Instruction of Forensic Voice Identification in Communication Sciences and Disorders Academic Programs in the USA

Kelsey Marie Provence-Kelly

CDIS 4993.26567

Oklahoma State University

Spring 2017

Abstract

Introduction

The field of Communication Sciences and Disorders (CDIS) offers many different and diverse career paths. These range from speech pathology and audiology, to even forensic voice science. The researchers hypothesized that student knowledge of forensic voice science is lacking in CDIS programs across the United States. A survey was formulated to uncover what the perceptions of careers in forensic voice science are amongst undergraduate and graduate students in CDIS programs across the United States. Little research is available about how forensic voice science is taught in universities, and this research looks to help fill that gap.

Methods

A survey consisting of 35 total questions was created through Qualtrics. The first section of the survey focused on demographics and whether the respondent had completed a speech science or related course. Respondents who had completed such a courses were directed to a series of questions about their knowledge of acoustic parameters, forensic voice science, and how acoustic parameters relate to forensic voice science. Respondents were then directed to questions about how the acoustic parameters were taught in their class and why they thought instruction in forensic voice science was lacking. Respondents who had not taken a speech science or related course were directed to a series of questions about their knowledge of forensic voice science and how they had gained this knowledge. The research team sent out emails to academic advisors and a program directors in CDIS programs and requested that the link to the perceptions of forensic voice science survey be sent out to all the students in the program. A total of 206 academic programs were contacted.

Results

A total of 409 responses were recorded, with 391 participants having taken a speech science or related course. Of those 391 responses, 61% could draw a correlation between speech science and forensic voice science. While the majority of participants responded that they understood the acoustic parameters commonly taught in speech science courses, only 5% were aware that a background in speech science enables a student to pursue further education in forensic voice science. The results strongly indicated that students have a good foundation in the basics of the tools used in forensic voice science, but there is little to no instruction about forensic voice science in the classroom or textbooks that are used.

Discussion

Speech science primarily focuses on the science of speech production and speech perception. Although students in this course are well poised to be the consumers of information that can be applied in forensic voice science seldom we see students who go on to make a career as a forensic speech scientist. So the current study aimed at investigating the instruction of forensic voice science in speech science courses that were taught in CSD programs across the United States. The results of the survey indicate that the basic fundamentals used in forensic speech science are taught in most speech science courses across the United States, but overall, there is little to no instruction about the applications of speech science concepts in forensic voice science. Overall, CSD students are well equipped with the knowledge of underlying principles for speaker identification in forensic speech science, but very few understand the applications and career options available to them in this field.

Table of Contents

1.1 Introduction

The field of Communication Sciences and Disorders offers many different and diverse career paths. These include being a speech-language pathologist (SLP), audiologist, a researcher, or even as a forensic voice scientist (FVS) ("Learning about the CSD professions," 2017). The number of professionals opting to work as SLPs outnumber the audiologists. The United States Bureau of Statistics reported that in 2014 about 135,400 SLPs worked in the USA, which is considerably higher in comparison to 13,200 audiologists during the same year.

As an SLP an individual has the opportunity to work in a number of settings, ranging from public schools to healthcare facilities, or even running a private practice clinic. The history of this profession can be mainly traced back to mid-1900's when many World War II soldiers who returned to the USA demonstrated communication disorders as a result of brain injury (Duchan, 2011). SLPs are typically certified by the American Speech-Language-Hearing Association's (ASHA) Council for Clinical Certification in Audiology and Speech-Language Pathology. ASHA's certification is a commonly preferred credential by employers, patients, and other stakeholders. Additionally, all 50 states and the District of Columbia require an SLP to obtain a state/district licensed as well. ("How to apply for certification in speech-language pathology" 2017).

To obtain ASHA certification, an applicant should have graduated from an academic program that is accredited by the Council of Academic Programs in Speech-Language Pathology and Audiology. An undergraduate education in Communication Sciences and Disorders is the most common way to get into a graduate program in speech-language pathology but it is not always required. Students with a different major will be required to complete pre-requisite coursework before gaining admission to the graduate program.

