UNIVERSITY OF CALIFORNIA

Los Angeles

The Artificial Masterpiece

An analysis of mockup and live performance perception

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Music

by

Jennifer Karen Fagre

2017

ABSTRACT OF THE DISSERTATION

The Artificial Masterpiece

An analysis of mockup and live performance perception

by

Jennifer Karen Fagre

Doctor of Philosophy in Music

University of California, Los Angeles, 2017

Professor Gregory A. Bryant, Co-Chair

Professor Ian Krouse, Co-Chair

This dissertation will explore how mockups (sampled/synthesized music) have evolved and incorporated themselves into today's music industry. Mockups are created using sample libraries, which are collections of digital or acoustic sound recordings, known as samples, for use by composers, arrangers, performers, and producers of music. Especially pertaining to film/TV and pop music, the amount of control available to producers in the studio with both sampled sounds and live recorded sounds has allowed musicians to achieve results they've never before been able to produce, and often times at a fraction of the cost it takes to record a live orchestra. Furthermore, considering that people still enjoy seeing music performed live, this new level of production creates an issue for transferring music into the realm of live performance. People generally think that live music is always better than mockups. This monograph presents research and reports about how people are now making judgments and observations about today's music when they may not fully understand what exactly they're hearing or how the music was produced. Two related experiments were conducted to determine whether or not people can tell the difference between a professional mockup and a live recording today, considering the evolution and saturation of mockups in media. The first experiment simply tests for accuracy at determining mockups versus live recordings, while the second experiment tests for preferences between mockups and live recordings. The experiments also explore whether or not certain personal factors affect results, such as a history of music experience, for instance.

The dissertation of Jennifer Karen Fagre is approved.

David S. Lefkowitz

Michael Dean

Robert Fink

Gregory A. Bryant, Committee Co-Chair

Ian Krouse, Committee Co-Chair

University of California, Los Angeles

2017

TABLE OF CONTENTS

LIST OF FIGURES

VITA/BIOGRAPHICAL SKETCH

Education

University of California Los Angeles
Master of the Arts – Composition (2014)

Conservatory of Recording Arts and Sciences, Gilbert, Arizona
Professional Certificate in Audio Engineering (2010)

Saint Olaf College, Northfield, Minnesota
Bachelor of Music – Theory/Composition (2009)

Teaching Appointments

Chaffey College
2017 – , Professor of Music (Music Appreciation)

Professional Experience

JoAnn Kane Music Service
2015 – , Copying, proofreading, take-downs, mock-ups, music preparation

Judith Finell MusicServices
2015 - , Take downs, musicological researching such as prior art, music database searching, and theoretical analysis for cases of possible copyright infringement

Musical Assistant/Engineer for Paul Chihara
2013 – , Copying, take-downs, mixing, mock-ups
Major projects include *YULAN, The Morning After, The Survivors, Death Race 2000, I Never Promised You a Rose Garden,* arrangements for Orpheus Chamber Orchestra

Professional Violist/Violinist
2009 – , San Bernardino Symphony, American Youth Symphony, Recording Sessions

Phantom Vox/Draco Rosa
2010 – , Performing various instruments for professional recordings, as well as arranging and composing for various projects.
Major projects include Grammy Winning Album *Vida*.

Honors and Awards

Recipient of Dissertation Year Fellowship at UCLA, 2016 – 2017
Recipient of Graduate Research Mentorship Scholarship at UCLA, 2014 – 2015
Recipient of Graduate Summer Research Mentorship Scholarship at UCLA, 2014
Performed strings on Grammy winning album *Vida* by Draco Rosa (won 2013)
Attended American Institute of Musical Studies on Viola in Graz, Austria, 2012
Graduated Magna Cum Laude from St. Olaf College, 2009
Recipient of Departmental Distinction in Composition at St. Olaf College, 2009
Salutatorian of High School Graduating Class at Cloquet Senior High School, 2005

<u>Compositions</u>

2017 ***Petos*** for full orchestra and mockup orchestra
2016 ***Untitled*** for full orchestra and mockup accompaniment
2015 **Piano Trio No. 1**
Winter Storm in the Gichigami (solo piano)
2014 **UCLA Thesis – Excerpts from *The Taking of Pelham 1-2-3*** (Digital Mockup)
2013 ***Gone From My Sight*** (SATB choir)
Under the Pelt (Sound Design for Dance Performance)
Duet for Violin and Guitar
2012 ***Vita Anime*** (Woodwind Quartet)
2011 ***Chicken Shed*** (Documentary Score for Piano Quintet)
2010 ***Obsession*** (String Septet)
2009 ***Celestial Call*** (Electronic Work)
The Muses (string quartet and percussion)
Walking in the Air (Dance Remix) by Howard Blake, Arr. Jennifer Fagre (Electronic work)
Memories (electronic music project)
Children's Carousel (Transcription for Piano)
2008 ***Memoirs of the Enchanted*** (full orchestra)
Fanfare for Science (brass quintet)
The Deep End (Original Film Score by Josh Terwey)
From Yesterday (Original Film Score by Josh Terwey)
Circle (clarinet and harp)
Oda al Vino (2 female voices and string trio; text by Pablo Neruda)
2007 **Modes of Vibration** (brass quintet)
Debussy Gone Scriabin (piano)

2006 ***Rosa Blanca*** (female voice and guitar)
Affirmation (male voice)
Virus (contrabassoon, tuba, timpani, and double bass)
Jingle Bells Variations (string quartet)
Dance Collaboration (violin and viola)
Emerging Green Builders of Canada (cello and piano)
2005 ***Children's Carousel*** (full orchestra)
1996 ***Butterfly Lullaby*** (piano)

Chapter 1: The History and Evolution of Music Production

With the invention of sound recordings, people can now enjoy music in the privacy of their own homes instead of needing to attend live concerts. Once artists began producing albums to be sold to the public, they eventually realized the possibilities were endless in the amount of control they had over sounds on the album. As technology continued to improve, and people continued to invent new machines and processors to manipulate and control sound, albums began to sound different. Many argue that the sound of albums today do not sound as good as they used to at a more "raw" time, yet people also embrace the new level of control and perfection exerted onto music. The people often most supportive of this immaculate control are the composers and artists, who can finally produce their music to sound exactly the way they had imagined it.

The general public, with or without their knowledge, has slowly been introduced to different sounding music as production has changed. Over the past few decades, the old analog sounds of albums from the past have been replaced with digital sounds. Some cherish the old analog days while others value the ease and clarity of the new digital formats. With technology improving every day, digital sounds now have a huge presence in the music industry, especially in the music of the 80s and again in the 2000s. Producing music "inside the box," meaning mostly within computer software itself instead of recording live sounds, has made music production accessible to a multitude of people who may or may not have had previous abilities to create a legitimate musical work. With the invention of programs like GarageBand, just as the name suggests, anyone can produce a professional sounding work without needing to hire musicians. With the control available to musicians in the studio allowing for a more "perfect" sound, specifically with intonation, it is possible musicians can explore other musical avenues knowing less time needs to be spent on perfecting rhythms, intonation, and other musical aspects that often require practice.

On the other hand, in an orchestral classical music performance, one witnesses a large number of people, anywhere from sixty to a hundred, all performing the same piece by a composer who may or may not be present. Regardless, with classical music, the composer almost never performs the actual work. Most pieces heard today are in fact written by composers who have long passed away, which leaves a lot of room for interpretation by the conductor, although the main goal is almost always to replicate what the composer wanted as closely as possible. In any case, no one is there to micromanage the performance, which is often the contrary within the pop music realm. With society embracing pop music, some production techniques used for pop are sneaking their way into the classical music production world, which has lead to issues with live performance yet to be remedied.

Chapter 2: Purpose of Experiments

The music production industry has been heatedly discussing the music from the Main Title of the *Game of Thrones* series on HBO. Considering the television show's popularity, the audience is vast and includes both professional musicians and the non-musical population. As can be seen in a blog by violinist/studio owner Lara St. John, there is a huge controversy about how the main title was produced, including a lot of negative accusations and comments.[1] Many musicians hate the main title assuming the entire thing is sampled without live musicians, yet most non-musicians greatly enjoy the music and consider it to be epic and exciting, likely without considering how it was produced. There was likely a lot of editing to the recording once it was made, which therefore gives musicians the impression of it using a sampled solo cello. Furthermore, during a podcast by Song Exploder, Ramin Djawadi informed the listeners that the entire main title was recorded remotely in Prague. These newly discovered facts contradicted the harsh judgments made by so many people.

St. John had to write an addendum to her original post.[2] She had such an overwhelming response to her first article that she felt compelled to write another to clarify a few things that had been addressed. She explained that she reached out to other professionals, specifically the head engineer of Warner Elektra Atlantic Studios in Burbank, Scott Levitin. He agreed that the original main title cello sounded sampled, and proceeded to interview eight other engineers at the

[1] Lara St. John, "Lara Takes On HBO and Game of Thrones in an Open Letter," Saurian Saint, May 08, 2014, accessed April 25, 2017, https://sauriansaint.wordpress.com/2014/02/15/lara-takes-on-hbo-in-an-open-letter/

[2] Lara St. John, "Addendum to Game of Thrones," Saurian Saint, February 23, 2014, accessed April 25, 2017, https://sauriansaint.wordpress.com/2014/02/23/addendum-to-game-of-thrones/

studio. Six also agreed it was sampled, one was unsure, and one thought it was real but could not be certain.[3]

Technology has reached the point where it is not easy to identify a mockup versus a live recording anymore.[4] If the mockup samples professionals use did not sound good, the music would not be as successful, even with the general public that does not have an ear for it. While St. John stated that any musician who plays an instrument would consider a sampled cello to be "soulless and devoid of meaning," many agree it sounds great, which is why it is so difficult to really tell if it is a real recording or not.

Importance of Understanding the Source

Specifically with film and television music, orchestral music has been controlled and enhanced heavily through recordings today compared to decades prior. Music for media often sounds highly polished, if you do not consider the fact that much of it sounds a bit digitized to the trained ear. Specific musical techniques, such as articulations, tiny margins of error between human players, etc. are often lost with samples, which signals to the trained ear that live players may not be present. On the other hand, when music for media is performed live, the balances that are achieved in the original recording are almost impossible without extreme amplification during live performance. There are many common performance practice issues when performing highly controlled musical works intended for at-home consumption. Balance between

[3] Although the editor has stated that the cello was performed live, skepticism remains. Without valid proof, many question the honesty of this statement considering the company's desire to preserve its reputation.

[4] There have been many debates about the concept of "live-ness" and this paper is not intended to simplify them. For the sake of easy reading and labeling, the term "live" will apply to music that was performed from beginning to end with humans on musical instruments, regardless of consumers listening to these recordings at home. To read more about "live-ness," see Philip Auslander's *Liveness* (2011, see bibliography for full details). The term "mockup" will refer to musical examples that are assembled with a "sequencer." Many mockups use samples, which are originally recorded live by musicians. But mockups use a sequencer to take tiny chunks of these samples and assemble them chronologically to create a realistic sound meant to mimic live instruments.

instrumental groups is often difficult, especially when live tracks are boosted with samples in the studio. With live players performing for an audience, there is the possibility that certain players will rush or drag the tempo, causing the music to sound out of sync, while these errors can be corrected in the studio. Solo instruments can be boosted above entire sections of instruments when mixing for an album. Yet on stage, the solo might need a microphone in addition to the rest of the orchestra needing to play much quieter for the solo to be heard. If instrumental sections are forced to play quieter than what is heard on the album, it will not sound like the album version.

