

# IMPROVING THE RELIABILITY OF PHONETIC TRANSCRIPTION IN CLEFT LIP AND PALATE USING ULTRASOUND TONGUE IMAGING

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## Background

- Phonetic transcription by specialists is the “gold-standard” in cleft lip and palate (CLP)<sup>1</sup>
- Used to determine speech outcomes following surgery and to measure intervention progress
- However, phonetic transcription is vulnerable to inter and intra-transcriber variability
- In contrast, instrumental phonetic techniques may be more objective and can reveal covert errors which may be diagnostically important<sup>2</sup>

### Research Questions:

Does adding an additional visual modality, namely ultrasound tongue imaging (UTI), to phonetic transcription impact the identification of compensatory articulations and improve inter-transcriber reliability?

## Method

- Thirty-nine English-speaking children aged 3 to 12 with CLP
- Recorded producing /aCa/ x10 for all places of articulation with simultaneous audio and probe-stabilised ultrasound
- Three types of transcriptions:
  - Descriptive observations (categorised into 9 different **Error Types**) from the live ultrasound by the clinician recording the data (CT)
  - Ultrasound-aided transcription by two ultrasound-trained clinicians (UA)
  - Traditional phonetic transcription by two CLP specialists from audio recording (AO)

We compared the number of consonants identified as in error by each transcriber and then classified errors into **eight different subcategories**.

