The Perceivable Auditory Difference Between Male and Female Footsteps

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Introduction and Previous Research

Humans seems to have an innate ability to distinguish between different sounds. If an individual has heard a sound before, he or she can often quickly identify that sound under different circumstances. Consider the ease with which humans can identify the voices of family members or close friends. Even without visual cues, such as when answering the telephone, the listener is often able to identify the speaker. If, however, the listener is unable to correctly identify the name of the speaker, often the listener is able to correctly identify at least the gender of the speaker. It seems logical to extrapolate from this common phenomenon to consider the human ability to identify other common environmental sounds, such as the sounds of human footsteps. Everyday humans hear the sounds of others walking from place to place, and, based on the above observations about sound memory, humans should be able to correctly identify the gender of an individual walking based on auditory cues alone.

Men and women have distinctly different body types that lead to different gait styles. According to previous work by James E Cutting,[1] the primary difference between male and female walkers occurs as a result of the varied shoulder and hip movements. Male walkers tend to be identifiable as male due to more shoulder motion, while other walkers are identifiable as female because of increased hip motion. As a result of these different types of gait, it seems logical that men and women would have distinctly different sounding footsteps. Additionally, it is critical to understand not only the difference that different gait styles play in the human ability to identify correctly male and female walkers, but also to consider the impact that different shoes have on our auditory cognition of footsteps. Stereotypically men and women wear different shoes; male dress shoes have a slight heel and either leather or rubber soles while women's dress shoes are high heeled[2] most often with a wooden heel and leather soul under the ball of the foot. However, there are shoes that are genderless: many different types of sandals, different types of slippers and scuffs, and, most commonly, sneakers. It follows that human ability to correctly identify the gender of a walker based on the sound of his or her footsteps alone would be significantly impacted by the type of shoes that the walker is wearing.

A pilot study conducted by the author at Stanford University in the spring of 2001 produced results that supported the above hypothesis. Specifically, this work showed that the primary auditory cue that affects a listener's ability to correctly identify a walker based on auditory cues is the type of shoe worn during recording. Walkers who were recorded wearing stereotypically gendered shoes were identified to be the correct gender much more frequently. Additionally, one male walker was recorded wearing wooden soled scuffs was identified as male because the sound his shoes made in contact with the floor was similar to the sounds that high heels would make. Based on the results of this pilot study, it seemed difficult to justify assertions that biological factors such as height and weight had much impact on human ability to correctly identify the gender of a walker.

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[1] Cutting, James E. Generation of synthetic male and female walkers through manipulation of a biomechanical invariant.

[2] The actual height of women's "high heels" can vary from anywhere between approximately an inch and a half to 4 or five inches off the ground.

There have been very few previously published works that detail the ability of men and women to correctly identify the gender of walkers based on auditory cues alone. In 1979, Li, Logan, and Pastore conducted a study of the human ability to correctly identify the gender of walkers when recordings were made of barefoot walkers and individuals wearing an array of different types of shoes. In the final discussion of their results, Li, Logan, and Pastore conclude that shoe type is not the primary factor in the human ability to correctly identify the gender of a walker based on auditory cues alone. Instead, this study argues that there are numerous factors that contribute to human ability and it is the conglomeration of all of these factors that allows humans to identify the gender of walkers based on gait alone.

General Methods

The present study was conducted by recording the footsteps of four different individuals (two male and two female). The individuals were asked to wear different combinations of shoes: first their own supplied dress shoes[3] and second the provided uniform sneakers with metal thumbtacks stuck into the soles (see the following explanation). Once the different sound samples were collected and edited[4] they were played to different listeners who would be asked to identify the gender of the walkers based on the auditory characteristics of their footsteps. The general aim of the study is to assess the human ability to correctly identify the gender of walkers based on the auditory characteristics of their footsteps.

Preparing the Stimuli – Recording Phase

All recording was conducted in a quiet hallway at the Center for Computer Research in Music and Acoustics (CCRMA) at Stanford University late in the evening on a weekday when very few other individuals were inside the building. Subjects walked twenty-five feet across a cement floor, while recordings were collected by one stereo microphone held two inches off the ground by a microphone stand. All recording was conducted using a portable DAT machine.[5] Both the starting and ending locations were marked on the floor by pieces of duct and electrical tape, and subjects were instructed to walk until they had comfortably crossed the ending marker not altering their stride in order to stop precisely on the tape. All walkers were instructed to walk naturally and were recorded wearing each type of shoes more than once in order to minimize any recording error that may have been caused when subjects walked self-consciously. The height, weight, age, shoe size, and gender for every walker was also collected and can be found in Table 1 below. All height and weight measurements were made using a standard measuring tape and bathroom scale respectively.

Walker Number	Gender	Age	Height (in)	Weight	Shoe Size (Men's)
1	F	20	65	120	7
2	M	22	69	161	9
3	M	20	67	169	9.5
4	F	18	65	155	8

Table 1. Biological data collected from walkers

As is evidenced from Table 1 at left, there was not an extremely large spread in the biological data for the walkers. All four subjects had similar heights, weights, and shoe sizes. Thus based on this data spread it would be hard to make a conclusive analysis of such biological data.

[3] For women, dress shoes would be high heels of any height in which they were comfortable walking, and for men, dress shoes would be any shoes that they might feel comfortable wearing with a business suit.
[4] As will be discussed later, each walker was asked to walk more than once, and the recordings would need to be split apart such that each sample would include the footsteps of an individual walking only once.
[5] All recordings were made using a TASCAM DAT recorder.