Also consider the famous TV show *American Idol*. One episode with the highest views is near the beginning of the season, where they showcase the auditions and all the terrible singers who thought they might have a chance at winning a spot in the competition. What is even more interesting is that these less-skilled singers actually *think* they are great singers. Perhaps some know they have no chance and simply go on to try to earn their two minutes of fame through embarrassment, yet it is safe to say many people are truly there because they love to sing and want to compete. What does this say about their criticism of professionals? Amateurs, who likely may not be able to tell the difference between a great singer and a poor singer, upload videos to YouTube that criticize artists for lip-syncing. On the other hand, these same people might also have a harder time distinguishing a truly live performance and a lip-synced performance. Regardless, the number of YouTube videos featuring terrible singing or lip-syncing proves it is a topic many people find valuable to discuss.

Moving away from the lip-syncing realm, other tools are often used to enhance live performances. Another notable "scandal," scarcely discussed in the media, is that of the popular TV show *The Voice*. *The Voice* is known for having excellent singers competing against each other for a $100,000 grand prize and a record deal with Universal. The majority of the show is presented on TV as raw material without much editing (at least in terms of the competitors' voices). There is one specific instance each season where editing is questionable, though. The contestants must perform together in "Battles" where duets are sung. During these duets episodes, a few vocal characteristics seem extremely processed.

Considering one person performing by themselves on stage with either instrumentalists or a prerecorded track, intonation is not necessarily an issue since there are no other live human voices with which to align. When you add another voice, however, you suddenly have two similar sounds that must work together, which is not as easy as it might seem. Especially with experience in Auto-Tune, a program used largely to tune voices or solo instruments, you can specifically hear the program processing the singers' voices throughout the duets, especially at moments where perfect intervals are held for a significant time duration. Acoustically speaking, perfect intervals such as 4^{ths}, 5^{ths}, and octaves have a very small window of being "in-tune" before sounding incorrect. Mathematically, 2^{nds}, 3^{rds}, 6^{ths}, and 7^{ths} have a larger window of "in-tuneness," especially given the different tuning methods in use throughout history. Perfect intervals are much harder to hit and maintain intonation, which is why some of these "perfect sounding" intervals heard during *The Voice* duets are very suspicious. Sadly, there is no direct documentation that they auto-tuned the duets, but, as mentioned previously, their production practices are largely left unmentioned to the general public.[5]

When discussing the mockup usage in the music industry today, one must be familiar with sample libraries. A sample library is a collection of digital or acoustic sound recordings, known as samples, for use by composers, arrangers, performers, and music producers. Especially

[5] As was with the music editor from *Game of Thrones*, in order to maintain reputation, it is possible that the producers from *The Voice* will never come forth to admit the level of processing used during the show.

pertaining to film/TV and pop music, the amount of control available to producers in the studio with both sampled sounds and live recorded sounds has allowed composers to achieve results they have never before been able to produce, and oftentimes at a fraction of the cost it takes to record a live orchestra.

Below, I will report the findings from two experimental studies examining how listeners today make judgments of music created using different techniques when the listeners may not fully understand exactly what they are hearing or how the music was produced. Music has evolved extensively over the past few centuries. Our culture has worked hard to make things easier, more efficient, and more enjoyable. With evolution also comes change, which many people have a hard time grasping. Live performance today is not what it used to be, and one can form their own opinions on what they would classify as "the glory days." Some may say live performance today is disappointing in that so much is enhanced by technology and the true sense of the musical artistry is lost, yet others may see the elaborate entertainment aspect from all angles as an exciting and promising future for music. Consider the role of the orchestra in film music. So much of the general "non-classical" public loves film scores, and might not encounter the sound of classical music at all without the precedent of orchestras in film. The visual aspect of film draws people in, which is worth pondering in terms of how visuals could be incorporated into live music acts.

As mentioned before, the sampled music saturation in society today has not only changed how we hear music, but also has created some issues for live performance. Due to the decline of interest in classical music, many financially failing orchestras are resorting to performing more popular genres and are often criticized due to the drastic difference heard between live orchestral instruments and studio-produced music.[6] The most successful performances have been actual film screenings with live orchestral accompaniment playing the direct soundtrack alongside the projected film, such as *The Wizard of Oz, Star Trek: Into Darkness,* and *ET: The Extraterrestrial*, to name a few. These "Films In Concert" have been successful because their composers wrote scores that can stand alone without digital enhancement, therefore making a smooth transition from theatre to concert hall without needing to bring in digital sonic assistance. This film composing method could be a new avenue for both orchestras and film composers, allowing for more performances outside of the movie theatre and therefore bringing in more revenue.

There are differing tastes among people from different backgrounds. Most people do not consider the reasons for creating a mockup, and one can possibly learn many valid reasons why a mockup is used in a professional setting. Several composers are incapable of hosting cost prohibitive recording sessions with live musicians, yet the final product when using only mockups is still professional and often fits moving picture well. When discussing why artists or producers might decide to use synthesized or sampled instruments, it is important to understand that some people, especially composers, might prefer the sampled sounds and the ability to control them. But others argue that real musicianship is always superior to synthesized sounds or mockup performances. One can appreciate both sides of the spectrum of live recordings vs. mockups, but each has its own place, and the lines are not drawn thick. Listening to a Mozart violin concerto with a sampled violin would probably be pretty grotesque for everyone, but a sampled instrument that can perform in ways a real cellist could never imagine might eventually find its place within the musical world. In general, when you have several instrumental layers in

[6] There are not many studies to confirm the decline of classical music, but there has been a lot of discussion, beginning as early at the late 1990s with Robert Fink's *Elvis Everywhere* (1998). See bibliography for full details.

a mockup, some subtleties you might be able to identify as artificial are masked by all the sounds occurring at once. When you listen to thinner textures with solo instruments, each sample is exposed and it is much easier to hear little glitches that occur with samples.

It is also worth considering that throughout the production process for film and TV, whether or not the ultimate intention is to record the music live, producers listen to a mockup track created for approval purposes by the composer. This track gets played alongside the film until the recording date for the music arrives, and the producer may really find that specific mockup sound making a home within his/her ears. Many composers also use extremely professional sounding samples. In the original *GoT* article posted by St. John, a commenter and prominent musician in the film and TV industry, Chris Ledesma, provides the following account:

> …let me share an incident that occurred between an Executive Producer and a Composer on a TV movie I worked on about 10 years ago. The composer had presented the entire score to the producer in synthesizer form (known in our biz as a "mockup") for approval before the recording session with the live orchestra. At the recording session, all went well until the recording of the FINAL CUE. The producer pulled the composer aside and asked what he had changed from the mockup to the orchestral version. The composer said, "Nothing. It is note-for-note the same as the mockup." The producer did not believe the composer and the discussion became rather heated and testy. I stood nearby and listened to the producer's argument and it became clear to me that he detected the difference in sound between the synth and the orchestra and came to believe that the composer had "changed" what had been approved. The producer could not be persuaded that day, but we had to go ahead and finish. Afterward, the composer sent the producer a CD with the synth version and the orchestral version of the cue in order to prove that they were "the same". The producer was finally convinced, but not ultimately happy – he preferred the synth version.[7]

Hiring a professional orchestra to record music is very expensive, whether it is for film or a simple sound recording. Most young professionals are not in the position to pay over $50,000 for a professional recording, considering all the factors involved. Most large-scale productions

[7] Lara St. John, "Lara Takes On HBO and Game of Thrones in an Open Letter."

for both film and television have a budget especially for the music. This is why big name companies like HBO turn so heavily to samples and digital instruments.

There are multiple reasons, especially for up-and-coming composers, to use MIDI/sampled instruments. Although samples are expensive, such as Vienna Instruments' "Super Package," which costs over $11,000, purchasing them is a one-time cost, after which you will have an entire library of extremely realistic sounding instruments at your fingertips. Composers have more control over the sound they are looking for, although there are work-arounds necessary to truly create a realistic product. Being a one-man-act has advantages but also requires extra work that would typically be expected of professional engineers and musicians at the recording studio.[8]

Purpose of Experiments

While there are many acoustics and perception studies, very little research has examined mockup perception in comparison to live recordings. James W. Beauchamp has completed a few scientific experiments in musical timbre perception. His usual goal has been "to test listener's ability to discriminate between original acoustic musical sounds and modified synthetic versions."[9] His work examines which acoustic properties contribute to people's ability to discriminate between different musical sounds.[10]

---

[8] Tom Player, another blogger and also composer from the UK, took a similar approach as Lara St. John, but used his own mockups and live recordings to convey how much better a live orchestra sounds compared to a mockup version. He published a series of six articles titled "Real Orchestra vs Synth Mockup" on the Audio Cookbook website. Each article contains a different piece composed by Player, and each piece has both a live recording and a corresponding mockup. To learn more about his findings, see bibliographic info.

[9] "James W. Beauchamp," Prof. James W. Beauchamp Home Page, accessed May 10, 2017, http://ems.music.uiuc.edu/beaucham/

[10] Stephen McAdams, James W. Beauchamp, and Suzanna Meneguzzi, "Discrimination of musical instrument sounds resynthesized with simplified spectrotemporal parameters," The Journal of the Acoustical Society of America 105, no. 2 (February 1999)

Furduj (2014) investigated the role of virtual instrumentation in the believability of music.[11] In describing his listening test, he demonstrated listeners' subjectivity when simply distinguishing between "human and computer generated music" by stating "subjective biases are hard to remove and these types of tests, as much as anything else, 'revealed much about the individual subjectivities of the participants."[12] In his work, he attempted to avoid these biases, while the present study described below attempted to expose them while also examining whether listeners may be biased against mockups yet unable to accurately distinguish them from live recordings.

Most sources pertaining to our purposes are blog entries or other websites where anyone could really say anything they want, whether it be truth or fiction. As unreliable as this is, it makes it even more interesting to dig deeper to find the truth behind these details. Considering the debates amongst musicians, a majority of the music elitists have a strong aversion to mockups for numerous reasons. Composers appreciate samples as a tool to produce their own music easily, yet composers with only mockups to provide are questioned as to why they cannot produce more live recordings and performances of their music. If a composer cannot find live musicians to perform their music, what does that say about the quality of the music they are composing? Truthfully, creating a professional sounding mockup is a difficult task and involves a lot of knowledge and practice, which of course varies with each sample library available. A mockup will likely never match the quality of a professional live performance, but in many circumstances, a mockup can in fact exceed the quality of a live performance due to lack of rehearsal time, lack of proficient players, simple performance errors, etc. Each composition and composer has its own goals and priorities for the final product.

---

[11] Boris Furduj, "Acoustic Instrument Simulation In Film Music Contexts," PhD diss., MacQuarie University, 2014

[12] Furduj, 41

In addition to a general criticism of mockups, there is quite possibly an over-confidence amongst musicians in their abilities to determine whether or not the music they hear is live or sampled. There is a particular bias amongst the older generations who may have not had as much experience with mockups or perhaps are not used to using them, and therefore do not quite realize a mockup's potential.

Nevertheless, there is so much negativity and criticism with production today, and something must change. Either the public must embrace the fact that performance today has changed and that lip-syncing and general enhancements are necessary to properly perform new music, or perhaps new music should not be performed live and instead only referenced by CD or MP3. The latter seems extreme, but it is important to note that the original tracks were in fact created, enhanced, and edited for at-home consumption. So many things in life are created in one medium and presented in others, and must be adjusted accordingly to match each format effectively, and consumers must understand this. Let us ultimately enjoy the show and throw out the unnecessary criticism.

