VOCAL PITCH MANIPULATION AND CREDIBILITY IN THE COURTROOM:

DIFFERENCES BETWEEN MALE AND FEMALE EXPERT WITNESSES

by

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Abstract

Nonverbal cues that occur during trial testimony have been shown to make a difference in juror ratings of expert witness credibility. Vocal pitch is an important nonverbal cue that has not been examined within the courtroom context. A limited number of studies have manipulated the vocal pitch variable in settings other than the courtroom. Results from this research provide preliminary evidence for a vocal attractiveness stereotype. Further, other studies found that a lower vocal pitch preference exists among most listener participants. The present study manipulated vocal pitch in order to assess whether the low pitch preference exists for mock jurors' ratings of expert testimony credibility and if this preference is held to the same degree for both male and female experts. A computerized voice transformation program was used to shift pitch frequencies of audiotaped testimony from a male and a female mock expert. Mock jurors were randomly assigned to one of six testimony conditions and asked to rate the credibility of the witnesses using the *Witness Credibility Scale (WCS)*. Gender was not found to significantly moderate the relationship between vocal pitch and credibility; however, a main effect was found for gender on total witness credibility, with males rated as significantly more credible than females. While there was no main effect for vocal pitch on total witness credibility score, pitch was found to make a difference on knowledge and confidence subscales as well as several individual item scores of the WCS. This research adds to a growing body of information available to trial consultants and other coaches preparing experts for the witness stand.

List of Abbreviations and Symbols

ANOVA	Analysis of Variance
F	Fisher's *F* Ratio (used in ANOVA)
Gp	Group
Hz	Hertz
M	Mean
Md	Median
N	Number of subjects
n	Number in subsample
p.	Page number
p	Probability
r	Pearson's correlation
SD	Standard deviation
U	Mann-Whitney test value
z	Z-score (standardized residual)
X^2	Chi square test value
<	Less than
=	Equal to

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Contents

List of Tables

List of Figures

Introduction

Expert witnesses are an invaluable source of information for courtroom decision makers. Unlike an evidentiary witness that testifies about facts alone, expert witnesses can offer opinions on case facts (Couch & Sigler, 2002). Expert testimony has the potential to influence the outcome of a legal proceeding. Given the important role of the expert witness, it is necessary to explore what variables affect juror interpretations of testimony credibility. Both verbal as well as nonverbal cues impact perceived credibility (Brodsky, 1999; Neal & Brodsky, 2008). Vocal pitch is a nonverbal variable that has not yet been studied in the courtroom context but is worth investigating, as it may significantly impact testimony credibility ratings by jurors. Male and female expert witnesses are judged differently in the expert witness role, and this may be because the traditional male nonverbal communication style fits more readily with what jurors would expect from an "expert." It is therefore hypothesized that expert gender will moderate the relationship between vocal pitch and credibility ratings. Gaining insight into this particular nonverbal variable, and how gender affects its impact on credibility ratings, will add to a growing body of information available to trial consultants and other coaches preparing experts for the witness stand.

The Dual Process Model of Persuasion offers an explanation as to why nonverbal communication cues are so powerful, particularly for members of a jury evaluating case testimony. Kenrick, Neuberg and Cialdini (2010) say that there are two kinds of attitude changes that someone receiving a message may experience. The first type involves a purer focus on the argument and evaluation of the quality of the message being received. The second type of attitude change involves the listener's attention to other "peripheral" factors (Chaiken & Trope, 1999; Petty & Cacioppo, 1986). Peripheral factors include nonverbal cues, which are

insignificant to the message's goal, but nonetheless have a very powerful influence over decision-making. Examples of nonverbal cues include hand gestures, professional background information, posture and vocal pitch (Weiten, Dunn & Hammer, 2012). A juror's focus on these types of variables leads to a peripheral, rather than central, route of persuasion. Investigations of mock juror cognition demonstrate that particularly when stimuli are unfamiliar, jurors are more likely to utilize a peripheral route of persuasion (Cooper, Bennett & Sukel, 1996; McKimmie, Newton, Terry & Schuller, 2004). Case information is frequently unfamiliar for jurors. In addition, this information can also be quite complex and technical. Attorneys and other key players in the courtroom may fail at conveying facts in a manner that is comprehensible to jurors of all backgrounds and education levels. Juries are groups of decision makers that are particularly prone to peripheral processing by way of nonverbal cues (Cooper et al., 1996; McKimmie et al., 2004).

Nonverbal Communication Differences Between Male and Female Expert Witnesses

Several important distinctions exist between traditional male and female nonverbal communication cues (Kenrick et al., 2010; Neal & Brodsky, 2008). Such differences may be quite influential to jurors evaluating case testimony, particularly when the central message is incomprehensible or unfamiliar (Cooper et al., 1996). Overall, men utilize a more assertive, domineering style as compared to women. Male speakers display power through behaviors such as claiming larger zones of personal space as compared to women (Kenrick et al., 2010). Additionally, men tend to intrude upon the space of others more frequently and use a more argumentative style. They are more likely to dominate conversations and also tend to maintain more eye contact with their audience when speaking (Kenrick et al., 2010; Neal & Brodsky, 2008). The female nonverbal style is viewed as more likeable than the male style in several

ways. For example, women tend to smile more. They behave more modestly than men when speaking and engage in less eye contact with their audience. Women utilize more nonverbal cues that are indicative of listening to others as compared to men (Kenrick et al., 2010).

Couch and Sigler (2002) posit that the gender of an expert witness may impact testimony effectiveness. Several empirical studies indicate that males do in fact have an advantage on the witness stand. This may in part be due to differences in communication style between the two sexes (Neal & Brodsky, 2008). An expert must convey mastery of testimony subject matter, which requires a high degree of assertive, more male-like nonverbal communication behaviors on the witness stand. Behaviors such as high amounts of eye contact and an assertive response style, which fit more traditionally into the male repertoire of nonverbal communication tools, are positively associated with perceived credibility (Larson & Brodsky, 2010; Neal & Brodsky, 2008). Women may not utilize such cues as readily and effectively as their male counterparts. Brodsky (1999) notes that male expert witnesses are taken more seriously than female expert witnesses. Further, it has been noted that attorneys frequently favor male expert witnesses over females since jurors view them as having a credibility advantage (Memon and Shuman, 1998). Women, because of their tendency to communicate in less assertive ways as compared to males, may be less convincing in the expert role.

Nonverbal Communication Variables in the Courtroom

Some empirical analyses have looked at how nonverbal messages affect juror judgments of witnesses (e.g., Couch & Sigler, 2002; McKimmie, et al., 2004; Neal & Brodsky, 2008). More often than not, investigators target the gender of the expert witness as having an impact on the relationship between the manipulated nonverbal variable and testimony effectiveness, as measured by mock juror opinion.

In one such study, Neal and Brodsky (2008) manipulated the amount of eye contact expert witnesses gave mock jurors while testifying about a defendant's likelihood of recidivism during a criminal trial. Here, participants were exposed to low, medium and high levels of eye contact from both male and female expert witnesses. Overall, it was found that the expert witnesses with high levels of eye contact were viewed as more credible than those with medium and low levels of eye contact. Also, males with high eye contact were rated as more credible than males with medium and low levels of eye contact. Level of eye contact was not found to be significant for female expert witnesses across the three conditions. Results from this study demonstrate that as a nonverbal variable utilized by expert witnesses on the stand, eye contact behavior matters in that it has the power to influence jurors' judgments about the testimony. Neal and Brodsky (2008) go on to say that male expert witnesses in particular may benefit from using high eye contact as a nonverbal strategy for increasing credibility while on the stand.

Expert witnesses' occupation or area of expertise is another important nonverbal variable that affects juror perceptions of case testimony. The influence that this nonverbal variable exerts upon testimony effectiveness is often highly dependent on the gender of the expert witness. Researchers have analyzed jurors' receptiveness to male witnesses speaking about case matter that is traditionally considered to be more feminine, as well as female witnesses testifying about a male-oriented case. McKimmie et al. (2004) had participants read a transcript from a courtroom proceeding involving price-fixing charges in either a "male or female oriented domain" (p. 131). The male-oriented case condition involved an automobile repair business and the female-oriented case condition involved a cosmetics company. Researchers predicted that testimony effectiveness would be highest when there was congruency between expert gender and the gender orientation of the case. As expected, it was found that mock jurors awarded more

damages when the expert gender matched the gender orientation of the case. In a related study, Schuller and Cripps (1998) studied the manipulation of expert gender on mock jurors' individual verdict in a murder trial. Battered woman syndrome was used as a defense and jurors found the female expert witness to be more effective than the male expert witness. Researchers purport that this is because jurors assumed a woman would have more expertise on a women's mental health issue.

Couch and Sigler (2002) note that jurors hold preconceptions about the ideal gender for certain occupations. In their experiment, they tested whether jurors could separate from these preconceptions while judging testimony from expert witnesses of varying occupations. Participants were exposed to civil case testimony in which an automotive engineer testified about an automobile accident. The gender of the expert witness was manipulated, with the expectation that participants would view the male engineer as the more effective witness. Surprisingly, the relationship between the witness' gender and juror ratings of expert testimony effectiveness was not found to be significant. Expert witness testimony persuasiveness may be impacted by how well an expert's gender fits the maleness or femaleness of the issue with which they are purported to have expertise. Although results in this area of research are mixed, area of expertise is an important nonverbal variable and jurors hold preconceived notions regarding the ideal gender for experts speaking about male versus female-oriented issues. Area of expertise and/or witness occupation is a nonverbal communication cue that may influence juror interpretations of expert credibility (Couch and Sigler, 2002; McKimmie et al., 2004; Schuller & Cripps, 1998).

