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Questions, propositions and assessing different levels of evidence: Forensic voice comparison in practice

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ABSTRACT

This paper contributes to the ongoing discussion about the distinction between observations and propositions in forensic inference, with a specific focus on forensic voice comparison casework conducted in the UK. We outline both linguistic and legal issues which make the evaluation of voice evidence and the refinement of propositions problematic in practice, and illustrate these using case examples. We will argue that group-level observations from the offender sample will always be evidential and that the value of this evidence must be determined by the expert. As such, a proposal is made that experts should, at least conceptually, think of voice evidence as having two levels, both with evidential value: group-level and individual-level. The two rely on different underlying assumptions, and the group-level observations can be used to inform the individual-level propositions. However, for the sake of interpretability, it is probably preferable to present only one combined conclusion to the end user. We also wish to reiterate points made in previous work: in providing conclusions, the forensic expert must acknowledge that the value of the evidence is dependent on a number of assumptions (propositions and background information) and these assumptions must be made clear and explicit to the user.

1. Introduction

In their 2015 paper in *Science and Justice*, Hicks et al. [1] discussed the formulation of propositions and the evaluation of forensic evidence. Specifically, they argued that it is essential that observations which form forensic evidence are not used to define propositions, upon which the evidence is conditional. Subsequent responses to this paper [2–4] have examined these issues more specifically in the context of forensic voice evidence. We wish to thank the authors for their stimulating discussion. Our paper is not intended to be a formal response to Hicks et al. or Morrison et al., but rather a contribution to the wider scientific debate. Here, we present our views on the issues of evidence, propositions, and background information from the perspective of forensic voice analysts working in the context of the justice systems in England and Wales, and Northern Ireland. Specifically, we outline issues arising from the nature of the voice as a form of forensic evidence, exemplifying these with case examples, and present a framework for thinking about observations and propositions when evaluating voice evidence.

1.1. The likelihood ratio

A forensic likelihood ratio (LR) is an expression of the weight or

strength of the evidence under the competing propositions of the prosecution and defence (for further discussion see [5–7]). It is expressed as:

$$\frac{p(E | H_p, I)}{p(E | H_d, I)}$$

where p is probability, H_p is the prosecution proposition, H_d is the defence proposition and I is background information in the case. The probability of the evidence (E) is conditional on the propositions and the background information, and in this way, the LR is the answer to a specific question. Appropriately defining the propositions, and in particular the defence (or alternative) proposition, is a crucial issue in forensic inference. This is because the defence proposition defines the relevant population which forms a baseline against which the expert assesses the typicality of the evidence. This is the same whether using statistical methods which require empirical data from a sample of the relevant population or more subjective methods based on published studies and experience.

1.2. General background

Hicks et al. [1] argue that forensic observations (i.e. evidential

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analytical findings) should not be included in propositions. Evidence is evaluated by the forensic expert and is defined by two properties; firstly, whether the observations have some probative value, and secondly, whether expert knowledge is required to determine the value of the observations. Propositions (i.e. two mutually exclusive scenarios representing the prosecution and defence views on the evidence), however, are evaluated by the Court, and thus should not be “findings led” (p. 521). If the observations have no value or if the value of the observations can be determined without expert knowledge, then Hicks et al. argue that they can be incorporated into the propositions.

In one example, they point to shoemark comparisons, where a “common sense” approach taken by many experts is to assess the strength of evidence based on the alternative proposition that the shoemark must have been left by a trainer of a similar brand - e.g. on the basis that the print came from another Nike Air Max. However, they argue that this ignores the evidential value of narrowing down the shoemark as having come from this particular brand and model of trainer, as opposed to any other trainer or type of shoe. The example which prompted the response in [2] related to voice comparison evidence, where Hicks et al. argue that, unless the *accent* of the offender is agreed by all parties, the alternative proposition should not include the expert's observations about group-level characteristics, such as regional background, age and gender (again, unless the court can be expected to assess and evaluate these aspects without expert knowledge).

Morrison et al. [2] disagree with this position, demonstrating empirically that without a well-defined alternative proposition, experts will not be able to accurately and reliably carry out voice comparison, and might grossly misrepresent the strength of evidence (while also reducing the validity of the system). If the reference sample does not match the questioned samples well (e.g. for age, sex and language spoken), the magnitude of the LR will be inflated. Further, if the relevant population is too widely defined, and subsequently too large, it will not be possible to adequately sample the population for a case. They contend that, if the assumptions made are clear, the expert can select propositions based on group-level characteristics through a pre-analytical screening exercise. Further, they argue that the court will *usually* be able to reliably determine the regional background (defined by country) and sex of the offender and make an inference about the evidential value of these group-level characteristics. Following this approach, Morrison et al. do not generally include the evidential value of group-level characteristics into their conclusion.

