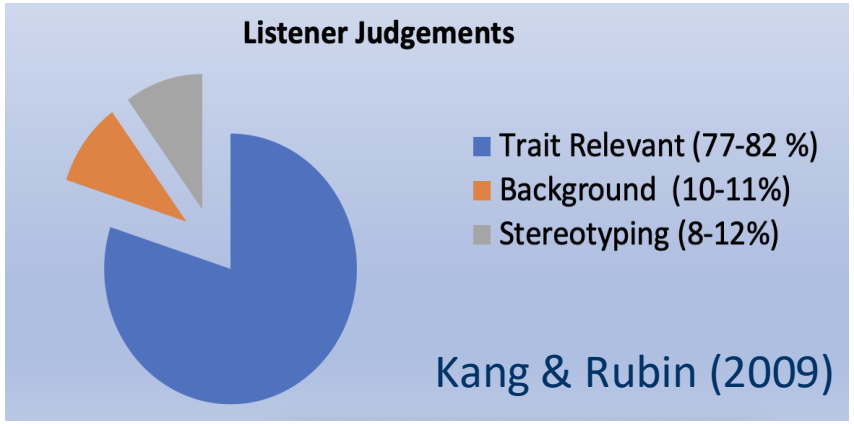
- **Does AI have any bias?**
  - Race/religion?
  - Gender?
  - L1s accent?



Human Listener Stereotyping and Background on Perceptions of L2 Speech

Many factors can affect our perception or judgement….

- Stereotyping (Kang & Rubin, 2009; Kang & Yaw, 2021; Levis & Moyer, 2014; Lindemann, 2002; Telo et al., 2024)
- Accent familiarity (Browne & Fulcher, 2017; Gass & Varonis, 1984; Miao & Kang, 2024; Ockey & French, 2014)
- Topic familiarity (Gass & Varonis, 1984)
- Shared-L1 effect (Kang et al., 2019; 2023; 2024; Munro et al., 2006; Shin et al., 2021)
- Training effect (Kang et al., 2020; Xi & Mollaun, 2011; Winke et al., 2013)
- L1 status (Fayer & Krasinksi 1987; Kang, 2012)



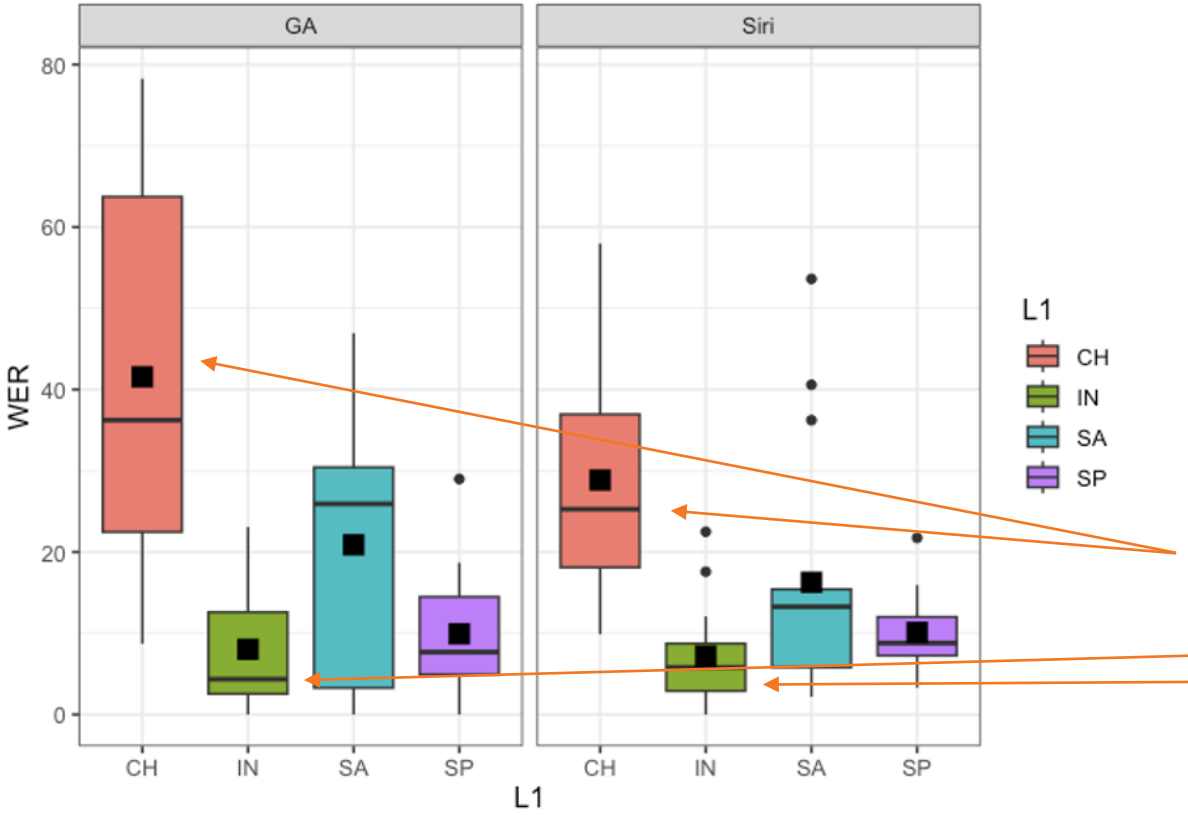
- Listener's attitudinal and background factors (Kang & Rubin, 2009)
  - **18-23 %** of variance