The general consensus on sampled music meant to replace live instruments ranges from neutral to negative, yet people (mostly non-musicians) do not realize the amount of sampled music they hear every day. Over the past decade, music samples have become extremely sophisticated and sound very realistic. There are not a lot of resources specifically addressing the public's ability to tell the difference between sampled and live music.

Learning about how the final products are created provides background for the reader and will also help people make more informed decisions and judgments about the music they hear. Without prying too much into producers' artistic secrets, it is still valuable to ask questions about why they may choose to use sampled instruments instead of live instruments, how much editing is typically applied to live instruments (such as Auto-Tune), or even asking the producers' own opinions on musical quality today, both live and sampled.

In general, it is important to make the public aware of the amount of control going on in the studios, and to help them understand that much of the music they hear on TV is in fact not played by real musicians. The technology gives the composer more control, which may better serve the film/picture. Even within concert music, more control for the composer allows for a final product that hopefully accurately represents the composer's intentions, but as we have seen thus far, it often eliminates the need for more collaboration between musicians, which to some may seem to degrade the "soulfulness" of the music. During this era of musical evolution, it is important for both audiences and musicians alike to understand the changes we may or may not be actively hearing, which hopefully will create a wider understanding and an easier transition forward to this technological era of music.

Chapter 3: Experiment 1 – Accuracy in Identifying Mockups

Experiment 1 was designed to examine the simple question of whether listeners can accurately identify mockups and live recordings, and whether experience with music was a relevant factor in that determination. The prediction was people would not be able to tell the difference between mockups and live recordings nearly as well as they thought they could.

Musical Stimuli

Twenty-four professional mockups and their corresponding identical live recordings were collected. It was important to use the most professional examples as possible in order to create a valid experimental test, as low quality mockups would be easy to identify for many listeners. The 24 examples were broken down into three basic genres: film music (12 examples labeled "F" or "Ch"), classical concert music (6 examples labeled "C" "Q" "H" and "Pn"), and pop music (6 examples labeled "P"). "F" simply referred to film, while "Ch" was a film example containing choir. "C" referred to full orchestral classical examples. "Q" referred to quartet textured classical examples. "H" referred to the presence of a chamber ensemble with solo harp. "Pn" referred to solo piano. "P" simply referred to pop. Orchestral mockups were predicted to be the most deceptive, therefore there was a higher concentration of film examples simply because orchestral mockups are more prominent within the world of media, and not nearly as prominent within classical concert music and pop music. The film cues were taken from three different popular films, one from 2001 and two from 2014. All films were high grossing, at $449.2 million, $363.2 million, and $87.2 million. A professional music company did the mockups for two of the films for the purposes of presenting composed music to the producers for approval, and therefore were of highest quality. The third film mockups were done by the same company with the same professional quality in mind, but were created for this experiment exclusively. The Digital Audio Workstation of choice for these film cues was Logic Pro X, and the sample libraries used were Spitfire, Voxos, Kontakt, Cinesamples, Project Sam, LA Scoring Strings, Symphobia, and various samples from Vienna Symphonic Library. Professional mixing plug-ins were used, such as Vienna's MIR Pro (Multi Impulse Response). The live recordings took place at the most successful recording stages in Los Angeles, such as Fox, Sony, and Warner Brothers, using the most sought after studio musicians. To protect economic interests, further specific details cannot be disclosed at this time.

The classical examples were originally composed as concert music. Two of the classical examples were symphonic pieces: Beethoven's 9^{th} Symphony, 4^{th} movement, and Ravel's Bolero. A prominent composer and professional in the sonic arts world created the Beethoven mockup, which was made for use in a film. The same music company that created the film cues created Bolero's mockup, which was used for the company's demo reel. Both corresponding live recordings in the experiment were taken from professional albums, and were used as a template for the mockups. The mockups mimicked the recordings identically in all aspects, such as tempo, instrumentation, and dynamics. The remaining three classical examples were created myself and are of smaller instrumentation. One example was a string quartet with piano, another was a string quartet with percussion, and the final example was solo clarinet with harp. The same professional DAW and samples were used for all classical mockups. The recordings were done at various professional recording studios around Los Angeles with professional classical musicians.

The pop examples were original works by a recording artist in Los Angeles. Each example contained between 5 and 8 instrumental layers, and instruments used were Bass Guitar, Rhythm Electric Guitar, Lead Electric Guitar, Acoustic Guitar, Shaker, Men's Choir (12 voices), Claps, Ukulele, and People Whistling. The artist created the mockups on a professional rig using Logic Pro X and the following sample libraries: Kontakt, Abbey Road 70s Drums, Audiowiesel E-Ukulele, Best Service Whistler, and Cinesamples Voxos. The recordings were made at a professional recording studio in Burbank with the recording artist performing all the tracks.

The examples ranged between 19 and 28 seconds in duration, with the average length being 22.8 seconds long. The experiments were conducted in quiet rooms on iMacs or Macbook Pro laptops, with Sony Dynamic Stereo Headphones (MDR V-250), using the software SuperLab 4.5.

Methods

Seventy-three subjects (29 males) participated in the experiment. Participants were recruited from the UCLA Communication Studies Subject Pool, as well as additional subjects recruited from personal networks in order to increase the number of individuals with a musical background. The ages ranged from 17.9 years to 95.0 years, with the average age being 32.1 years. After obtaining informed consent, each subject was told they would listen to music clips and identify whether the instrumental sounds were played by people in real time, or were generated using only a computer program (for full instructions see **Appendix D**). Each listener heard one version from each of the 24 examples (half mockup and half live) in random order. After each trial they were instructed to press a button indicating whether the piece was a mockup or live, and then they proceeded to the next trial.

After the experiment was completed participants were administered a demographic questionnaire that asked about education, musical background, and several other pieces of information. For a full questionnaire description, see the Supplemental Discussion in addition to **Appendix C**.

The four-page questionnaire was created with questions useful for the results to help determine why people may have scored a certain way. Some questions were effective while others had no effect on the results. The questionnaire details can be found in **Appendix C**, while the primary focus is displayed in the material presented below.

Age in Years and Months

Many younger people have spent most of their formative years listening to MP3s and digital music, and might possibly be more used to hearing the sound quality of these files as opposed to people who grew up listening to vinyl, cassette tapes, and even CDs. Mockups are entirely digital, which corresponds to most modern day music sound formats, therefore allowing the prediction that young people might have a harder time identifying a mockup, considering the sound format seems familiar to them. They have also spent a larger percentage of their lives being exposed to mockups and perhaps are not as familiar with the live orchestral sounds.

Jonathan Berger, Professor of Music at Stanford University, has done studies over the past eight years determining that the younger generation who has grown up with iPods and MP3s actually prefers the sound of MP3s to CDs or vinyl. MP3 compression uses psychoacoustics to remove "unnecessary" frequencies from the spectrum that the codec "knows" will not be audible anyway, creating a much smaller file size easier to transfer and store on devices. Even though the MP3s are roughly one-tenth the size of the original PCM files, people could not tell the difference. People who have spent their entire lives (or a large portion) listening to MP3s have become accustomed to the “one-tenth” sound, which is highly criticized by the opposite side: those who prefer vinyl and CDs with higher fidelity.

Other factors, according to Berger, have played a role in leading younger ears to prefer the sound of MP3s. With the introduction of streaming services that require Internet or satellite, listeners stream music from their computers or mobile devices that are usually not equipped with high quality speakers, which in turn results in an automatic decrease in sound quality regardless of how good the original recording sounds. Rennie Pilgrem, a dance music producer, concludes that people become accustomed to a certain sound and over time become comfortable with that sound.[13]

Not only has sound recording quality changed with formats like MP3, but the preference for this new quality has risen as well. This is a similar development with mockups and sampled recordings. Soon we may all be like the film producer who preferred the digital mockup to the “real thing.” We have already reached the stage where people at least cannot tell the difference between a mockup (a supposedly low quality production) and a live recording (a supposedly higher quality production).

On the other hand, older listeners witnessed the musical evolution over time and may be able to identify mockups more easily. Someone’s age also ties into general life experience, especially if someone is a musician in these circumstances, which will be addressed later.

---

[13] Nick Spence, "IPod generation prefer MP3 fidelity to CD says study," Macworld UK, November 06, 2012, accessed April 25, 2017, http://www.macworld.co.uk/news/apple/ipod-generation-prefer-MP3-fidelity-cd-says-study-25288/

Identifying Gender

This question was simply to determine if sex shows any difference in accuracy. Today in 2017, we still have some inequalities between men and women, and it is possible there are more men with higher education than women for various reasons, which might merit different scores.

Are you currently or have you in the past been a musician?

Being a musician will likely increase a subject's accuracy with determining a mockup from a live performance. As a musician, people become extremely familiar with the sounds and timbres of their own instruments in addition to other musical sounds they hear regularly. It is similar to recognizing someone's voice you know well. Even with voices, imagine how far technology has come today with computerized voices and automated response systems. In addition, when asking subjects to specify their involvement with music, it is likely composers will score higher than other musicians simply because composers often work directly with mockups.

The next sub-question asked whether the subject was a hobbyist or a professional, as one can assume professionals spend more time with music on a daily basis than a hobbyist does, making them more likely to score highly on the experiment.

The following sub-question asked about musical academic study. It is likely most professionals have also studied music academically, but it could be interesting to see how much education these professional musicians have, and if higher levels of education have any effects on their scores.

The last sub-question asked how many other immediate family members participated in music while growing up. If living in a household surrounded by other musical people, it simply gives the subject more exposure and the possible ability to score highly in the experiment.

Results

A repeated-measures ANOVA was created with performance (mockup or live) and musical genre (classical, film, or pop) included as within-subjects factors, and musician status (musician and non-musician) included as a between-subjects factor, and hit rate (i.e., accuracy) as the dependent measure. Least significant differences (LSD) tests were used for pairwise comparisons.

Live recordings ($M = 0.60$; $SD = 0.49$) and mockups ($M = 0.54$; $SD = 0.50$) were recognized at similar rates, $F(1, 71) = 1.16, p = 0.284, \eta 2 = 0.016$ (**see Figure 1**). There was a main effect for genre, $F(2, 70) = 7.42, p < 0.01, \eta 2 = 0.175$ with pop examples ($M = 0.64$; $SD = 0.48$) judged more accurately than film examples ($M = 0.56$; $SD = 0.50$) ($p < 0.0001$) and classical examples ($M = 0.52$; $SD = 0.50$) ($p < 0.01$), but film and classical examples were judged similarly ($p = 0.13$) (**see Figure 2**). Finally, musicians ($M = 0.61$; $SD = 0.48$) performed significantly better than non-musicians ($M = 0.53$; $SD = 0.49$) overall ($p < 0.0001$) (**see Figure 3**). A post-hoc analysis within the category of musician status with composers separated out (n = 6) from other musicians and non-musicians showed that composers had significantly higher accuracy than the other groups (73% correct), $F(2, 70) = 13.48, p < 0.001, \eta 2 = 0.278$ (**see Figure 4**).

There was no relationship between listeners' age and accuracy (r = -0.09, p = 0.43) (**see Figure 5**).

Figure 1 - Accuracy for each example based on mockups or live recordings.