The first recordings of all walkers were made wearing their own stereotypically gendered dress shoes. Women were instructed to bring heels of any height in which they would be comfortable walking. For both female subjects such heels were between three and four inches tall and were strappy dress sandals. Neither of the two subjects chose to wear stereotypical pumps or flats. Men were asked to bring a pair of dress shoes, preferably leather soled, in which they would be comfortable walking and that they might wear with a business suit for a nice occasion. Subject number two was able to provide such a requested pair of leather soled dress shoes, while subject number three wore rubber soled dress shoes.

After four recordings were made of each subject wearing his or her stereotypically gendered shoes, each subject was asked to wear the specially prepared sneakers of the correct size. The prepared sneakers were all precisely the same shoes purchased in four different sizes (one for each subject). Into the soles of these sneakers, were pushed metal thumb tacks to exaggerate the sound of the foot making contact with the concrete floor. Based on the work of numerous researchers about the biomechanics of human gait, three tacks were stuck into the heel of the shoe, two into the middle rear portion of the sole, three where the ball of the foot would be located, and two into the forward-most portion of the shoe (at the tip of the big toe) – for further detail see Figure 1 below. By comparing the results from the sound samples where each walker is wearing the stereotypically gendered shoes with the results from the standardized sneakers, one can begin to assess the effect that different shoe type actually has on the listener's ability to correctly identify the gender of a walker.

Figure 1. Positioning of the tacks on the sole of the prepared sneakers.

Sound Sample Analysis

The different sound samples ranged in loudness and pitch timber based not only on the shoe type of the walker, but also on the biomechanics of the walker's gait. Sonograms depicting frequency changes in the eight samples which would be played to the listeners are provided in Appendix A at the conclusion of this report.

As is evidenced by the sonograms presented in Appendix A, one major difference between the male and female collected sound samples is that there is more overall noise in the recordings of females wearing high heels. Additionally, there are very clearly defined heel strikes – the spikes rising to the tops of the graphs. In the sonogram for sound sample 1 (the chosen recording for of subject one wearing her own provided high heels), high intensity heel clicks are followed closely by a spike of exactly the same magnitude slightly delayed. These "double clicks" are most likely a result of the reverberation in the cement corridor in which these recordings were collected. However, these "double clicks" do not appear in any of the other

recordings, and thus are a defining characteristic of the high heels. It is also important to note that these "double clicks" disappear in the recording of the same individual wearing the prepared sneakers.

All of the walkers tended to move at the same pace when wearing the prepared sneakers as when wearing their own stereotypically gendered dress shoes. In other words, the same walkers covered the same distance in approximately the same time regardless of the shoes that they were wearing. The number of footfalls that take place between the start and end of the recordings seem to also be constant between the sonograms for the walkers wearing both the stereotypically gendered shoes and the prepared sneakers.

From the sonograms, one can also compare the different pitches and timbers associated with the different shoe types. It is clear from the peaks in the sonograms presented in Appendix A that the samples of individuals wearing the prepared sneakers with tacks stuck into the soles are actually more similar to the sound samples of the women wearing high-heeled shoes.

Collecting Data and Result Analysis

Once all sound samples had been collected from walkers and analyzed in order to assure sound quality. It was critical to select clear sound samples with minimal background noise as representatives of each walker. Without such clarity and the presence of excessive background noise, the listener might be distracted or have difficulty classifying the walker as either male or female.

Pilot Study – In-class Data

A pilot study was first conducted on the students of a musical cognition class at Stanford University. This class serves as the "Writing in the Major" class for Music Science and Technology majors at Stanford and has an enrollment of seventeen students. Of these seventeen students ten were asked to listen to the eight selected sound samples (played in random order) and to identify the walkers as either male or female and provide a rating of their certainty in their classification. The other seven students were given an open ended questionnaire and were asked to simply provide as much information as possible about the walker whose footsteps they would be hearing. At the conclusion of each of these surveys, the listeners were asked to answer a few questions about their listening experiences.

All in-class subjects were listening to eight selected samples on an in-class sound system with the volume set at a constant comfortably audible level. All students were listening to the samples at the same time and were provided with a twenty to thirty second window between samples to respond to their respective questions. Within the room, individuals answering survey questions and those categorizing sound samples as specifically male and female were randomly distributed. The data collected from the ten individuals – five males and five females - asked to specifically classify the gender of the walkers is presented below in Table 2.

Sample #	Sample Gender	Sample Shoe Type	% Male	Average Certainty
1	#1 F	Dress Shoes	20.0%	2.3
4	#1 F	Sneakers	90.0%	2.7
11	#2 M	Dress Shoes	90.0%	2.8
12	#2 M	Sneakers	90.0%	3.1
17	#2 M	Dress Shoes	60.0%	3.1
22	#3 M	Sneakers	90.0%	2.7
27	#4 F	Dress Shoes	30.0%	2.5
30	#4 F	Sneakers	30.0%	2.6

Table 2. Data Collected In-class from students asked to specifically characterize sound samples as being the footsteps of either males or females. Certainty was ranked on a scale of 1 to 5, where 1 denotes complete certainty in the classification and 5 denotes complete uncertainty.

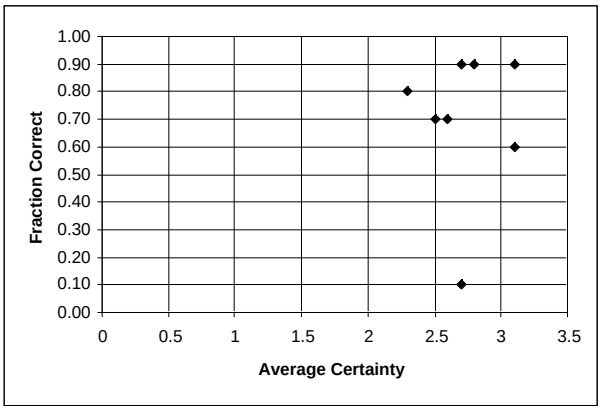


Figure 2. Data Collected in class. The average certainty for a given classification of a sound sample vs. the fraction of the time that that sound sample was classified correctly.