Larson and Brodsky (2010) analyzed both verbal and nonverbal cues characteristic of different response styles of expert witnesses. Attorney questioning was either intrusive or non-intrusive in this experiment. Nonverbal cues associated with the assertive expert style consisted

of direct eye contact and an extension of the arms with palms open while speaking. The defensive expert response style involved nonverbal communication cues such as avoiding direct eye contact and speaking with the arms folded. Results from this study indicate that male expert witnesses are viewed as more credible than female expert witnesses. Also, experts were more credible, confident and likeable when utilizing an assertive response style rather than a defensive response style. Again, this study demonstrates the advantages that male expert witnesses have on the stand with respect to juror credibility ratings. This advantage is especially prevalent when male experts communicate using an assertive style that is associated with several effective nonverbal cues.

The Voice as a Nonverbal Communication Cue

Numerous aspects of the human voice are considered to be nonverbal communication cues. Strain, roughness, breathiness, pitch, loudness, and nasality are just a small number of the variables that impact a listener's perception of a speaker's voice. As a nonverbal communication cue, the voice has been shown to make a difference in people's perceptions of speakers (Tigue, Borak, O'Connor, Schandl & Feinberg, 2011; Weiten et al., 2012). DeGroot and Motowidlo (1999) video and audiotaped male and female job applicants and measured participant viewers' responses to the applicants' visual and vocal cues. On ratings of interview and job performance, researchers found that participants more strongly relied on vocal, rather than visual cues. This implies that not only are qualities of the voice important in our judgments of others, in some situations they may prove to be even more influential than visual information. Guerrero and Hecht (2008) argue that a vocal attractiveness stereotype exists among listeners. People tend to believe that "what sounds beautiful is good" (p.155). Further empirical explorations of the

attractive voice stereotype have found that attractive voices make the person speaking seem more powerful, strong, assertive and dominant (Guerrero & Hecht, 2008).

The Lower Vocal Pitch Preference

Pitch is just one perceptual feature of voice. It is described as the vocally produced musical note, or how high or low a voice sounds (Behrman, 2007; Leathers, 1997; Guerrero & Hecht, 2008). Pitch is the perception of vocal fundamental frequency measured in Hertz (Hz) or cycles per decond. This is the rate at which vocal folds vibrate (Breedlove, Watson and Rosenzweig, 2010). Breedlove et al. (2010) note that frequency and pitch are not the same thing. Frequency describes a biomechanical process whereas pitch is an individual's sensory experience of this process. Most humans can detect rather small changes in frequency over the audible range of 20 Hz to 20,000 Hz. A person's ability to detect changes in frequency is measured as the minimal discriminable frequency difference between two stimuli. The detectable difference is approximately 2 Hz for tones as high as 2000 Hz (Breedlove, Watson & Rosenzweig, 2010). Published norms for speaking fundamental frequencies indicate that men's habitual mean speaking frequency while reading is 115 Hz. Women's habitual mean speaking frequency while reading is significantly higher at 215 Hz (Behrman, 2007).

Empirical investigations of vocal quality show that manipulations of vocal pitch level can have a significant impact on how listeners perceive and judge a speaker (Tigue et al., 2011; Ko, Judd & Stapel, 2009). In two experiments, Ko et al. (2009) examined how vocal cues influence listener judgments of speaker traits. In the first experiment, participants assigned to an audio condition listened to voices belonging to mock job applicants as they read resum**é**s. Participants were asked to form opinions about the applicants' warmth and competence. Vocal femininity of job applicant was negatively associated with competence ratings. Vocal femininity was

positively associated with warmth ratings, but the strength of the vocal femininity effect was far more pronounced for competence ratings than for warmth ratings. In the second experiment, the bias against applicants with feminine voices was replicated in the competency ratings, even when scenarios regarding applicants' past behavior were introduced to the participants as competing information. The negative effect of vocal femininity on ratings of job applicant competence may have been due to an overall preference for lower-pitched voices among the participants. Overall, studies indicate that lower pitched voices, as compared to higher pitched voices, are more likely to be associated with attractiveness, dominance, maturity, honesty and other positive judgments from listeners (Imhof, 2010; O'Hair & Cody, 1987; Tigue et al., 2011).

Deceptive versus honest vocal pitch. One reason that listeners tend to prefer lower voices is because higher pitched voices are more commonly associated with deception (Ekman & Friesen, 1976; O'Hair & Cody, 1987). Experiments that analyze vocal pitch during instances of deception versus instances of truth support this notion. The idea is that as speakers deceive, they become psychologically aroused in certain ways that tend to put stress on vocal features, leading to an increase in pitch (Ekman & Friesen, 1976). Ekman and Friesen (1976) conducted an experiment utilizing 16 different nursing students as participants. All participants watched pleasant video stimuli, as well as a video depicting victims of amputations and burns. The second video stimulus was designed to arouse negative feelings in the participant. In the honest interview condition, participants described their frank feelings about the film. In the deceptive interview condition, participants were instructed to hide their negative emotions and convince the interviewer that they had seen another pleasant film. These interviews were recorded and researchers measured the nursing students' pitch by exposing the audio to a speech analysis

computer program. In the deceptive interview condition, the speech analysis data indicated significant increases in voice pitch.

O'Hair and Cody (1987) studied variations in vocal pitch measurements as they relate to prepared and spontaneous lying behavior in both men and women. The researchers included gender differences as a predictive factor of vocal stress during lying. Their participants were exposed to a simulated pre-employment interview and told to either lie or be truthful when certain questions were asked. Unknown to the participants, a follow-up question was asked that allowed researchers to study the spontaneous vocal behavior of both liars and truth-tellers as they reacted to unexpected questions. No significant difference in vocal stress scores were uncovered in participants' spontaneous lies as compared to their truthful responses. Women, however, did demonstrate higher vocal stress scores in their prepared lies as compared to truthful answers (O'Hair & Cody, 1987). This research shows that prepared lies may cause more vocal stress than spontaneous lies. Further, this effect may be more pronounced in females. People associate higher pitched voices with dishonesty; empirical investigations of this stereotype have shown that there is some truth to this view, particularly when it comes to feminine voices (O'Hair & Cody, 1987).

Lower pitched voices and the attribution of positive speaker characteristics. Lower pitched voices are associated with different speaker personality characteristics than higher pitched voices (Imhof, 2010; Ko et al., 2009, Tigue, et al., 2011). Imhof (2010) isolated vocal pitch in order to test how this variable impacts listeners' judgments of the people speaking. Participant listeners were presented with technologically manipulated voices of low and high frequency and instructed to give personality, as well as physical attributions about the people behind the voices. In general, higher voices were associated with youthfulness and participants

indicated that they were more desirous to meet people behind higher pitched voices, as compared to lower pitched voices. Higher pitched voices were more likely to be associated with agreeableness. Decreased conscientiousness and lower emotional stability were ascribed more often to higher pitched voices. Lower pitched voices were associated with a significantly taller person than the higher pitched voices. People speaking with a lower pitched voice were also found to be more sociable and relaxed. Additionally it was found that pitch is judged differently between male and female voices. Women with low voices were more agreeable than women with high voices; however, men with lower voices were perceived as less agreeable than men with higher voices.

In an examination of vocal pitch and voting-related perceptions, Tigue et al. (2011) obtained vocal recordings of nine different United States presidents and technically manipulated each recording to get a low and high pitch condition for each. Participants listened to audio recordings, ascribed personality traits to the voices and indicated which candidates they were more likely to vote for. Results indicate that men with lower pitched voices are more likely to have positive personality traits ascribed to them. Further, vocal pitch exerted an important influence on voting behavior with the participants significantly more likely to vote for candidates with lower voices (Tigue et al., 2011).

The Current Study

Several nonverbal cues of expert witnesses have been examined with respect to their effect on credibility ratings. In many of these studies, the gender of the expert witness moderated the influence that the nonverbal variable exerted on ratings of testimony effectiveness (e.g., Neal & Brodsky, 2008). Vocal pitch is an important nonverbal cue that expert witnesses use when testifying and its impact has not yet been examined empirically within the courtroom

context. Past research that manipulates vocal pitch in settings other than the courtroom provide evidence for a vocal attractiveness stereotype. It is argued that a lower vocal pitch preference exists among most listeners (Guerrero & Hecht, 2008; Imhof, 2010; Ko et al., 2009; Tigue et al., 2011). Lower pitched voices are more often associated with personality traits such as maturity and sophistication and less often associated with negative qualities such as deceitfulness (Ekman & Friesen, 1976; Imhof, 2010; Weiten et al., 2012). The speaker qualities typically ascribed to lower pitched voices are desirous for expert witnesses attempting to convey mastery of the topic they are testifying about. It is argued that manipulations of vocal pitch will significantly impact juror ratings of expert witness credibility and the lower pitch vocal preference will exist in the courtroom context. Because male and females are viewed differently in the expert role and because listeners' vocal preferences are often dependent on the sex of the speaker, it is expected that the gender of the expert witness will interact significantly with the relationship between vocal pitch level and juror ratings of credibility.

