Acoustic measures of online and offline collected speech produced by children with cerebral palsy and dysarthria: steps towards validation

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Introduction

- More than 50 percent of children with cerebral palsy (CP) present with dysarthria, affecting their functional communication [A,B].
- Access to clinical assessment, treatment, and research participation might be limited (due to reduced mobility, geographic distance, pandemic, etc.).
- Online treatment programs may overcome these obstacles, if data collected from online recordings are valid.

The aim of the current study was to take initial steps towards validating the analysis of acoustic outcome measures obtained from online recorded dysarthric speech in children with CP by comparing those to outcome measures obtained from offline audio recording

Method

Participants

Fifteen American-English children with dysarthria due to CP (mean age = 10;8; range 7;6–14;0; 7 females, 8 males) participated in the study. CP subtypes included spastic, ataxic, and mixed; dysarthria severity ranged from mild to severe.

Child	Age	Sex	Type of CP	GMFCS*	Dysarthria Severity	Language Skills**
H01	12;0	M	mixed	V	Severe	WNL
H02	7;4	F	mixed	III	Mild	delayed
H03	12;8	M	spastic	V	Moderate	delayed
H04	15;7	M	mixed	V	Mild	delayed
H05	14;7	M	spastic	II	Mild	WNL
H06	16;1	M	spastic	I	Mild	WNL
H07	10;9	M	spastic	II	Mild	delayed
H08	5;2	M	spastic	IV	Moderate	delayed
H09	12;5	F	spastic	IV	Severe	delayed
H10	13;2	F	spastic	IV	Moderate-Severe	delayed
H11	9;7	M	mixed	II	Mild	WNL
H12	5;1	M	spastic	IV	Mild	WNL
H13	14;1	M	ataxic	II	Mild-Moderate	delayed
H14	9;3	M	spastic	V	Severe	delayed
H15	6;6	F	spastic	IV	Moderate	WNL

*Gross Motor Classification System (GMFCS).   **Test of Auditory Comprehension of Language (TACL) or Clinical Evaluation of Language Fundamentals-5 (CELF-5) scores.

Recording Stimuli

- Children repeated pre-recorded utterances
- 12 words in the carrier phrase "They say CVC(C) again":
- ship, chip, shock, chalk, dot, knot, pot, boot, beat, bat, doubt, shape

Experimental Setup

Two recording methods performed <u>simultaneously</u> on two consecutive days of recording

1. Zoom online communication
Using caregiver's device (desktop PC, laptop, or iPad)

Distance between microphone of device and child was set at 30cm

Audio enhancements and noise cancellation were disabled during Zoom online communication

2. Audio recording device
Zoom H4n Handy audio recorder and Countryman EMW Lavalier microphone

Microphone taped onto child's forehead, 8cm away from mouth

For both recording modalities, input level remained constant and SPL calibration was conducted pre- and post-recording, using the sound level meter sent with recording equipment.