Results and Discussion – Individuals Asked Specifically to Identify the Gender of the Walkers

The data collected from the pilot study, leads one to believe that humans are able to distinguish between male and female footsteps when asked specifically to identify the gender of the footsteps and when the walkers are wearing stereotypically gendered dress shoes. These results are clearly illustrated in Table 2 below. Overall, women wearing high heels were correctly identified as female 75% of the time and males wearing dress shoes were identified as male 75% of the time. From these results it seems evident that humans can correctly identify the gender of walkers when those walkers are wearing stereotypically gendered shoes.

Perhaps the more interesting results, however, come from a discussion of the listener's attempts to correctly classify the gender of the walkers from the sound samples wearing the standard prepared sneakers with thumbtacks. For only one walker was the sound sample when that walker was wearing the prepared sneakers identified as male less than half of the time (see

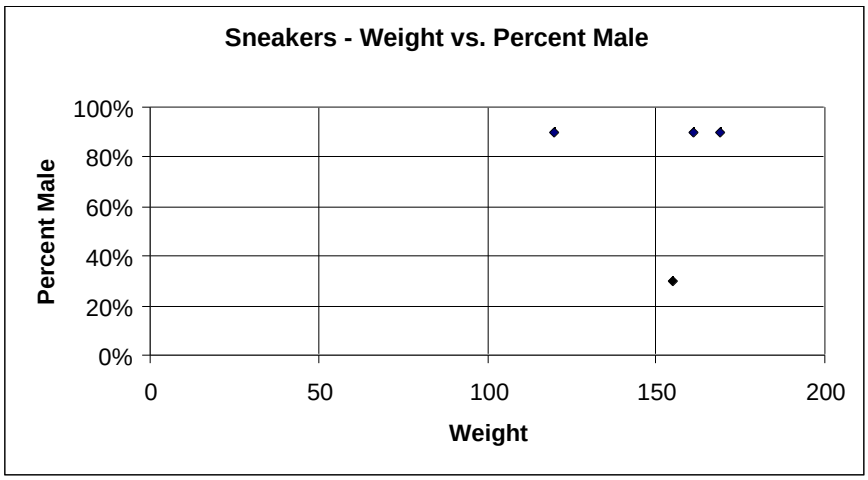


Figure 3. Weight vs. the percent of times that a given sound sample was identified to be male. The only samples included in this plot are those recorded when walkers were wearing the prepared sneakers.

sample 30 from walker #4). Overall, walkers wearing the prepared shoes with tacks in the soles were identified as male 75% of the time – similar to the identification of men wearing dress shoes. Thus this preliminary result leads one to believe that humans are unable to correctly identify the gender of walkers based on auditory cues alone whenever the walkers are wearing standardized shoes.

Figure 2 attempts to present the correlation between the perceived certainty that an individual has in his or her classification of the walker as either male or female with the overall correctness of a given classification. One would expect the percentage correct to increase linearly with respect to the certainty that an individual has in his or her classification. From this graph it is evident that there is seemingly no relation between an individual's certainty in his or her classification and the correctness of the classification. Thus although humans seem to be able to distinguish between male and female footsteps whenever the walkers are wearing stereotypically gendered shoes, on average, the subjects seem to be no more sure of their classifications when they are correct than when their classifications are false.

Figure 3 attempts to illustrate the correlation between the weight of a given subject and the percentage of times that that subject was identified as male during the course of the study. It seems from the presented graph as though there is not a linear correlation as was expected. Because men are generally heavier than women, it seems as though weight might play a large role in the number of times that a given sample is identified as being male, however, from the presented plot, because the four data points seem to be placed almost randomly, one can infer that this hypothesis is false. These results may be due to the minimal range in weights among all subjects. This study did not present as large a weight gap as is often present between male and female individuals and therefore it is possible that weight became an obscured variable in this study.

Results and Discussion – In-class data when asking for general description

In the more qualitative response surveys, gender was only mentioned twenty-five times overall. Because seven people completed these more qualitative surveys and each survey provided space for responses to eight different sound samples, gender was only mentioned in 44.6% of the responses to individual sounds. Less than half of the time, the listener is compelled to write about the gender of the walker when asked to provide as much information as possible about the subject of the sound samples. There were a few cases in which the listener failed to provide specific classification of the gender of the walker, and instead attempted to provide the type of shoe that the walker was wearing, for example writing that the sample is a "person with high heels."

Of all of the references to gender provided in these surveys, the gender was correctly identified 82.1% of the time.[6] This result is significantly better than that obtained through the forced gender recognition study. This study probably produces the given result because an individual is less likely to describe human footsteps as specifically male or female unless he or she is completely certain of his or her classification. These classifications were made primarily for the recordings where the women were wearing high heels and men were in dress shoes.

[6] For this calculation, data points were also included for which the listeners described the walker as wearing high heels. Such data points were entered into the calculation as if the individual had simply denoted that the walker was female.

Rarely did any of the listeners attempt to classify the sound samples in which the walkers were wearing the prepared sneakers. Thus these high statistical results can be paralleled to the responses that were given when the individuals attempted to specifically categorize the gender of the walkers in the previously discussed experiment. Therefore, although these percentages seem to illustrate that humans can correctly identify male and female footsteps regardless of the shoe type, in actuality, these percentages merely support the claim that humans distinguish between male and female footsteps primarily on the basis of shoe type.