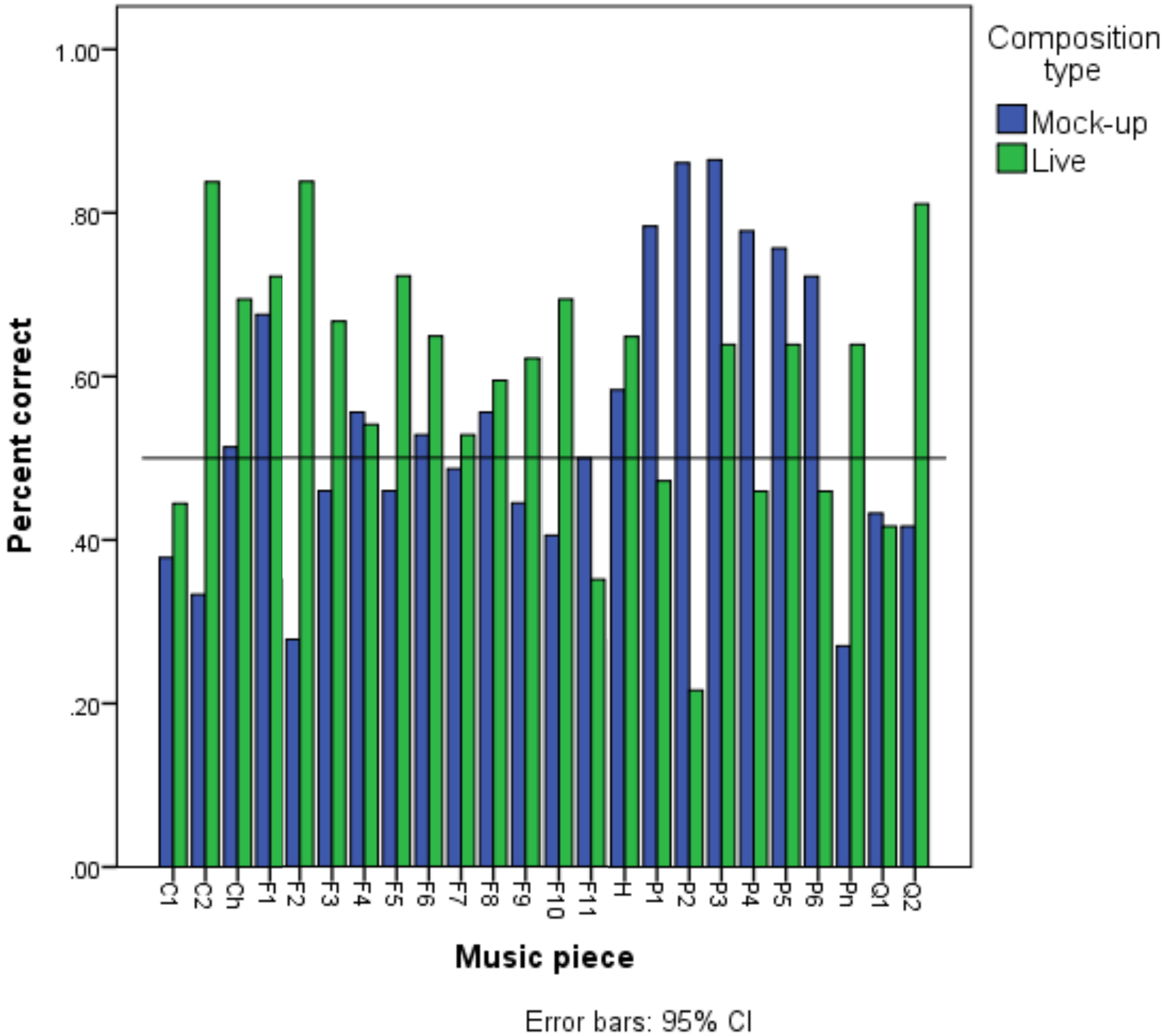


Figure 1G - Standard Deviation

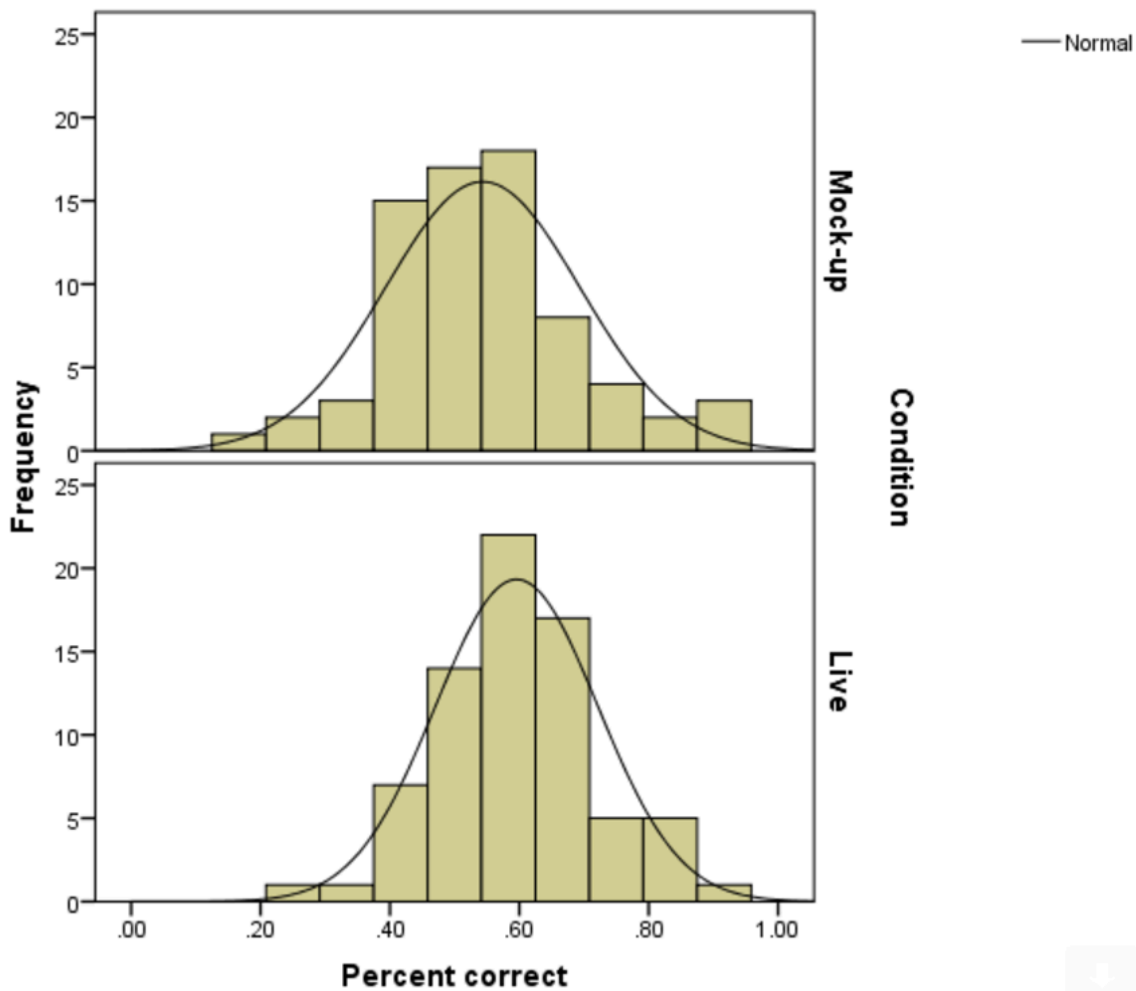


Figure 2 - Accuracy for mockups and live recordings based on genre.

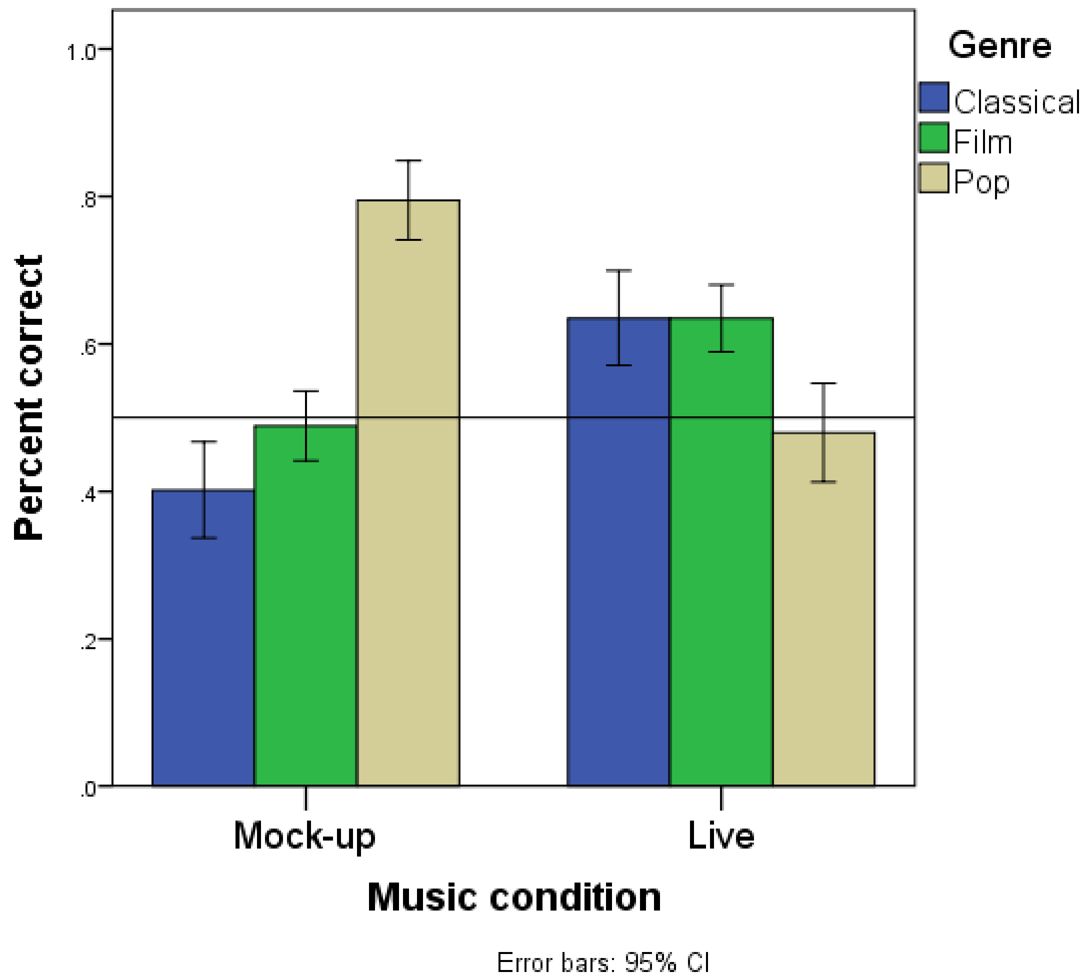


Figure 3 - Accuracy for musicians and non-musicians in judging whether compositions were mockups or live recordings.