Students studying for undergraduate as well as graduate degrees in Speech-Language Pathology receive instruction on different courses within the realm of Communication Sciences and Disorders. Some of the commonly required coursework in this program ranges from common speech and language disorders in children and adults, normal speech and language development, basic audiology, aural rehabilitation, phonetics, neurological disorders, diagnostics, methods useful in clinical therapy sessions, and Speech Science ("Communication sciences & disorders," 2017-2018). Although all the above-courses are very useful as well as necessary to successfully complete undergraduate as well as graduate degree in speech-language pathology, a neglected instructional topic is the area of forensic voice science.

There are many different specializations within the field of Forensic Voice Science. Aspects such as voiceprints and spectrographs can be used as evidence in criminal court cases in the United States (Broeders, 1998). Other aspects, such as authenticating audio recordings and linguistic authorship identification can also be used to support evidence in criminal court cases (Broeders, 1998). Other techniques in the field of Forensic Voice Science, such as accurate speaker identification from a recording or spectrograph, are not deemed reliable enough to use as evidence in criminal court cases. However, the promise of the technology is there with further research to refine the process (Broeders, 1998).

The study of speech science is usually a core course for undergraduate and/or graduate students in SLP programs, and covers the basics of acoustics, and how to record and interpret acoustic measurements in voice science. The acoustic measurements of voice can be used as evidence or indicators of neurological diseases, such as Parkinson's disease and ALS (Rusz, J., Cmejla, R., Ruzickova H., & Ruzicka, E., 2010). Though SLP's and Speech Scientists cannot

directly diagnose or treat these diseases, it is within their scope of practice to treat the voice disorders that are commonly associated with these diseases.

Many of the basic topics covered in the speech science course are the basic fundamentals used in the career field of forensic voice science. Acoustic measurements, such as a spectrograph which measures time vs. frequency vs. intensity of voice, fundamental frequency are commonly used by forensic voice scientists to identify speakers through voice recordings. Though students in Communication Sciences and Disorders are well versed in acoustic measurements, forensic voice science is rarely mentioned as a career option during any of their course work and no courses are offered covering this topic in-depth. Additionally, there is little to no mention of the work done by Forensic Voice Scientists in the textbooks available to undergraduate Speech-Language Pathology students. Considering this limitation, the aim of this study is to survey to what extent students majoring in speech-language pathology receive classroom instruction on forensic voice science, and their awareness and perception of the field of forensic voice science. A total of 206 speech-language pathology academic programs and advisors (undergraduate and graduate) across the United States were surveyed.

2.1 Methods

2.2 Development of online survey

For the purpose of developing the online survey, the second author completed a thorough literature review on forensic voice science in general and specifically on curriculum related to forensic voice science in speech-language pathology programs. The literature review revealed that minimal information is available about student perceptions of forensic voice science in speech-language pathology academic programs and most literature available on forensic voice science were dated by a decade or more. To address this limitation, an online survey

questionnaire was developed using the Qualtrics© software (Qualtrics, Provo, UT, 2005). The questions listed on the survey were specifically prepared to understand the student awareness of forensic voice, applications of forensic voice, and the extent to which forensic voice science is integrated in the speech-language pathology curriculum.

This questionnaire consisted of 35 questions in total, but based on their responses, each respondent could answer a maximum of 27 questions. This questionnaire took a maximum of 10 minutes to complete and included multiple choice questions, yes/no questions, and several questions offered respondents the opportunity to write in their own response. Several questions also included the phrase 'choose all that apply,' and offered 3-5 different options for the respondents to select from. The survey was designed in such a manner that would cater to students with differing levels of knowledge about forensic voice ranging from students who had not taken speech science and did not know what forensic voice to students who were very well aware of the field of forensic voice science and its applications.

The first question of the survey asked the participant to indicate their consent to have their answers recorded in the data; a selection of "no" took the participant to the end of the survey and thanked them for their time. A selection of "yes" took the participant to the first of three sections of questions in the survey. The first section asked basic demographic questions about the student. These questions included what their age was, their gender, their selected major, whether they had taken a speech science course or the equivalent of, and if that course was taken at a college, two-year university, four-year university, or graduate program. The second section focused on the student's previous experience in speech science and phonetics courses and established whether they had heard about forensic voice science before. This section

also determined where the student had learned about forensic voice science; whether through their professor, supplemental material used in the classroom, their textbook, or by other means.