The responses to the final two questions on the survey: (1) "What specific auditory characteristic(s) did you pay the closest attention to? Why?" and (2) "What was the most memorable/defining auditory characteristic of the recordings?" produced extremely varied responses. One subject ventured to remark that "it's kinda hard to tell. They all sound very close to each other." In making this remark, this subject is bringing to light much of the uncertainty associated with this study. It seems as though this individual along with a few of the other subjects felt as though this is an extraordinarily difficult task. In reading the responses to the individual sound samples, it is common that there is a sense of uncertainty as a result of the similarity between sound samples. Many of the comments are the same or read as though the listener felt forced to find distinguishing characteristics between the sound samples.

Therefore, although the provided statistics might help to show that individuals can correctly identify the gender of walkers based on auditory cues alone, it seems as though this study may to some degree force individuals to identify sound samples that they might otherwise identify as gender neutral or rather just classify them as footsteps.

Conclusions – In-class collected data

From the pilot study conducted in-class on a group of seventeen Stanford University students (both undergraduate and graduate students), it is clear that individuals can correctly identify the gender of male and female walkers based on auditory cues alone only when the walkers are wearing stereotypically gendered shoes. The sound samples for which the walkers were wearing the gender neutral prepared shoes were much more difficult for the listeners to identify; by default, the walkers in these samples seem to be identified as male. Thus through the compilation of all of the data in this study, it is clear that the primary means by which individuals attempt to identify the gender of a walker based on auditory cues alone is through analysis of the shoe type of the walker. When an individual hears what he/she believes to be a high heel or the heel of a leather male dress shoe, he/she quickly attempts to identify the walker as either female or male respectively.

It is possible there was some confusion resulting as a result of the pitch and timbre of the tacks making contact with the floor. To some degree, the sound of the tacks making contact with the concrete floor has a similar pitch to that of the heel of a female high heeled shoe making contact with the floor. Thus it is possible that the listener's attempts to recognize the male and female walkers was somewhat obscured by the timbre of the thumbtacks making contact with the cement floor.

Methods - Online Study

In order to broaden the data pool, eight of the sound samples were posted online in order that additional listeners might attempt to provide gender classification of the walkers. The online study was constructed to parallel the first type of study presented to the in-class subjects; it asked listeners to classify the sound samples as either male or female and did not provide more room for free responses to the footsteps. The actual sounds were linked to the page using the embed HTML tag and thus required an appropriate browser plugin. Each sound sample was only set to play when a subject clicked on the play button inside it's play window. Next to each sample, were two radio buttons in which the listener could classify the sound sample as either male or female but not both. The order in which the sound samples were presented to each subject was randomized at the time the page was loaded using Javascript. After all of the sound samples and radio buttons, there were three free response questions to which the subject was expected to provide answers. Because the data collected from the certainty rankings was seemingly inconclusive, it follows that it was omitted from the online study in hopes of preventing unnecessary confusion in what appears to be an already somewhat confused presentation of the questionnaire. For a better understanding about the layout of the page see appendix B which includes screen-shots of the website. Subjects who would respond to this website were recruited via email announcement on Stanford University mailing lists.

Results and Discussion – Online Study

Although the online study seems like a good way to get a broader range of individuals to take the survey, it does introduce numerous new forms of error. Perhaps the most prominent and important to mention here is the extreme possible variation in listening environment. Although the study specifically requests that all subjects complete the study wearing headphones and without altering the volume level between sound samples to sound sample, it is impossible to determine whether the subjects did actually follow this request. For the purposes of data analysis, one assumes that the listeners did in fact all listen to the sound samples in the same listening environment, all wearing headphones with little to no background noise; however, it is likely that the subjects in fact listened to the sound samples in extremely varied environments. Undoubtedly, some individuals listened to the sound samples with different types of headphones while others did not wear headphones at all. The variance in the listening environments of the subjects leads to increased variability in the collected data and introduces error that can not be quantified by the data analysis process.

Additionally the online form did not require that the subjects actually listen to the sound sample before entering their gender classifications. Although it is unlikely that an individual would attempt to complete the survey without listening to the footsteps, there is nothing in the form to *prevent* this from happening. Therefore, one can not avoid any error that may result from an individual attempting to complete the study who never listened to any of the sound samples.

Because the ordering of the sound samples is randomized at the load time for the website, it is possible to re-randomize the sound samples while viewing the page by clicking the "Reload" button in the Internet browser. Because a listener could conceivably reload the page while in the midst of completing the study and thereby reorder the sound samples, it is possible that a subject who did in fact reload the page while in the midst of completing the survey might believe that they are classifying different sound samples than the computer believes that they are classifying.

It is unlikely that this in fact happened because the plugins for actually playing the sound samples take a few moments to load and thus reloading the page causes a visible change to the website.

Finally, there is additional variability introduced in the online study because listeners are free to listen to the footstep samples as many times and in whichever order they desire. Thus despite the randomization of the ordering in which the sound samples are presented to the listener, the subject is free to listen to the samples out of order and play and replay the samples until he or she is comfortable with his or her classification. This is simply another manner in which additional variability was introduced into the listening environment of the subjects. Because this format allows the listener to play and replay the sound samples, the listener can approach the classification task in the following manner:

> He counts the number of sound samples. He figures that of the total number of the sound samples half must be male and the other half must be female. He listens to the sound samples and attempts to classify the male half of the sound samples (or the female half of the sound samples) listening to one sound and comparing it to all of the others. Once he has selected half of the samples to be male (or female), he assumes that the other half must be female (or male).

Although one can not be sure that the task was in fact approached in this manner, the online data presentation did allow for a subject to attack the problem as explained above. Such a comparative process undoubtedly introduced additional variation and error in the data collected from the online survey.

