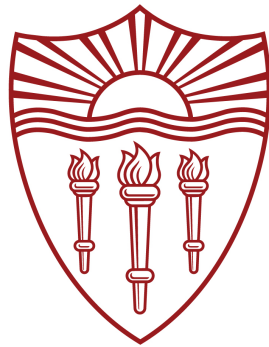




On Simultaneous Electromagnetic Articulography and Electroglottography Data Acquisition

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BACKGROUND

It is recommended that ferrous metal be kept out of range of electromagnetic articulography (EMA) systems due to their use of electromagnetic fields [1],[2], and the consequent potential for measurement inference.

But...In what circumstance might this concern be obviated?

Concerns over potential for interference have discouraged simultaneous use of EMA and electroglottography (EGG) in speech research.

- However some evidence suggests that the presence of EGG in EMA field does not cause interference, at least for sensors adhered to a static rigid body following a repetitive path of motion [3].

Ability to use both systems simultaneously in speech research would enable more thorough examination of laryngeal and supralaryngeal coordination in speech production.

Objective of Present Study: Examine whether using EMA and EGG for concurrent data acquisition in natural speech results in any significant interference with EMA sensor measurements

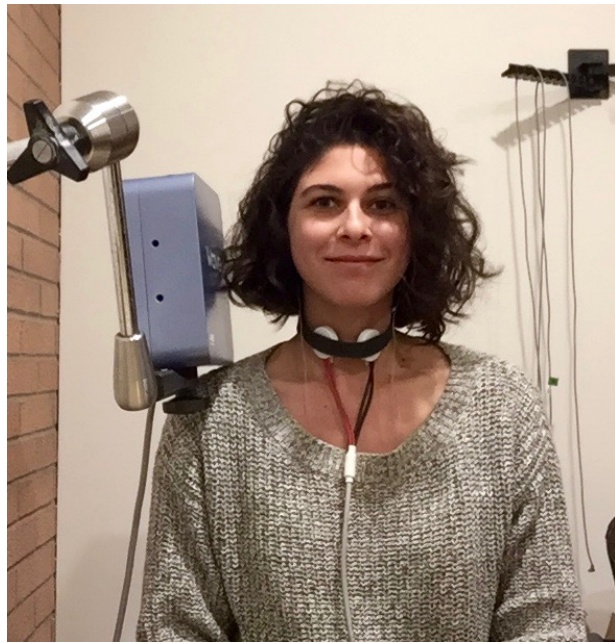
DATA COLLECTION

Simultaneous audio, EMA, and EGG data collected from three participants (1 female, 2 male).

- 3 conditions:
 - (1) No EGG (EMA only)
 - (2) EGG off
 - (3) EGG on.
- Three repetitions of a list of short sentences recorded in each condition by each speaker in a single recording session.

	No EGG	EGG Off	EGG On
F1	✓	✗	✓
M2	✓	✗	✓
M3	✓	✓	✓

Table 1: Conditions recorded for each participant



Dynamic EMA trajectories obtained from sensors placed on the tongue tip (TT), lower lip (LL), and lower jaw (JAW)
Static reference sensors placed behind each ear (REF-L and REF-R) and on maxillary process (UI).

MEASUREMENTS

Intersensor Distance

- 3-D Euclidean Distance between each pair of sensors calculated at each sampling time
- Distances averaged within each repetition and compared across conditions (comparisons collapsed across repetitions).

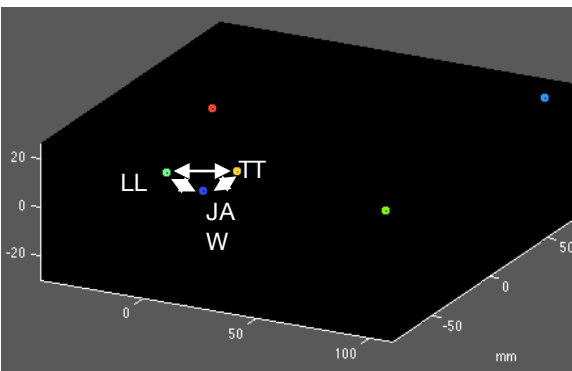


Fig. 1: Intersensor Distances for Articulatory Sensors

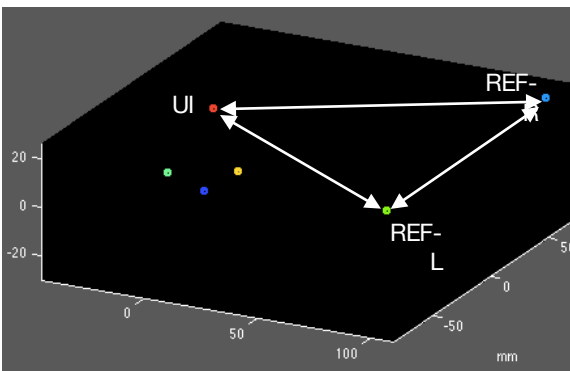


Fig. 2: Intersensor Distances for Reference Sensors

Articulatory sensor velocities were also examined

ARTICULATORY SENSOR DISTANCES

No significant difference found between conditions for any speaker.
Measurement error within acceptable error range for NDI-Wave system (< 1 mm) [4] for all comparisons.