There were two options for the third section: if the student's responses indicated they had knowledge of forensic voice science they were given questions to determine their level of knowledge and education about the subject. However, if the student's responses indicated that they had no knowledge of forensic voice science they were given questions to determine where and why this information was lacking from their education and if the student would have been interested in learning about forensic voice science.

The Institutional Review Board at the authors' university approved the current study. The participants in this research were made aware that they could withdraw their consent to participating in the research survey at any point, and that any information they provided throughout the course of the survey would be kept confidential by the researchers.

2.3 Procedure

An invitation e-mail message was sent to 206 academic programs in Communication Sciences and Disorders in the USA. The researchers used the ASHA EdFind website (http://www.asha.org/edfind/) to identify these academic programs. Using the National Geographic map of Regions in the United States, 27 programs in the West, 25 programs in the Southwest, 49 programs in the Midwest, 55 programs in the Southeast, 49 programs in the Northeast, and 1 program in Puerto Rico were contacted (United States Regions, National Geographic, 2017). The invitation e-mail was specifically sent to academic advisors in the above programs using the Qualtrics© software survey distribution feature. The invitation e-mail described the nature of the survey, the approximate time required to complete the survey, the rationale for conducting the survey, link to the online survey questionnaire, and offered

participants the opportunity to receive a copy of the survey results if they so desired. The academic advisors were requested to have the survey link distributed to undergraduate as well as graduate students in their programs.

3.1 Results Section

3.2 Demographics

For this survey, the researchers received 409 responses from various colleges and universities. All respondents were currently or formerly majoring in communication sciences and disorders with emphasis in either speech pathology or audiology. The first section of questions established the demographic of survey participants. Of the 409 survey participants, 391 responded that they had completed a Speech Science or related course, 7 responded that they had not taken such a course, 3 respondents were unsure if they had taken this course, and 8 responded that they planned to take this course in the future. As shown in Table 1, there were responses recorded from 37 out of 50 States, and 2 countries outside of the United States. 94% of respondents answered female, 4% answered male, and 0.73% participants responded other or chose to not identify their gender.

Table 1

State	# of Responses	% of Responses		***State***	# of Responses	% of Responses
Alaska	1	0.251256281		**Nevada**	1	0.251256281
Arizona	1	0.251256281		**New Jersey**	4	1.005025126
Arkansas	4	1.005025126		**New Mexico**	33	8.291457286
California	18	4.522613065		**New York**	16	4.020100503
Colorado	4	1.005025126		**N. Carolina**	25	6.281407035
Conneticut	4	1.005025126		**S. Carolina**	9	2.261306533

Florida	2	0.502512563		**North Dakota**	1	0.251256281
Georgia	1	0.251256281		**Ohio**	3	0.753768844
Idaho	24	6.030150754		**Oklahoma**	10	2.512562814
Illinois	19	4.773869347		**Oregon**	7	1.75879397
Indiana	36	9.045226131		**Pennsylvania**	4	1.005025126
Iowa	2	0.502512563		**Tennesee**	10	2.512562814
Kansas	25	6.281407035		**Texas**	36	9.045226131
Kentucky	17	4.271356784		**Utah**	6	1.507537688
Louisiana	12	3.015075377		**Virginia**	2	0.502512563
Massachutes	2	0.502512563		**Washington**	13	3.266331658
Michigan	2	0.502512563		**Winsconsin**	19	4.773869347
Missouri	26	6.532663317		**Wyoming**	1	0.251256281
Mississippi	2	0.502512563		Canada	2	0.502512563
				New Zealand	1	0.251256281

3.3 Respondents who had taken a speech science or related course

For individuals who responded "yes" to taking a Speech Science or related course, 8% participated in the course during their Freshman year, 29% during their Sophomore year, 34% during their Junior year, 11% during their senior year, and 18% took this course in graduate school (Table 2).

