Linguistics 450
New Horizons in Speaker Identification
Prof. Sandra Ferrari Disner
Fall semester, 2016

The question of whether a speaker can be identified by his or her voice has figured in legal cases for at least 350 years.   In 1660, the executioner of King Charles I of England was identified in a court of law solely by means of his voice (as his face had been concealed by a black hood).   In 1934, Col. Charles Lindbergh, having been prompted by a District Attorney, overcame his earlier reluctance and identified the voice of a suspect as that of his son's kidnapper -- more than two years after that fateful event. In 2012, the friends and family of Trayvon Martin identified his voice in the shouted calls for help on a 911 recording, but the friends and family of George Zimmerman drew the opposite conclusion from the very same shouts.

Jurors tend to give great credence to witnesses who were at the scene of a crime, and earwitness testimony is subject to even fewer courtroom challenges than is eyewitness testimony.   But remarkably little evidence has been gathered for the purpose of determining *how reliably* earwitnesses make correct identifications. One of the few studies conducted under carefully controlled conditions probed the ability of a world-renowned linguist to recognize personally-familiar speakers. The success rate was only 66%, and would likely have been even lower if a less-skilled listener, less-familiar speakers, or shorter, degraded, or distorted (e.g., shouted) stimuli had been involved, or if identical twins were included among the speakers. Moreover, there is at least some experimental evidence that listener expectations affect earwitness identification.

Other voice identification strategies that have been presented as evidence in the courtroom are analyses of recorded voices that rely on solid scientific principles such as acoustic phonetics. These may involve spectrograms -- printouts of the acoustic output of the speaker's vocal tract -- or the newer "reassigned" spectrograms, which are targeted, phase-enhanced images of this same acoustic output. Again, the success rate has much to do with the quality of the recording (sufficient length and clarity are essential) and also with the skill of the analyst (expert phoneticians perform significantly better than laypersons).

In this course we will examine the success rate of all of these methods, and in addition consider their robustness in the presence of noise, and also under mimicry and disguise. Students will receive instruction in some of the most promising speaker-identification strategies developed to date, and will be challenged to identify voices, objectively, on their own. The main emphasis will be on the scientific analysis of the recorded voice, based on precise measurements of vocal overtones, the pitch of the voice, speech rate, the 'open quotient' of the vocal cords, and other characteristics such as breathiness and creak.

As a way of understanding the articulatory differences that underlie the acoustic differences, we will study the architecture of the larynx, and also its development (along with the

supralaryngeal articulators) from childhood through adolescence and adulthood, in normal subjects and in those with dwarfism.

Grades for this course will be based on a critical review of a journal article or other (pre-approved) source; on class participation, including the creation and evaluation of voice comparisons; and on a final paper.   Any necessary instruction in the theory and methodology of phonetics (the study of sounds) will be provided in class for the benefit of those who are new to linguistics. **There are no prerequisites for this course.**

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Course information:
Time and place: Mondays and Wednesdays, 2 to 3:20 pm in GFS 220
Instructor contact: Sandra Ferrari Disner, Ph.D.   sdisner@usc.edu
Office hours: Monday 11 – noon and Friday 11 - noon in GFS 301d
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The components of the final grade will be weighted as follows:
  • term paper, representing original research, and its presentation in week 15 (50%).
  • critical review of one of the assigned readings, or other (pre-approved) source (15%)
  • class participation and creation and interpretation of speech demos (35%)

The textbook for this course is ***Foundations of Voice Studies***, by Jody Kreiman and Diana Sidtis (Wiley-Blackwell 2011).   A copy will be on loan shortly in Leavey Library.   The textbook will be supplemented by articles provided on Blackboard by the instructor.