Method

Subjects

Subjects of this study were 402 undergraduate students at The University of Alabama. Subjects were recruited to participate in the study through The University of Alabama Psychology Subject Pool. This study required that participants were each at least 18 years of age. Students signed up for the study on the online subject pool website. Participants received one research credit for completion of this study in fulfillment of their Psychology 101 research requirement. Prospective participants were informed, "this study seeks to investigate mock jurors' decisions during a civil trial." They were then directed to a hyperlink via the online subject pool website. This linked them to the SurveyMonkey website containing experimental stimuli and questionnaires. Subjects completed this study in their own time and space, via the online link.

A power analysis was conducted using the G*Power 3 program in order to determine how many participants were needed for recruitment (Faul, Erdfelder, Buchner & Lang, 2009). The power analysis utilized a medium effect size of $F = 0.30$ (the mean of effect sizes included in the literature review for this study), a significance of $p = .01$, and a power of .95 (1-beta). It was estimated that 235 participants were needed. The 401 participants utilized in this experiment exceed this requirement and this number was determined to be sufficient to uncover significant effects. The study sample included 117 male (29.2%) and 284 female participants (70.8%). Participants identified themselves as White/Caucasian (83.0%), Black/African-American (10.5%), Asian-American (1.7%), Hispanic/Latino (1.7%), Biracial (2.2%) and other (0.7%). Approximately 98.8% of the sample fell between the ages of 18 to 22 years of age, with 19 years being the mode age within the group. Only 0.5% of the participants reported ever

having served on a jury before. Please note that one participant chose to not respond to demographic questions. His/her data is not included in this description of the study sample.

Procedures

Establishing a methodology for examining vocal pitch. Several methodological challenges had to be met to begin an investigation of vocal pitch in the courtroom. Previous research exploring the impact of nonverbal variables on juror judgments of credibility utilized videotaped testimony as experimental stimuli. This methodology was considered during the conception of this study, but ultimately it was decided that videotaped testimony would introduce too many visual variables that may impact the dependent measure. There were other important considerations surrounding how to produce the six audio stimuli conditions in a manner that holds constant all extraneous variables. Initially, actors were going to be asked to manipulate their voices in accordance with the six experimental conditions. It was decided that using a human manipulation of pitch for the six different recording sessions would introduce extra features of the audio that were not relevant to this research. For example, during a reading in the low pitch recording session, the speaker may be more breathy than in their reading during the high pitch recording session. Using the same recording for the male and female conditions allowed for a better isolation of pitch as the main variable of interest.

Another unexpected challenge occurred after the first attempt at recording the scripted testimony. Upon listening to the audio file, it was determined that the voice of the female mock expert sounded quite “shaky”, most likely a result of this person feeling nervous during the recording session. A different voice was used for the creation of the three female audio experimental conditions. An informal manipulation check was conducted to test experimental materials, including audio recordings and survey questions. Feedback from participants helped

determine that the male and female recordings that were ultimately used in this study contained no emotional undertones that might cloud the effect of the variables of interest.

Production of audio stimuli. Prior to recording, the mock witnesses were given a script of their testimony and asked to study it. The "experts" were then told that they were required to be familiar with the script before the day of audio recording. They were asked not to speak as though they were reading from a text, but instead speak with a normal conversational voice. They were also instructed to deliver the testimony script evenly, in a pitch that did not fluctuate very much. The mock experts were recorded in a single-walled sound booth (Model RE-142; Acoustic Systems, Austin, TX) at the Speech and Hearing Center at The University of Alabama. Two original recordings were obtained at this session, one male expert voice recording and one female expert voice recording. Each vocal recording fell within the normative pitch range for the expert's gender (approximately 115 Hz for the male and approximately 215 Hz for the female). To check this, I had both experts produce a short recording that was then analyzed for mean pitch frequency. These informal analyses ensured that each voice pitch approximated the normative range for each mock expert's gender. It was determined by the researcher that each testimony recording was delivered in a fairly even pitch, close to what would be expected from an expert on the witness stand during a real trial. Using a voice transformation program (PSOLA method in Praat, Boersma & Weenink, 2009), both the male and female versions of the audio recordings were manipulated into low and high vocal pitch versions. Table 1 includes a description of each experimental condition and the number of participants included in each group. By manipulating two recordings into six different experimental conditions, the objective was to maintain all other speaker and voice characteristics (e.g., speed, pausing, etc.), at least within the two gender condition categories. Separate vocal recordings were created for scripted speech from a mock

judge, plaintiff and attorney. These recordings were not manipulated in any way and were utilized for each of the six experimental conditions.

Each line of the testimony script was isolated as a separate phrase unit and saved as an individual sound file. Using a coding system developed for the purpose of this study, phrase units were then merged into master testimony audio files. Each audio file contained the appropriate phrase units for that experimental condition as well as the same unmanipulated phrase units from the attorney, plaintiff and judge. This method was used in an attempt to keep constant all irrelevant aspects of the audio while isolating the variable of interest.

A case summary and scripted testimony was used for the six different conditions in this study (see Appendices B & D). The brief synopsis of a civil case and subsequent testimony from an expert witness testifying in court has been used by previous empirical investigations of mock-juror decision-making (e.g., Ziemke, 2011). The original script (see Appendix C) is adapted slightly for the purpose of this study (with edits indicated in Appendix C) in order to make the language sound less like a script, and more like conversational testimony. The case information and expert testimony were the same for each experimental condition, with only expert gender and vocal pitch differing between the experimental conditions.

Manipulation check. Audio stimuli were checked for external validity via an informal manipulation check. Before running the primary study, the investigator conducted an informal manipulation check with a small focus group consisting of five of the investigator's peers. Results of this preliminary work support experimental requirements that (a) appropriate differential ratings of voice pitch exist between the six conditions, (b) technologically manipulated experimental stimuli sound within the range of normal human speech so as to maintain external validity, and (c) participants have acceptable understanding of the

experimental task and are motivated to comply with study procedures. The focus group helped the researcher determine how far pitches should be manipulated for each experimental condition. Each vocal manipulation consists of lowering or raising vocal pitch by three semitones, except for the male high pitch condition. The male high pitch condition was raised by four semitones because it was determined by the focus group that this manipulated pitch still fell within normal pitch range. The investigator wished to manipulate each voice as much as possible as to create a noticeable difference between experimental conditions while at the same time still keeping experimental stimuli externally valid. This is why the male high pitch condition was manipulated four semitones rather than three. The male low condition and the female high and low conditions were all manipulated by three semitones because it was determined that going beyond this manipulation caused audio stimuli to sound artificial, something the researcher did not want. Focus group participants also agreed that both the male and female expert testimony was recorded with an even delivery of pitch, similar to what would be expected on the witness stand during a real trial.

Presentation of experimental stimuli. The psychology research subject pool website contained an announcement that briefly described the study and recruited participants (see Appendix A). When the participant was ready to take part in the study he/she chose a link, which opened the SurveyMonkey website containing the study materials. From here, the participant read an information screen that outlined participant rights with regard to confidentiality and withdrawal from participation. The information screen stated that the study relates to how different parts of a trial affect a juror's decisions in the case. The information screen did not inform participants that researchers were looking at the effect of vocal pitch on juror decision-making. Once all relevant information was addressed, participants who were

willing and interested in taking part clicked the appropriate button to move forward in the study. Experimental condition was randomly assigned to participants utilizing the random assignment feature in SurveyMonkey. Via the SurveyMonkey website, participants were each asked to watch a YouTube video. In this video, the only visual information shown was a logo for The University of Alabama Witness Research Lab. Audio testimony played for approximately six minutes for each of the experimental conditions.

All participants completed the experimental materials in the following order: (1) case summary, (2) one of six audio stimuli presenting expert witness testimony in a civil case, (3) *Witness Credibility Scale (WCS)*, and (4) the demographics questionnaire. The case summary, given to participants prior to one of six audio stimuli, provided context for testimony participants were about to hear. Since I was primarily interested in jurors' perceptions of the testimony stimuli, participants were exposed to the audio immediately before being asked to complete questionnaires. The demographics questionnaire was placed last so that participants had the option of not providing this information while at the same time still providing data related to the variables of primary interest.

Upon completion of the questionnaires, participants viewed a debriefing/second consent form that provided information about the full purpose of the study. This form explained that they were not told that this study was investigating perceptions of expert witness vocal pitch. The purpose for the lack of full disclosure prior to beginning the study was explained and participants were given a choice to either allow their data to be used in the study or to not have their data used and to have their data immediately destroyed. They indicated their choice by selecting the appropriate button on the webpage. To protect the study manipulation, participants were asked to not discuss the nature of the study with anyone else. Thirty participants chose to

not include their data and instead have it destroyed. Trial runs of the experiment indicated that the experimental tasks took up to 30 minutes for participants to complete.

Measures

Participants completed the following questionnaires aimed at measuring juror agreement with testimony and expert witness credibility ratings. Participants were asked to complete the following measures: (1) *Witness Credibility Scale (WCS)*, (2) a juror decision scale, and (3) the demographics questionnaire.

Witness Credibility Scale (WCS). Mock juror ratings of expert witness credibility were measured using the *Witness Credibility Scale* (Brodsky, Griffin & Cramer, 2010). This scale includes 20 bipolar adjectives, which are each set on a 10-point Likert scale. For example, the adjective *unkind* is anchored at 1, while the adjective *kind* is anchored at 10 points. All 20 items are grouped into one of four facets associated with expert witness credibility: "likeability", "trustworthiness", "knowledge", and "credibility". Each scale item loads onto one of the aforementioned credibility facets at the .500 level or above. There are a total of 200 possible points on this measure. Higher scores are indicative of greater juror credibility ratings. The *Witness Credibility Scale (WCS)* has been found to be both a valid and reliable measure of credibility that is appropriate for the present experimental purposes (Alpha = .945). The *Witness Credibility Scale (WCS)* is found in Appendix E.