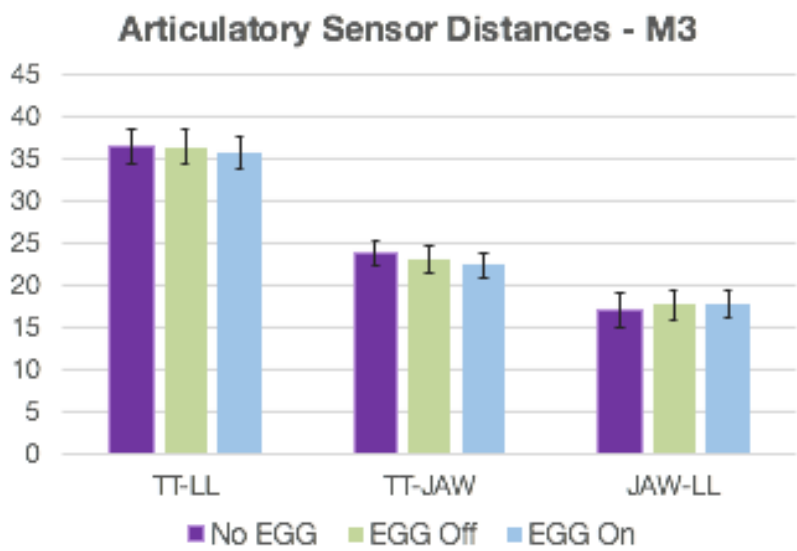
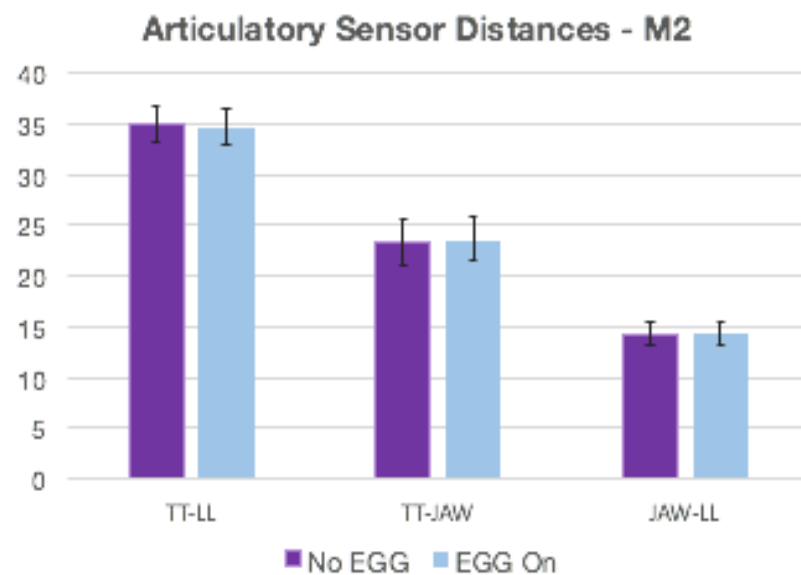
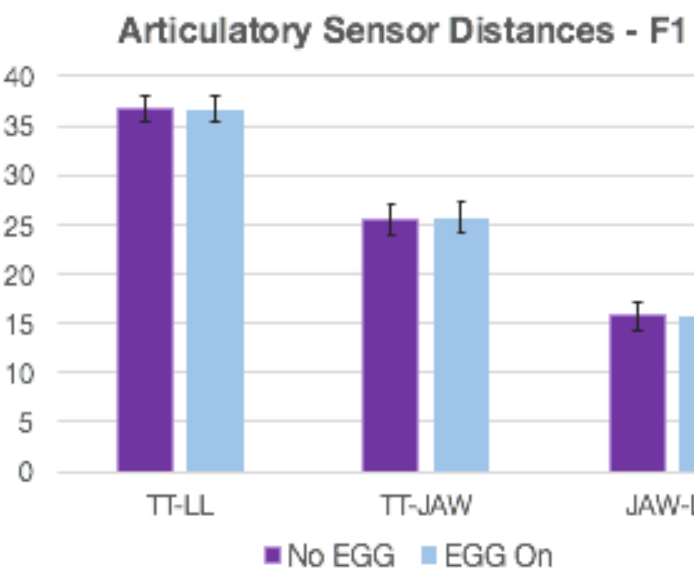


Table 2: Measurement Error Between Conditions (Articulatory Sensors)

	No EGG - EGG On	No EGG - EGG Off	EGG Off - EGG On
F1	-0.32	--	--
M2	0.24	--	--
M3	0.1	-0.22	-0.43

REFERENCE SENSOR DISTANCES

No significant difference found between conditions for speaker F1 or M3.
Significant differences between No-EGG vs. EGG-On for M2's L/R-to-maxillary sensor distances, though not for Left-Right intersensor distance.
Measurement error within acceptable error range (< 1 mm), except for M2's comparisons involving the maxillary sensor (REF-L~UI & REF-R~UI).