AI Understanding of Accent Varieties

- ASR transcription accuracy:
  - Persistent misrecognition of linguistic varieties (Choi & Choi, 2025)
  - Sustained error rate variability among 26 different English accents (Swain et al., 2025)
  - Lower accuracy in African American varieties than White American varieties (Koenecke et al., 2020)
  - Lower accuracy in women speakers than men (Tatman, 2017)

Testing AI's intelligibility: Do voice-activated AI assistants have L1 bias? (Bae & Kang, 2025, under review)

Figure 1. Distribution of WER by AI Type Across L1 Varieties in Dataset 1



Note. GA = Google Assistant, Siri = Apple's Siri
Note. CH = Chinese, IN = Indian, SA = South African, and SP = Mexican Spanish.

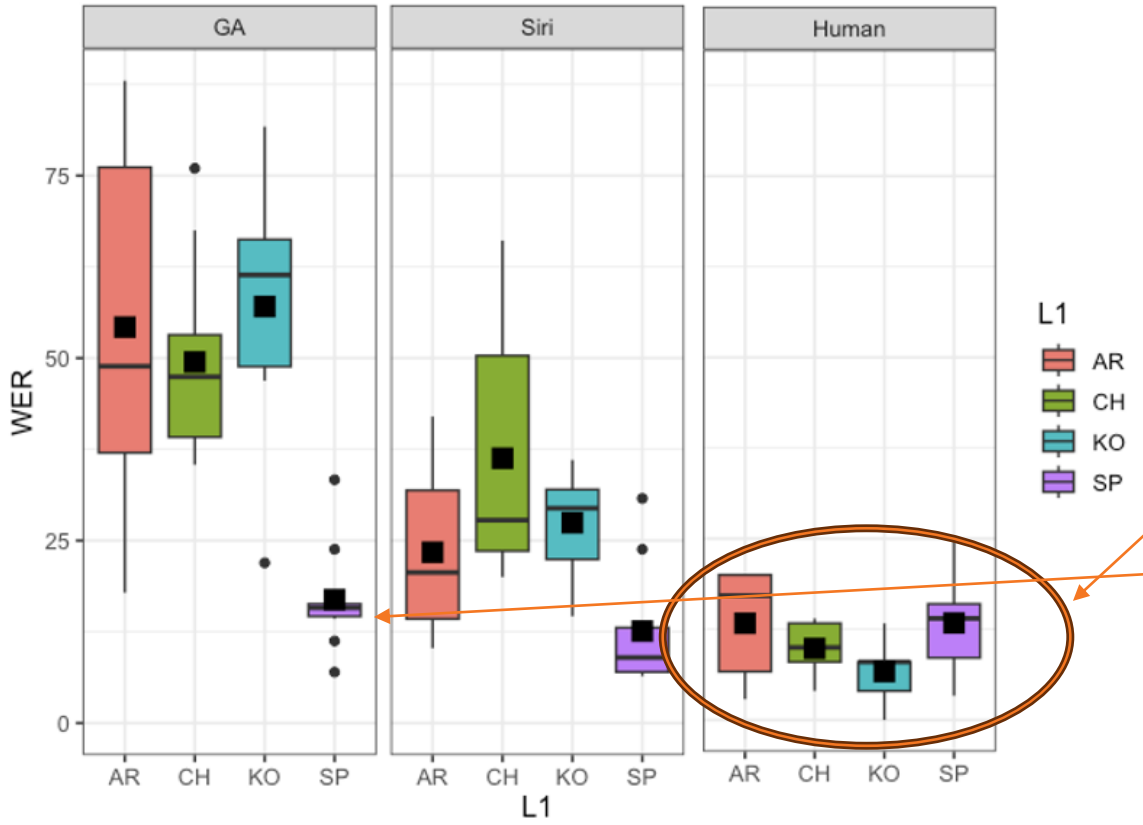
- **Dataset**: 60 Accent Archive speech
- Google Assistant vs. Apple's Siri
- **5 Expert raters** : High intelligibility confirmed through transcription (85% or above)

- Especially **Chinese accent** with a high word error rate
- **Indian and Spanish accents** with low error rates

AI Ratings vs. Human Ratings

(Bae & Kang, 2025, under review)