Demographics questionnaire. Participants were asked to complete a demographics form that includes questions pertaining to their age, sex, race, education, and jury service experience. Participants had the option to decline answering demographic information. The demographics questionnaire is located in Appendix F.

Results

The primary and exploratory independent variables included gender (coded as male = 1 and female = 2), and vocal pitch (coded as low = 1, normal = 2 and high = 3). The variables encompassing witness credibility were found to violate parametric assumptions of normality and homogeneity of variance. For parametric testing, significance was established at a more stringent level of $p = .01$ to account for these violations and attenuate the risk of a Type I error. Additionally, the use of a large sample size ($N = 402$) ensured that the analyses of variance remained robust against parametric violations. Exploratory analyses examined the influence of vocal pitch on the four facets of the *Witness Credibility Scale (WCS)*, as well as the 20 individual items comprising the measure. For this, non-parametric testing was used since only one independent variable, vocal pitch, was being examined with respect to the dependent measures. Non-parametric testing for significant differences between vocal pitch groups allowed for further exploration of the vocal pitch variable without violation to any test assumptions. Significant differences between vocal pitch groups on both WCS facets and individual items were found at the .01 and .05 alpha level.

Parametric Testing of Vocal Pitch and Gender

A two-way between-groups analysis of variance (ANOVA) was conducted to explore the impact of expert witness gender and voice pitch on total witness credibility, as measured by the WCS. The interaction effect between sex and voice pitch was not statistically significant, F (2, 396) = .902, $p = .407$. It was concluded that the relationship between voice pitch and overall witness credibility was not significantly moderated by the gender of the expert witness (see Figure 1). This means that any influence of vocal pitch on scores of overall credibility did not depend on whether the expert is male or female. There was a statistically significant main effect

for expert witness gender, F (1, 396) = 7.52, p = .006; however, the effect size was small (partial eta squared = .02). These results suggest that as anticipated, male expert witnesses were judged to be significantly more credible than female expert witnesses. Several previous studies have uncovered the same male advantage on the witness stand and the results of the current study corroborate those findings. Table 2 lists the means and standard deviations for gender on overall expert witness credibility scores. The male expert mean credibility score was higher than that of the female expert by approximately eight WCS points. The main effect for voice pitch, F (2, 396) = 2.482, p = .085, did not reach statistical significance. This means that in terms of overall expert witness credibility, the three vocal pitch groups did not differ significantly from one another. Table 3 lists the means and standard deviations for voice pitch on overall expert witness credibility score. One can see from this table as well as in Figure 1 that the mean WCS score of the experts with low pitch is higher than that of the normal and high pitch experts; however, this difference in mean scores did not reach statistical significance.

Non-parametric Exploration of Vocal Pitch in the Courtroom

Exploratory analyses examined the influence of vocal pitch on the four facets of the WCS as well as individual item scores. Given the parametric violations discussed above and the testing of only one independent variable comprised of three levels (low, medium and high), non-parametric testing was used. Non-parametric tests were viewed as a more conservative approach to studying the relationship between vocal pitch and WCS facets and individual items. This is because all assumptions including random sampling and independence of observations were met using such tests. The Kruskal-Wallis Test was chosen as an alternative to the one-way between groups ANOVA for uncovering any significant differences between the three vocal pitch groups. Significance was established at p = .05 for these analyses. The Kruskal-Wallis Test converts

scores on a continuous dependent measure into mean ranks for each group being compared. Inspection of the mean ranks for each group being compared uncovers which of the groups had the highest overall rank corresponding to the highest score on a dependent measure.

Mann-Whitney U tests were utilized as a non-parametric alternative to the independent samples t-test to test each group pair with one another. This means that for each significant difference found between pitch groups on a dependent measure, three Mann-Whitney U tests were used to compare low and high pitch conditions. For each of the Mann-Whitney U tests used for group comparisons, a Bonferonni adjustment was made by dividing the $p = .05$ significance value by the number of tests being conducted (in this case, three). For all group comparisons, significance was established at a more conservative .02 alpha level in order to counteract the problem of multiple comparisons.

Testing the four subscales of the WCS. The WCS is composed of four different subscales representing four facets of witness credibility. These four subscales are: likeability, trustworthiness, confidence and knowledge. A maximum score of 50 is possible on each of the four WCS subscales. Table 4 contains means and standard deviations for vocal pitch on the WCS subscales. Five scale items comprise each of the four facets of witness credibility. Significant differences across the three vocal pitch groups (Gp1, $n = 147$: low, Gp2, $n = 140$: normal, Gp3, $n = 115$) were found for two out of the four WCS subscales. Pitch exerted a significant influence on jurors' ratings of expert witness confidence and knowledge. Vocal pitch did not exert a significant influence on the likeability and trustworthiness subscales (see Table 5).

Likeability. A Kruskal-Wallis Test showed no significant differences across the three vocal pitch groups for the likeability facet, X^2 (2, $n = 402$) = .972, $p = .615$. The low pitched

group recorded a median likability score of 41, while experts with normal and high pitched voices both recorded a median score of 40.

Trustworthiness. No significant differences for trustworthiness were found across the three vocal pitch groups, X^2 (2, n = 402) = 5.156, p = .076. None of the three vocal pitch groups differed significantly from one another on this WCS facet. Experts with low and normal pitch both recorded median scores of 44 on the subscale and the experts with high pitch recorded a score of 42.

Confidence. A significant difference was found across the three vocal conditions for expert witness confidence, X^2 (2, n = 402) = 7.219, p = .027. Further testing revealed a significant advantage for experts with low pitch in juror ratings of witness confidence. Low pitched experts *(Md* = 42) scored higher on the confidence subscale than high pitched experts (*Md* = 38), U = 6976.500, z = -2.429, p = .015, r = -0.11. Normal pitched experts (*Md* = 40) did not differ significantly from the other two pitch groups.

Knowledge. Analyses uncovered a significant influence of vocal pitch on expert witness' score on the knowledge facet, X^2 (2, n = 402) = 6.305, p = .043. As with the confidence subscale, low pitched experts (*Md* = 45) displayed a significant advantage as compared to high pitched experts. Mock jurors rated low pitched experts significantly higher on the knowledge subscale than high pitched experts (*Md* = 44), U = 6970.500, z = -2.442, p = .015, r = -0.122. Normal pitched experts, with a median score of 45, did not differ significantly from high pitched experts or low pitched experts on ratings of knowledge.

Testing individual WCS scale items. Twenty individual items make up the WCS. A maximum score of 10 is possible on each of these items. Means and standard deviations of vocal pitch on individual scale items are found in Table 6. Individual Kruskal-Wallis Tests were used

to examine pitch group differences across each item as a dependent measure. Vocal pitch was found to significantly impact seven out of the 20 WCS items. Vocal pitch appears to make a difference on items measuring the degree to which an expert is seen as reliable, confident, well-spoken, self-assured, informed, logical and wise. No significant differences were found across the three vocal pitch groups for the following 13 scale items: friendly vs. unfriendly, kind vs. unkind, well-mannered vs. ill-mannered, pleasant vs. unpleasant, trustworthy vs. untrustworthy, relaxed vs. tense, poised vs. shaken, educated vs. uneducated, scientific vs. unscientific, truthful vs. untruthful, dependable vs. undependable, respectful vs. disrespectful, and honest vs. dishonest. Significant test results and significant differences between vocal pitch groups on individual test items are described below. A summary of these data is found in Table 7.

Reliable versus unreliable. A Kruskal-Wallis Test showed a statistically significant difference in reliability scores across the three pitch conditions (Gp1, n = 147: low, Gp2, n = 140: normal, Gp3, n = 115: high), X^2 (2, n = 402) = 6.921, p = .031. The low and normal pitched experts both recorded a higher median reliability score of 9, while the high pitched experts recorded a median of 8. Mann-Whitney U tests uncovered which of the three vocal pitch groups were statistically different from one another. It was found that experts with low pitch are rated as significantly more reliable than high pitched experts, U = 7019.50, z = -2.411, p = .016, r = -0.12.

Confident versus unconfident. A significant difference was also found in confidence scores across the three voice pitch conditions, X^2 (2, n = 402) = 8.397, p = .015. Low pitched experts had a higher median on scores of confidence (Md = 9) compared to both normal and high pitched experts, which both recorded median values of 8. Mann-Whitney U tests show that low

pitched experts are rated as significantly more confident than both normal, $U = 8726.00$, $z = -2.28$, $p = .02$, $r = -0.11$ and high pitched experts, $U = 6899.50$, $z = -2.614$, $p = .009$, $r = -0.13$.

Well-spoken versus inarticulate. A Kruskal-Wallis Test revealed a statistically significant difference at the $p < .01$ level for the degree to which an expert witness was viewed as well-spoken across the three pitch conditions, X^2 (2, $n = 402$) = 11.190, $p = .004$. The experts with low pitch recorded a higher median score ($Md = 9$) than the other two pitch groups, which both recorded median values of 8. Mann-Whitney U tests showed that low pitched experts were scored as significantly more well-spoken than experts with normal pitch, $U = 8107.00$, $z = -3.192$, $p = .001$, $r = -0.16$.

