MEASURING THE MULTILINGUAL HOME:

An Interdisciplinary Approach Using Wearable Tech and Automated Speech Recognition

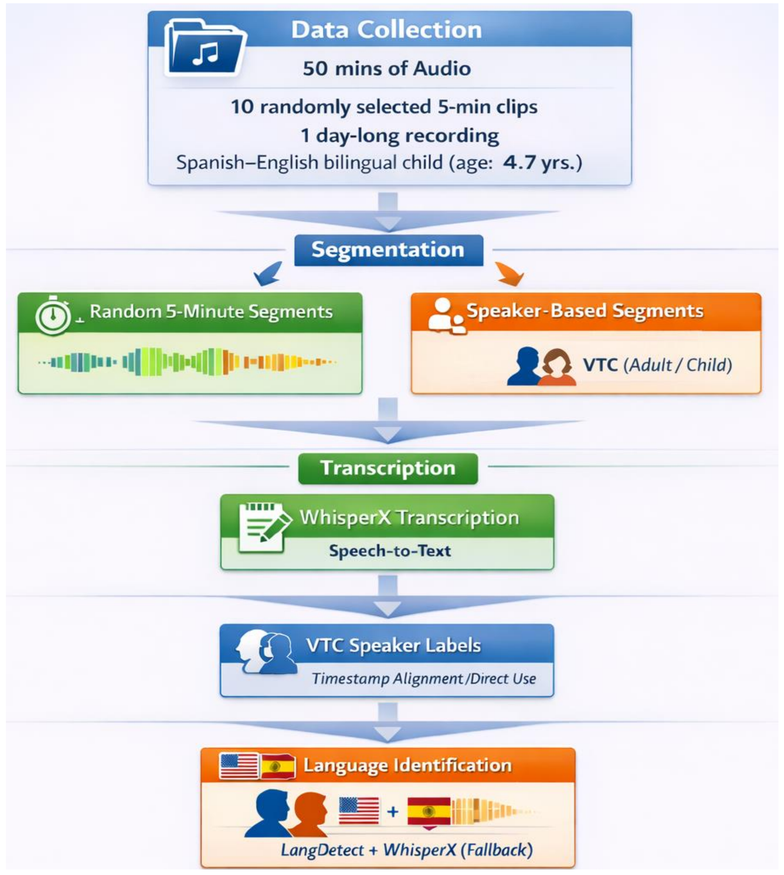
Katherine Melbourne[1], Sarah Surrain[2], Alfa Montiel[2], Gaurab Subedi[3], & Jorge Fonseca[3]

[1]World Languages and Cultures; [2]Early Childhood, Multilingual, and Special Education; [3]Computer Science

Introduction

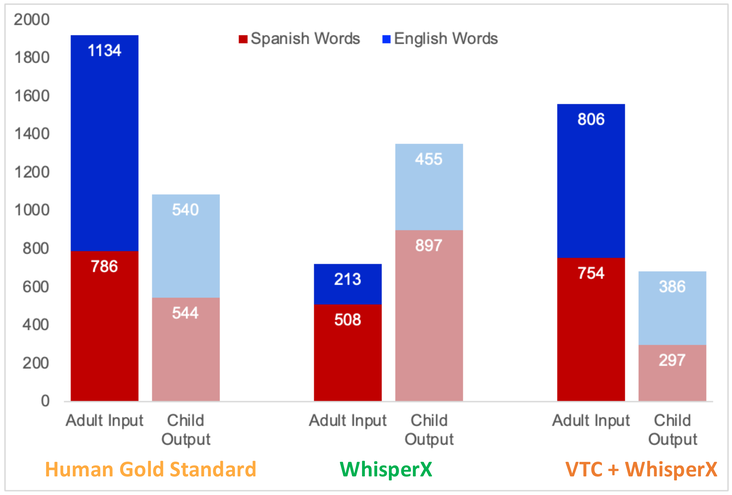
- Advances in wearable technology have made to possible to estimate the quantity of adult input and child output in a typical day, like a pedometer for speech (LENA; Gilkerson et al., 2017).
- Studies using LENA have shown that children's home environments play an integral role in their language development (e.g., Wang et al., 2020).
- But for children in multilingual homes, LENA can't detect which language is being spoken. Knowing the amount of input and output in each language would inform theories of bilingual language acquisition and enhance intervention research.
- The current study tests new ASR pipelines to detect languages and accurately transcribe speech in English and Spanish in daylong recordings (Bain et al., 2023; Lavechin et al., 2020).

