



# Maximum Phonation Time, Maximum Expiration Time and the s/z ratio in twins

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## BACKGROUND & OBJECTIVE

### Previous investigations

- Research on **Twins + COVID-19**:  
 ✓ **Scarce studies** despite the fact that...  
 ...genetic factors contribute to the pathogenesis of a disease +  
 ...play an important role in the explanation of a person's response to a medical condition

"family history is thought to be a good predictor of an individual's disease risk because family members most closely represent the unique genomic and environmental interactions that an individual experiences" [1]

✓ Some studies focus on the susceptibility to, and recovery from, COVID-19 infection by investigating **monozygotic (MZ) and dizygotic (DZ) twins** [2]

✓ As a highly infectious respiratory tract disease, **COVID-19** can cause many dysfunctions (e.g. shortness of breath and a range of laryngeal and other nonrespiratory sequelae) [3, 4]

✓ A few studies have investigated **asthma-concordant and asthma-discordant** twin pairs [5], and individualized programmes for the **respiratory rehabilitation** of patients are being implemented [6]

❖ To the best of our knowledge, no studies have focused on measures of vocal function or aerodynamic measures / tests of glottal efficiency in both MZ and DZ twins

although correlations between MZ twins for MPT were found in [7]

### Objective

□ Determine how MZ and DZ twins perform in the following measures:

<b>Maximum Phonation Time</b>	<b>MPT</b>	<b>/a/</b>
<b>Maximum Expiration Time</b>	<b>MET</b>	<b>/s/</b>
<b>s/z ratio</b>	$\frac{/s/}{/a/}$	
<b>s/a ratio</b>		

□ **Potential relevance of the findings:**

- Use as pre-covid baseline to compare with post-covid data

→ Corpus used for this study: recordings made between 2012 – 2013 (pre-pandemic recordings)

→ WHO estimates that more than 10% of global population is infected with COVID-19 (Oct 2020)

## MATERIALS & METHOD

### Subjects

- 28 healthy male adults; native speakers of Standard Peninsular Spanish [8]

- 10 pairs of MZ twins
- 4 pairs of DZ twins

### Recording setup

- Omnidirectional condenser microphones (*Countryman E6i*)  
 - Soundcard: *Cakewalk by Roland UA-25EX USB AudioCapture*

- Specifications: 44.1 kHz, 16 bits of resolution

### Speech samples

- Speakers were asked to sustain:

- /a/ x 3 times
- /s/ x 3 times

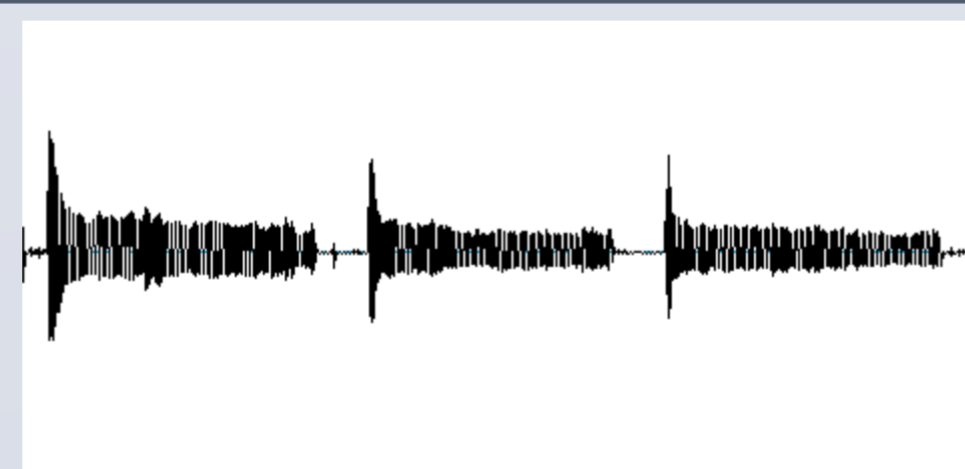
- Tasks performed at a comfortable pitch and loudness after maximum inhalation