Despite the aforementioned possible sources of error, however, the data collected from the online survey seemed to parallel that collected from the first in-class survey. The tabulated geographical data about the listeners is presented in Table 3. As is evidenced in Table 3, the subjects who completed the online study were more frequently than not, females and were average aged college students.

# Male Subjects	5
# Female Subjects	12
Total # Subjects	17
Average Age	19.53

Table 3. Geographical information about the subjects who completed the online survey.

Sample #	Walker Gender	Sample Shoe Type	% Male
1	#1 F	Dress Shoes	18%
4	#1 F	Sneakers	71%
11	#2 M	Dress Shoes	53%
14	#2 M	Sneakers	65%
17	#3 M	Dress Shoes	76%
22	#3 M	Sneakers	65%
27	#4 F	Dress Shoes	29%
29	#4 F	Sneakers	71%

Table 4. Complete tabulated data from the online survey.

From the results presented in Table 4 above, it is clear that most of the subjects of this online study were able to correctly identify the gender of the walkers when the walkers were wearing stereotypically gendered shoes particularly when the walkers were women wearing high

heeled shoes. It is noticeable here that the listeners were not as successful at identifying the males wearing stereotypically male shoes in this online study as subjects were during the in-class study. It is also important to note that different representative sound samples were used in the online study from those presented to the in-class subjects. This decision was a result of more careful analysis of the sound samples and the discovery that a few of the sound samples presented to the in-class subjects were not as clear as some of the other sound samples.

The differences in the subjects' ability to correctly identify the gender of the male walkers wearing stereotypically male gendered shoes, is most likely due to the varied and unpredictable listening environment for subjects who participated in the online survey (see above discussion). As is evidenced in the sonograms presented in appendix A, the sound samples of men wearing male dress shoes are generally quieter than the sound samples of women wearing high heeled shoes. Additionally, the variation between the sonograms in which males were wearing dress shoes and the sonograms in which all individuals were wearing the prepared sneakers was minimal. Therefore, it is not surprising that listeners, when in a less than optimal listening environment, would have difficulty distinguishing between male and female footsteps when the overall volume was rather low.

Similarly, the subjects participating in this online study had difficulty correctly identifying the gender of individuals wearing the prepared sneakers. When the results presented in Table 4 are compared to those presented in Table 3, the results from the in-class data, one can see that the results calculated from the online survey show more of the error associated with variable listening environments and, as a result, an inability to hear many of the small nuances between sound samples.

Thus, because of the difficulty associated with regulating the listening environment for the individuals participating in the online study, many of the specifics of the data collected in this portion of the study should be ignored due to variations and their associated error. From this data, however, one can infer the same general trends that presented themselves in the pilot in-class study. Humans are able to identify the gender of a walker when he or she is wearing stereotypically gendered shoes, dress shoes for men, and high heels for women, however, are much less successful at identifying the gender of individuals who are wearing gender neutral shoes, the prepared shoes with thumbtacks pushed into the soles.

Conclusions and Suggestions for Further Research

From this experiment, one can draw conclusions that contrast those presented in the aforementioned work of Li, Logan, and Pastore who stated that individuals can distinguish between male and female footsteps on the basis of auditory cues alone regardless of shoe type (even when a walker is barefooted). The present work shows that humans are unable to distinguish successfully between male and female footsteps samples unless the walking individuals are wearing stereotypically gendered shoes – high heels for women and dress shoes for men.

From the present study, it also seems as though a listener does not rely upon biological information about the walker in order to distinguish the footsteps as belonging to a male or a female. This is evidenced in the seemingly absent correlation between weight and the percent of times a specific subject was identified as male.

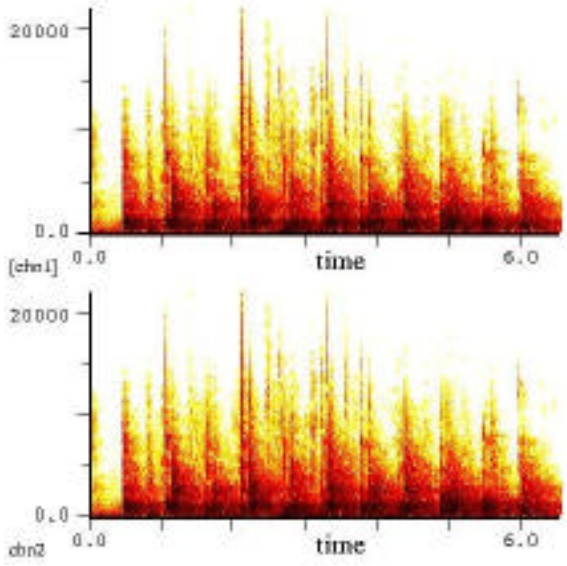
It seems as though the logical extension of the research in this field would be to reproduce the Li, Logan, and Pastore study precisely. In other words, it would make sense to request that individuals walk barefooted across a wooden stage toward a microphone and then ask listeners to attempt to identify the gender of the walker. The current study leads one to believe that individuals would not be able to correctly identify the gender of walkers in this case because there is not any auditory data about the stereotypically gendered type of shoe that the walker would wear, however, before one can state that the results reached by Li, Logan, and Pastore are not as hard fast as seems to be argued in their paper, it would be important to reproduce their study in its entirety.

Additionally, it would be interesting to collect more precise data about the timing of the individual's footsteps making contact with the ground. Such data could be collected through the use of an insole pressure sensing system which would not only monitor the timing of the contact between the foot of the walker and the floor but would also provide information about the pressure associated with each step. Thus one could determine precisely how much pressure was being exerted upon the floor at every moment as the human walked across the floor and this data could be correlated with the auditory data collected through analysis of the sound samples.