Table 2

Q7: Where did you take the course?	*# of Responses*	*% of Responses*
4-year degree college	*332*	81.17359413
2-year associates degree college	*1*	0.244498778
Community College	*58*	14.1809291
Graduate Program	*0*	0
Q9: course required, elective, or recommended		
Elective	1	0.244498778
Requirement	405	99.02200489
Recommended	3	0.733496333

Q 10: Year in school when course was taken		
Freshman	34	8.312958435
Sophomore	115	28.11735941
Junior	147	35.94132029
Senior	43	10.51344743
Graduate	70	17.11491443

3.4 Student awareness of speech science applications in voice analysis having taken speech science course

Participants who responded "yes" to taking a Speech Science or related course were directed to a set of survey questions that asked about their experience with speech science and forensic speech science. Questions and Results are shown in Table 3. For question 11, participants were able to select one or all responses for the fields that speech science can be applied in. Of the 391 students who had completed a speech science or related course, only 251 selected forensic science as a field that speech science was applicable in. Of these 251 students, only 84% understood that speech science concepts are the core of speaker identification in forensic speech science. For question 13, a correct response was a definition of speaker identification that included information about recognizing who was speaking, identifying the speaker through aural or automatic methods, or using acoustic parameters to determine if a recorded voice was male or female.

Table 3

Q 11: What fields can Speech Science be applied in	*# of Responses*	*% of Responses*
Ear, Nose, & Throat (ENT)	349	85.53921569
Pediatrics	347	85.04901961
Neurology	322	78.92156863
Forensic Science	251	61.51960784
Other	58	14.21568627

Q 12: How can Speech Science be applied in Forensic Science		
Speaker Recognition/Identification	207	84.14634146
Diagnosing Speech Disorders	24	9.756097561
Treating Speech Problems	7	2.845528455
Gender Alteration	8	3.25203252
Q13: What do you understand by speaker identification		
Correct Response	166	89.72972973
Incorrect Response	19	10.27027027
Q 14: Which of these acoustic parameters is useful in speaker identification		
Fundamental Frequency	188	95.43147208
Intensity	143	72.58883249
Time	109	55.32994924
Speaking Rate	175	88.83248731
Dialect	190	96.44670051
Vowel Idiosyncrasies	172	87.30964467
Other	11	5.583756345
Q 15: Do you feel you understand what each of these parameters means		
Definitely Yes	81	41.11675127
Probably Yes	89	45.17766497
Might or Might Not	22	11.16751269
Probably Not	5	2.538071066
Definitely Not	0	0

3.5 Where students learned about acoustic parameters and their applications

The majority of participants, as shown in table 4, had learned about the acoustic parameters and concepts through their course work in their speech science course, and were able to deduce how these parameters could be applied in forensic speech science. The majority of participants learned about the acoustic parameters and core concepts used in speech science and

applicable to forensic speech science through lectures, power-point presentations, and hands on learning used directly in the classroom. As shown in Table 3, the majority of participants felt that they mostly understood the acoustic parameters, however the majority of participants reported that their professors never mentioned the application of these concepts in forensic speech science (Table 4).

Table 4

Q 16: Where did you learn about these acoustic parameters	*# of Responses*	*% of Responses*
Classroom Instruction	145	75.52083333
Classroom Instruction/Self Study	44	22.91666667
Self Study through textbooks	3	1.5625
Q 17: What techniques helped your professor convey these topics to you		
Lab Sessions	89	47.59358289
Illustrations and Examples during class	167	89.30481283
Lecturing from PPT's and Textbook	146	78.07486631
Additional Office Hours during weeks these topics were covered	25	13.36898396
Other	14	7.486631016
Q 18: Did your professor discuss the application of acoustic parameters in Forensic Speech Science		
Yes	5	2.631578947
Maybe	61	32.10526316
No	124	65.26315789

3.6 Student knowledge of forensic voice science career option

As shown in Table 5, most survey participants were unware of the possible career of being a forensic speech scientist. Only 5% of respondents indicated that they were aware of the career field in forensic speech science, but 58% of respondents indicated that while they did not

know about this career option, they would be interested in learning more. The majority of survey respondents indicated that they were unsure or did not believe that their knowledge of speech science concepts equipped them to continue their education for a degree in forensic speech science. The researchers did find a correlation between responses to question 15 (how well are you aware of the acoustic parameters) in Table 3 and question 20 (do you feel you have the background to be a Forensic Voice Scientist) in Table 5.