Figure 3. Distribution of WER by Rater Type Across L1 Varieties in Dataset 2

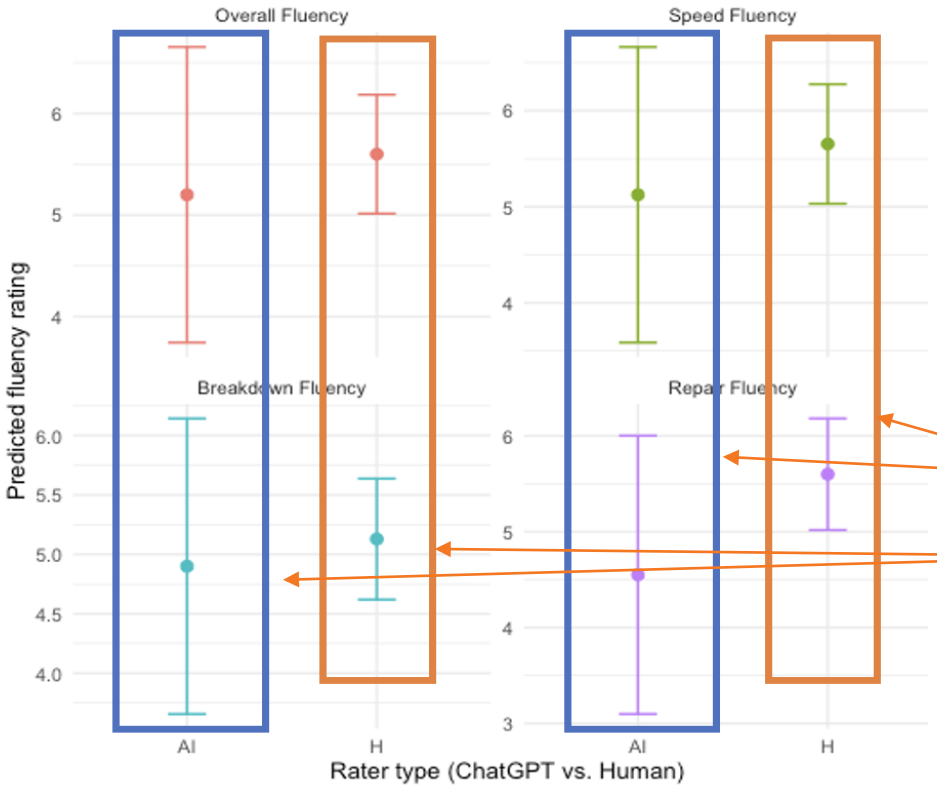


- Human raters are so consistent
- The **Spanish** accent has a low error rate.

AI as Potential Learning Tools for L2 Oral Fluency? (Bae & Kang, 2025)

ChatGPT vs. Expert Human Raters

Figure 1. Visual plot of the LMEM results



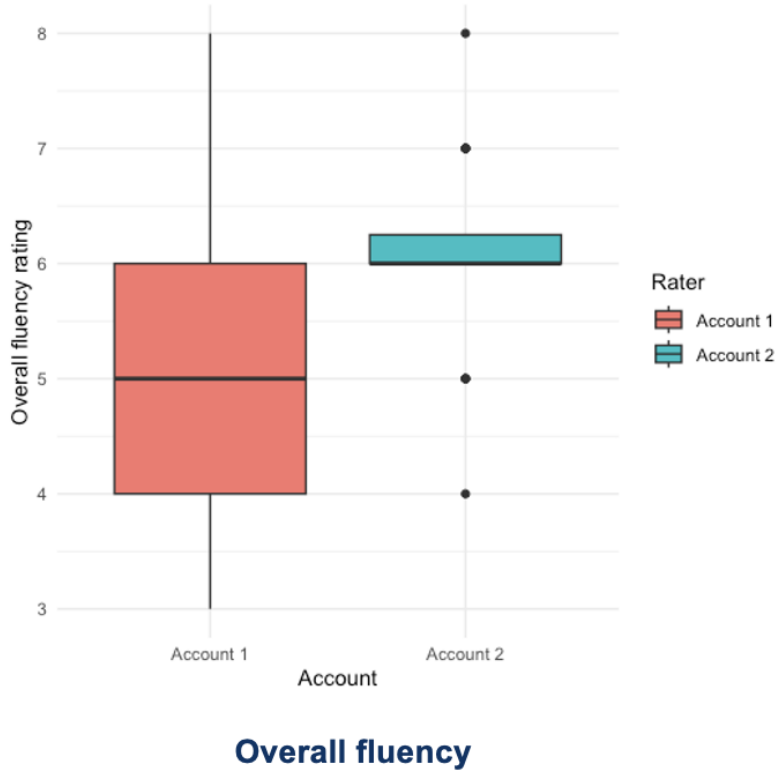
Note. AI = ChatGPT, H = Human experts

- 40 speech files from the Cambridge English Language Assessment (Kang & Yan, 2018)
- Human raters: 7 experts, ICC = .80 or higher)
- ChatGPT 4.0

- No statistical difference between the two rating types, but the clustering patters differed.
- ChatGPT: Broader variability

Inter-rater reliability: Consistency of ChatGPT fluency ratings across different accounts

Figure 2. Box plots of the results for each fluency feature rating across ChatGPT accounts