Self-assured versus not self-assured. On a WCS item measuring expert self-assuredness, a significant difference was found for the different pitch groups, X^2 (2, $n = 402$) = 6.568, $p = .037$. Low pitched experts recorded a median score of 9, while both normal and high pitched experts recorded median scores of 8. Mann-Whitney U testing shows that on the measure of self-assuredness, experts with low pitched voices are judged as significantly more self-assured than experts with high pitched voices, $U = 6967.00$, $z = -2.49$, $p = .013$, $r = -0.12$.

Informed versus uninformed. Testing revealed a significant difference across vocal pitch groups on a WCS item measuring the degree to which an expert witness is viewed as informed, X^2 (2, $n = 402$) = 7.451, $p = .024$. Low, normal and high pitched experts all recorded median values of 9. Mann-Whitney U testing revealed which groups of experts differed significantly from one another. It was found that low pitched experts are judged by mock jurors to be significantly more informed than high pitched experts, $U = 6862.00$, $z = -2.72$, $p = .006$, $r = -0.14$.

Logical versus illogical. The three vocal pitch conditions differ significantly on a WCS item measuring the degree to which an expert witness is rated as logical versus illogical, X^2 (2, n = 402) = 6.813, p = .033. Low, normal and high pitched experts all recorded median values of 9. Further testing uncovered a significant difference between low and high pitched experts, with low pitched experts deemed to be more logical, U = 6943.50, z = -2.57, p = .01, r = -0.13 than high pitched experts.

Wise versus unwise. On an item measuring wisdom, the three groups of experts recorded significantly different scores, X^2 (2, n = 402) = 8.367, p = .015. Both low and normal pitched experts recorded a median of 9, while experts with high pitch recorded a median value of 8. Further testing shows a significant difference on wisdom scores for the three groups with high pitched voices rated as significantly less wise than both normal, U = 6575.00, z = -2.57, p = .01, r = -0.13, and low pitched voices, U = 6946, z = -2.52, p = .01, r = -0.13.

Table 1

Experimental Conditions and Participants Included in Each Group

	Low	Normal	High	
Male Expert	- 3 semitones	Mean = 112 Hz	+ 4 semitones	*n* = 201
Female Expert	- 3 semitones	Mean = 223 Hz	+ 3 semitones	*n* = 201
	n = 147	*n* = 140	*n* = 115	

Table 2

Means (and Standard Deviations) for Gender on Overall Credibility

Gender of Expert	Mean	*n*	*SD*
Male	166.98	201	25.58
Female	159.16	201	26.41
Total	163.07	$N = 402$	26.26

Table 3

Means (and Standard Deviations) for Vocal Pitch on Overall Credibility

Vocal Pitch of Expert	Mean	*n*	*SD*
Low	166.47	147	23.40
Normal	163.03	140	25.24
High	158.77	115	30.23
Total	163.07	*N* = 402	26.26

Table 4

Means (and Standard Deviations) for Vocal Pitch on the WCS Subscales

	Low	Normal	High
Likeability	39.37 (6.79)	39.12 (7.18)	39.57 (8.21)
Trustworthiness	42.27 (7.12)	41.55 (7.61)	39.97 (8.22)
Confidence	41.18 (6.78)	39.28 (7.44)	38.10 (9.29)
Knowledge	43.65 (6.24)	43.08 (6.68)	41.12 (7.83)

Table 5

Mean Ranks for Vocal Pitch on the WCS Subscales using the Kruskal-Wallis Test

	Low	Normal	High
Likeability	199.00	196.82	210.40
Trustworthiness	213.98	204.61	181.76
Confidence	221.52*	193.68	185.43
Knowledge	213.94*	206.86	179.08

*Mean rank is significant at the 0.05 level

Table 6

Means (and Standard Deviations) for Vocal Pitch on the WCS Items

	Low	Normal	High
Friendly vs. Unfriendly	M = 7.24 (1.68)	M = 7.34 (1.64)	M = 7.57 (1.85)
Respectful vs. Disrespectful	M = 8.49 (1.57)	M = 8.28 (1.59)	M = 8.21 (1.80)
Kind vs. Unkind	M = 7.37 (1.67)	M = 7.50 (1.68)	M = 7.61 (1.77)
Well-mannered vs. Ill-mannered	M = 8.62 (1.52)	M = 8.41 (1.58)	M = 8.40 (1.67)
Pleasant vs. Unpleasant	M = 7.64 (1.78)	M = 7.60 (1.88)	M = 7.78 (1.91)
Trustworthy vs. Untrustworthy	M = 8.46 (1.53)	M = 8.24 (1.69)	M = 8.05 (1.71)
Truthful vs. Untruthful	M = 8.46 (1.57)	M = 8.29 (1.72)	M = 8.05 (1.73)
Dependable vs. Undependable	M = 8.36 (1.57)	M = 8.24 (1.62)	M = 7.94 (1.69)
Honest vs. Dishonest	M = 8.52 (1.52)	M = 8.35 (1.59)	M = 7.98 (1.96)
Reliable vs. Unreliable	M = 8.45 (1.46)	M = 8.44 (1.49)	M = 7.95 (1.74)
Confident vs. Unconfident	M = 8.45 (1.53)	M = 8.01 (1.74)	M = 7.79 (2.00)
Well-spoken vs. Inarticulate	M = 8.56 (1.58)	M = 7.96 (1.68)	M = 7.96 (1.99)
Relaxed vs. Tense	M = 7.85 (1.93)	M = 7.56 (1.84)	M = 7.30 (2.15)
Poised vs. Shaken	M = 8.03 (1.59)	M = 7.78 (1.65)	M = 7.48 (1.99)
Self-assured vs. Not self-assured	M = 8.27 (1.48)	M = 7.97 (1.61)	M = 7.57 (2.05)
Informed vs. Uninformed	M = 8.90 (1.30)	M = 8.63 (1.57)	M = 8.23 (1.84)
Logical vs. Illogical	M = 8.78 (1.36)	M = 8.60 (1.57)	M = 8.20 (1.76)
Educated vs. Uneducated	M = 9.14 (1.35)	M = 8.99 (1.49)	M = 8.68 (1.63)
Wise vs. Unwise	M = 8.29 (1.54)	M = 8.31 (1.52)	M = 7.77 (1.70)
Scientific vs. Unscientific	M = 8.54 (1.52)	M = 8.56 (1.36)	M = 8.24 (1.61)

Table 7

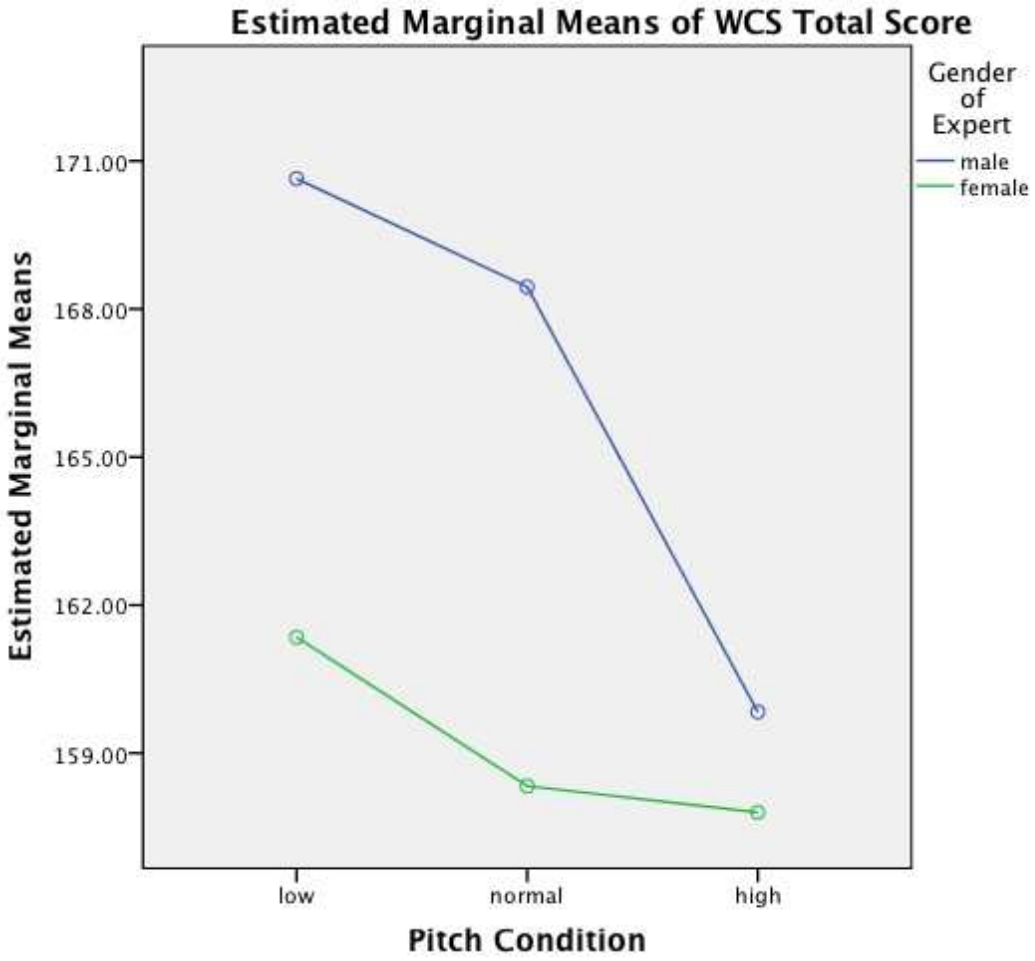
Mean Ranks for Vocal Pitch on the WCS Items using the Kruskal-Wallis Test

