Issues and opportunities for the application of the numerical likelihood ratio framework to forensic speaker comparison

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Across the field of forensic speech science, the likelihood ratio (LR) is increasingly becoming accepted as the "logically and legally correct" (Rose and Morrison 2009:143) framework for the expression of expert conclusions. There has been a relatively strong representation of the LR framework in forensic speaker comparison, with roughly 20% of experts using either a numerical or verbal LR (Gold and French 2011). Development of the LR framework in the field of FP is largely thanks to a small community of researchers. The work in this area has predominantly focused on two main areas: assessing speaker discrimination using a numerical LR and the overall improvement in methodologies for the computation of LRs. However, a substantial issue for the application of the LR to FSC, and one which has been considerably overlooked in the literature, is the unique complexity of naturally occurring spontaneous speech as evidence.

Speech is inherently variable, such that no two utterances even produced by the same individual one after another are identical. Such *intra*-speaker variability separates speech from other forms of forensic evidence (such as DNA) in that the numerator of the LR $p(E|H_{ss})$ can never be 1. Variation between speakers is also highly conditioned by biological, anatomical, systemic-phonological and social factors. Further, unlike other forms of forensic evidence, the range of parameters analysed in componential FSC means that forensic phoneticians deal with with both discrete (frequency counts primarily for consonantal and higher-order parameters) and continuous (incl. formant frequencies and f0) data. Although much of the continuous data are assumed to be normally distributed, non-normally distributed data are also common in FSC. In addition, values within-speakers may display a different distribution to those between-speakers even for the same parameter. Finally, disputed forensic speech samples are made in atypical contexts (often during a crime) using mobile telephone (either using in build recording software or recorded on the other end of the telephone line in a 999 control room).

Despite the considerable progress made over the last 12 years there remain a number of theoretical and practical shortcomings in the procedures applied for computing LRs based on speech evidence. In this paper we review how the LR is currently applied to speaker comparison evidence and outline three specific areas which we believe deserve further investigation; namely statistical modelling, the definition of the *relevant population* (Aitken and Taroni 2004) and the combination of LRs from correlated parameters. Whilst these issues have previously been considered to varying extents, the complexity of the problems has often been overlooked and the solutions offered are not without fault. In order to ensure that there is an accurate estimation of

the strength of evidence, it is important that further attention is directed towards more appropriate and ultimately successful solutions. In this paper we assess each issue in turn considering the evolution of current procedures and their shortcomings, followed by a discussion of potential directions for future research.

References

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