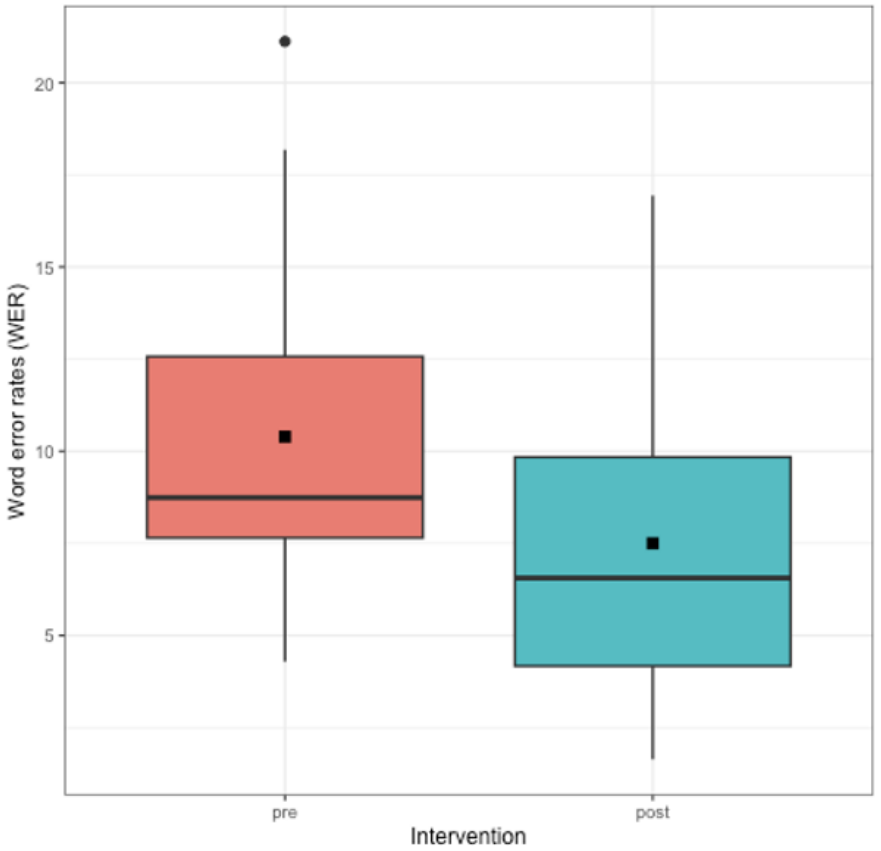


- This different account type explained 20% to 38.7% of the variance in ratings.
- A significant effect of account type (ChatGPT 1 vs. ChatGPT 2)

AI Training Through GE Varieties
(Bae & Kang, under review)

- **WE training** (Miao, Kang, & Meng, 2025) used for human listeners
- **The same training for ChatGPT 4**
  - Phonetic explanations and audio examples illustrating specific features of each accent variety for 30 speech samples
    - Chinese, Indian, Korean and Spanish
    - the phonological features in the accent varieties and differences from American English
  - Checked WERs

Intelligibility Scores



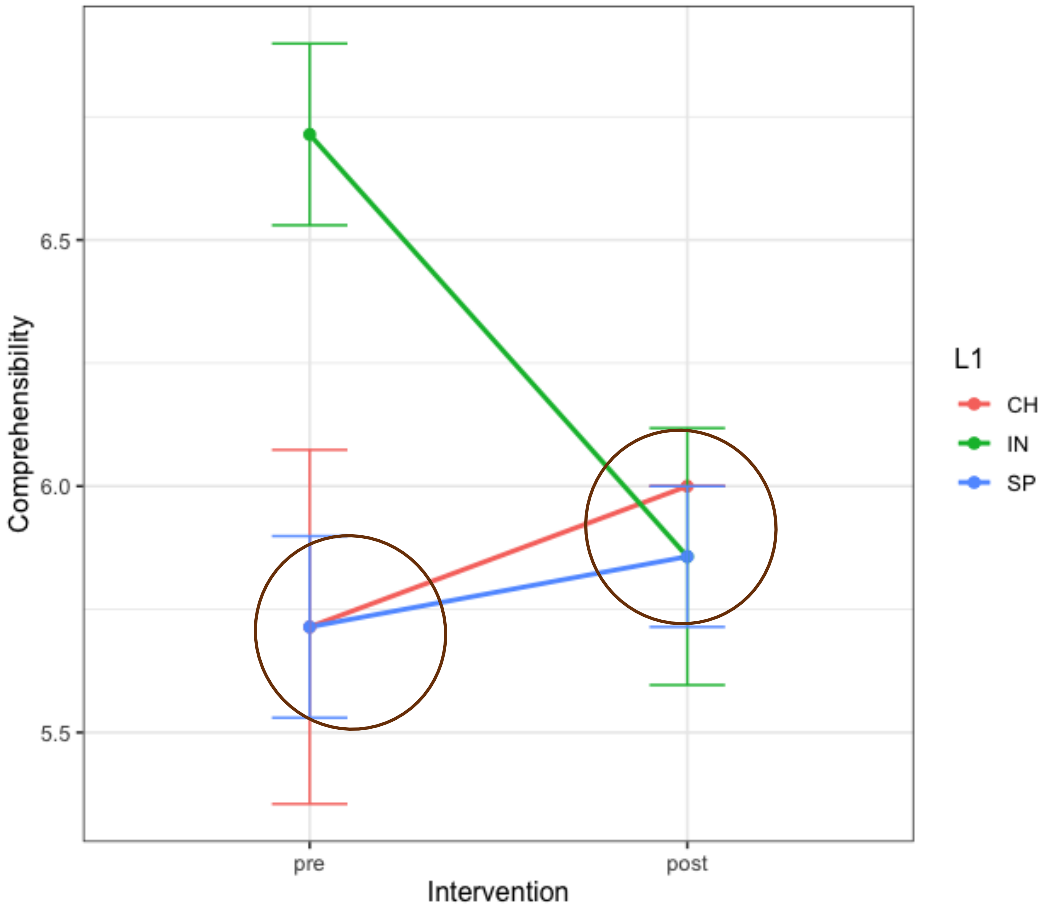
Pre=pre intervention; post=post-intervention