sent to caregiver
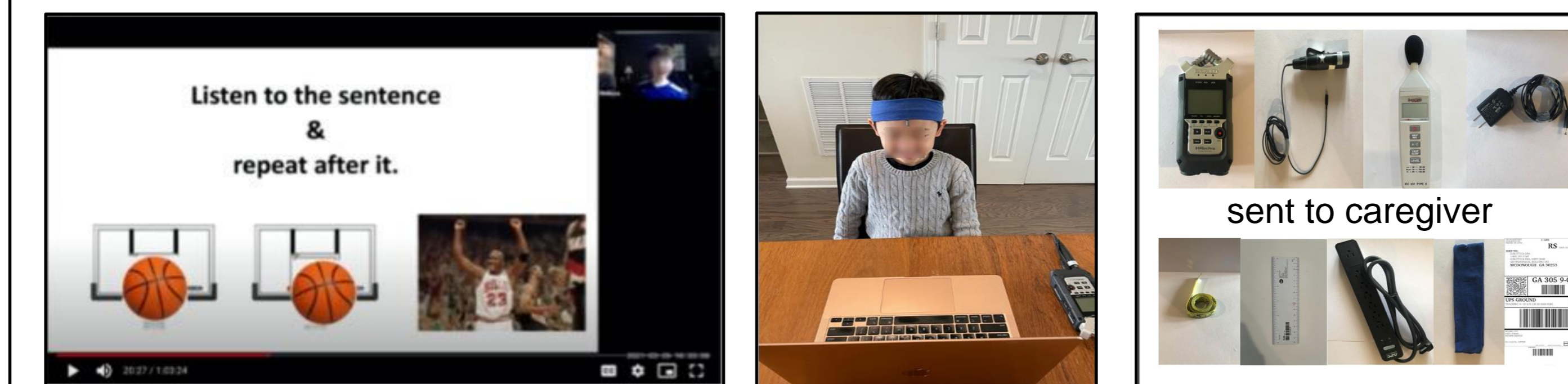
Acoustic measures:
- Word duration, F0 Mean, SPL Mean, HnR, Shimmer (custom Praat scripts)
- F2 range and slope of diphthongs and fricative-affricate duration difference [C] (manually measured)
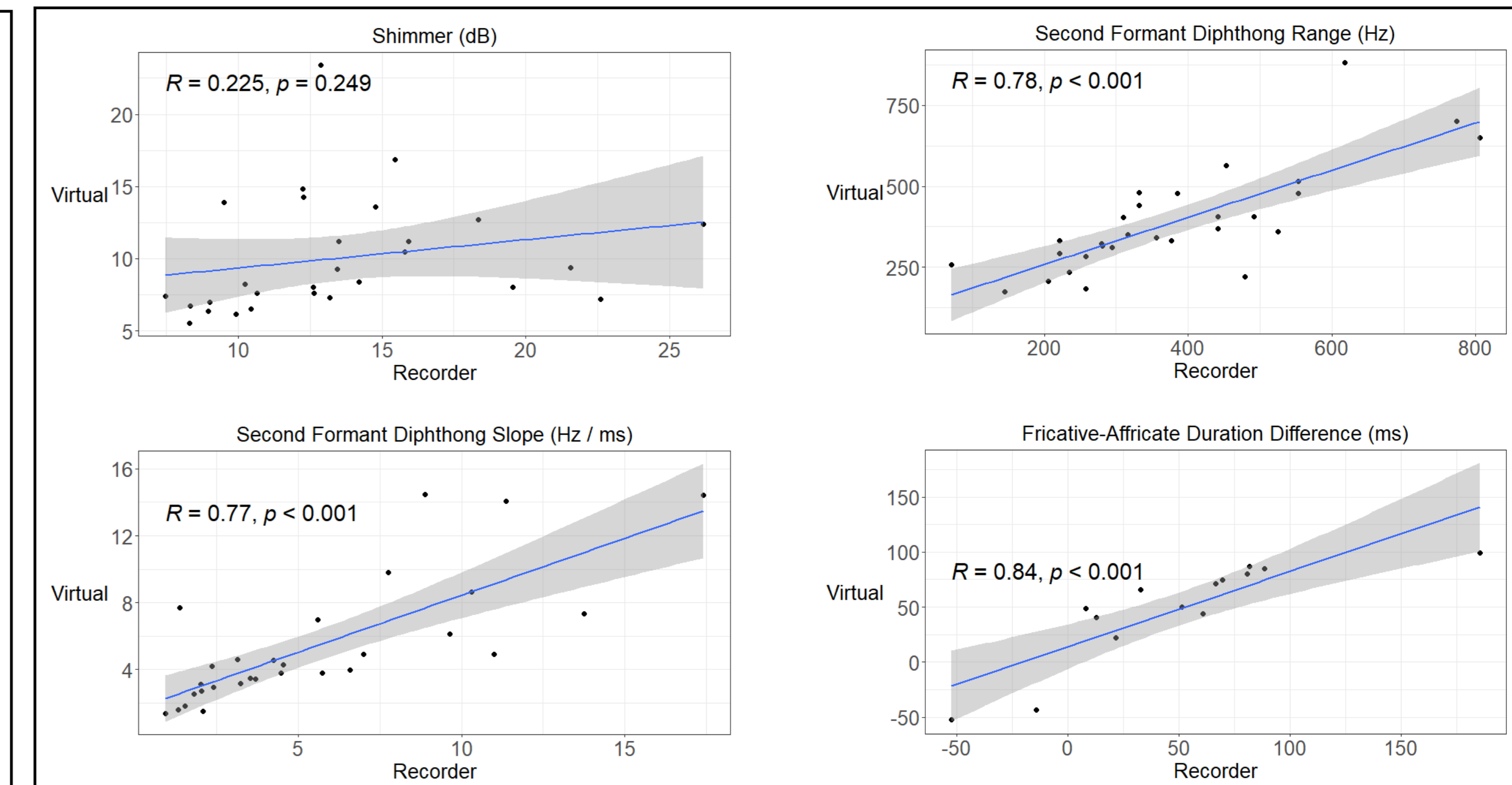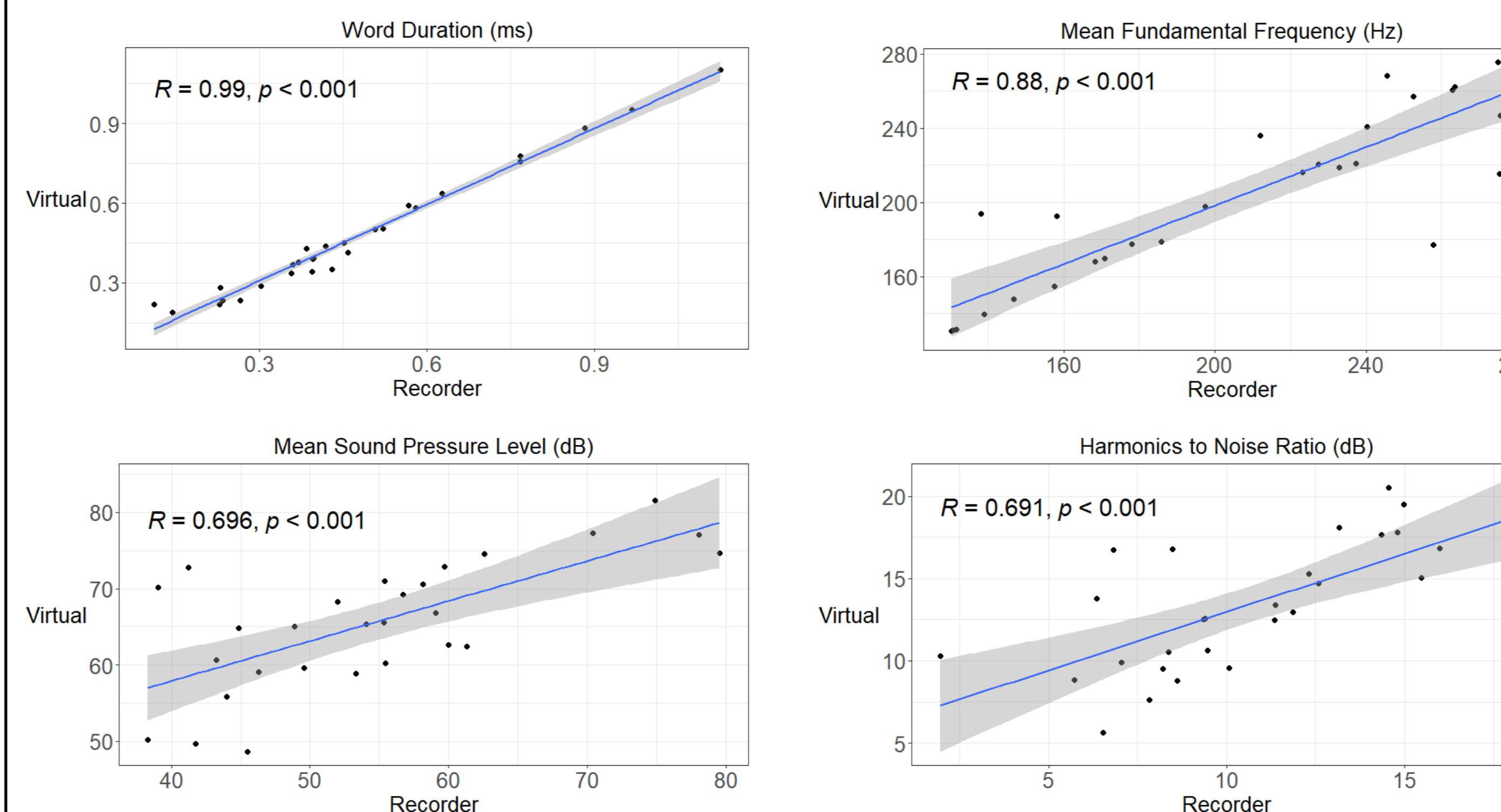
Validity measures:
- Pearson product-moment *correlations* calculated between acoustic outcome measures from Zoom online recording and from audio recording device

Results

Validity

An ***r*-value greater than .70** was considered to represent a measure of **sufficient validity**

Interrater Reliability

- Twenty percent of the speech data from both online recording and audio recorder were randomly selected and remeasured by a second investigator
- Pearson product-moment correlations showed *strong* agreement between investigators for most measures ($r = 0.94 - 0.99$), except for F2 slope, which showed *moderately strong* agreement ($r = 0.78$).

Summary and Discussion

- Most acoustic measures revealed a strong correlation between online recording and audio device recording, reaching the validity criterion on both days. This finding supports online recording as a valid alternative for children with dysarthria due to CP.
- In the Zoom online recordings, variability in participants' devices and microphones, and in children's distance from the microphone might have affected the signal.

Acoustic measures extracted from online recordings may be valid!

- Findings are an important step towards building the evidence base for on-line speech evaluation and, potentially, treatment, supporting clinicians and researchers to consider employing methods of remote data collection for clinical research, assessment or monitoring treatment progress.
- Future directions include further acoustic measures (pairwise variability index [PVI] and vowel space area), as well as intelligibility assessment of online versus audio recording device speech data.

References

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