### Analyses

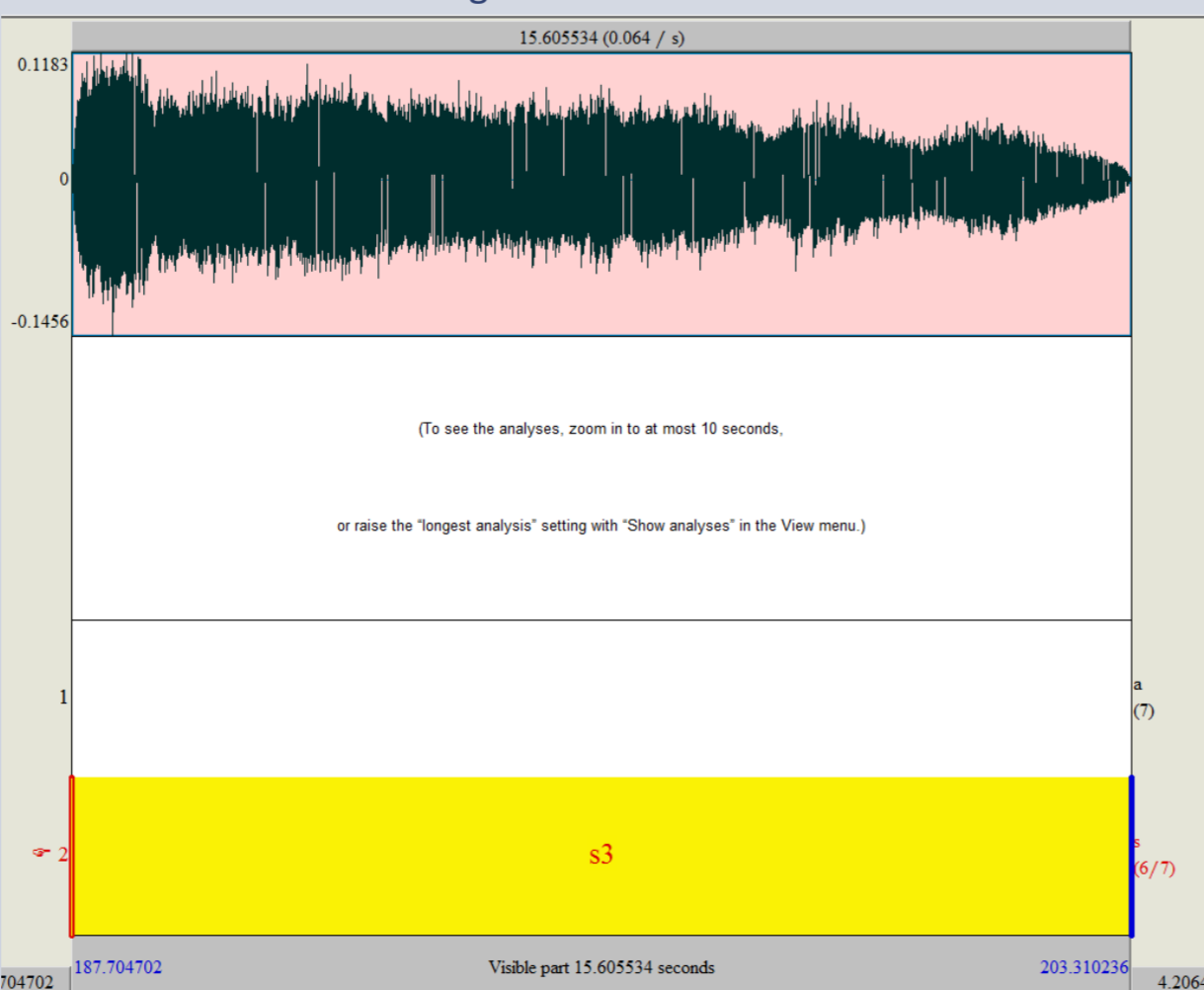
- 84 tokens manually labelled in *Praat*  
 - Durations calculated and extracted with a *Praat* script.  
 - MPT and MET → average of the 3 trials

### s/a ratio

- /a/ substitutes /z/ [9]  
 - Threshold: 95% of people with some difficulty affecting the movement of their vocal folds have a ratio greater than 1.40  
 → possible vocal fold dysfunction [10]