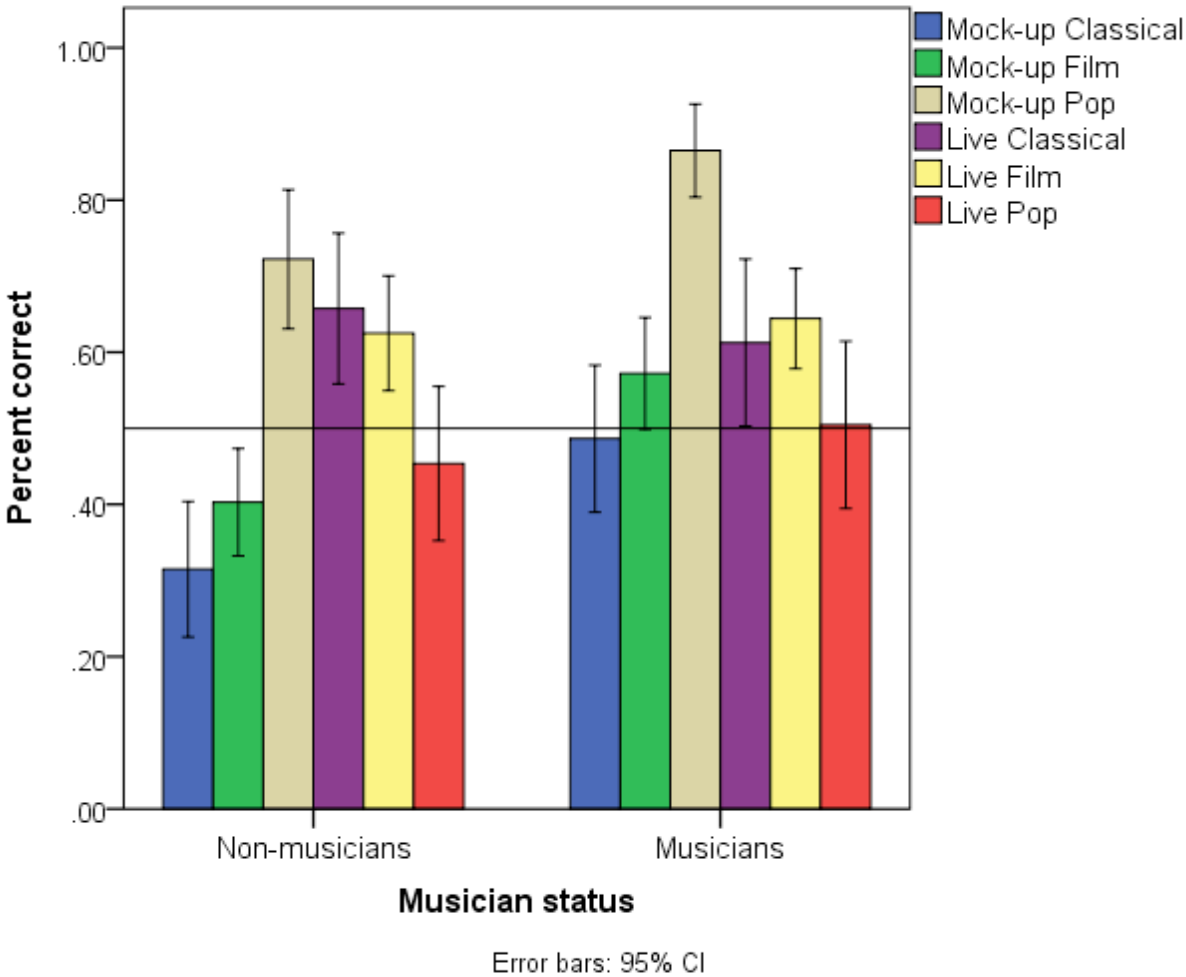


Figure 4 - Accuracy for non-musicians, musicians, and composers in judging whether compositions were mockups or live recordings.

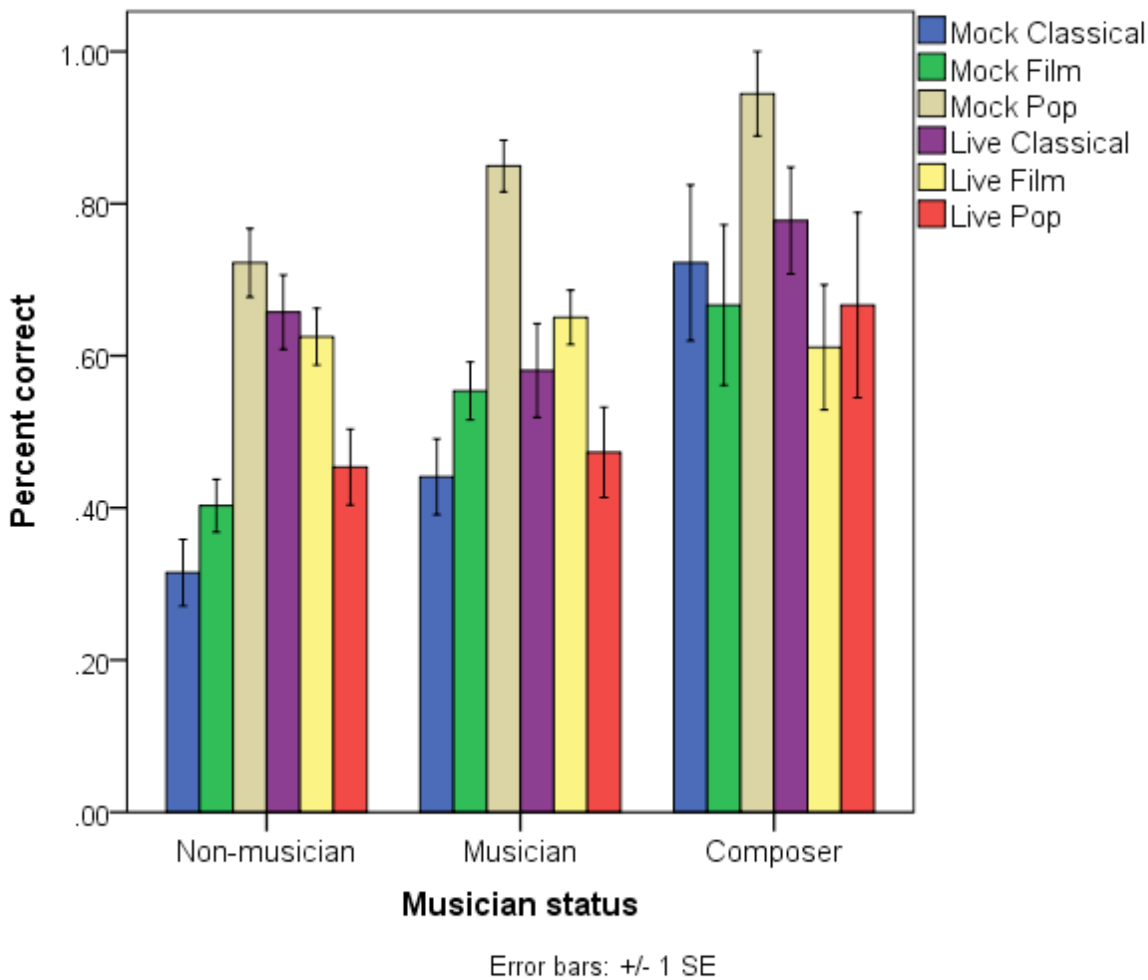
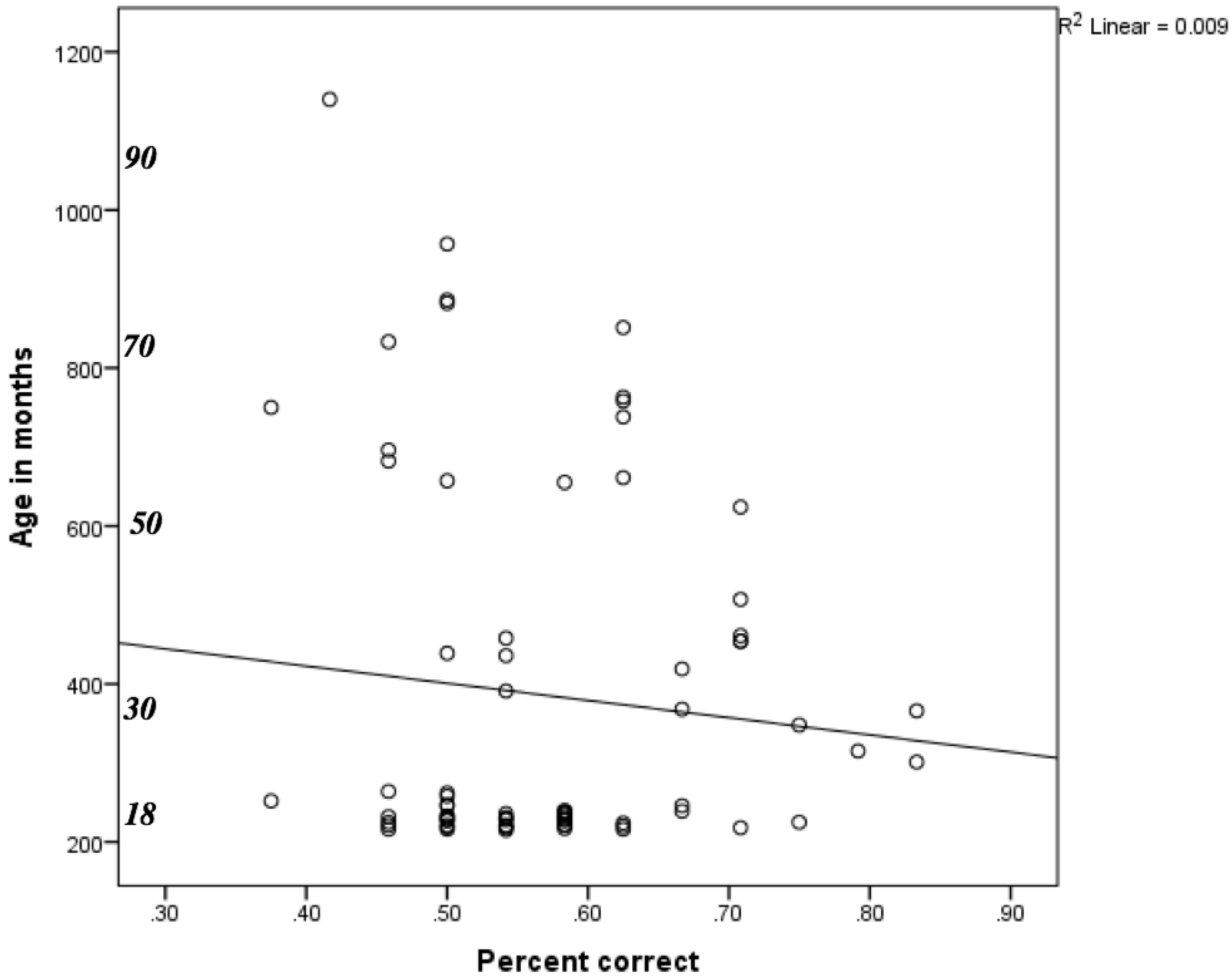


Figure 5 - Accuracy based on age.



Chapter 4: Experiment 2 – Preferences for Mockups and Live Recordings

Experiment 2 was designed to determine if people gravitated more towards live recordings or mockups. The prediction was that if people are told they were hearing all mockups, they would like the musical examples less overall compared to if they were told they were hearing all live recordings. This experiment used the same exact stimuli from the first experiment, but in two groups of instruction.

Methods

One hundred fifty subjects (58 males) participated in experiment 2. Participants were recruited from the UCLA Communication Studies Subject Pool, as well as additional subjects recruited from personal networks in order to increase the number of individuals with a musical background. The ages ranged from 18.0 years to 65.3 years, with the average age being 22.2 years. After obtaining informed consent, each subject was told they would listen to music clips and rate each example on a scale from 1 to 7 based on how much they liked it (for full instructions see **Appendix D**). Half of the participants were told they would hear only mockups, while the other half were told they would hear only live recordings, when in fact everyone was presented with half mockup and half live examples. Each listener heard one version of each of the 24 examples in random order. After each trial they were instructed to press a button indicating how much they liked the music, and then they proceeded to the next trial.

After the experiment was completed participants were administered a demographic questionnaire that asked about education, musical background, and several other pieces of information. For the full questionnaire description, see the Supplemental Discussion in addition to **Appendix C**.