August 22 -- Overview
"Who Said That?" (Solan & Tiersma 2005, on Blackboard)

August 24 -- A case study in earwitness identification
"Factors affecting lay persons' identification of speakers" (Yarmey 2012, on Blackboard)
Foundations of Voice Studies, chapter 7

August 29 -- How well can earwitnesses be expected to perform?
"Common sense beliefs and the identification of familiar voices" (Yarmey et al 2001)

August 31 -- Linguistic factors
         → sample length, background noise, familiarity
"The ability of listeners to identify voices" (Ladefoged and Ladefoged 1980, on Blackboard)
"Naïve auditory identification and discrimination of similar voices by familiar listeners" (Rose & Duncan 1995, on Blackboard)

September 7, 12 -- Psychological factors:
         → co-witness conformity, priming, listener expectations, preparation
"Expectation affects identification by listening" (Ladefoged 1978)
"Memory conformity: Disentangling the steps toward influence during a discussion" (Gabbert et al., 2006)

"Earwitness identification: Some influences on voice recognition" (Read & Craik 1995; experiment 2 only)

September 14 -- Voice quality: Physical, psychological, and social characteristics
Foundations of Voice Studies, chapter 1 "Introduction"

September 19 -- Voice quality (continued)
Foundations of Voice Studies, chapter 2 "Producing a voice & controlling its sound"

September 21, 26 -- Tutorial on the fundamentals of acoustic phonetics
A Course in Phonetics (Ladefoged 2011, on Blackboard), excerpts from chapters 8 & 9.

September 28, October 3-- A testable model of how speakers differ
Foundations of Voice Studies, read §8.3 and review §1.3
"The Phonetic description of voice quality" (Laver 1980)

October 5, 10 -- Making and interpreting sound spectrograms
A Course in Phonetics, ch. 8 (Ladefoged & Johnson 2011)
"A Simple guide to using Praat" (handout, Li 2010)

October 12, 17 -- Sound spectrograms (continued)
Foundations of Voice Studies, read §10.1-10.2.2
"Hearing Voices: Speaker Identification in American Courts" (Solan & Tiersma 2003), excerpts on Blackboard.
"The Law Is Not Science" (Ladefoged 2004, on Blackboard)

October 19, 24 -- Developmental changes in the vocal articulators, and gender differences
Foundations of Voice Studies, chapter 4 "Physical Characteristics and the Voice"
(only pp. 110-130 and 150-155)
"Inferring speakers' physical attributes from their voices" (Krauss et al. 2002)

October 26, 31 -- The vocal folds in motion: reassigned spectrograms
"A Spectrogram for the twenty-first century" (Fulop & Fitz 2006)
Special guest: Prof. Sean Fulop, Dept of Linguistics, Cal State, Fresno.

November 2 -- The recognition of familiar and unfamiliar voices.
Guest speaker: Prof. Jody Kreiman, Dept of Head & Neck Surgery, UCLA
Foundations of Voice Studies, chapter 5 "Recognizing Speaker Identity from Voice"
(pp. 156-179 only)
"Unfamiliar voice discrimination and familiar voice recognition are independent and unordered abilities" (Van Lancker & Kreiman 1987).

November 7, 9 -- Dialect variation: cues from regional accents of the US and around the world.
Guest speaker on November 9: Prof. Louis Goldstein, USC and Haskins Laboratories
"The Judicial Testing of Linguistic Theory" (Labov 1988, on Blackboard)

November 14, 16 -- The effects of mimicry and disguise
"Effects of selected vocal disguise" (Reich & Duke 1979)
"Detection of imitated voices" (Eriksson et al., 2010)
Foundations of Voice Studies, §7.2.4 and §7.2.5

November 21: Mystery spectrograms, with phonation type variations and other disguises

November 23: [No class today]

November 28: Conclusions
"Current methods in forensic speaker identification" (Cambier-Langeveld 2007)
"Speaker Recognition and Forensic Phonetics" (Nolan 1997)

November 30: Discussion of projects (preliminary version only; final due in exam week)

December 9, 2 – 4 pm: Submission of term papers (in Prof. Disner's office)

<u>Bibliography of Required and Optional Readings</u>

Alpert, M., R.L. Kurtzberg, M. Pilot, and A.J. Friedhoff (1963). "Spectral characteristics of the voices of twins", *Acta Genetica Med. Gemellol* 12:335-41.

Blatchford, Helen, and Paul Foulkes (2006). "Identification of Voices in Shouting", *International Journal of Speech, Language, and the Law* 13(2): 241-254.

Cambier-Langeveld, Tina (2007). "Current methods in forensic speaker identification", *International Journal of Speech, Language, and the Law* 14(2): 223-243.

Eriksson, Erik, Kirk Sullivan, Elisabeth Zetterholm, Peter Czigler, James Green, Asa Skagerstrand, and Jan van Doorn (2010). "Detection of imitated voices", *International Journal of Speech, Language, and the Law* 17(1): 25-44.