AI Training Through Cognitive Dissonance Theory-based Intervention

(Bae & Kang, in process)

Comprehensibility Rating

- 40 speech files from a human training study (Miao, Moran, and Kang, 2023)
  - WE phonological feature training
- Chinese accent perception improved (red line); Indian accent (green) dropped.
  - Differences merged into a much narrower variance



Human vs. AI Ratings of Personal Traits

(Hirschi, Kang, & Bae, 2025/ in-progress)

GPT Prompt

- How would you rate the speaker on a scale from 1 to 9 in the following descriptors?

The statement is…

- emotional—unemotional
- graceful—awkward
- plain—expressive
- effective — ineffective

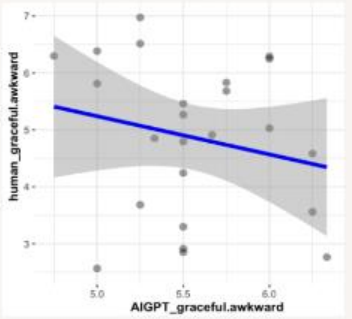
……..

- **The Study**
- 24 speech samples
- 161 listeners' ratings
- Preview-4o-Audio (Open AI API) model were given same instructions (April/2025)
- Compared them with human ratings

Very inconsistent ratings and no relationships

graceful/awkward

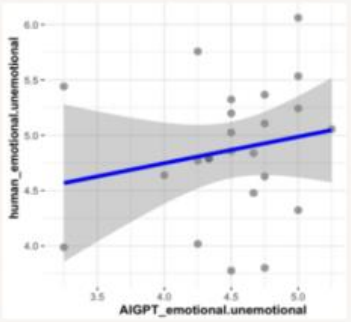
(r = -.21, p = .32)



ICC_{GPT} = .87

emotional/unemotional

(r = .20, p = .36)



ICC_{GPT} = .49

Intelligibility-Based Feedback: Objective Speech Intelligibility Measure (OSIM)

(Kang et al., ongoing)

- Create **a computerized system** for measurement of speech features and L2 speech intelligibility scores to provide teachers and learners with feedbac
- How doe
  OSIM co
  progress
  intelligib
  time?

There should be some kind of training for learners and teachers (instructional impact).

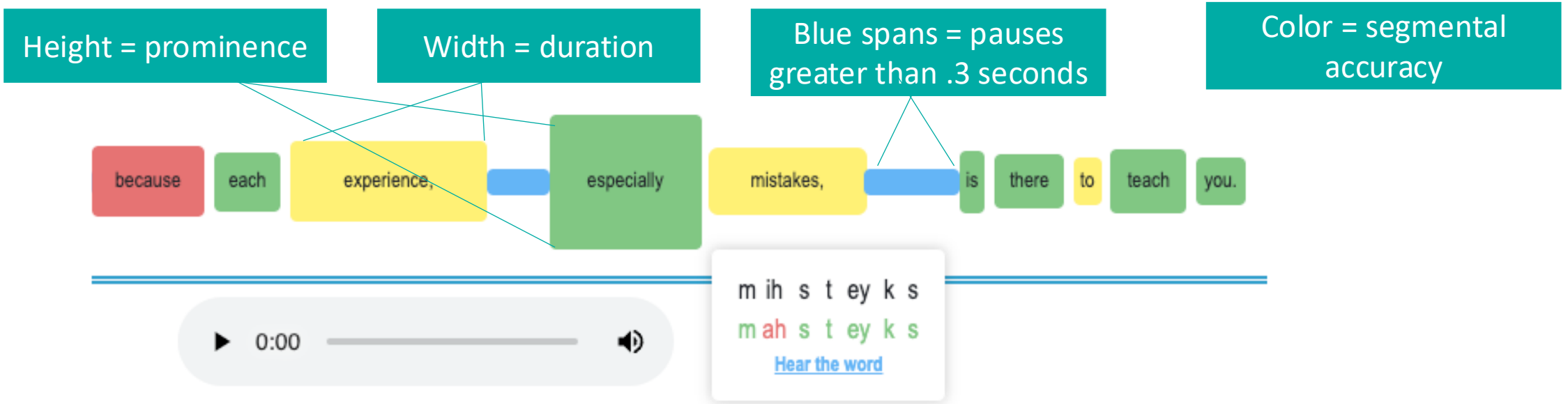
Speech analysis data:

Speech Event	Intelligibility	Speech Rate	Avg Pause Length	Rhythm Index	Word Stress Accuracy
Presentation Practice	97.67%	4.65 syl / sec	0.6 sec	0.6	79%

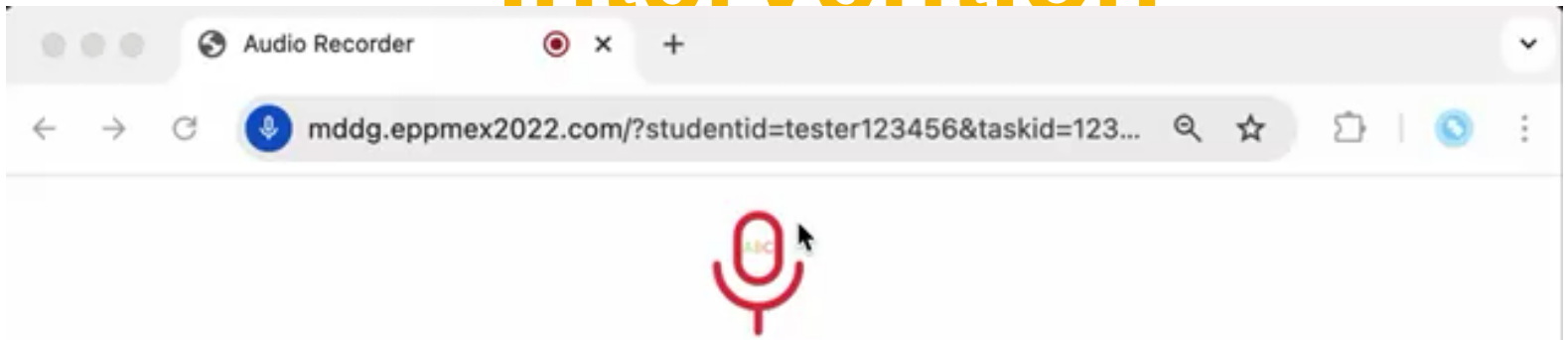
Your intelligibility is 97.67%	**Intelligibility**	ts, vowels, ake words difficult to understand. See the next page for a list of words to practice!
Your speech rate is 4.65 syllables per second.	**Speech Rate**	Your speech rate is near the target range (4 to 4.5 syllables per second). However, you can still practice speaking important words more slowly.

AI-based Mispronunciation Detection and ChatGPT Tutoring (Hirschi et al., LL, 2025)

- Fine-tuned wav2vec2.0 model (Yang et al., 2022)
  - ASR with Whisper, word-level segmentation with wav2vec2, fined-tuned wav2vec2 model which has a high accuracy rate, and prominence scores with Wavelet prosody toolkit, and finally ChatGPT feedback
- Phonemic-level error detection informed by L2 intelligibility



Intervention



Visual/Narrative Group: Significant improvements with ChatGPT tutoring in **pause placement**, and **prominence**

Critical AI

- Critical AI/digital literacy (Darvin, 2025)
  - The inequalities of user resources and the datasets of large language models (e.g., ChatGPT misunderstanding spoken Vietnamese)
  - The inequalities of high-resource and low-resource languages
- Access inequality: Some learners have more access to AI platforms than others
  - ChatGPT, Copilot, CharacterAI, ChatAI, Snapchat My AI, and Dall-E
  - **Paid vs. unpaid versions**
- Limited interpretability: Over-reliance without understanding each feature contribution (Zechner & Evanini, 2020)
  - AI-feedback situated clearly within construct
- Algorithms reproduce certain biases
  - Privileging some languages and forms of knowledge over others
  - **Transparency** (Buijsman, 2024): Users, educators, and learners being informed about system accuracy

Intelligibility in Global Contexts

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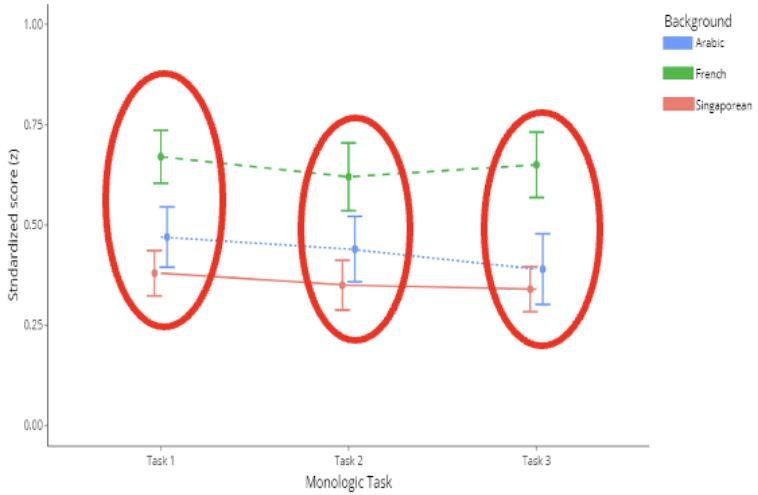
Learners' Perceptions Toward Accents vs. Their Listening Test Performance

Test-takers from different L1 backgrounds taking simulated high-stakes listening tests

- Kang et al. (2018): TOEFL
- Kang et al. (2022): the DET
- Kang & Kostromitina (2025): the British Council

No significant difference with highly intelligible speakers.