The following paragraphs pertain to experiment 2's correlations with the questionnaire data.

Age in Years and Months

As a reminder, experiment 2 dealt with simply rating each example from 1 to 7 in terms of how much the listener enjoyed the example or how strongly the listener wished to continue listening to the example. A few different predictions can be made, one being that older generations have nostalgia for analog sounds, and therefore would subliminally (or intentionally) tend to prefer listening to the mockups less than the live recordings. It is also important to remember the deceptive part of experiment 2 where the listeners were told they were hearing either all mockups or all live recordings. This knowledge provided before listening was intended to create a bias for the listener. The overall mockup scores were expected to be higher if the listener was told all pieces were live. On the contrary, the live examples were expected to have lower scores for the other half of the experiments where the listeners were told that all the examples were mockups. It is possible that older generations have no knowledge that mockups exist in media today, and upon being told that all the examples they hear are mockups, they are inherently impressed and rate the examples higher than they would have if they thought the examples were simply live.

The overall prediction was that people will give lower scores to all examples when taking the experiment that claims to provide only mockups, and higher scores when taking the experiment that claims to provide only live examples. When comparing each individual example to its counterpart (comparing a mockup with the scores of both truthful and deceptive experiments), it was expected to see a higher score for the “told all live” experiments, and a lower score for the “told all mockup” experiments.

Are you currently or have you in the past been a musician?

Since musicians are likely to be more familiar with live instrumental sounds, it is also likely they are familiar with mockups and understand that using mockups in the industry today has in several instances replaced some valuable performance gigs. Becoming a musician takes thousands of hours of practice and acquiring skills, which can frustrate musicians when they see one person at a computer replicating the sounds they have worked so hard to perfect. You could consider performing musicians today to be modern day non-violent “Luddites.”[14] The Luddites of the early 19th century were British weavers and textile workers concerned by the invention of automated looms and knitting frames. These workers had spent many years learning their craft and were afraid their efforts were for naught, let alone the possibility of the machinery taking away their careers and livelihood. Although we have not yet reached the phase where mockups have completely replaced live performances, there are film and television studios that no longer hire live musicians (or hire smaller groups and boost the sound with mockups). This has left a bad taste in the musicians’ mouths, and therefore creates a bias when listening to mockups. The prediction was that the musician subjects who were told they were hearing entirely mockups during experiment 2 would end up rating each example lower than all subjects who took the “all live recordings” version of the experiment.

On another note, most pop music today is produced entirely with sampled instruments. In 2014, the famous show *Dancing With the Stars* fired its entire orchestra and replaced it with a

---

[14] Evan Andrews, "Who were the Luddites?," History.com, August 07, 2015, accessed May 16, 2017, http://www.history.com/news/ask-history/who-were-the-luddites.

very small group of four musicians. In addition to this small group, the show planned to play current music recordings with the hopes of attracting a younger audience for the show. Over the past several seasons, the main demographic for the dance show was elderly people, as this "ballroom" dancing style itself is also something not as popular for the younger generation. It is doubtful the show made this choice with financial reasons in mind, although it is likely many people did not object to saving a few extra bucks with a smaller music group.

Results

A repeated measures ANOVA was created with performance (mockup or live) and musical genre (classical, film, or pop) included as within-subjects factors, musician status (musician and non-musician) and instruction (i.e., instructed that music pieces were mockups or live recordings) included as between-subjects factors, and ratings of how much the listener liked the music on a 1-7 scale as the dependent measure. Least significant differences (LSD) tests were used for pairwise comparisons.

Live recordings ($M = 4.49$; $SD = 1.67$) were preferred to mockups ($M = 4.36$; $SD = 1.65$) overall, $F(1, 120) = 6.39$, $p < 0.05$, $\eta^2 = 0.051$. There was a main effect for genre, $F(2, 119) = 7.70$, $p < 0.01$, $\eta^2 = 0.115$ as well, with classical examples ($M = 4.28$; $SD = 1.61$) rated lower than film ($M = 4.51$; $SD = 1.67$)($p < 0.01$) and pop ($M = 4.59$; $SD = 1.69$)($p < 0.01$) examples. Finally, there was a significant interaction between performance and instruction such that when listeners were told they were hearing mockups, they preferred live performances, but when told they were hearing live performances, they did not show a preference for either, $F(1, 120) = 5.37$, $p < 0.05$, $\eta^2 = 0.043$ (**see Figure 8**).

Musicians did not rate the pieces overall differently than non-musicians, $F(1, 120) = 1.34$, $p = 0.25$, $\eta^2 = 0.011$ but there was an interaction between musician status and genre such that musicians preferred classical and film examples to pop examples, and non-musicians showed the opposite pattern, $F(2, 119) = 3.46$, $p < 0.05$, $\eta^2 = 0.055$ (**see Figure 9**). A post-hoc analysis within the category of musician status with composers separated from musicians (n = 16) showed that composers overall liked the musical examples more than musicians or non-musicians with a preference for live classical and film pieces in particular, $F(2, 118) = 3.53$, $p < 0.05$, $\eta^2 = 0.056$ (**see Figure 10**).

There was a significant positive correlation between listeners' age and ratings of how much they liked the music overall ($r = 0.20$, $p < 0.05$) (**see Figure 12**).

No other interactions between the variables were significant (all ps < 0.10). To see a breakdown of individual scores by piece, see **Figure 11**.

Figure 8 - Ratings of music compositions by different instruction condition, genre, and performance.

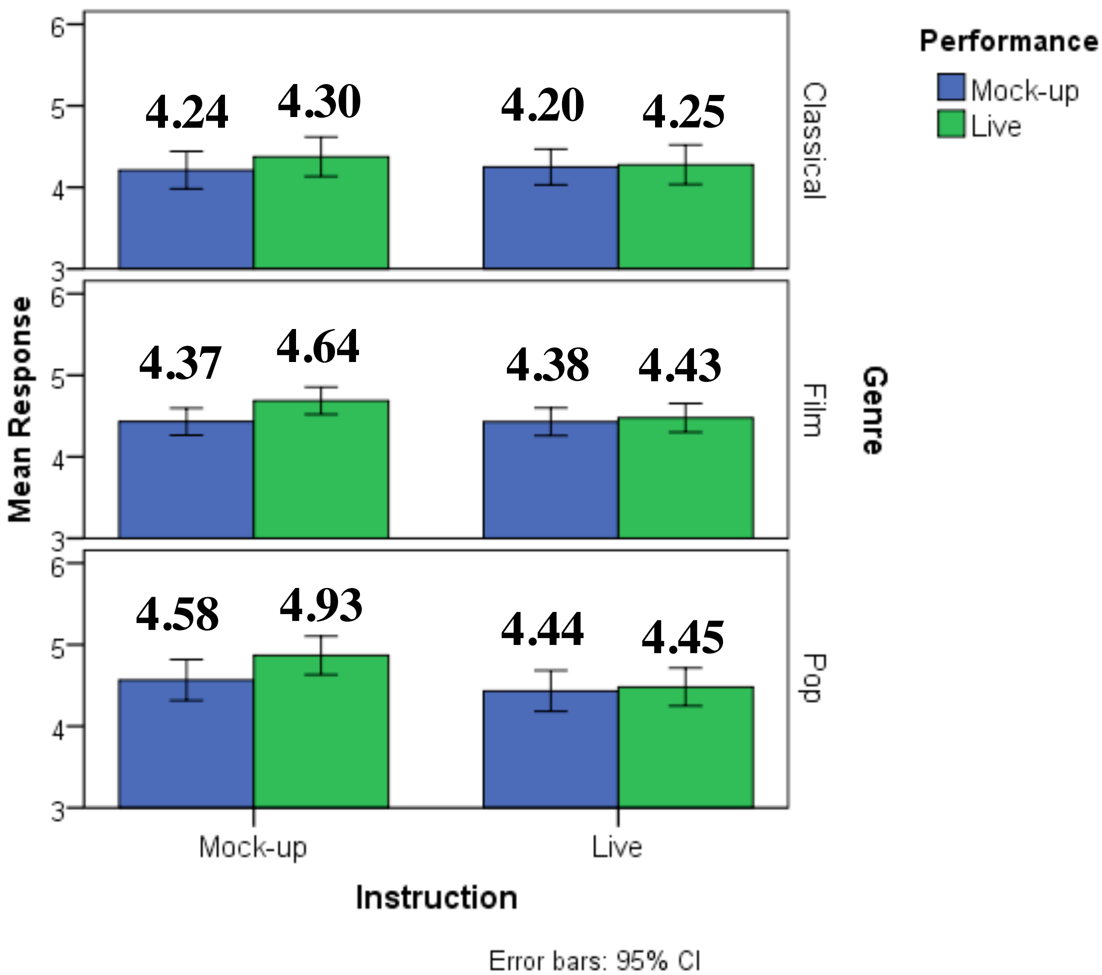


Figure 9 - Ratings of music compositions by instruction, musician status, performance, and genre.

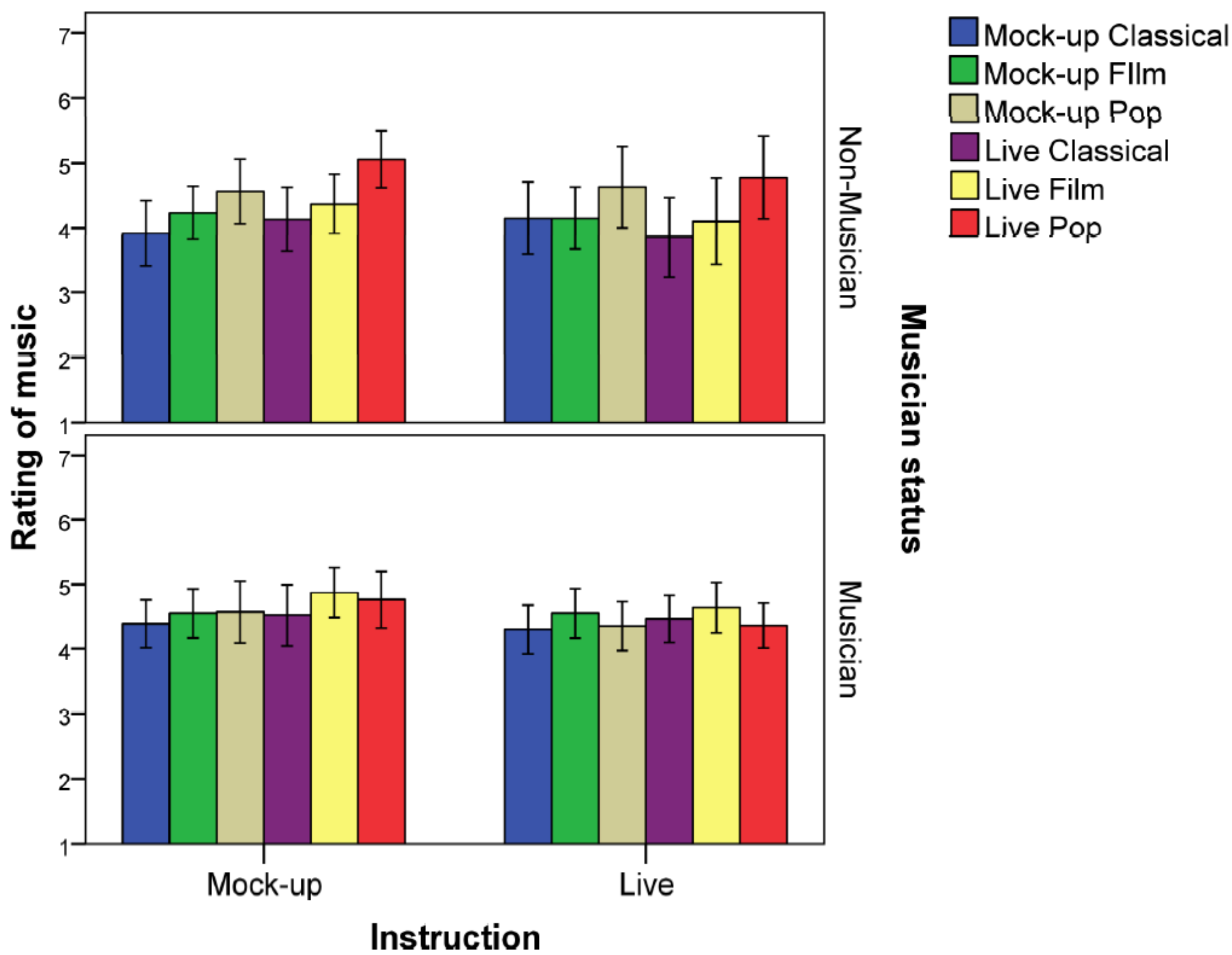


Figure 10 - Ratings of music compositions by musician status, performance, and genre.