Fulop, Sean, and Kelly Fitz (2006). "A Spectrogram for the twenty-first century", *Acoustics Today* 2(3):26–33.

Gabbert, Fiona, Amina Memon and Daniel Wright (2006). "Memory conformity: Disentangling the steps toward influence during a discussion", *Psychonomic Bulletin and Review.* 13: 480-485.

Kim, Kyung-Wha (2013). "Voice and speech variation under physical stress", *International Journal of Speech, Language, and the Law* 20(1):143-5.

Krauss, Robert, Robin Freyberg, and Ezequiel Morsella (2002). "Inferring speakers' physical attributes from their voices", *Journal of Experimental Social Psychology* 38: 618–625.

Labov, William (1988). "The judicial testing of linguistic theory", in D. Tannen (ed.), *Language in Context: Connecting Observation and Understanding*. Norwood: Ablex. pp. 159-182.

Ladefoged, Peter (1978). "Expectation affects identification by listening", *Language and Speech* 21(4):373-4.

Ladefoged, Peter (2004) "The Law Is Not Science" *JASA Echoes* 14/2 (2004), pp. 14–15. (also http://www.acoustics.org/press/146th/Ladefoged.htm)

Ladefoged, Peter, and Sandra Disner (2012). *Vowels and Consonants*. Oxford: Wiley-Blackwell. (chapters 3-6 only)

Ladefoged, Peter, and Keith Johnson (2011). *A Course in Phonetics*. Boston: Wadsworth-Cengage. (chapters 8-9 only)

Ladefoged, Peter, and Jenny Ladefoged (1980). "The ability of listeners to identify voices", *UCLA Working Papers in Phonetics* 49:43-51.

Laver, John (1980). *The Phonetic Description of Voice Quality*. Cambridge: Cambridge University Press.

Nolan, Francis (1997). "Speaker Recognition and Forensic Phonetics" in *The Handbook of Phonetic Sciences* (W.J. Hardcastle and J. Laver, eds.) Oxford: Blackwell.

Read, Daniel, and Fergus Craik (1995). "Earwitness identification: Some influences on voice recognition", *Journal of Experimental Psychology: Applied* 1: 6-18.

Reich, Alan R., and James E. Duke (1979). "Effects of selected vocal disguise", *J. Acoust. Soc. Am.* 66: 1023-28.

Reich, Alan R. (1981). "Detecting the presence of vocal disguise in the male voice", *J. Acoust Soc. Am.* 69(5): 1458-61.

Rose, Philip (2002). "Why voices are difficult to discriminate phonetically" in *Forensic Speaker Identification,* 9-15. New York: Taylor & Francis.

Rose, Philip, and Sally Duncan (1995). "Naïve auditory identification and discrimination of similar voices by familiar listeners", *International Journal of Speech, Language, and the Law* 2: 1-17.

Solan, Lawrence M., and Peter M. Tiersma (2003). "Hearing voices: Speaker identification in American courts", *54 Hastings Law Journal* 373, 2003.

Solan, Lawrence M., and Peter M. Tiersma (2005). "Who said that?" in *Speaking of crime: The Language of criminal justice*, 117-148. Chicago: University of Chicago Press.

Van Lancker, Diana, and Jody Kreiman (1987). "Unfamiliar voice discrimination and familiar voice recognition are independent and unordered abilities" *Neuropsychologia* 25: 829-34.

Yarmey, A.D. (2012). "Factors affecting lay persons' identification of speakers" in *The Oxford Handbook of Language and Law*, 547-556. Oxford: Oxford University Press.

Yarmey, A.D., A.L. Yarmey, M.J. Yarmey, and L. Parliament (2001). "Common sense beliefs and the identification of familiar voices." *Applied Cognitive Psychology* 15:283-99.

Zetterholm, Elisabeth, Farhan Sarwar, Valgeir Thorvaldsson, and Carl Allwood (2012). "Earwitnesses: The Effect of type of vocal differences on correct identification." *International Journal of Speech, Language, and the Law* 19(2): 219-237.

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Statement for Students with Disabilities
Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity
USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *Scampus,* the Student Guidebook, contains the Student Conduct Code in Section 10.00 http://scampus.usc.edu/university-student-conduct-code/ The recommended sanctions are located in Section 13.11. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found in section 13.00.