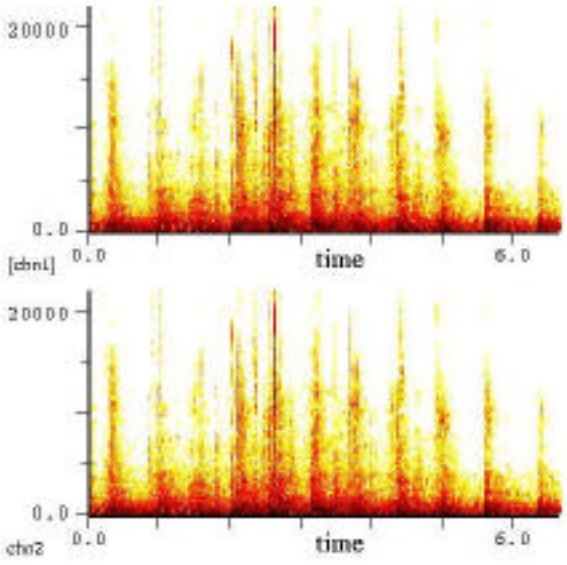
Appendix A

Sonograms for analysis of the individual sound samples. Sonograms depict the frequency decay over time for each footstep. It is clear from these pictorial representations of the sound samples that each individual walked past the stereo microphone at approximately time 3. Both channels are presented for each sound sample.

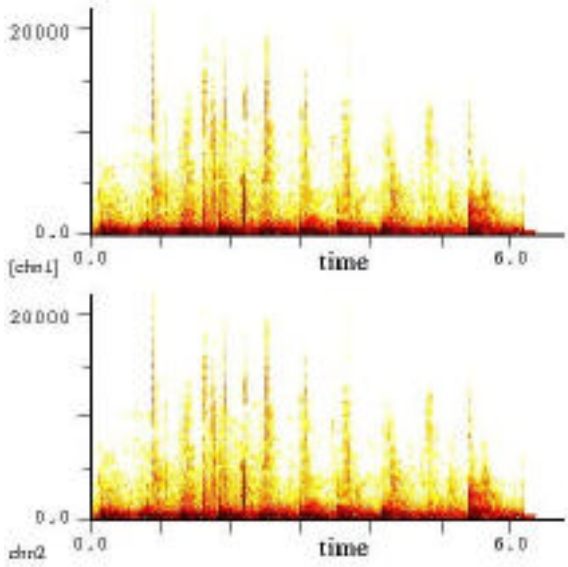
All sample numberings denote the overall number of the snippet of recording. Because four or more recordings were collected of each individual wearing each type of shoe, these recording numbers do not correlate directly to the subject number (also provided).



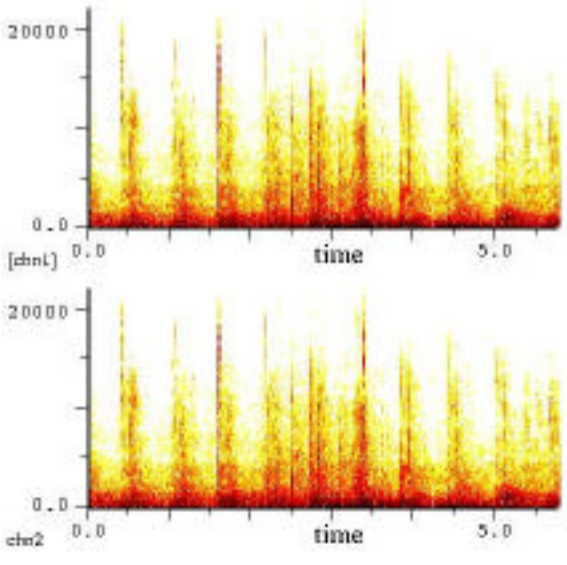
Sample 1. Walker 1 wearing heels.



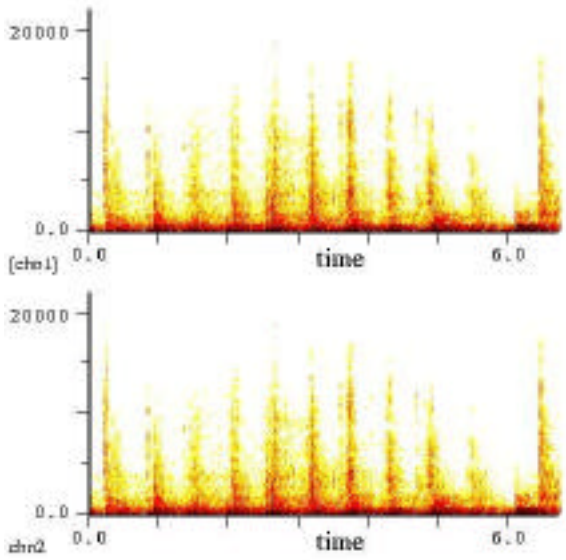
Sample 4. Walker 1 wearing prepared sneakers.



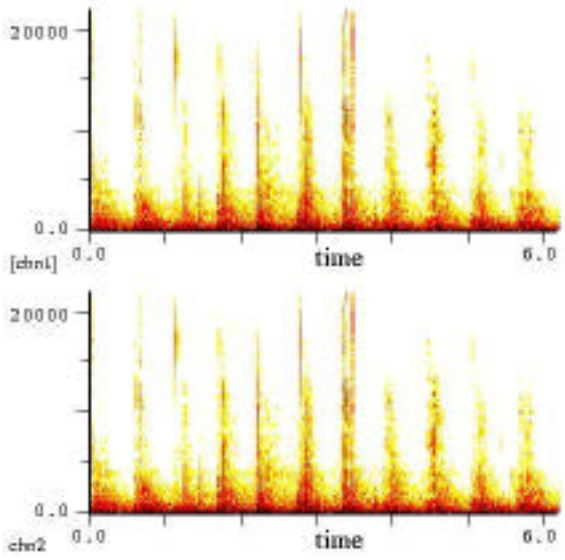
Sample 11. Walker 2 wearing dress shoes.