Table 5

Q 19: Are you aware that a background in speech science will allow you to obtain a degree in forensic voice science	*# of Responses*	*% of Responses*
Yes	11	5.789473684
Maybe	26	13.68421053
No - Interested in learning more	111	58.42105263
No - Not interested in that career	42	22.10526316
Q 20: After completing a Speech Science course do you feel that you have the minimum background to work in Forensic Voice Science		
Strongly agree	12	6.315789474
Somewhat agree	62	32.63157895
I am not sure	76	40
Somewhat disagree	24	12.63157895
Strongly disagree	16	8.421052632
Q 21: Would you be interested in a career in Forensic Speech Science or interested in learning more about it		
Definitely Yes	48	25.26315789
Probably Yes	58	30.52631579
Might or might not	30	15.78947368
Probably no	40	21.05263158
Definitely no	14	7.368421053

3.7 Students knowledge of specific forensic voice science concepts

Survey respondents with a background in a speech science or related course were asked basic questions about core concepts used in forensic speech science. These questions and responses are shown in Table 6. The majority of respondents had not heard of any of the core forms of speaker identification used in forensic speech science. For respondents who indicated that they had not heard of any of the forms of speaker identification, they were asked why they felt this was the case. Interestingly, 71% of responses indicated that these topics were never mentioned during their speech science course.

Table 6

Q 22: What forms of speaker identification have you heard of before	*# of Responses*	*% of Responses*
Aural Identification	20	13.42281879
Automatic Identification	11	7.382550336
Semi-Automatic Identification	7	4.697986577
Never heard of any of these	122	81.87919463
Other	1	0.67114094
Q 23: What do you understand by aural identification		
*The ability to listen to and recognize speakers based on their voice alone with varying degrees of success	17	62.96296296
*Recognizing the person's voice looking at a spectrogram	2	7.407407407
*Procedure that is based on extraction of acoustic parameters using signal analysis techniques	7	25.92592593
*Other	1	3.703703704
Q 24: What do you understand by automatic speaker recognition		
*The ability to listen to and recognize speakers based on their voice alone with varying degrees of success	9	34.61538462
*Recognizing the person's voice looking at a spectrogram	7	26.92307692

*Procedure that is based on extraction of acoustic parameters using signal analysis techniques	8	30.76923077
*Other	2	7.692307692

Q 29: Why do you feel you do not understand these topics?	*# of Responses*	*% of Responses*
Not enough time was spent in class	23	19.00826446
I know the "acoustic parameters" are not useful in speech science	1	0.826446281
Our textbook did not cover these topics/did not cover them well	33	27.27272727
There were no lab sessions offered to give students hands on experience	19	15.70247934
These topics were not discussed in my classes	86	71.07438017
I did not find these topics of interest and only memorized what I needed to know for the exams	6	4.958677686
Other	9	7.438016529

3.8 Student perception of challenges to being a forensic speech scientist

Shown in Table 7, survey respondents were asked what challenges they perceived to becoming a forensic speech scientist. Surprisingly, 0% responded that there would be no challenges to them becoming a forensic speech scientist.

Table 7

Q 25: What obstacles can you foresee standing in the way of you becoming a Forensic Speech Scientist? (Check all that apply)	*# of Responses*	*% of Responses*
None	0	0
Not enough information offered at my school	18	66.66666667
There are not enough classes/resources to further my knowledge in this field	13	48.14814815
I am not sure if the pay is good for this job	8	29.62962963

The field is not well respected	2	7.407407407
This seems to be a stressful job to me	1	3.703703704
Other	4	14.81481481

3.9 Students who had not taken a speech science or related course

For participants who responded anything other than "yes" to having taken a speech science or related course, they were directed to the set of questions displayed in Table 8. These questions asked about their knowledge of forensic speech science and the possible career opportunities in this line of work. The majority of participants had not heard that speech science was applicable in forensic speech science. Any survey respondent not choosing the option of forensic science in question 11, displayed in Table 3, was also directed to this set of questions.

