Institution: University of York		
Unit of Assessment: 26 - Modern Languages and Linguistics		
Title of case study: Forensic Speech Science: Informing policy and practice		
Period when the underpinning research was undertaken: 2010-2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Peter French	Professor	Jan 2015 - present
Paul Foulkes	Professor	Jul 2000 - present
Philip Harrison	Research fellow	Feb 2015 - present, with breaks
Vincent Hughes	Lecturer	Feb 2015 - present
Carmen Llamas	Professor	Oct 2007 - present
Dominic Watt	Senior Lecturer	Oct 2007 - present
Period when the claimed impact occurred: Aug 2013-2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact (indicative maximum 100 words)

Speech and audio recordings are routinely analysed for investigative and evidential purposes around the world. Research conducted by the Forensic Speech Science group at York, through collaboration with partners J P French Associates and Nuance Communications, is central to developments in all aspects of the field. The two main strands of impact are: (i) developing UK policy by informing the Forensic Regulator's guidance for the field and providing advice to government, and (ii) conducting forensic casework that affects decisions made by courts both nationally and internationally, as well as enhancing the professional practices of experts and organisations in the field.

2. Underpinning research (indicative maximum 500 words)

York is a world-leading research centre for Forensic Speech Science (FSS) and has secured c.GBP2,000,000 in UKRI funding since August 2013. Members of the group are authorities in FSS and have published on all aspects of the field, through a wide range of empirical research, as well as extensively referenced overviews of the discipline, such as a contribution to the major Oxford handbook in the area [3.1]. Our research is interdisciplinary, bringing together phonetics and sociolinguistics with engineering, statistics, and psychology. We also benefit from a long-standing relationship with J P French Associates (JPFA), the UK's largest independent forensic speech and audio laboratory. The impact of York research on JPFA was the basis for our 2014 REF case study. Since then, we have actively strengthened this relationship, with **French** and **Harrison**, both directors at JPFA, now employed on fractional contracts within the Department. This is a unique pathway to impact that means our research is directly informed by forensic practitioners and it provides a mechanism for continuous knowledge exchange.

A major focus of our research is forensic speaker comparison, whereby recordings of an unknown criminal (e.g. from a bugged car) and a known suspect (e.g. from a police interview) are analysed to assess the likelihood that the voices belong to the same individual. Our research involves developing and testing analytical methods used by experts in casework. In particular, we rigorously investigate automatic speaker recognition systems, which are increasingly used in forensic casework around the world. [3.2] examines relationships between different measures of vocal output that are used by linguists and automatic systems, and compares the speaker discriminatory performance of the different methods. Results reveal that errors made by automatic systems can be resolved by experts using auditory analysis (i.e. detailed listening), suggesting that a combined approach of automatic and linguistic methods is optimal in speaker comparison. We have also conducted research testing the sensitivity of automatic systems to regional variations in accent using the state-of-the-art Nuance Forensics system [3.3]. Results show that while overall error rates are relatively unaffected by accent, the results for individuals may be considerably over-inflated when using mismatched accent data.

To understand how individual voices differ from each other, it is essential to examine structured variation according to regional and social factors. For example, [3.4] describes phonetic, phonological, and morphosyntactic differences between accents in the North East of England -

accents that are often confused by lay people from outside the North East. Such work is essential for forensic casework, as experts must consider not only the similarities between the suspect's voice and that of the unknown criminal, but also the distinctiveness of the voice relative to other speakers in the population - the more unusual the voice, the stronger the evidence. Our sociolinguistic research allows experts to judge distinctiveness in a more objective way than relying on their experience alone. Sociolinguistic knowledge can also be applied to other forensically relevant questions, such as 'Language Analysis in the Asylum Process' (LAAP) cases, where language is used to help determine an individual's country of origin. There is much debate about the best methods to use in such cases and our research has empirically tested the performance of linguists and native speakers with a view to integrating approaches. The findings provide new insights into the best way to conduct LAAP casework, which have been described in influential overviews of the area, such as [3.5]. Our research also covers other applications of FSS, such as transcription - producing an orthographic record of what was said in a recording. [3.6] argues that transcription in forensic cases, where audio quality is often very poor, should not be undertaken by non-linguists (e.g. police officers), and outlines a protocol for transcribing indistinct audio in forensic cases.