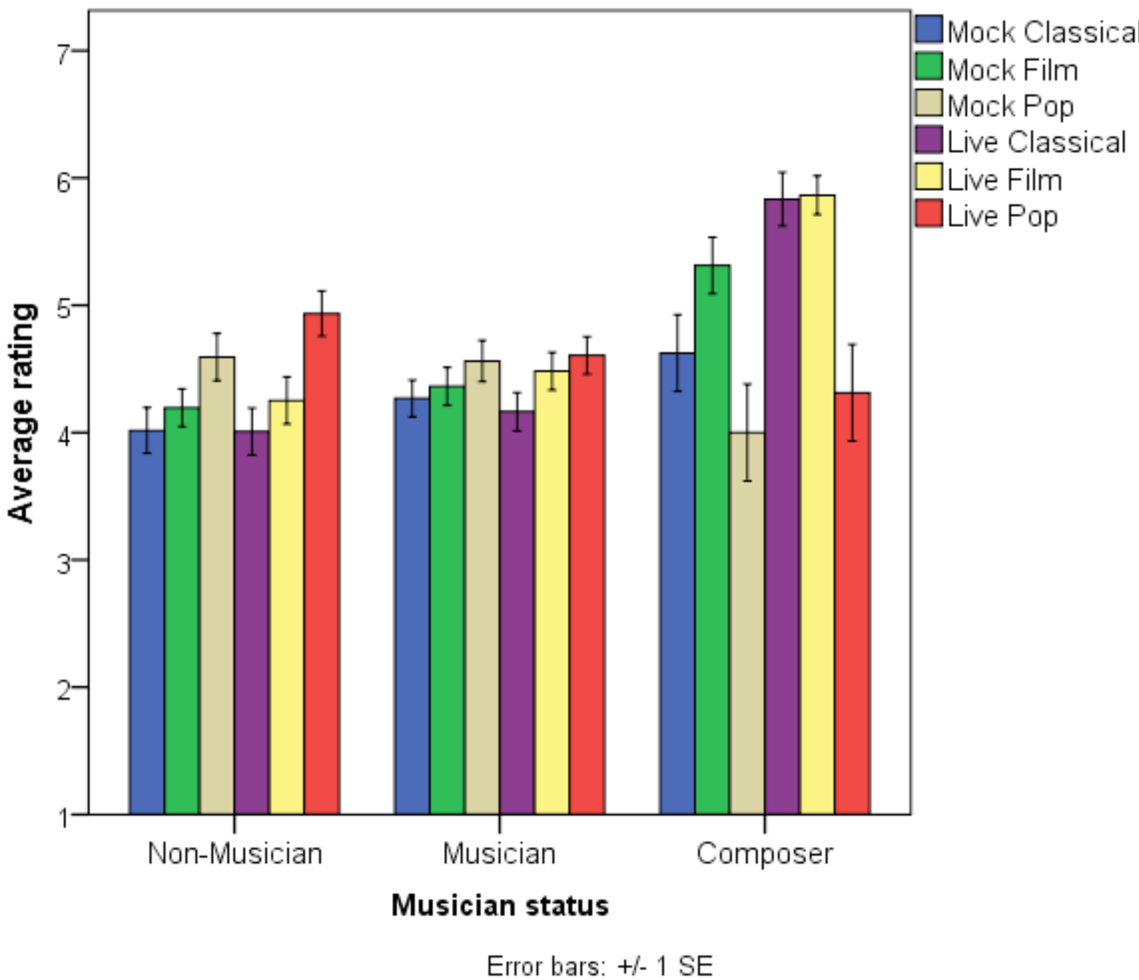


Figure 11 - Ratings of music compositions by performance.

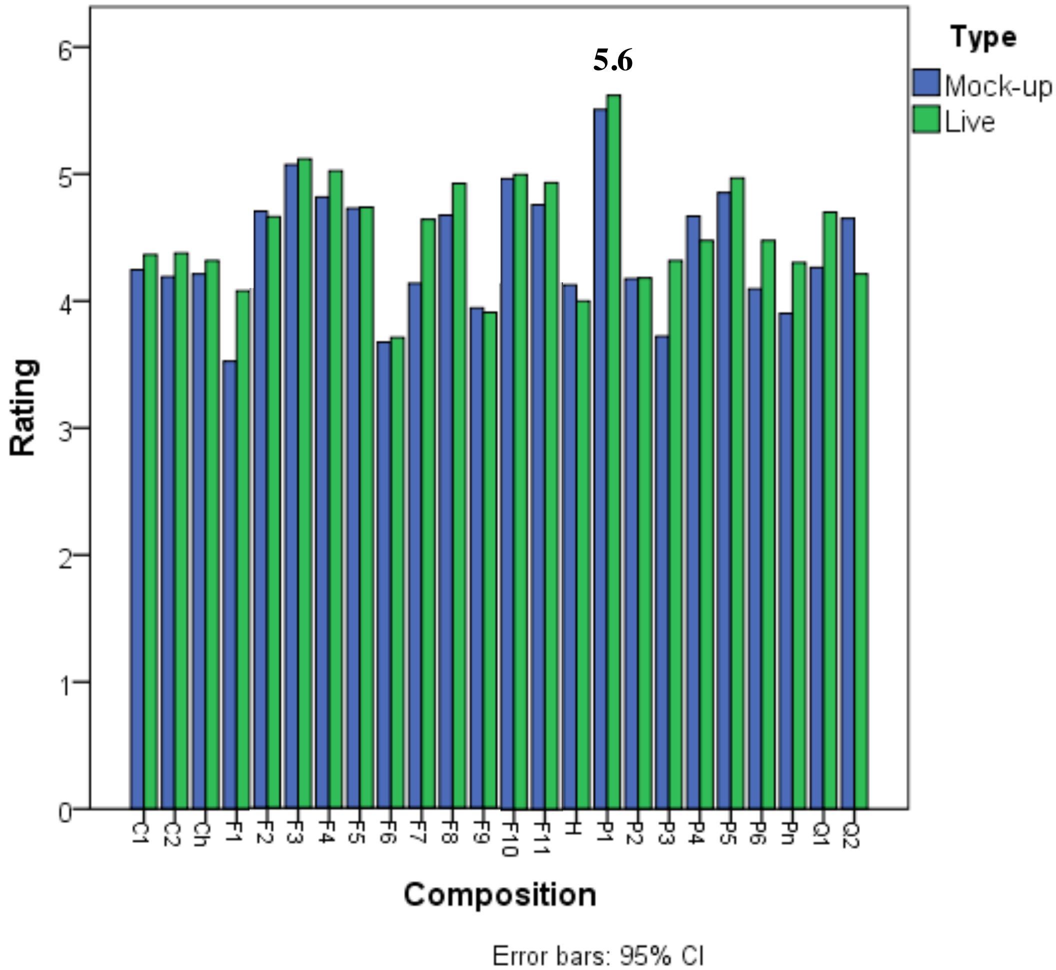
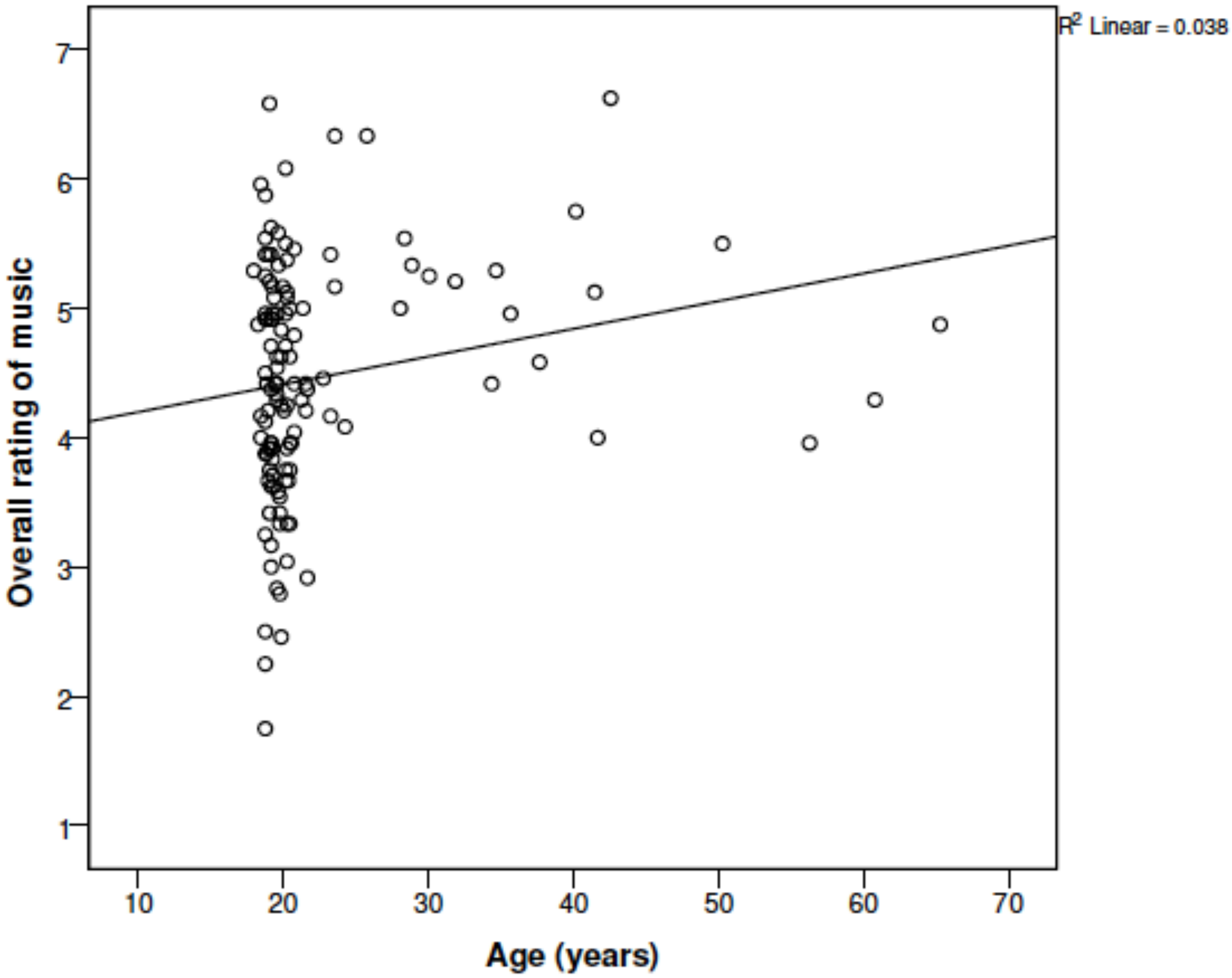


Figure 12 - Ratings of music compositions by age.