Table 8

Q 33: Have you heard that speech science can be applied in forensic speech science	*# of Responses*	*% of Responses*
Yes	10	5.847953216
Possibly, but not sure where	26	15.20467836
No	135	78.94736842
Q 34: What was the source of this information?		
Magazine	2	33.33333333
Other	4	66.66666667

4.1 Discussion

The aim of this study was to identify the perceptions about forensic speech science in students in higher education CSD programs across the United States who had completed a speech science or related course. Speech science primarily focuses on the science of speech

production and speech perception. Although students in this course are well poised to be the consumers of information that can be applied in forensic voice science seldom we see students who go on to make a career as a forensic speech scientist. So the current study aimed at investigating the instruction of forensic voice science in speech science courses that were taught in CSD programs across the United States. We distributed a survey questionnaire to students in 207 of programs to address the aim of the study.

The results of the survey indicate that the basic fundamentals used in forensic speech science are taught in most speech science courses across the United States, but overall, there is little to no instruction about the applications of speech science concepts in forensic voice science. Overall, CSD students are well equipped with the knowledge of underlying principles for speaker identification in forensic speech science, but very few understand the applications and career options available to them in this field.

As shown in Table 3, 84% of survey participants deduced that speech science was applicable to forensic speech science through speaker identification. Also as seen in Table 3, the majority of respondents understood which acoustic parameters are useful for speaker identification, and the majority of these respondents felt they understood these concepts. As shown in Table 4, 75% of respondents reported learning about the acoustic parameters inside the classroom, but 65% of respondents reported that their professor never mentioned the application of the acoustic parameters of speech science to speaker identification in forensic voice science. Also, the results of the correlation between questions 15 and 20 revealed that students who understood the acoustic parameter felt confident that they had the background to be a forensic voice scientist. These results indicate that professors are teaching and discussing the basic concepts and principles of speech science that are used daily in forensic voice science, but that

there is little to no discussion about the applications of these concepts and principles to the careers available in forensic speech science.

Forensic speech science is a highly specialized profession that incorporates speaker identification/recognition. There are a number of techniques used in speaker identification, including manual, aural, and automatic. For students in speech science to understand these different techniques, they must be exposed to them through theoretical and practical standpoints. But the current results of the survey indicate that the majority of the respondents were not receiving in-depth knowledge on how to apply the acoustic parameters to forensic voice science speaker identification and speaker identification techniques. Surprisingly, the majority of speech science courses incorporate the acoustic parameters and concepts to treat and assess speech disorders, but there is limited emphasis on broader applications of speech science to other fields.

The current results are an eye-opener to modify instruction trends in CSD curriculums across the United States. It is the opinion of the researchers that future surveys should solicit the opinions of university professors about incorporating specific aspects of forensic voice science in their speech science courses.

Reference List

"Communication sciences & disorders." (August, 2016). *Oklahoma State Univeristy.* Retrieved from: http://registrar.okstate.edu/sites/default/files/Documents/DegreeSheets/2016-2017/CAS/AS41.pdf

Duchan, J. F., (2011). History of speech-language pathology: Twentieth century. *University at Buffalo.* Retrieved from: http://www.acsu.buffalo.edu/~duchan/history.html

"History of ASHA." (2017). *American Speech-Language-Hearing Association.* Retrieved from: http://www.asha.org/about/history.htm

"How to apply for certification in speech-language pathology." (2017). *American speech-language-hearing association.* Retrieved from: http://www.asha.org/Certification/SLPCertification/

"Learning about the CSD professions." (2017). *American Speech-Language-Hearing Association.* Retrieved from: http://www.asha.org/Students/Learn-About-the-CSD-Professions/

Rusz, J., Cmejla, R., Ruzickova H., & Ruzicka, E. (2010). Quantitative acoustic measurements for characterization of speech and voice disorders in early untreated Parkinson's disease. *University of Texas at Dallas,* 350-367. http://www.utdallas.edu/~hynek/citing_papers/Rusz_Quantitative%20acoustic%20measurements%20for%20characterization%20of%20speech%20and%20voice%20disorders%20in%20early%20untreated%20Parkinson's%20disease.pdf

"United States Regions." (2017, June). *National Geographic.* Retrieved from: https://www.nationalgeographic.org/maps/united-states-regions/