

## CLINICAL PRACTICE BRIEF

# Altered Speech Just Before and During Migraine Attacks: A Prospective, Longitudinal Study

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### STUDY BACKGROUND

Although speech changes during migraine attacks are reported by those with migraine, objectively measured changes in speech associated with migraine have not previously been investigated. The study team hypothesized that subtle changes in speech, changes that an individual might not notice but that can be detected objectively, are present during the hours preceding a migraine attack and during the attack itself. Detection of speech changes prior to an individual realizing he/she is developing a migraine attack might allow for treatment to be administered very early, thus preventing development of full-blown migraine symptoms.

### OBJECTIVES

- Compare speech features between individuals with migraine and healthy people without migraine.
- Compare speech features within individuals with migraine during different migraine phases: migraine attack, the hours preceding a migraine attack and between migraine attacks.
- Determine the accuracy of identifying migraine attacks early due to changes in speech occurring during the pre-attack phase.

### METHODS

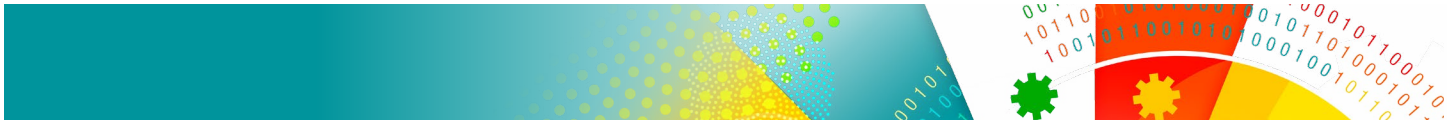
Adults with episodic migraine and non-migraine healthy controls participated in this prospective, longitudinal study. Those with migraine used a mobile app to maintain a daily electronic headache diary and to provide speech samples 3 times per day for at least 3 months and until 20 migraine attacks were captured. Healthy controls provided speech samples 3 times per day for 1 month. The speech paradigm consisted of reading and reciting sentences, enunciating vowel sounds, and repeating words. Speech features were compared between participants with migraine and healthy controls and within those with migraine during different migraine phases (between attacks, pre-attack, attack). Statistical modeling was used to predict oncoming migraine attacks based upon changes in speech during the pre-attack phase.

### RESULTS

- 56,767 speech samples were collected, including 13,665 speech samples from healthy controls and 43,102 from individuals with migraine.
- There were differences in speech when comparing the group of individuals with migraine to those without migraine.
- Amongst individuals with migraine, several had changes in speech during the hours prior to a migraine attack and during the migraine attack compared to when they were between attacks.
- Differences in speech indicated a loss in articulatory precision during migraine and during the pre-attack phase. Articulatory precision refers to the clarity with which a speaker generates individual phonemes as he/she speaks. For example, a person slurring his/her words has low articulatory precision, whereas a person carefully enunciating every individual phoneme as he/she speaks has high articulatory precision.

### KEY FINDINGS

- This is a first-of-its kind study investigating objective changes in speech that occur with migraine attacks.
- The study showed there are changes in speech just before and during migraine attacks compared to the between migraine-attack period.
- Subtle changes in speech that occur in some people just before migraine attacks may prove useful when used in conjunction with other variables for early identification of oncoming migraine attacks.



## IMPLICATIONS

- Subtle changes in speech occurring during the hours preceding a migraine attack might be used in conjunction with other variables (e.g. language changes, cognitive performance, exposure to migraine attack triggers) for early identification of a migraine attack.
- Early identification of migraine attack would allow for earlier treatment; an approach that may result in a clinically meaningful paradigm shift for migraine treatment and provide for superior outcomes compared with the current standard of care.

**Table 1. Speech Feature Comparisons Between Individuals with Migraine and Those Without Migraine and Between Different Migraine Phases.** Numbers less than <.05 (those in bold type) indicate that there was a significant difference.

	Migraine Attack vs Between Attack	Migraine Attack vs Pre-Attack	Migraine Attack vs Healthy Control	Between Attacks vs Pre-Attack	Between Attacks vs Healthy Control	Pre-Attack vs Healthy Control
Speaking Rate [syllables/s]	<b>0.000</b>	0.663	0.304	<b>0.003</b>	<b>0.000</b>	0.896
Pause Rate [% of recording length]	0.281	<b>0.016</b>	<b>0.044</b>	<b>0.049</b>	0.143	0.216
Articulation Rate [syllables/s]	<b>0.000</b>	0.364	0.086	<b>0.001</b>	<b>0.000</b>	0.980
Articulation Entropy	<b>0.000</b>	0.339	<b>0.000</b>	<b>0.000</b>	0.358	<b>0.000</b>
Vowel Space Area [Hz <sup>2</sup> ]	0.296	0.347	0.379	0.051	0.698	0.066
Energy Decay Slope [dB/s]	0.570	0.173	0.083	0.236	0.040	0.697
Phonatory Duration [s]	<b>0.049</b>	0.626	<b>0.000</b>	0.305	<b>0.000</b>	<b>0.000</b>

## DESCRIPTION OF THE INDIVIDUAL SPEECH MEASURES

**Speaking rate** – the average number of syllables the speaker produces per second.

**Pause rate** – the average percent of time the speaker pauses during speech production.

**Articulation rate** – the rapidity with which the speaker moves his/her articulators to generate phonemes. Measured in syllables per second. In contrast to speaking rate, pause between words will not impact the articulation rate but will decrease the speaking rate.

**Articulation entropy** – a measure of articulatory precision. Articulatory precision refers to the clarity with which a speaker generates individual phonemes as he/she speaks. For example, a person slurring their words has low articulatory precision, whereas a person carefully enunciating every individual phoneme as he/she speaks has high articulatory precision.

**Vowel space area** – a measure of vowel distinctiveness. The larger the vowel space area, the more distinct the individual vowels are.

**Energy decay slope** – a measure of loudness decrease during the sustained phonations. A proxy for speaker fatigue.

**Phonatory duration** – the length of time of the sustained phonation.

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