Kang & Kostromitina (2025): Aptis Listening test



L1 Shared L2 choice

Some emotional reactions: Korean test-takers hated an Indian accent.

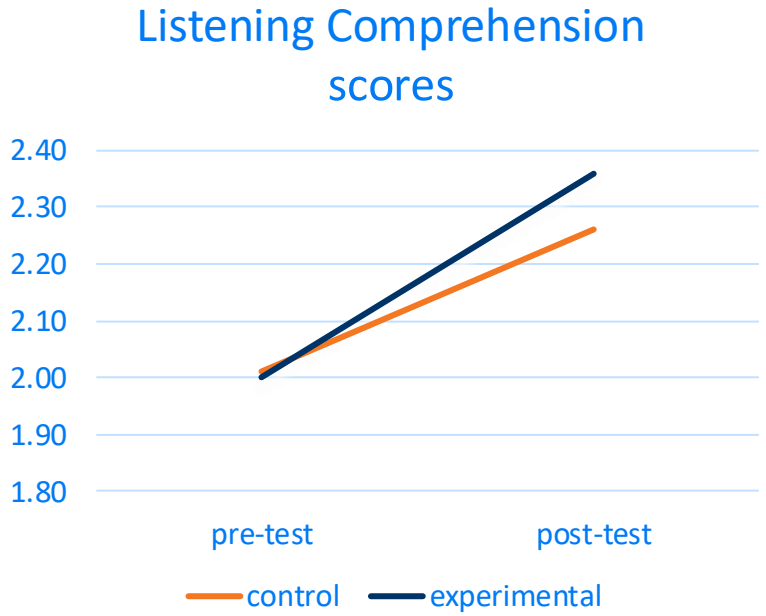
- Let learners choose an accent of their choice (Kang & Kostromitina, 2025): Ecological Validity

Different Accent Varieties

(Kang, Liu, Moran, & Miao, under review)

- Different varieties of accents for listening training (Kang & Liu, 2018)
  - 110 EFL students in Beijing
  - Listening skill training
  - **Control:** American accent
  - **Experimental**: Accent varieties

- High variability phonetic training (Barriuso & Hayes-Harb,2018)



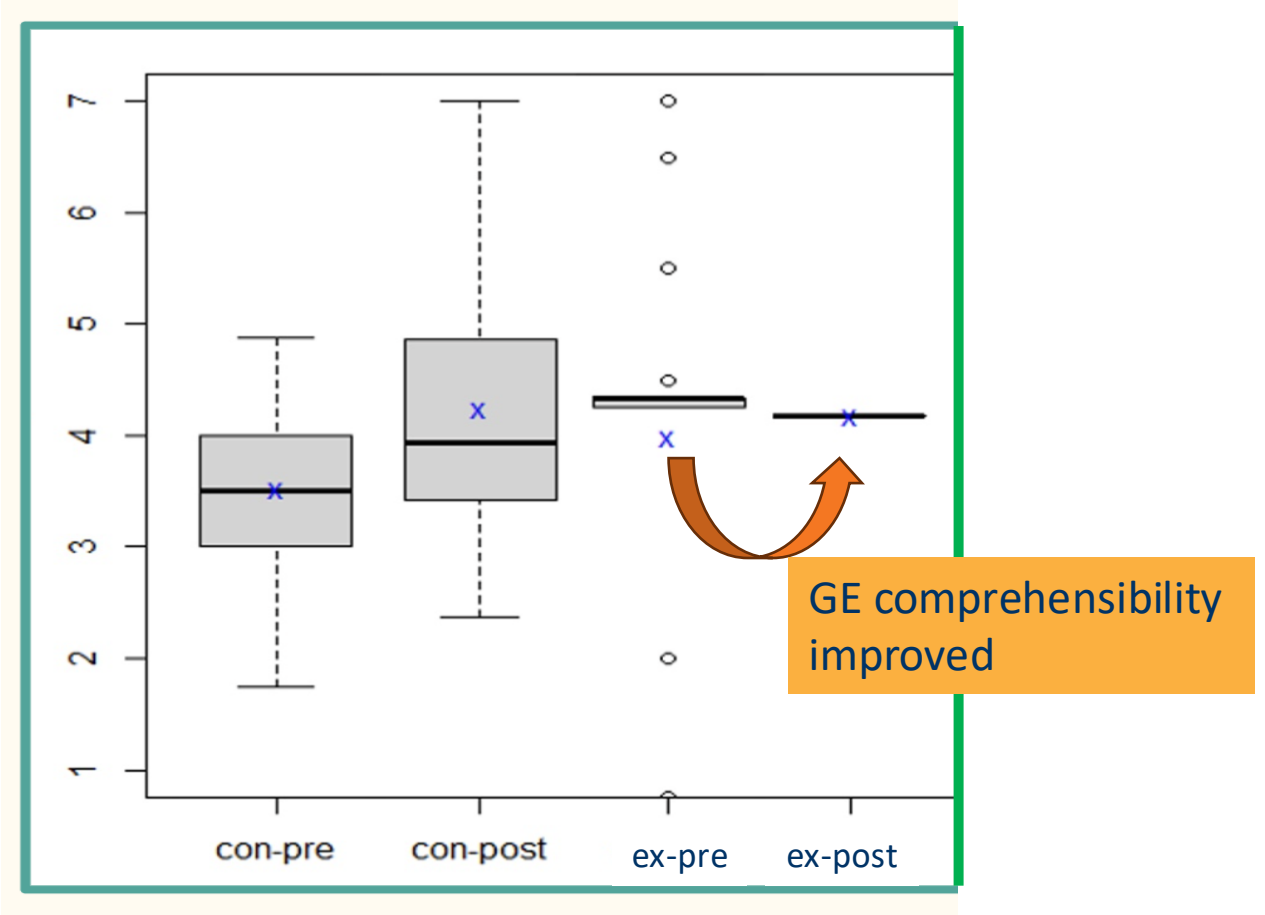
Only experimental group improved when learners listened to different accent varieties in their listening test.