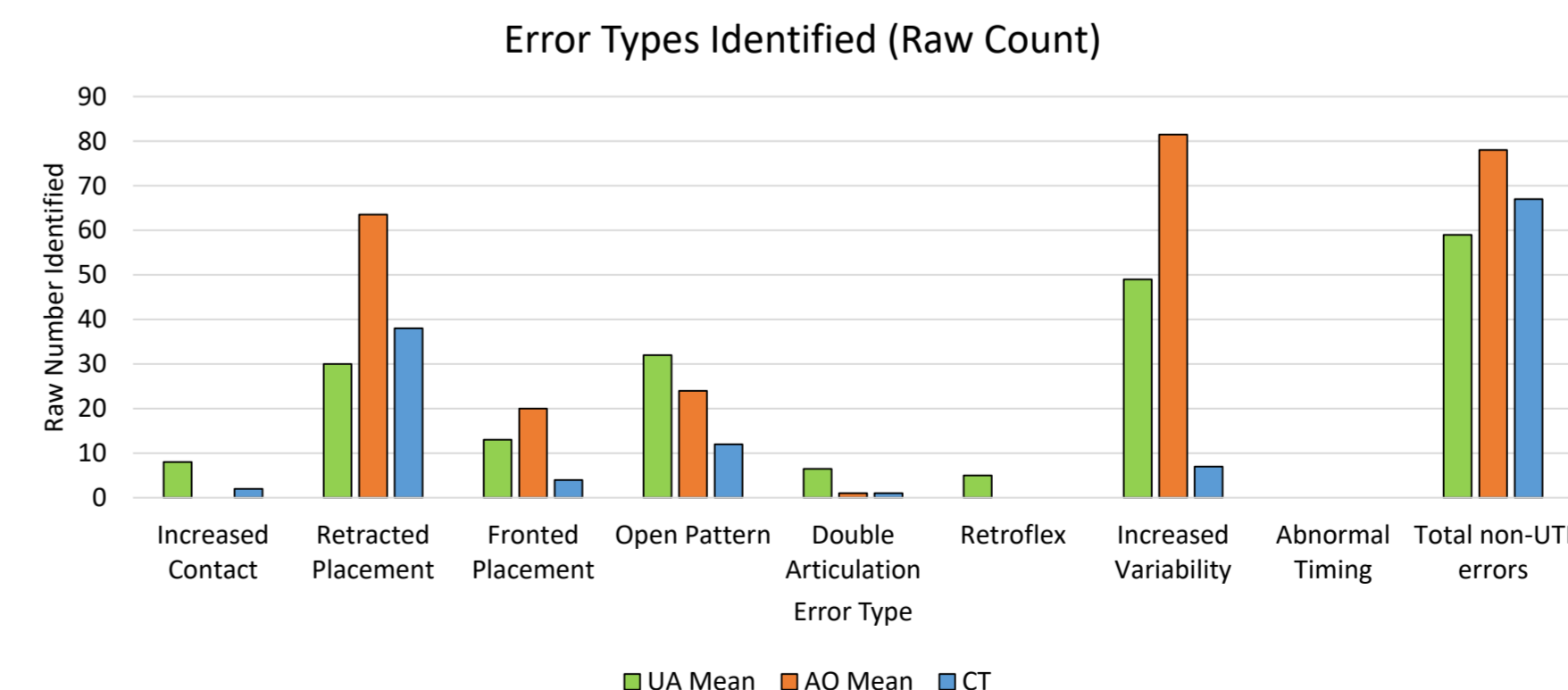
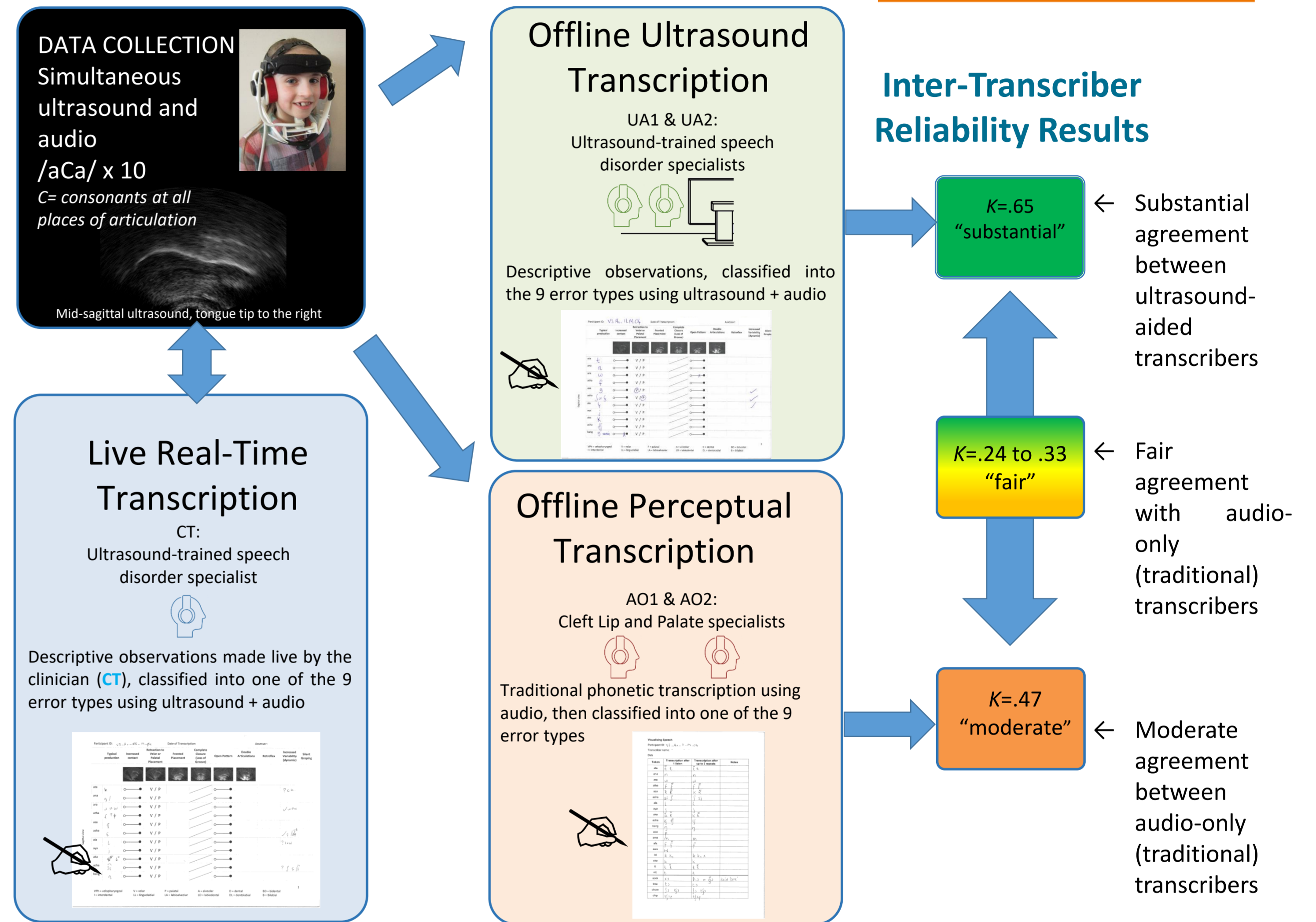
## Error Types