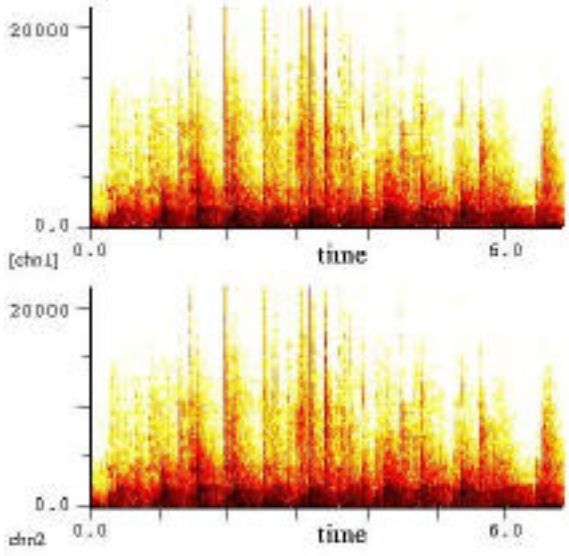
Sample 14. Walker 2 wearing prepared sneakers.



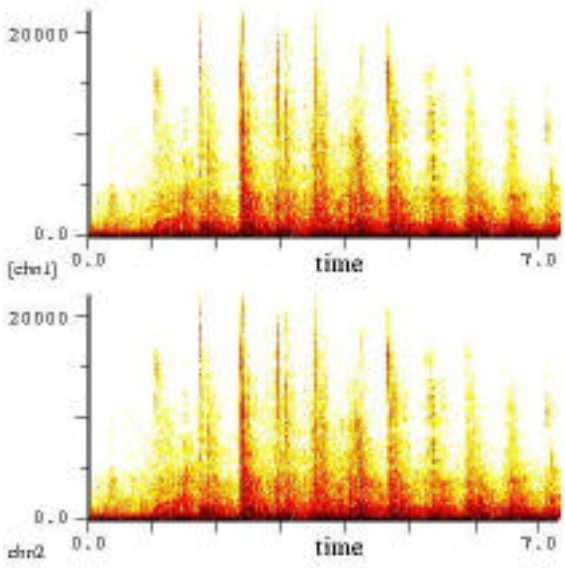
Sample 17. Walker 3 wearing dress shoes.



Sample 22. Walker 3 wearing prepared sneakers.



Sample 27. Walker 4 wearing heels.



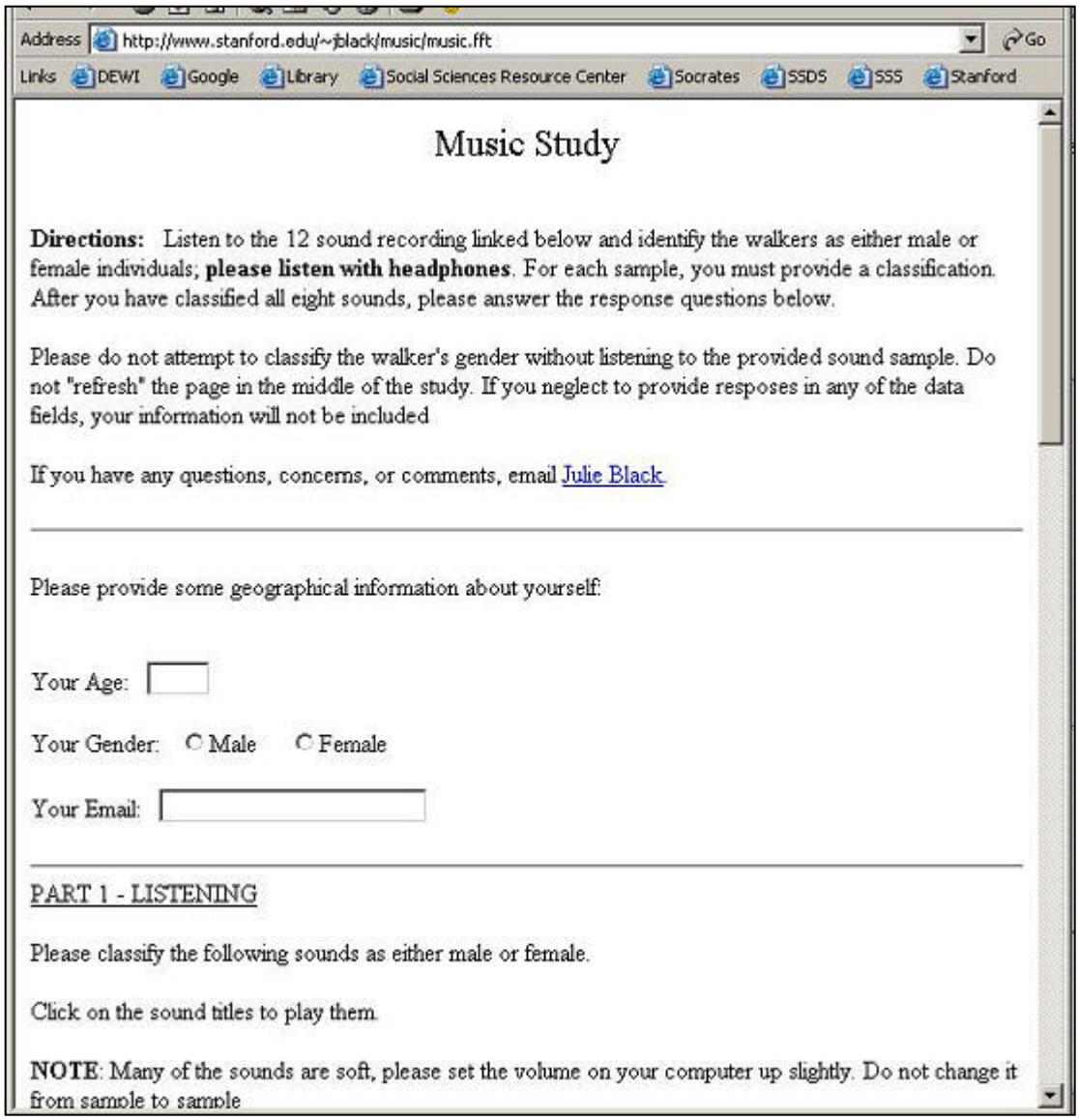
Sample 29. Walker 4 wearing prepared sneakers.