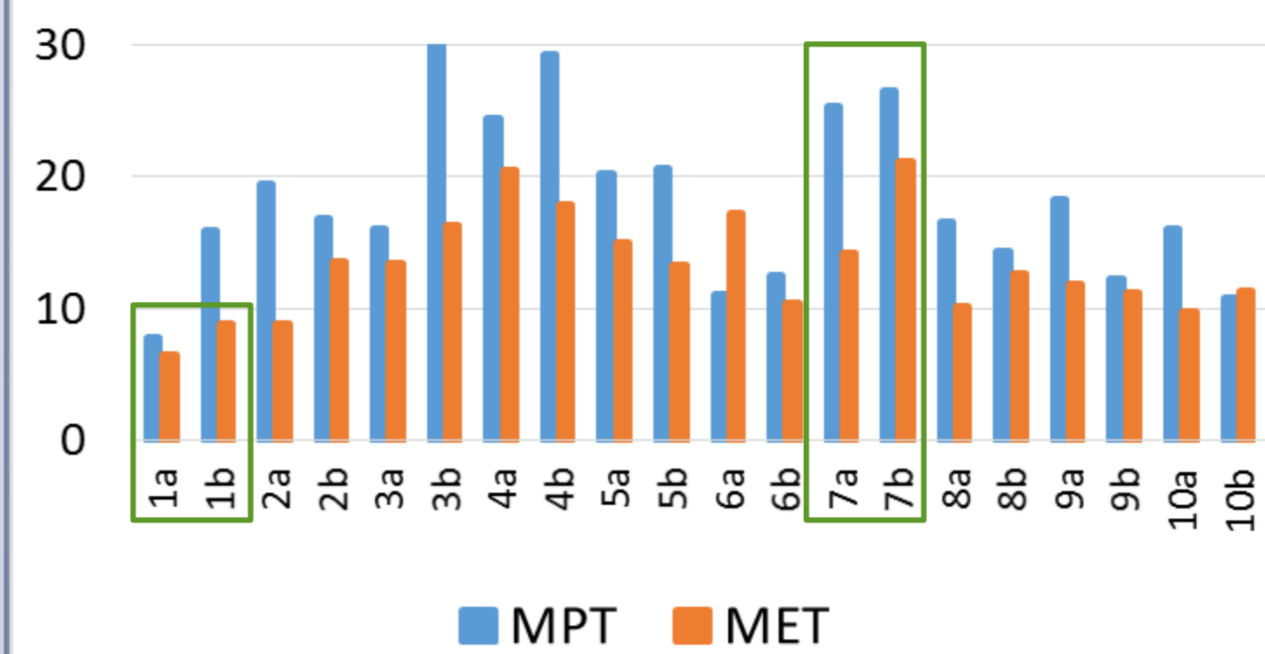
Praat interface: waveform of the 3 sustained /a/ and the labels in a Textgrid for DZ twin 13a



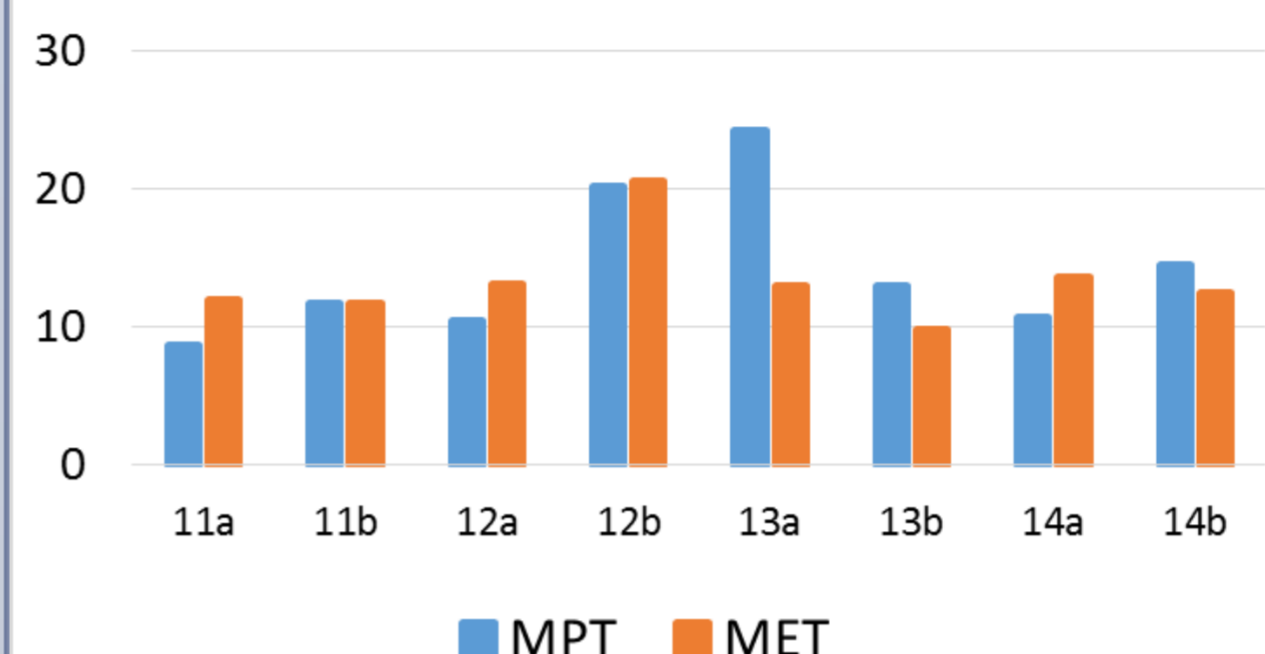
Praat interface: waveform and Textgrid of sustained /s/ (DZ twin 13a)