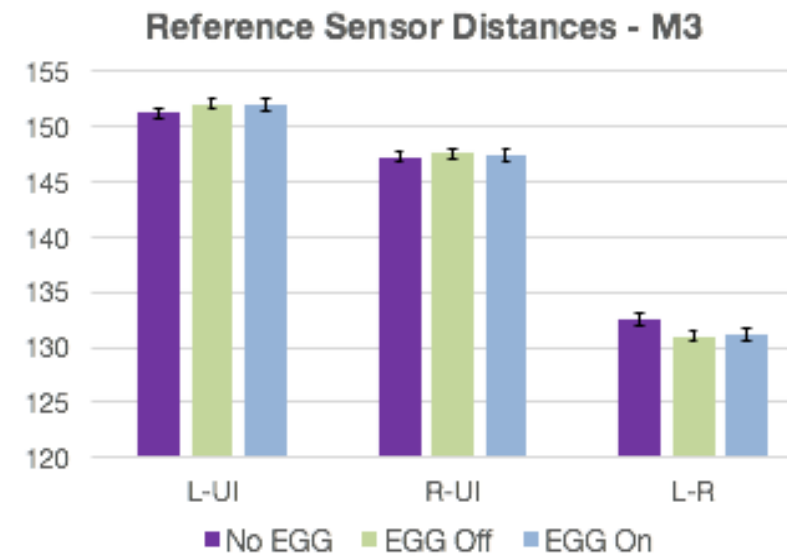
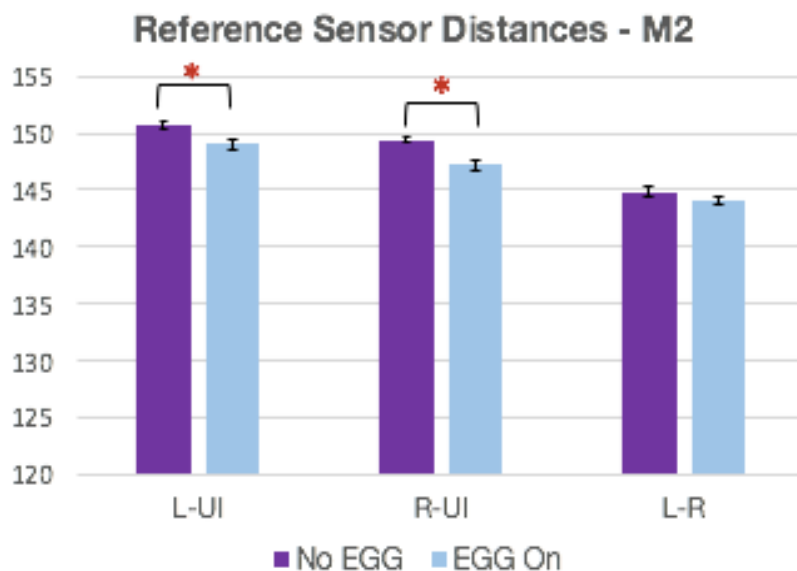
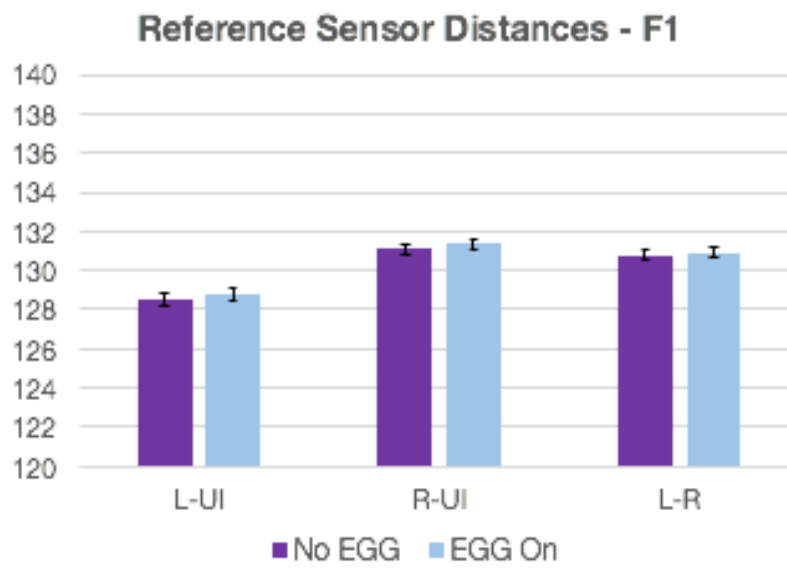


Table 3: Measurement Error Between Conditions (Reference Sensors)

	No EGG - EGG On	No EGG - EGG Off	EGG Off - EGG On
F1	-0.19	--	--
M2	1.66	--	--
M3	0.14	0.13	0.006

We suspect a wobbly maxillary sensor during M2's session was responsible for the larger measurement error for M2. Error still <2mm.

CONCLUSIONS

Use of EGG with EMA data collection does not appear to cause significant interference in measurement of articulatory kinematics.

- No significant difference found in measurements of articulatory sensors on the tongue tip, lower lip, and jaw.
- Although some significant differences were observed for reference sensor measurements, these are generally within the expected margin of error for the NDI-Wave system.