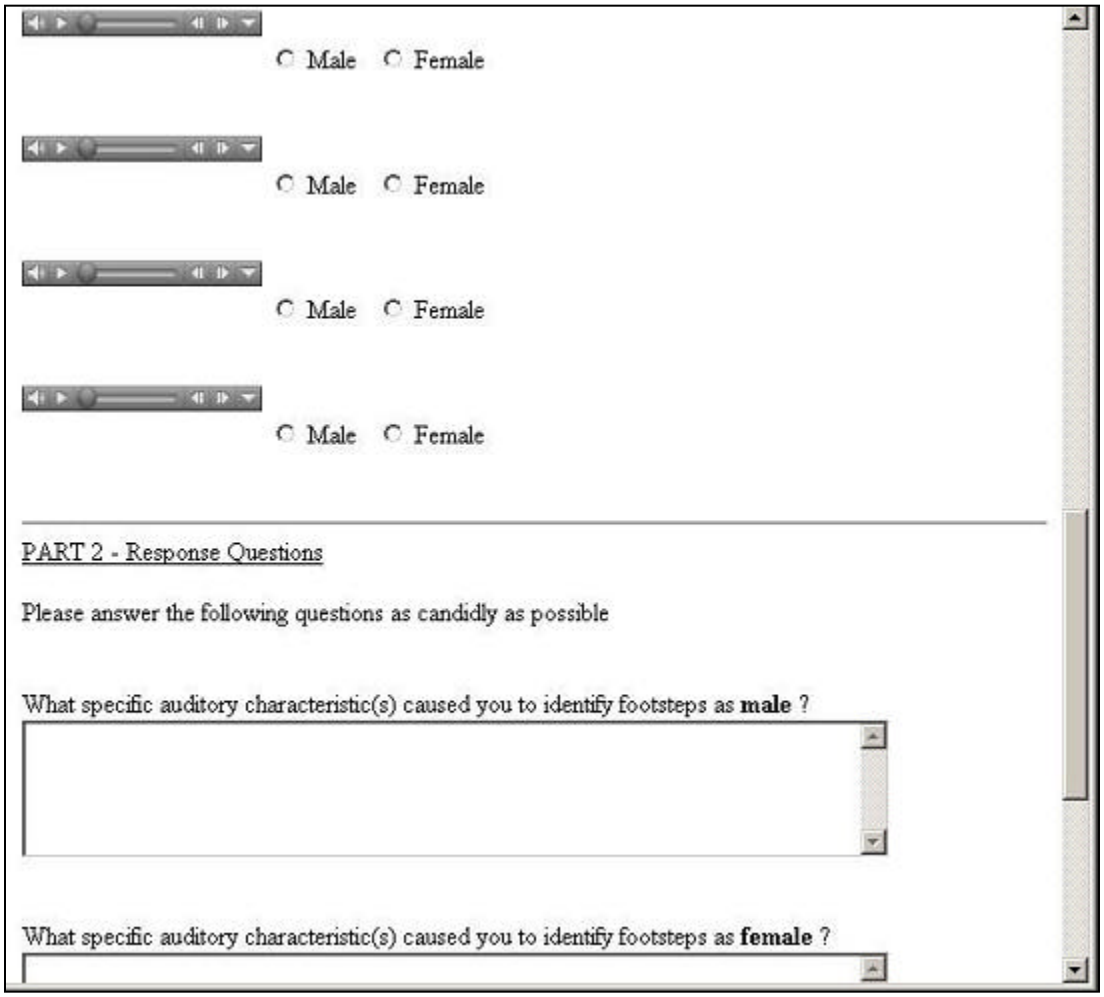
Appendix B

Screen-shots from the online survey in order to provide the reader with a glimpse of the questionnaire format. These screen-shots are merely portions of the survey and do not display the questionnaire in it's entirety. There were three free response questions at the conclusion of the study as follows:

(1) What specific auditory characteristic(s) caused you to identify footsteps as **male**?
(2) What specific auditory characteristic(s) caused you to identify footsteps as **female**?
(3) What auditory characteristic(s) made it difficult to identify footsteps as either male or female?

The following two images are screen-shots of the survey, the first illustrating the top of the page and the second illustrating the middle and end of the page, the manner in which the sound samples were displayed and the beginning of the free response questions.




Male Female
Male Female
Male Female
Male Female
PART 2 - Response Questions
Please answer the following questions as candidly as possible
What specific auditory characteristic(s) caused you to identify footsteps as **male** ?
What specific auditory characteristic(s) caused you to identify footsteps as **female** ?

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