## RESULTS

### MZ TWINS



### DZ TWINS



- **MPT** values are longer in MZ twins (mean:18.25) than in DZ twins (mean: 14.17)
- **MET** values are very similar in both groups (mean MZ: 13.19; mean DZ: 13.32).
- Overall, the **s/a ratio** in MZ twins is lower than in DZ twins.
- When considering the **Euclidean Distances (ED)** of s/a ratios in intra-twin comparisons, values are very similar in MZ and in DZ twins.

MZ	s/a	ED	DZ	s/a	ED
1a	0.83		11a	1.40	
1b	0.56	0.27	11b	1.01	0.39
2a	0.46		12a	1.26	
2b	0.81	0.35	12b	1.02	0.24
3a	0.84		13a	0.54	
3b	0.53	0.31	13b	0.76	0.22
4a	0.84		14a	1.28	
4b	0.61	0.23	14b	0.86	0.41
5a	0.74		<b>mean</b>	<b>1.01</b>	<b>0.32</b>
5b	0.65	0.09			
6a	1.56				
6b	0.84	0.72			
7a	0.56				
7b	0.80	0.24			
8a	0.61				
8b	0.88	0.27			
9a	0.65				
9b	0.91	0.26			
10a	0.61				
10b	1.04	0.43			
<b>mean</b>	<b>0.77</b>	<b>0.32</b>			

MPT is a frequently used measure in voice assessment:

- unexpensive
- +
- quick
- +
- noninvasive

## DISCUSSION

- Results do not show great differences between MZ and DZ twin pairs:

- ✓ Dissimilarity measured in Euclidean Distances (ED).
  - ✓ Large values: more different
  - ✓ Small values: more similar

- Results were examined in view of each subject's anamnesis:

- ✓ DZ speaker 14b: thyroidectomy
- ✓ Some subjects: smokers

- Future: consider the best trial of three, not the average.

## CONCLUSIONS & FUTURE WORK

- Twin studies show potential in clinical voice examination

-Acoustic measures seem worth exploring in future studies

- An increased sample size would be necessary in order to determine whether respiratory and glottal efficiency is influenced by genetic factors

✓ This would be better measured with heritability estimates

- This sort of studies could be useful to understand more about how a highly infectious respiratory disease such as COVID-19 affects different people differently depending on genetic predisposition

## REFERENCES

- [1] Kardias SL, Modell SM & Peyser PA. 2003. Family-centered approaches to understanding and preventing coronary heart disease. *American Journal of Preventive Medicine* 24(2), 143-51.
- [2] Segal, N. L. 2020. COVID-19: Twin Research in Progress. *Twin Research and Human Genetics* 23(4), 259-63.
- [3] Arviso L.C., Klein A.M. & Johns MM. 2012. The management of postintubation phonatory insufficiency. *Journal of Voice* 26, 530-33.
- [4] Holding, L., Carroll, T. L., Nix, J., Johns, M. M., LeBorgne, W. D., & Meyer, D. 2020. COVID-19 After Effects: Concerns for Singers. *Journal of Voice* (In Press).
- [5] Dhondalay, G. K. R., Bunning, B., Bauer, R. N., Barnathan, E. S., Maniscalco, C., Baribaud, F., : : & Andorf, S. 2019. Transcriptomic and methylomic features in asthmatic and non-asthmatic twins. *Allergy* 75, 989-91.
- [6] Yang, L. L. & Yang, T. 2020. Pulmonary rehabilitation for patients with coronavirus disease 2019 (COVID-19). *Chronic Diseases and Translational Medicine* 6, 79-86.
- [7] van Lierde, K., Vinck, B., De Ley, S., Clement, G., & Van Cauwenberge, P. 2005. Genetics of vocal quality characteristics in monozygotic twins: a multiparameter approach. *Journal of Voice*, 19(4), 511-518
- [8] San Segundo, E. 2013. A Phonetic Corpus of Spanish Male Twins and Siblings: Corpus Design and Forensic Application. *Procedia-Social and Behavioral Sciences*, 95, 59-67.
- [9] Batalla, F. N., & Nieto, C. S. 1998. *Manual de Evaluación y Diagnóstico de la Voz*. Universidad de Oviedo.
- [10] Eckel, F.C. & Boone, D.R. 1981. The S/Z ratio as an indicator of laryngeal pathology, *Journal of Speech and Hearing Disorders* 46, 2, 147-9.

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