3. References to the research (indicative maximum of six references)

3.1 **Foulkes, P.** & **French, P.** (2012). Forensic speaker comparison: a linguistic-acoustic perspective. In P. Tiersma & L. Solan (Eds.) *The Oxford Handbook of Language and Law*. Oxford: OUP. pp. 557-572. DOI *

3.2 **Hughes, V.**, **Harrison, P.**, **Foulkes, P.**, **French, P.**, Kavanagh, C. & San Segundo, E. (2017). Mapping across feature spaces in forensic voice comparison: the contribution of auditory-based voice quality to (semi-)automatic system testing. *Proc. Interspeech*. pp. 3892-3896. DOI (AHRC Voice and identity: source, filter, biometric, PI Foulkes, CI French, Feb 15-Sept 19, GBP892,210) *^

3.3 **Watt, D.**, **Harrison, P.**, **Hughes, V.**, **French, P.**, **Llamas, C.**, Braun, A. & Robertson, D. (2020). Assessing the effects of accent-mismatched reference population databases on the performance of an automatic speaker recognition system. *IJSLL* 27(1):1-34. DOI (ESRC The use and utility of localised speech forms in determining identity: forensic and sociophonetic perspectives, PI Llamas, CI Watt, CI French, Jan 16-July 19, GBP843,895) *+^

3.4 Beal, J., Burbano-Elizondo, L. & **Llamas, C.** (2012). *Urban North-Eastern English: Tyneside to Teesside*. Edinburgh: EUP. *

3.5 Wilson, K. & **Foulkes, P.** (2014). Borders, variation and identity: Language Analysis for the Determination of Origin (LADO). In D. Watt & C. Llamas (Eds.) *Language, Borders and Identity.* Edinburgh: EUP. pp. 218-229. JSTOR *

3.6 **French, P.** & Fraser, H. (2018). Why 'ad hoc experts' should not provide transcripts of indistinct forensic audio, and a proposal for a better approach. *Crim. Law Journal* 42(5): 298-302 URL *

*=peer-reviewed; +=returned to REF2021; ^=produced with peer-reviewed funding

4. Details of the impact (indicative maximum 750 words)

Forensic Speech Science (FSS) is the analysis of speech and audio for evidential and investigative applications. Since August 2013, York research has had considerable impact on the field. Specifically, we have (1) guided national-level Government policy and (2) contributed to high-profile national and international casework and informed professional practice in the field.

Background: In the UK alone, there are an estimated 600 cases per year involving FSS analysis, and J P French Associates (JPFA) has consulted on more of these than any other expert or firm (around 120-200 cases and consultations per year) [5.1a]. Law enforcement and security services also regularly use speech and audio analysis for investigative purposes. Outside the UK, FSS casework is often undertaken by Government forensic laboratories. However, as many countries do not have dedicated labs, JPFA regularly conduct casework internationally, especially in high profile cases [5.1a]. FSS methods have developed considerably in recent years, most notably through the adoption of automatic speaker recognition (ASR) software and new frameworks for expressing conclusions. Forensic science, as a whole, is under increasing pressure to improve standards, in light of high-profile miscarriages of justice based on unscientific and untested forensic evidence. The UK Government Forensic Science Regulator is responsible for improving the quality of forensic evidence, through a process of accreditation, in line with international

standards (ISO/IEC17025). Accreditation is becoming a crucial factor in courts' decisions about the admissibility of expert evidence and the weight attached to it.

Impact:

(1) Policy

- In 2013, the Forensic Science Regulator appointed **French** to chair a five-member committee for Forensic Speech and Audio, which included **Harrison** and **Watt**. As confirmed by [text removed for publication], York members were recruited on the basis of their long-standing research expertise in the field [5.1b], underpinned by publications such as [3.1]. The committee produced an Appendix to the Regulator's Code of Practice and Conduct, published in 2016 [5.2a] with a second issue published in 2020 [5.2b]. The Appendix provides specific guidance on record keeping, handling of materials, methods and validation in FSS. This is the Government's official guidance for the area, and it is incumbent on experts to follow the recommendations. The Regulator's Code of Practice, of which the Appendix is a part, will be used when assessing forensic laboratories for accreditation purposes [5.2c] and so it will be essential to show compliance with the guidance. As a result of the guidance in the Appendix, [text removed for publication] is now "including statements (in reports) that note equipment can have impact on the quality of … outputs" [5.1b]. York members "continue to provide guidance through the committee as part of the Regulator's ongoing efforts to update and streamline the Code of Practice for the forensic science sector" [5.1b].

