

Forensic voice comparison using glottal parameters in twins and non-twin siblings

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Forensic phoneticians have traditionally relied on the information found in the vocal folds for speaker identification: from the analysis of classical distortion parameters like jitter and shimmer (Künzel & Köster, 1992) and other laryngeal features (Jessen, 1997) to the automatic approaches exploring the usefulness of the combined use of vocal source and vocal tract information in order to improve speaker-recognition systems (Zheng, 2005; Farrús, 2008). Based on previous voice-pathology investigations (Gómez et al., 2007), other studies by these authors have more recently shown that their voice-analysis methodology based in the decoupling of vocal tract from glottal source estimates can also be useful for the biometric characterization of speakers (Gómez et al., 2009, 2010). Following these studies, San Segundo (2012) was a pilot experiment with a relatively small sample of MZ and DZ twins (12 and 8, respectively), and using only some of the glottal parameters provided by a specific software package implementing vocal tract inversion and glottal source parameterization (www.biometrosoft.com).

For the current study 54 speakers were recruited: 24 MZ pairs, 10 DZ pairs, 8 non-twin brothers and 12 reference-population speakers. In a first step, as a follow-up of San Segundo (2012), some reexaminations and in-depth voice analyses were carried out for all the 20 speakers' voices already analyzed in the above-mentioned proof of concept: 1) anamnesis reexamination to discard possible voice-related pathologies; 2) reexamination of the parameter values extracted, since the analysis in the pilot experiment was carried out in a batch-mode and this kind of processing may entail certain evaluation software artifacts (ESA); and 3) new voice analysis and back annotation with the aim of visually inspecting the glottal waveform of the speakers' voices and checking their fitting to usual normophonic thresholds. Besides, if deemed necessary, a DNA test was carried out to confirm the twins' zygosity. In a later step, the naturally-sustained [e:] fillers of all the 54 speakers (2 sessions per speaker) were extracted and analyzed with the same software creating a vector of 68 parameters from each vowel segment, comprising: 1) f₀ and distortion parameters; 2) cepstral coefficients of the glottal source power spectral density (PSD); 3) singularities of the glottal source PSD; 4) biomechanical estimates of vocal fold mass, tension and losses; 5) time-based glottal source coefficients; 6) glottal gap (closure) coefficients; and 7) tremor (cyclic) coefficients. Finally, a forensic comparison was carried out using the methodology described in Gómez et al. (2012). The results suggest that the parameters analyzed are somehow genetically related, as more similarity is found in MZ twins than in DZ twins or non-twin siblings. Besides, the between-speaker comparisons for unrelated speakers yield LLRs homogeneously around -10, indicating a very good performance of the system.

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