In Hicks et al.'s [3] rejoinder, they come to some agreement that the expert is rightly expected to form well-defined propositions, but that this process has evidential value and might be evaluated formally as an LR (if it requires expert knowledge). In an online reply, Morrison et al. [4] claim that these characteristics will usually be obvious to all parties, and thus their assessment is usually outside the expert's domain as it does not require expert knowledge. Therefore, this can be used to form the alternative proposition, rather than being assessed as part of the evidence.

We agree with many of the points raised in this series of papers, that:

- The LR is the answer to a specific question
- The expert must carefully consider propositions in each case
- Group-level characteristics narrow down the pool of possible offenders
- Analysis methods are better, i.e., more valid and more reliable, when the relevant population matches the offender sample well
- Forensic evidence should be compatible with reasonable expectations of users
- Assumptions should, therefore, be made clear to those users

However, we would like to expand on these and further points, particularly in the context of forensic voice comparison evidence in England and Wales, and Northern Ireland. Morrison et al. [4] express

their satisfaction that the Hicks et al. rejoinder “mostly resolves apparent disagreements between us”. However, there remain fairly key questions to be addressed: should the expert incorporate the evidential value of group-level characteristics (age-group/gender/accent type etc.) into their conclusion, or can this be safely left to the court to assess? Does this require expert knowledge? Further, how and when can an expert include this information, and in what circumstances are they in a better position to do so than the Court? And fundamentally, is the expert's conclusion answering the question that the justice system is asking? We address these questions below and in Section 4 provide example cases which illustrate these issues.

2. Practical issues in forensic voice comparison

Forensic voice comparison accounts for the vast majority (c. 70%; [8]) of work carried out by forensic speech scientists in legal and civil cases in the UK. Such cases usually involve the comparison of a voice in a recording of an unknown offender (e.g. a threatening telephone call) and a recording of a known suspect (e.g. a police interview). For a detailed overview of forensic voice comparison methods see [9–11]. In such cases, the prosecution proposition will be, straightforwardly, that the criminal recording and known recording contain the voice of the same speaker. At the most general level, the defence proposition is that the recordings contain the voices of different speakers. In the following sections we outline issues with the refinement of the defence proposition for forensic voice comparison evidence (for further discussion see [12,13]) relating to the nature of voice evidence and its evaluation in practice.

2.1. The nature of voice evidence

2.1.1. The voice as a carrier of group and individual information

Unlike other forms of forensic evidence (e.g. fingerprints), information about the groups of which the offender is a member is available via an evidential recording of his/her voice. The speech signal encodes information about both the individual speaker and the group(s) to which that speaker belongs. This theoretical dichotomy between individual- and group-level information is convenient, but notoriously problematic in linguistics (see [14]). Indeed, the complexity of the relationship between individual- and group-level information is one factor which makes speech a difficult form of forensic evidence (as discussed in [15]), especially when discussing the distinction between evidence and propositions. There are a number of reasons for this. The phonetic features which indicate a speaker's group memberships are often referred to as the speaker's *accent* (although within the field of forensic voice comparison, e.g. in Morrison et al. [2], and outside of linguistics, the term is generally used restrictively to refer to a speaker's regional background). However, *accent* is multidimensional in terms of the regional and social groups which define it. In forensic voice comparison, there is generally a focus on ‘regional background’ (often defined broadly on a country level, e.g. Australian English; see [2]) and ‘sex’ (binary male or female). However, accent is much more than geography and sex. There may be many other relevant factors including socially-defined gender, socioeconomic class, ethnicity and geographical mobility (to name but a few). In many ways it is more appropriate to define a speaker's *accent* in terms of the point of overlap between numerous groups. Defined narrowly enough, this intersection between multiple groups may itself be individualising (i.e. it may reduce the population of potential offenders down to an extremely small number, or even a single person). *Accents* are also multidimensional in terms of the linguistic and phonetic features which characterise them. Speakers are often variable in speech production, even for features which are stereotypical of a certain region or social group (e.g. style shifting). What it means to be a member of any single group (with the exception of biologically fixed factors such as sex) is also fluid, dependent on a speaker's attitudes and stance, the topic of conversation

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