- In 2015, our research informed an official briefing document for MPs on forensic linguistics and phonetics [5.3], produced by the Parliamentary Office of Science and Technology (POST). The document was written in consultation with **French** and **Watt**, and makes extensive reference to our research, particularly in speaker comparison [3.1] and Language Analysis in the Asylum Process (LAAP) [3.5]. The document was used by Roger Mullin MP as the basis of a Private Members Bill to introduce standards into the field, which was brought before the House of Commons in 2016 [5.1c, 5.4]. The Knowledge Exchange Lead at POST states that "**French** and colleagues provided further insights, crucial to my understanding of the topic, which fed into my drafting of the briefing" and that "expert insights provided by researchers from York, supported by their publications, were key to the development of the POSTnote [briefing] on Forensic Language Analysis" [5.1c].

- A BBC investigation uncovered alleged cheating on English language oral tests used as part of the UK immigration process. The company administering the tests (ETS) used an automatic speaker recognition system along with trained human listeners to analyse whether the same voices of 'proxy exam sitters' were recurring in their data. In 2016, **French** was asked by the Home Office to produce a report [5.5] outlining how well ETS's methods were able to detect fraudulent tests. **French**'s opinion was that, on the basis of the information provided to him, the testing process was robust. **French**'s report, which makes direct reference to an earlier version of work which became [3.2], has informed parliamentary process, having been cited by the Home Office in its response to the House of Commons Home Affairs Committee [5.6a]. It has also been cited in at least five immigration tribunal rulings as the basis for not overturning asylum decisions [5.6b]. Both **French** and **Harrison** were called to a meeting of the All Party Parliamentary Group on Tests of English for International Communication in the House of Commons in 2019. Their evidence is referenced extensively in the group's report [5.6c].

(2) Training, professional practice, and casework

- York is a world-leading centre for research-led FSS training, through which we have influenced the practice of FSS practitioners around the world. York's Department of Language and Linguistic Science offers the world's only postgraduate (MSc) degree in FSS. The programme is heavily informed by our research and provides training in all elements of FSS underpinned by [3.1, 3.5, 3.6], as well as speech technology and forensic statistics underpinned by [3.2, 3.3]. As of August 2020, at least 20 of our graduates now work within FSS, police, law enforcement and security, and Government departments and organisations both nationally and internationally [5.7], [text removed for publication] [5.1d].

According to a Forensic Audio and Video Analyst at the Royal Canadian Mounted Police (RCMP), and former student on the MSc, the programme provides "both the theoretical and practical basis for … day-to-day casework" [5.1e].

- In 2016, **French**, **Harrison**, **Hughes**, and **Watt** developed a Continuing Professional Development course in FSS. Delivery of the course is made possible through a partnership with Nuance Communications, the world's largest speech technology company, who provide automatic speaker recognition software for teaching and research (used in [3.3]). The course has run six times between 2016 and 2019, with a total of 61 participants, the majority of whom (approximately 70%) were from national and international law enforcement and security services. Course content is heavily underpinned by our research [3.1], with a particular focus on understanding the principles of automatic systems [3.2, 3.3]. The course has changed practice at [text removed for publication]: it is now part of the training programme for recruits who are new to the field as it "equips them with the knowledge and understanding to more effectively carry out casework" as well as reinforcing "current best practices among ... lab staff" [5.1b]. An Audio Examiner from North Wales Police also said that knowledge gained from the course has "taken a lot of time-consuming 'guesswork' out of what I do, now that I know I can expect a particular result by applying a particular technique" [5.1f].

- We have continued to inform the work of JPFA. The company consists of four full-time members of staff, all of whom hold postgraduate degrees in FSS from York, as well as **French** and **Harrison**. The relationship between York and JPFA is a long-standing one and the appointments of **French** and **Harrison** at the University reflect a strategic decision to strengthen this relationship, providing a more direct pathway for our research to have impact on the majority of forensic speech and audio casework nationally and internationally. The JPFA Research Manager states that "York research is essential in guiding (JPFA) casework practice, both in terms of methods and frameworks for evaluating evidence" [5.1a]. The relationship between JPFA and York, and the benefits to JPFA from York research, have also been identified as reasons for JPFA's high standing within the field by external organisations [5.1b, 5.1d].

- In their roles at JPFA, **French** and **Harrison** regularly conduct casework that affects the outcomes of criminal trials. For example, in 2014, York research on accent variation in the North East of England [3.4] was used by **French** to inform a speaker comparison in the case of the murder of David Wilson in Sunderland. **French**'s analysis of a telephone call made to police from the victim's phone helped police identify where the suspect was from [5.8a]; that call was described by DCI Mark Ord as a "key piece of evidence" [5.8b] in convicting Daniel Johnson. Our research has also informed high-profile international cases. For example, in 2018, **French** re-transcribed audio recordings for the Supreme Court of the Australian Capital Territory in the retrial of David Eastman, using the protocol in [3.6]. The transcriptions weakened the prosecution's claim that the recordings contained admissions to murder. This expert evidence was delivered by **French** personally from the witness box and the judge referred to it when instructing the jury in the retrial, which ended in Eastman's acquittal [5.9].