	Low	Normal	High
Friendly vs. Unfriendly	193.03	196.41	218.53
Respectful vs. Disrespectful	211.76	195.34	195.88
Kind vs. Unkind	193.19	201.80	211.76
Well-mannered vs. Ill-mannered	211.46	195.26	196.37
Pleasant vs. Unpleasant	197.86	197.58	210.93
Trustworthy vs. Untrustworthy	213.89	200.72	186.62
Truthful vs. Untruthful	212.52	203.10	185.47
Dependable vs. Undependable	213.12	204.41	183.10
Honest vs. Dishonest	214.22	201.03	185.81
Reliable vs. Unreliable	211.72*	210.04	178.03
Confident vs. Unconfident	222.70*	193.03	184.71
Well-spoken vs. Inarticulate	226.03**	183.60	191.93
Relaxed vs. Tense	216.93	197.22	186.99
Poised vs. Shaken	216.49	198.60	185.87
Self-assured vs. Not self-assured	218.55*	199.32	182.37
Informed vs. Uninformed	217.24*	203.03	179.51
Logical vs. Illogical	215.13*	205.36	179.38
Educated vs. Uneducated	214.02	204.69	181.61
Wise vs. Unwise	211.48	212.30*	175.60
Scientific vs. Unscientific	209.07	205.52	186.92

**Mean rank is significant at the 0.01 level; *Mean rank is significant at the 0.05 level

Figure 1

Two-way Between Groups ANOVA Exploring Gender and Voice Pitch



Discussion

Several nonverbal cues have been studied in the courtroom context. It has been shown that these nonverbal variables influence juror ratings of expert witness credibility (e.g., Couch & Sigler, 2002; Neal & Brodsky, 2008; Larson & Brodsky, 2010). Vocal pitch has been shown to exert a powerful influence in other contexts, but this variable has not yet been studied within the courtroom. There is a body of literature supporting the idea of a lower vocal pitch preference. Participants tend to ascribe more positive personality traits to lower pitched voices (O'Hair & Cody, 1987; Imhof, 2010). It was predicted that this lower pitch preference would exert an influence in the courtroom. Further, because there is a great deal of evidence suggesting that males are viewed more favorably in the expert witness role, the investigator predicted that expert gender would moderate the relationship between vocal pitch and credibility. For example, it was speculated that the higher pitched voices would be more acceptable to jurors when coming from a female speaker than a male.

Contrary to predictions, no significant interaction was found between the independent variables of gender and expert voice pitch. This suggests that gender does not moderate the relationship between vocal pitch and credibility ratings as expected. For the current study, pitch differences between experimental conditions were quite small in order to protect external validity. It is likely that all experimental audio fell within the range that listeners would expect from a witness testifying during a court appearance. This may be what caused the small differences in scores for the six conditions utilized. Another possibility is that expert witness gender overpowered the influence of voice pitch on overall witness credibility. This means that participants may have held strong traditional gender stereotypes that designate males as more credible expert witnesses as compared to females. Pitch may not have made a big enough

difference relative to these participant attitudes. Furthermore, vocal quality perception is very multi-dimensional and the relationship between factors is complex.

While using the methodological groundwork of the current study, future investigations of vocal pitch in the courtroom may want to look at larger differences between pitch conditions, provided that proper precautions are taken to ensure that the experimental stimuli sound within the range of a human voice pitch that might be encountered in the real world. In order words, external validity must be protected while further testing the potential influence of pitch on juror interpretations of witness credibility. The current study separated high and low pitch conditions from the normative range for each gender by three to four semitones. A subsequent study may establish high and low pitch conditions as six to eight semitones away from normative ranges for each gender. This may allow for an impact of voice pitch on credibility ratings that is as strong or stronger than that of expert gender. By addressing this and some other key limitations, it may be discovered that vocal pitch has a stronger influence on mock juror judgments of expert witness credibility than the data currently suggests.

Findings on Gender and Vocal Pitch in the Courtroom

As an independent variable, gender did exert a main effect on overall credibility and this finding corroborates previous research and theory demonstrating the male's advantage in the expert witness role (e.g., Memon & Shuman 1998; Brodsky, 1999; Couch & Sigler, 2002). Much of the research exploring this male advantage focuses on the fact that the traditional male communication style is more readily associated with credibility than the traditional female communication style. Neal and Brodsky (1999) found that males were viewed as more credible on the witness stand. More importantly, the males displaying assertiveness through the use of high amounts of eye contact were viewed as more credible than those maintaining less eye

contact with their audience. Larson and Brodsky (2010) also found that males are judged as more credible on the witness stand than females. They also report that credibility ratings are boosted further when experts utilize an assertive nonverbal communication style. Results of the current study are important because my data suggest that the male advantage in credibility holds even when visual nonverbal variables (e.g., gesturing, eye contact, etc.) are controlled. In the current study, participants are only exposed to audio information coming from the expert witnesses. Since vocal pitch did not exert a main effect on overall credibility, it is suggested that the male expert's advantage in overall credibility is due simply to the expert's maleness, and not due to other visual or vocal elements of the traditional male communication style.

Expert witness vocal pitch did not exert a significant main effect on mock juror ratings of overall witness credibility; however, pitch was found to make a difference on subscales of the WCS as well as some individual scale item scores. Exploratory analyses uncovered differences between the three vocal pitch groups for WCS subscale measures of confidence and knowledge. Low pitched experts held an advantage for both traits associated with credibility on the stand (see Table 5). For individual scale items, all significant differences between the groups favored low pitched experts over either the normal or high pitched experts, or both (see Table 7). The low pitched expert advantage was apparent in juror ratings of credibility, regardless of witness gender. These findings provide support for existing theories in the literature suggesting that listeners have a preference for lower pitch voices. Previous research shows that low pitched voices are more desirous for those in leadership roles (Tigue et al., 2011). Additionally, previous studies have found that more positive personality traits are associated with low pitched voices than with high pitched voices (O'Hair & Cody, 1987; Imhof, 2010). The current study uncovers additional positive personality characteristics associated with low pitched speakers and suggests

that these traits are critical to jurors' perceptions of witness credibility. This study reveals that speakers with voice pitch that falls within the lower limits of the normative range are judged as more knowledgeable, confident, reliable, well-spoken, self-assured, informed, logical and wise. This is not only valuable information for those preparing to present expert testimony on the witness stand. These results further boost the notion that speakers wishing to be perceived as credible may want to consider modifications to the pitch of their voice, especially if it is especially elevated.

The Current Study and Directions for Future Research

Limitations. Significant results were uncovered across pitch conditions on both WCS subscale scores as well as individual items. Although the data look promising, conclusions should be drawn with care. There are some limitations to the current study that should be addressed. Firstly, experimental data did not conform to parametric assumptions of normality and homogeneity of variance. As a result, the researcher was conservative in establishing significance across the vocal pitch groups. Additionally, the decision was made to analyze WCS subscale and individual item scores using non-parametric tests in order to avoid further violation of parametric assumptions. With a data set that conforms to parametric assumptions, future investigations may look at possible interactions between voice pitch and gender on each of the four WCS subscales as well as on each individual scale item. Results of these analyses may bring more to light about the influence of vocal pitch on juror judgments of expert witness credibility.

Results of this study could have been strengthened by the use of a more externally valid sample. All participants were undergraduate students at the same large, Southern university. Except for only a few outliers, almost every participant fell between the ages of 18 – 22 years

old. Most of the participants were Caucasian. Additionally, these participants were all relatively well educated, since each was enrolled in a college course at the time of study participation. Real juries are made up of more variable demographics and a more externally valid sample may exhibit different perspectives with regard to the influence of pitch on ratings of expert credibility. For instance, participants with lower levels of education may focus more on expert witness peripheral qualities like vocal pitch, especially in cases where the testimony is overly complex or technical. Inclusion of less educated participants may strengthen the influence of vocal pitch on ratings of credibility. Additionally, because this sample was made up mostly of people born and raised in the Southeastern United States, there may be certain regional attitudes regarding gender roles that confound the results. Future investigations into the influence of vocal pitch within the courtroom could be strengthened by utilization of a sample from the community comprised of various ages and backgrounds. Internet resources such as Craigslist or Amazon's Mechanical Turk (MTurk) may be useful places to turn for obtaining more representative mock juries. Results from a study using a community sample should then be compared to the results of the current study to see if more accurate information is gleaned from an externally valid sample of mock juror participants.

The present study utilized an online participation format wherein participants completed this study on a personal computer in their own space and time. This methodology offered several advantages. For instance, data from over 400 subjects was compiled in a very short amount of time. There was no need to schedule participants in time slots supervised by an available researcher. Participants may have chosen to complete the study due in part to the fact that they did not have to schedule their time and travel to an experiment location. While data collection was quicker and easier, some disadvantages to the online participation model should

be mentioned. No experimenter was present to have a face-to-face interaction with subjects or to ensure that experimental steps were followed appropriately. As a result, some participants may not have attended adequately to the experimental stimuli. For example, there was nothing stopping a study participant from playing the audio testimony and then leaving their computer to go do other things. In an attempt to address this problem, the study information screen did include a warning to the participant that they would be asked to answer questions about audio testimony to come. Also, each participant was asked at the end of the study to comment on factors that influenced their decision-making. While entering data, answers to this question were evaluated. Fortunately, only a small number of participants chose to not respond and those that did answer appeared to have retained significant information from case testimony. In the future, researchers may want to run a small live sample of mock jurors participating in this study to ensure that the live sample results are consistent with those participants that completed the study in their own space and time, via the online methodology.

