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

Eugenia San Segundo
Dept. Spanish Language & General Linguistics, UNED, Madrid, Spain

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

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:
  Maximum Phonation Time: MPT /a/
  Maximum Expiration Time: MET /s/
  s/z ratio /s/ /z/
  s/a ratio /s/ /a/

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

RESULTS

MZ TWINS

<table>
<thead>
<tr>
<th>s/a</th>
<th>ED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>0.83</td>
</tr>
<tr>
<td>1b</td>
<td>0.56</td>
</tr>
<tr>
<td>2a</td>
<td>0.46</td>
</tr>
<tr>
<td>2b</td>
<td>0.81</td>
</tr>
<tr>
<td>3a</td>
<td>0.84</td>
</tr>
<tr>
<td>3b</td>
<td>0.53</td>
</tr>
<tr>
<td>4a</td>
<td>0.84</td>
</tr>
<tr>
<td>4b</td>
<td>0.61</td>
</tr>
<tr>
<td>5a</td>
<td>0.74</td>
</tr>
<tr>
<td>5b</td>
<td>0.65</td>
</tr>
<tr>
<td>6a</td>
<td>1.56</td>
</tr>
<tr>
<td>6b</td>
<td>0.84</td>
</tr>
<tr>
<td>7a</td>
<td>0.56</td>
</tr>
<tr>
<td>7b</td>
<td>0.80</td>
</tr>
<tr>
<td>8a</td>
<td>0.61</td>
</tr>
<tr>
<td>8b</td>
<td>0.88</td>
</tr>
<tr>
<td>9a</td>
<td>0.65</td>
</tr>
<tr>
<td>9b</td>
<td>0.91</td>
</tr>
<tr>
<td>10a</td>
<td>0.61</td>
</tr>
<tr>
<td>10b</td>
<td>1.04</td>
</tr>
<tr>
<td>mean</td>
<td>0.77</td>
</tr>
</tbody>
</table>

DZ TWINS

<table>
<thead>
<tr>
<th>s/a</th>
<th>ED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>1.01</td>
</tr>
<tr>
<td>1b</td>
<td>0.39</td>
</tr>
<tr>
<td>2a</td>
<td>1.26</td>
</tr>
<tr>
<td>2b</td>
<td>1.02</td>
</tr>
<tr>
<td>3a</td>
<td>0.54</td>
</tr>
<tr>
<td>3b</td>
<td>0.76</td>
</tr>
<tr>
<td>4a</td>
<td>1.28</td>
</tr>
<tr>
<td>4b</td>
<td>0.86</td>
</tr>
<tr>
<td>5a</td>
<td>1.01</td>
</tr>
<tr>
<td>5b</td>
<td>0.32</td>
</tr>
</tbody>
</table>

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.

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: thyrodecomy
  ✓ 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
  centered approaches to understanding and preventing
  coronary heart disease. American Journal of Preventive
  Medicine 24(2), 143-51.
  Progress. Twin Research and Human Genetics 23(4),
  159-63.
  The management of postinfluenza pharyngeal insufficiency.
  Journal of Voice 26, 530-33.
  Barmathan, E. S., Mancia, C., Barbaud, F.; &
  Andorf, S. 2019. Transcriptomic and methylation
  features in asymptomatic and non-asymptomatic twins. Allergy
  75, 899-91.
  Chronic Diseases and Translational Medicine 6, 79-86.
  Van Cauwenberge, P. 2005. Genetics of vocal quality
  characteristics in monogenic twins: a multiparameter
  Male Twins and Siblings: Corpus Design and Forensic
  Application. Procedia-Social and Behavioral Sciences, 95,
  59-67.
  Evaluación y Diagnóstico de la Voz. Universidad de
  Oviedo.
    indicator of laryngeal pathology. Journal of Speech and
    Hearing Disorders 46, 2, 147-9.

CONTACT
Email: esansegundo@fsa.uned.es
Twitter: @sponse_eu