- At a national level, York research has informed [text removed for publication] [5.1d]. Our research has also had substantial international impact on casework practices in Government laboratories in Europe and North America. York research "significantly contribute(s) to the scientific underpinning of forensic casework" at the Netherlands Forensic Institute (NFI) [5.1g]. Papers such as [3.5] are used by the Netherlands Immigration and Naturalisation Service in LAAP cases and provide "much needed empirical investigation of language analysis" for such cases [5.1h]. According to a Forensic Speech Scientist from the Bundeskriminalamt (BKA; German Federal forensic laboratory), York is "consistently producing research highly relevant for forensic institutes like ours at the BKA" and is "the only institute worldwide that pursues this line of research with this level of intensity and practical relevance" [5.1i], with specific reference made to our work on automatic speaker recognition [3.2, 3.3]. Finally, York research (with specific reference

to [3.2]) informs forensic analysis in all cases conducted by the Royal Canadian Mounted Police Audio Video Analysis Unit (approximately 25 cases per year) and means that the RCMP "is more confident in ... internal forensic casework practices and produce(s) more reliable and robust analysis to support investigations across Canada at all levels of law enforcement" [5.1e].

- In 2014, **French**, **Harrison**, and **Hughes** presented a research talk (on work that led to [3.2]) at a workshop run by the European Network of Forensic Science Institutes (ENFSI). ENFSI is a network of public forensic science laboratories across Europe that has the aim of promoting knowledge exchange and developing and implementing international standards. The outcome of this workshop was a set of guidelines for the use of automatic speaker recognition systems in forensic casework [5.10]. The guidelines make extensive reference to York research, including [3.1]. According to an author of the guidelines, York staff "made important comments that led to improvements of the guideline document" which has "become an integral part of casework at the BKA" [5.1i].

As evidenced above, York research has informed, and responded to, changes within the field of FSS and across forensic science more generally. By informing policy and practice, at both national and international levels, our research has had wide-ranging and far-reaching impact that has shaped the field and will continue to do so in the future.

5. Sources to corroborate the impact (indicative maximum of 10 references)

5.1 Testimonials: **(a)** Research Manager, J P French Associates; **(b)** [text removed for publication]; **(c)** Knowledge Exchange Lead, Parliamentary Office of Science and Technology; **(d)** [text removed for publication]; **(e)** Forensic Audio and Video Analyst, Royal Canadian Mounted Police; **(f)** Audio Examiner, North Wales Police; **(g)** Forensic Speech Scientists, Netherlands Forensic Institute; **(h)** Forensic Speech Scientist, Netherlands Immigration and Naturalisation Service; **(i)** Forensic Speech Scientist, Bundeskriminalamt (Federal Forensic Laboratory), Germany.

5.2 Forensic Science Regulator documentation: **(a)** (2016) *Codes of Practice and Conduct. Appendix: Speech and Audio Forensic Services* FSR-C-134 (issue 1); **(b)** (2020) *Codes of Practice and Conduct. Appendix: Speech and Audio Forensic Services* FSR-C-134 (issue 2); **(c)** (2020) *Codes of Practice and Conduct (for forensic science providers and practitioners in the Criminal Justice System)* FSR-C-100 (issue 5).

5.3 Parliamentary Office of Science and Technology (2015) *Forensic Language Analysis* (Number 509).

5.4 Forensic Linguistics (Standards) Bill 2015-16. HC Deb 20 April 2016, vol 608, col 934.

5.5 French, P. (2016) Report on forensic speaker comparison tests undertaken by ETS (On behalf of: Secretary of State for the Home Department).

5.6 Reports and rulings on ETS: **(a)** Home Office response to House of Commons Home Affairs Committee: *The Work of the Immigration Directorates (Q4 2015): Government Response to the Committee's Second Report of Session 2016-17*; **(b)** Portfolio of Immigration Tribunal Rulings; **(c)** *Report of the APPG on TOEIC* (2019).

5.7 FSS@York Alumni (annotated list available).

5.8 David Wilson murder news reports: **a)** Daily Mail 12 July 2017; **b)** BBC News 12 July 2017.

5.9 R v David Eastman [2018] ACTSC 321

5.10 Drygajlo, A., Jessen, M., Gfroerer, S., Wagner, I., Vermeulen, J. & Niemi, T. (2015) *Methodological Guidelines for Best Practice in Forensic Semiautomatic and Automatic Speaker Recognition*. European Network of Forensic Science Institutes