Previous Approaches to Listener Training

Cross-cultural awareness	• Use of speakers' discussion of their experiences (Derwing et al., 2002)
Explicit instruction/ exposure	• Lessons on sound systems (Lindemann et al., 2016) or WE varieties (Kang et al, under review; Miao et al., 2025) • High variability phonetic training (Thomson, 2018)
Social psychology approaches	• Positive contact with L2 speakers (Kang & Moran, 2015; Kang et al., 2015; Yaw & Kang, 2021) or Dissonance theory (Miao et al., 2025)
Accent familiarity training	• Various accent-related measures and activities (Miao & Kang, 2023; Yaw, & Kang, under review)

The Role of Social Media Use in Listeners' Perception of Wes (Sullivan, Anolin, & Kang, in process)

- 24 participants for 2 weeks
- Follow and watch selected 10 videos from SNS influencers with GE accents
- Complete attention checks to ensure engagement
- Follow the platform's algorithms



GE Contexts: “Together We Communicate”

- Willingness to communicate
- Willingness to listen
- Listening skills
- Perceptions of social support
- Perceived common humanity, interpersonal skills
- Empathy

NAU Project: “Together We Communicate”
Kang (2024):

Future Directions

Future Research Issues

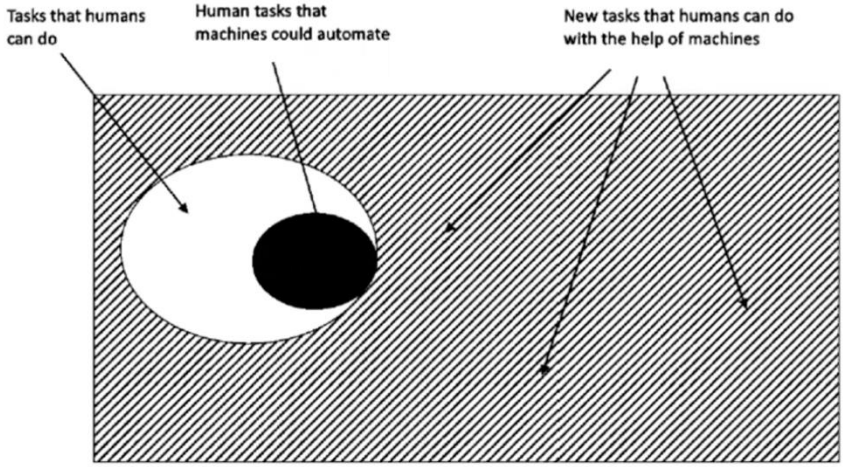
- AI cannot capture the full **complexity and expressiveness of human speech**, particularly in nuanced prosodic variations (e.g., **pragmatic and linguistic function**, etc.)
- L2 speech in global contexts
  - Pragmatically and culturally sensitive AI
  - L1 specific AI
  - Design for customizability: Let users select **target models**
  - New technologies (e.g., ASR, NLP, and AI) still largely rely on “native speaker” models

Future Research Issues

- Diversity, Equity, and Inclusion
  - Technology availability in all types of learners for all places.
  - **Critical AI: AI biased equity issues**
  - **=> AI trainer …human after all**.
- **Avoid one-size-fits-all model**
- Combine AI output with **human feedback**
- Collaboration among interdisciplinary researchers

GenAI Technologies for L2 Speaking: Critical AI

- Critical AI approaches:
  - Examining the extent to which the tools recognize their L1s
  - Comparing different platforms
  - Asking the GenAI platform for feedback
- There so many new tasks that humans can do with the help of AI.



Erik Brynjolfsson, The turing trap: The promise & peril of human-like artificial intelligence (Retrieved in January 2026)

Okim.Kang@nau.edu

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