Participants were not told in the initial description of this study that researchers were interested in their perceptions of vocal pitch. Although this deception was disclosed at the experiment's end, researchers wanted to protect against participant harm by giving all study subjects the option to have their data destroyed subsequent to completing each questionnaire. In total, 30 participants chose to destroy their data. While this is only a small number relative to the large sample size, this number is likely far greater than it would have been had the experiment been conducted in a traditional lab setting. Because they were alone completing the study, some of these 30 individuals may have chosen to be oppositional and have their data destroyed when given the option. It is unlikely that each of the 30 participants that chose to have their data destroyed truly felt harmed do to the experimenter's use of deception. If these participants had

met an experimenter and taken the time to locate and come to a laboratory for study completion, they may have felt more invested in the research and would not have chosen to have their data destroyed.

Although the development of a valid and reliable methodology for the study of vocal pitch in the courtroom is considered one of this study's key strengths, some specific necessary improvements to experimental stimuli have been considered. As mentioned, great care was taken to produce audio stimuli deemed as externally valid. This means that it was important to make sure that the computer manipulations of vocal pitch sounded like they could come from a typical male or female on the witness stand. It is likely that vocal pitch most often affects listeners' views of the speaker in cases where the pitch is abnormal or extreme. Therefore, in order to enhance the role of pitch within the stimuli, future experiments should strongly consider using more noticeable pitch differences. Additionally, more voices should be utilized in experimental conditions in order to ensure that the extraneous qualities of any one voice are not influencing dependent variables. If this study were conducted this study again, it would be worthwhile to consider a more neutral case summary and testimony script. A more neutral case scenario may be one in which a person was not physically harmed in order to decrease the likelihood of jurors focusing solely on the element of pain in the story. Although the current materials have been used in previous studies examining witness credibility, there are some emotional elements to the utilized legal situation and mock jurors' reactions to these elements may overpower subjects' judgments of the variables of interest. By addressing these issues, we may find that vocal pitch is more powerful in the courtroom than data from the current study presently suggests.

Strengths. There are several noteworthy strengths to the current study including its large sample size. By allowing online participation, a large amount of data was collected very quickly. This is due to the fact that students would rather complete studies from home than come to a laboratory setting. There were some drawbacks to online participation, but in the end this was the right choice given the benefits it provided for analysis of the data. For instance, the large sample size helped in rationalizing the use of a parametric test to evaluate the primary prediction that an interaction effect would exist between gender and vocal pitch on credibility ratings. Had the sample been much smaller, the investigator would not have felt justified in exploring this hypothesis using an ANOVA.

While previous research has demonstrated time and again that voice pitch has a significant impact on listener's judgments of speakers, this is the first study to examine the relationship between vocal pitch and juror ratings of expert witness credibility in a courtroom context. Much of this study's strength comes from the development of a reliable and valid methodology for studying the variable of voice pitch. Several unique challenges were faced in determining how to best investigate vocal pitch. The use of voice altering technology and the technique of merging individual audio files together into six different pitch conditions helped ensure that many extraneous variables were eliminated from this study. This study provides a methodological groundwork for future examinations of a very important nonverbal variable. Future investigations looking at vocal pitch in other contexts may draw on the methodology utilized by the current study.

Vocal pitch is an influential nonverbal variable that has not yet been studied in the courtroom context. Although data from the current study do not support a strong influence of vocal pitch on overall expert witness credibility ratings, significant differences were found across

pitch conditions on several of the WCS subscales and individual scale item scores. In each of these cases, low voices were judged as significantly more positive than one or both of the other experimental conditions. Effect sizes were small; however, this may be due to the small differences in perceived pitch between the experimental conditions. Nevertheless, results from the current study add to an existing literature supporting a lower vocal pitch preference. Several other researchers have found that listeners hold lower voices more favorably in contexts other than the courtroom (e.g., O'Hair & Cody, 1987; Imhof, 2010; Tigue et al., in press). Among the many positive personality traits found to be associated with low pitched voices, several previous studies have suggested that listeners deem speakers with low pitched voices to be more honest and less deceitful (Ekman & Friesen, 1976; O'Hair & Cody, 1987). Additionally, it has been found that those with a low pitched voice are seen as better leaders (Tigue et al., 2011). In fact, upon recommendation from her advisors, Margaret Thatcher underwent a vocal training program that included exercises aimed at lowering the pitch of her voice soon after becoming the Prime Minister (Pierce, 2009).

Many of the positive speaker characteristics associated with low pitched voices in previous studies are desirable for a male or female testifying as an expert witness. For the current study, exploratory analyses revealed that low pitched experts hold an advantage on measures of confidence and knowledge as well as on several individual WCS scale items. Mock jurors perceived experts with low pitch to be significantly more reliable, well-spoken, confident, informed, self-assured, logical and wise than other experts. This tells us that vocal pitch does make a difference in the courtroom setting. During the televised and highly-publicized Jodi Arias trial, a commentator remarked on the differences in vocal pitch of two key experts. The commentator noted that he viewed one of the experts more favorably because her vocal pitch did

not change much when answering tough questions on cross-examination (McKinney, 2013). These types of comments show that there is a publicly held belief that a speaker's vocal pitch yields some insight into their credibility. Further, this indicates that there is a need to further explore the influence of vocal pitch. The current study utilized audio testimony that was purposely delivered in an even voice pitch, but in the future, it may be fruitful to examine whether speakers with a great deal of pitch variability are viewed as less credible. By addressing some of the limitations of the current study and utilizing the methodology set in place by this initial attempt, future investigations can uncover how and when vocal pitch impacts juror decision-making with more precision.

An exploration into the impact of vocal pitch in the courtroom is a worthwhile endeavor because it yields useful information about how jurors make decisions about case testimony. Results of the current study suggest that there is reason for trial consultants to attend with care to vocal pitch in preparing experts for trial. The data from this study suggest that even slight changes to vocal pitch can impact the degree to which jurors associate experts with positive characteristics; however, the small effect size that pitch exerts on judgments of such speaker qualities implies that modifications to the voice that cause discomfort or appear unnatural would present more of a cost to credibility than it is worth. Empirical assessments of nonverbal cues will further reveal how jurors engage in the decision-making and deliberation process. This information may be valuable to trial consultants and other coaches as they prepare experts for the witness stand; however, it should be noted that vocal pitch is a variable that has not been addressed before in the courtroom. Testifying experts should move in small steps with regard to pitch training until more is understood (Boyle & Brodsky, 2012).

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Appendix A

Research announcement that will be posted to the Psychology 101 subject pool website:

Study Name: *Civil trial: You be the juror!*

Description: This study seeks to investigate mock jurors' decisions during a civil trial. Participants will be asked to read case summary, listen to audio testimony and fill out three questionnaires. Participation will likely not take the entire hour (most will finish in 30 minutes).

Eligibility Requirements: Participants must be 18 years of age or older.

Duration of participation: 30 minutes.

Credits: 1.0

Researcher: Jessica A. Boyle, MA
Office: GP 404
Email: WRLvocalpitch@gmail.com

Appendix B

Case Background

Instructions: The following is a brief description of the case on which you will be asked to render an award decision. Please read the following details carefully

On April 15, 2007, Mr. Don Barrett was involved in an accident while walking past a construction site. Witnesses reported that Mr. Barrett was struck on the head with a large piece of falling debris while walking on the sidewalk past a construction site. This construction site was run by USA Builders, Inc., a large nationwide construction company.

Witness reports indicate that Mr. Barrett's "head was bleeding" and he was briefly unconscious (estimated at approximately 2-3 minutes). When he was revived, he complained of a headache and nausea, while appearing confused and disoriented. Mr. Barrett was transported by ambulance to the local hospital. He was examined by an emergency room physician and underwent a computerized tomography (CT) scan of his head. All tests came back normal, but Mr. Barrett did sustain a concussion. He also suffered a cut on the right side of his forehead, requiring four stitches. He was discharged from the hospital that evening with a diagnosis of mild traumatic brain injury.

Mr. Barrett's medical bills and lost wages amounted to approximately $50,000. He is filing a civil lawsuit against USA Builders, Inc. for these damages. Mr. Barrett is also seeking financial compensation for pain, suffering, and loss of future earning potential in the amount of $2,000,000. The USA Builders, Inc. has accepted complete responsibility for the accident. The events surrounding the accident are not in dispute. However, the company is contesting the extent of Mr. Barrett's disabilities as a result of the accident.

Since the accident, Mr. Barrett reports difficulty concentrating, memory problems, and significant fatigue. As a result, he has been unable to return to a full-time work schedule. Mr. Barrett has undergone a neuropsychological evaluation to determine the nature and extent of his cognitive disabilities.

You are to think as if you are a juror on this case and determine what amount, if any, of compensation is appropriate for Mr. Barrett's case. Even though you may want additional details regarding this case, specific questions regarding the case history or testimony will not be answered. Like all jurors, you must rely on the information you have been presented to reach your decision.

Thank you for participating in this important study on juror decision making.

Appendix C

Expert Testimony Script with Edits

Attorney: Your Honor, the defense would like to call Doctor Taylor Smith. Doctor Smith, please state your name for the court.

Expert: My name is Doctor Taylor Smith.

Attorney: Where did you earn your degree and do your training?

Expert: I received my Ph.D. from Loyola and then did a post-doctoral fellowship in neuropsychology at Rochester Medical Center.