- Errors were classified using a modified version of Gibbon’s taxonomy<sup>3</sup> of eight different error types identified in electropalatography studies of speakers with CLP (*table 1*)
- Additionally, retroflex errors were identified using ultrasound tongue imaging

Error Type	EPG Description	Ultrasound Description	Ultrasound Example	Expected Transcription
<b>Increased Contact</b>	Increased contact between tongue and hard palate	Raising of tongue body and tip/blade towards hard palate		Simultaneous alveolar + postalveolar + palatal
<b>Retraction</b>	Alveolar target retracted to velar or palatal	Alveolar target retracted to velar or palatal		Velar or palatal
<b>Fronted</b>	Posterior target fronted to palatal, post-alveolar, or alveolar	Posterior target fronted to palatal, post-alveolar, or alveolar		Alveolar, post-alveolar, or palatal
<b>Complete Closure</b>	Complete closure in alveolar rows during sibilant production	No visible groove in the coronal view		Any lateral sibilant
<b>Open Pattern</b>	No contact between tongue and hard palate	Uvular or pharyngeal articulation OR undershoot		Uvular, pharyngeal or “lowered” diacritic
<b>Double Articulation</b>	Simultaneous production of two consonants	Simultaneous production of two consonants		Any double articulation e.g. [kt] or [pt]
<b>Increased Variability</b>	Different EPG patterns per repetition	Different tongue-shapes per repetition	(dynamic analysis required)	Different transcriptions across repetitions
<b>Abnormal Timing</b>	Mis-directed articulatory gestures or release of articulations with abnormal timing	Mis-directed articulatory gestures or release of articulations with abnormal timing	(dynamic analysis required)	Any diacritic denoting timing such as lengthening marks
<b>Retroflexion</b>	NA	Tongue tip retroflexion during any non-retroflex target		Any retroflex consonant

Table 1: Modified Version of Gibbon’s Taxonomy of Error Types

REFERENCES  
<sup>1</sup>Sell, D. (2005). Issues in perceptual speech analysis in cleft palate and related disorders: a review. *International Journal of Language & Communication Disorders*, 40(2), 103-121.  
<sup>2</sup>Cleland, J., Scobbie, J. M., Heyde, C., Roxburgh, Z., & Wrench, A. A. (2017). Covert contrast and covert errors in persistent velar fronting. *Clinical Linguistics & Phonetics*, 31(1), 35-55.  
<sup>3</sup>Gibbon, F. (2004). Abnormal patterns of tongue-palate contact in the speech of individuals with cleft palate. *Clinical Linguistics & Phonetics*, 18, 285-311.



← CT had small error detection rates, suggesting it is difficult to transcribe live with ultrasound in the clinic  
 ← AO and UA transcribers noted a similar numbers of errors overall  
 ← UA pair noted substantially more instances of increased contact, double articulation, and retroflex productions

**The Bottom Line:** Using **ultrasound** does not affect the overall number of errors identified in children’s speech, but it is a **more reliable method than traditional transcription** for deciding the *type* of errors.