Methods

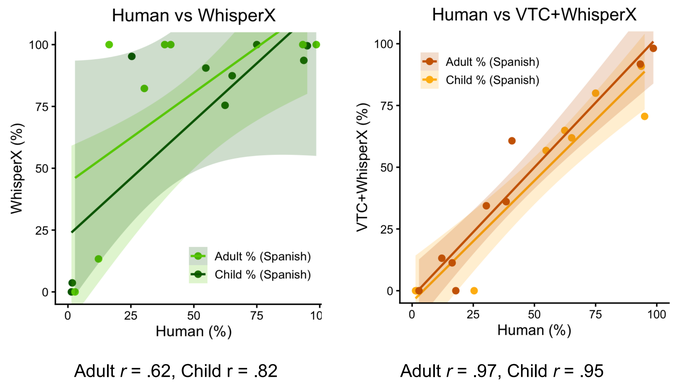


Results

Human transcripts vs. ASR Pipelines: How well do WhisperX and VTC+WhisperX estimate wordcounts?



How well do WhisperX and VTC+WhisperX estimate percent Spanish used in each 5-minute clip?



Adult *r* = .62, Child r = .82

Adult *r* = .97, Child *r* = .95

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Discussion

Human Gold Standard	WhisperX	VTC + WhisperX
Mom: Bueno, entonces ya me voy, no voy a jugar contigo.	Child: Bueno, entonces ya no voy a jugar contigo.	Child: Bueno, entonces ya no voy a jugar contigo.
Child: Y no me pone feliz!	Child: Y no me pone feliz.	Child: Y no me pone feliz.
Dad: Hey, don't talk to Mommy that way.		
Child: Yo voy a jugar como yo quiera.	Child: Yo voy a jugar como yo quiera.	Mom: Yo voy a jugar como yo quiera.
Dad: I don't remember how xxx.		

- Finding: WhisperX undercounts words said in Spanish and English, but provides a reliable estimate of percent Spanish, especially when preprocessing with VTC.
- Next steps include validating our ASR pipeline with additional recordings and examining the content of adult-child talk in our full dataset (*n* = 146).
- Automatically detecting the degree to which each language is spoken will shed light on how children learn and maintain their home languages, and will streamline daylong recording research.
- This research is a first step in our work on how caregivers support their child's bilingual development at home.

References

➢ Bain, M., Huh, J., Han, T., & Zisserman, A. (2023). *WhisperX: Time-Accurate Speech Transcription of Long-Form Audio* (No. arXiv:2303.00747). arXiv. https://doi.org/10.48550/arXiv.2303.00747

➢ Gilkerson, J., Richards, J. A., Warren, S. F., Montgomery, J. K., Greenwood, C. R., Kimbrough Oller, D., Hansen, J. H. L., & Paul, T. D. (2017). Mapping the early language environment using all-day recordings and automated analysis. *American Journal of Speech-Language Pathology*, *26*(2), 248–265. https://doi.org/10.1044/2016_AJSLP-15-0169

➢ Lavechin, M., Bousbib, R., Bredin, H., Dupoux, E., & Cristia, A. (2020). An Open-Source Voice Type Classifier for Child-Centered Daylong Recordings. *Interspeech 2020*, 3072–3076. https://doi.org/10.21437/Interspeech.2020-1690

➢ Wang, Y., Williams, R., Dilley, L., & Houston, D. M. (2020). A meta-analysis of the predictability of LENA™ automated measures for child language development. *Developmental Review*, *57*, 100921. https://doi.org/10.1016/j.dr.2020.100921

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katherine.melbourne@unlv.edu, sarah.surrain@unlv.edu, alfa.montiel@unlv.edu