Attorney: Would you tell the Judge and jury what your profession is?

Expert: I am a psychologist and I uh, specialize in clinical neuropsychology.

Attorney: Can you briefly describe the specialized training you've received in the area of neuropsychology?

Expert: Yes. Well, I took several classes on neuropsychology while ~~I was~~ in graduate school. I was trained in the use of specific measures and scales that are used in neuropsychology. I, uh, conducted several neuropsychological assessments while in graduate school and was supervised by a licensed clinical psychologist who was also specialized in neuropsychology. I also completed two years of post-doctoral training with a specialization in neuropsychology.

Attorney: Are you licensed in this state?

Expert: Yes, I have been licensed in this state for over uh, 10 years.

Attorney: Where are you currently employed?

Expert: I teach at Purdue University and have a private practice where I primarily conduct neuropsychological assessments.

Attorney: What are your duties at the University?

Expert: I teach classes at both the graduate and undergraduate level. I also conduct research in the area of neuropsychology.

Attorney: Has any research you've conducted been published?

Expert: Currently, I have been an author on um, 32 published articles. I also have several articles under review by various journals.

Attorney: Your Honor, I move that the court accept Dr. Taylor Smith as a qualified expert in the field of neuropsychology.

Judge: Plaintiff, any objections?

Plaintiff: No, Your Honor.

Judge: Dr. Taylor Smith is admitted as a qualified expert in the field of neuropsychology. Proceed counselor.

DIRECT TESTIMONY

Attorney: Alright, Dr. Smith, please tell the court what neuropsychology is.

Expert: Neuropsychology is essentially the study of brain-behavior relationships. A neuropsychologist uses validated testing instruments and assessment procedures to evaluate cognitive functioning. ~~Determining~~ I then uh, determine the nature and extent of a patient's cognitive complaints. This can be quite complex and neuropsychologists rely on a variety of materials to arrive at diagnoses and recommendations.

Attorney: Dr. Smith, how did you become involved in this case?

Expert: In May of 2007, I was contacted by the defense and was asked to perform a neuropsychological evaluation on Mr. Barrett here.

Attorney: Did you receive any records prior to the evaluation?

Expert: I did receive his hospital records from the day of the injury. This includedi~~ng~~ his physician's reports and the radiologist's report from his CT. I also looked over Mr. Barrett's employment records, including the incident reports from that day, his employment history prior to the event, and behavior at work following the event.

Attorney: Would you please tell the court what you discovered based on this information?

Expert: Well, Mr. Barrett appears to have suffered from a mild traumatic brain injury.

Attorney: How is it determined whether a head injury is mild or severe?

Expert: These decisions are really, uh, based on the amount of time the individual is unconscious and the presence or absence of amnesia following the injury. Probably the most commonly used system to assess head injuries is the Glasgow Coma Scale, ~~or~~ the, uh, GCS. The GCS tests the ability to respond to commands, control movements, and awareness of surroundings. A low GCS score means a severe injury; a higher score means the patient probably experienced a mild injury.

Attorney: What was Mr. Barrett's score?

Expert: His treating physician at the emergency room assessed his GCS score at 12. The range is 3-15, so his score was relatively high.

Attorney: Okay. So, what else did your tests reveal for Mr. Barrett?

Expert: Mr. Barrett's profile of results was quite variable. For example, his performance was significantly better on complex items than simpler items, and he had many discrepancies between measures that assessed the same cognitive domain, particularly memory tasks. His results were fairly inconsistent.

Attorney: What did you make of this?

Expert: Well, those results can occur when someone is not giving their best effort. This can be intentional or unintentional. And it can be due to a number of different reasons, such as fatigue, psychological symptoms, or malingering.

Attorney: What is malingering, Doctor?

Expert: Well, according to the Diagnostic and Statistical Manual of Mental Disorders, malingering is when someone intentionally fakes or grossly exaggerates symptoms for an external reward.

Attorney: Could you please explain what you mean?

Expert: In a civil case there is an incentive to fake or exaggerate symptoms when monetary gains are dependent on the nature and extent of an injury. Therefore, it is important to be mindful of malingering, particularly in forensic cases.

Attorney: Was Mr. Barrett malingering?

Expert: He did malinger on some tests designed to assess effort, but performed adequately on others.

Attorney: Were you able to determine whether he has any cognitive disabilities?

Expert: Yes. Mr. Barrett does have some legitimate cognitive impairments, particularly in the domain of attention, but he also had a tendency to exaggerate some of his symptoms or deficits. For example, his processing speed was slowed on tests of reaction time and his distractibility was elevated in comparison to same-aged peers. These results were found on empirically derived neuropsychological tests, and also evident in his conversational speech and behavior during the evaluation. Attention deficits are not uncommon in cases of mild traumatic brain injury, and Mr. Barrett's testing results are consistent with that profile. In some cases, attention difficulties will lead an individual to think they have memory impairments. In my opinion, this is a probable explanation for the intentional or unintentional exaggeration I observed in Mr. Barrett's performance on the memory tasks.

Attorney: What are the consequences of attention problems?

Expert: Individuals often experience decreased concentration levels, heightened distractibility, and difficulty multi-tasking. In addition, some people report heightened confusion and difficulties thinking clearly. The result is often increased irritability and fatigue as they try to focus their efforts, with uh, limited success.

Attorney: Dr. Smith, what is your expert opinion regarding Mr. Barrett's cognitive functioning?

Expert: It is my opinion that Mr. Barrett is experiencing significant cognitive deficits that are related to the head injury he sustained. However, Mr. Barrett also appeared to exaggerate the extent of his existing disability.

Attorney: Do you think there is a neuropsychological basis for the symptoms he has reported?

Expert: Yes, I do.

Attorney: Nothing further Your Honor.

Appendix D

Expert Testimony Script (Final Version without Markup)

Attorney: Your Honor, the defense would like to call Doctor Taylor Smith. Doctor Smith, please state your name for the court.

Expert: My name is Doctor Taylor Smith.

Attorney: Where did you earn your degree and do your training?

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Expert: I am a psychologist and I uh, specialize in clinical neuropsychology.

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Expert: I teach at Purdue University and have a private practice where I primarily conduct neuropsychological assessments.

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Expert: Mr. Barrett's profile of results was quite variable. For example, his performance was significantly better on complex items than simpler items, and he had many discrepancies between measures that assessed the same cognitive domain, particularly memory tasks. His results were fairly inconsistent.

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Expert: Well, according to the Diagnostic and Statistical Manual of Mental Disorders, malingering is when someone intentionally fakes or grossly exaggerates symptoms for an external reward.

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Attorney: Dr. Smith, what is your expert opinion regarding Mr. Barrett's cognitive functioning?

Expert: It is my opinion that Mr. Barrett is experiencing significant cognitive deficits that are related to the head injury he sustained. However, Mr. Barrett also appeared to exaggerate the extent of his existing disability.

Attorney: Do you think there is a neuropsychological basis for the symptoms he has reported?

Expert: Yes, I do.

Attorney: Nothing further Your Honor.

Appendix E

Witness Credibility Scale

Instructions: *Please rate the* ***defense expert witness*** *for the following items on the scale provided.*
If you are unsure, please take your BEST GUESS.

Example:

1	*2*	*3*	*4*	*5* ✓	*6*	*7*	*8*	*9*	*10*
Dressed Formally									*Dressed Informally*

1	2	3	4	5	6	7	8	9	10
Unfriendly									Friendly

1	2	3	4	5	6	7	8	9	10
Disrespectful									Respectful

1	2	3	4	5	6	7	8	9	10
Unkind									Kind

1	2	3	4	5	6	7	8	9	10
Ill-mannered									Well-mannered

1	2	3	4	5	6	7	8	9	10
Unpleasant									Pleasant

1	2	3	4	5	6	7	8	9	10
Untrustworthy									Trustworthy

1	2	3	4	5	6	7	8	9	10
Untruthful									Truthful

1	2	3	4	5	6	7	8	9	10
Undependable									Dependable

1	2	3	4	5	6	7	8	9	10

Dishonest Honest

1	2	3	4	5	6	7	8	9	10

Unreliable Reliable

1	2	3	4	5	6	7	8	9	10

Not confident Confident

1	2	3	4	5	6	7	8	9	10

Inarticulate Well-spoken

1	2	3	4	5	6	7	8	9	10

Tense Relaxed

1	2	3	4	5	6	7	8	9	10

Shaken Poised

1	2	3	4	5	6	7	8	9	10

Not Self-Assured Self-Assured

1	2	3	4	5	6	7	8	9	10

Uninformed Informed

1	2	3	4	5	6	7	8	9	10

Illogical Logical

1	2	3	4	5	6	7	8	9	10

Uneducated Educated

1	2	3	4	5	6	7	8	9	10

Unwise Wise

1	2	3	4	5	6	7	8	9	10

Unscientific Scientific

Appendix F

Demographics Questionnaire

I am: _____Male _____ Female

I am: _____ years old

I consider myself:

__ White/Caucasian
__ Black/African-American
__ Asian-American
__ Other (Specify_____)
__ Hispanic/Latino
__ Native American
__ Biracial

My highest level of education is:

__ No high school
__ Some high school
__ High school diploma/GED
__ Some college
__ Bachelor's degree
__ Master's or Doctoral degree __ Other (Specify_____)

Have you ever been called for jury duty before? Yes____ No_____

Have you ever served on a jury? Yes____ No____

If yes, what was the verdict? _____