Chapter 5: Discussion

Experiment 1 examined whether people could tell the difference between mockups and live recordings. Average performance was 57% correct **(see Table 1B)** suggesting that listeners are not highly skilled in discriminating between these categories. While this is better than chance performance, it is not evidence of high sensitivity. Below, I will describe other interesting data comparisons based on the accompanying questionnaire. Keep in mind that the questions can lead to quite complex results that could not nearly be accomplished in one paper. The discussion instead focuses on some more obvious data comparisons and further future research is a possibility.

The overall hypothesis was that people could no longer easily tell the difference between live recordings and mockups (especially when used for media). The average non-musician can listen to an entire professional mockup, whether it accompanies picture or is a singular standalone audio sample, and the thought of the audio sounding artificial or sampled will never cross their mind. So many people who tune into commercials, movies, radio shows, any television series, or other visual media with an accompanying musical score have become accustomed to listening to mockups without even realizing, and the result has caused a sort of loosely-based Stockholm effect on the brain. The music we often hear in media (due to the ease and lower production cost) is all sampled while the general public has no knowledge or reason to discuss this fact. With the slow evolution of professional sounding sampled sounds in mockups came the slow evolution of people hearing more and more sampled sounds in media.

Experiment 1 – Overall Scores by Example

To see a more detailed accuracy breakdown by genre, see **Table 2A.** People were best at determining the pop examples (64% correct) while worst at determining the classical examples (52% correct), with film scoring in the middle (yet closer to classical) at 56% correct.

Furthermore, if you refer to **Figure 2,** you can see how people scored in each genre based on whether they were hearing mockups or live recordings. With classical examples, people incorrectly thought the mockups were live about 60% of the time. When hearing live classical examples, people incorrectly thought they were hearing a mockup 35% of the time. Therefore, people were more accurate when listening to the live examples, and overall tended to think most classical examples were live (see **Table 2B**). For the film examples, when hearing a mockup, people incorrectly thought they were hearing a live recording 50% of the time. When hearing a live film example, people incorrectly thought they were hearing a mockup 35% of the time. Therefore, people were more accurate when listening to live recordings, as was also seen with the classical examples. As with the classical examples, people tended to think they were more often hearing live recordings instead of mockups, which can be seen in the bottom chart of **Figure 2B.** Finally, with the pop examples, when hearing a mockup, people incorrectly thought it was a live recording only 20% of the time. When hearing pop examples as live recordings, people incorrectly thought they were hearing a mockup 50% of the time. The pop examples differ from the classical and film examples in that people usually thought they were instead hearing a mockup a majority of the time, as can be seen in **Table 2B**. Thus, people were *least* deceived overall by the pop examples, especially when they were mockups. People were *most* deceived by the classical examples, especially when they were mockups. And finally, people were more likely to think the pop examples were mockups, while thinking the classical and film examples were mostly live.

Figures 1 and Table 1A show both a graph and chart representation of the individual scores from all examples. Note that the blue mockup bars in the graph are consistently higher than their live counterparts, which matches the explanation in the previous paragraph of people tending to think they were hearing mockups more often when listening to all pop examples. In general throughout the entire graph, you can see that the green bars typically rise above the blue *except* for the pop examples.

It could be helpful to note the highest and lowest scoring examples throughout the experiment and to compare their features to determine if any common factors contributed to overall scores. A simple analysis was created for each musical example and are labeled in **Tables 1C – F** as F (full sound) or S (more solo instruments/thinner textures), and a few other features of the following examples will be described in the upcoming paragraphs. Two of the examples that tied for most correct were the mockups for pop examples 2 and 3, tying at 86% correct. The 2nd pop example had a brisk tempo with strumming electric guitars, vocals, tambourine, and electric bass. The 3rd pop example had a melodic lead guitar, a strumming guitar, an electric bass, and shaker.

Strangely enough, the example with the lowest average score is also the 2nd pop example, but its live version, topping off at a low 22% correct. It is interesting to see that people who were listening to the 2nd pop example thought it was a mockup 86% of the time.

Two more of the next highest scores were the live version of the Beethoven's 5th symphony 4th movement and the 2nd live film example. The Beethoven is a full orchestra with strings, woodwinds, brass, and percussion. The example is quite lively. The 2nd live film example is a little less exciting and more mysterious, still a full orchestra, with a strings texture muttering in the background with solo woodwinds and solo celli playing ominous melodies on top with some light glockenspiel. For the classical example, it is surprising because the texture is really thick, which in the past has been harder to determine mockups from live recordings compared to mockups that use solos and thinner textures.

There are a few other peculiar things to notice with the scores between mockup and live versions. If you notice **Tables 1C – F**, there are 15 examples where people scored more accurately when listening to mockups. In other words, with all 15 examples, whether they were live or not, people were more likely to think what they were hearing was live. There are 9 remaining examples where regardless of whether they were live or mockups, people were more likely to think what they were hearing was a mockup. Since there are more examples of people thinking they are hearing live recordings, mockups truly were fooling people a majority of the time.

As is obvious with a few other graphs and tables, **Table 1C** (sorted by texture) shows there is no correlation between texture and accuracy. Full textures typically mask the qualities of samples that you could maybe pick out of the texture to identify it as a mockup, while thinner textures with fewer instruments oftentimes allow for more careful listening to each instrument. In this case, the fuller textures were more often thought to be live 53% of the time, while the thinner textures were more often thought to be live 78% of the time. If the previous hypothesis about this were true, it is expected to see a higher number from the full textures, not the thinner textures.

Notice from another angle in **Table 1F** that all six pop examples were thought to be mockups a majority of the time. In other words, no matter whether or not someone heard a live recording or a mockup, they more often assumed they were hearing a mockup. Is it possible that since pop music is the most "popular" genre in our culture today, people have a false sense of skill with determining whether pop songs are live or mocked up? There are a certain amount of expectations and predictions that populate in a subject's head when they sit down to do the experiment. Since the instructions tell them they will be determining if they are hearing a mockup or live recording, one will likely assume they will be hearing an equal number of both, or roughly equal. It would be strange and irrational to expect to hear any off-kilter ratios (such as 1/10 for example) of live vs. mockups, although it is not impossible (and may have been an interesting idea in hindsight), and example percentages that would be live or mockups was not divulged. It is important to not skew the listener's judgment by informing them how many examples of each to expect, as they might try to count their ratings throughout the experiment and start answering based on what they think they *should* answer instead of their instinctual answers. However, evidence from experimental psychology suggests that subjects often implicitly expect balanced designs—that is, an even number of tokens from each category they are asked to judge.[15]

As mentioned before, mockups are meant to do exactly as they are titled: mock live sound. If the mockups are done professionally and are doing their job properly, they are meant to make people think they are hearing live music. Since many people are not trained to identify mockups, it was predicted that since people were hearing a bunch of orchestral instruments (which they also are likely not to be as familiar with as pop instruments) and with their inexperience, they were assuming most examples were live. The examples were always played in a random order, so the six pop tunes were always distributed differently throughout the

[15] D. W. Massaro, *Experimental Psychology: An information processing approach*, Harcourt Brace Jovanovich (1989).

experiment for each subject, but there were only 25% pop examples. People were hearing 75% orchestral classical examples and likely started feeling more comfortable and familiar when hearing the pop examples and decided to assume they were mockups since they had already chosen several other examples to be live recordings.

This is all speculation, and in hindsight, there are other valuable questions to include in the experiment to help determine these factors. In this case, it would have been interesting to see how confident people felt after answering each example. One mentioned afterwards that she literally guessed on every single example. It would be nice to know the number of people who thought they were doing well and how many people were just pushing buttons.

Experiment 1 – Age

There was no correlation between age and accuracy. It is interesting to note the two highest scores were clearly on the younger side of the spectrum, while the oldest subject scored quite low (as did some younger subjects). Although this is not conclusive, one can also consider the general decline of our aural abilities with age. Someone who is younger is more likely to have a better sense of hearing than someone older, as our hearing abilities deteriorate over time. We may want to test for the effects of hearing loss in a future study.

Experiment 1 – Identifying Gender

As can be seen in **Table 6A**, there is a slight battle of the sexes, with males scoring at an average 59% and females scoring at an average 56%. In order to explain the reason for the difference in scores, we also reverted back to the hypothesis that musicians will score higher than non-musicians, so the musician percentage between each gender was calculated, shown in the bottom chart of **Table 6A**. 59% of the male subjects were musicians, compared to only 45% of the female subjects. Once again, considering the hypothesis about musicians scoring better than non-musicians, these scores align with the predictions. Some people may also notice there is an imbalance of male to female subjects in the experiment.

Since a large percentage of the subjects were UCLA undergraduate students, it is valuable actually to include the undergraduate student population demographics, displayed in **Table 6B**.[16] Females represent roughly 56% of the undergraduate population at UCLA with men representing roughly 44%. This changes with the graduate data, where females become the minority at 46% and males increase their population to 54%. If education plays a role in the subject's ability to make these judgments, score differences between men and women may be partially accounted for.

Experiment 1 – Are you a musician?

Finally, some data about how being a musician affects peoples overall scores, which has been a large focus of all the previous data. Even representation of musicians and non-musicians was achieved, with 36 people as non-musicians and 37 musicians (**Table 4A)**. The average score difference was quite significant, with musicians scoring 61% correct and non-musicians scoring only 53% correct. These numbers help verify all the other questions posed earlier explaining why numbers were different, such as with gender, where males scored higher possibly because there were more musicians in the male group.

Another musicianship aspect is whether or not studying music as either a serious hobby or academically would help improve overall scores. Here a similar result to general musicians is

[16] "CIS - US Colleges and Universities - University of California Los Angeles," Minnesota Career Information System, 2016, accessed April 25, 2017, https://mncis.intocareers.org/SchInfo.aspx?FileID=NSch&SchID=840297&TopicNum=2&SourceState=MN

seen, with music education topping the chart at 62% correct while no music education scored 54% (**Table 4B**). There are only 34% of subjects claiming to study music, so since that number is relatively low, it did not help boost the overall scores, as 66% of subjects do not have a musical education and therefore seemed to bring the average score down significantly.

Experiment 2 – Overall Results

In experiment 2, we explored how the mockup perception affects judgments of quality and evocativeness. Experiment 2 involved deception, since the subjects were told in advance they were going to hear either all live examples or all mockups, when in fact they were again hearing half and half. There were two groups of instruction: one told they were hearing all live examples, while another was told they are hearing mockups. Each subject was asked to indicate on a scale of 1 through 7 to describe how much they "liked" each example they heard. Subjects in the "hearing only live" group read the following instructions:

> People all around the world enjoy listening to music, but little is known about what features of music contribute to people's preferences.
> In this experiment you will be asked to listen to original musical works recorded by live musicians in a studio.
> The musical works you will hear are all about 20 seconds long. Let the music finish playing, and then using a scale of 1 to 7, rate how much you liked each piece with 1 being "Not at all" and 7 being "Very much."
> Press the space bar to hear a practice trial.

Subjects in the "hearing only mockups" group read the same instructions, but instead of the text "recorded by live musicians in a studio," it read, "created on a computer using a program." The expectations were that any time a subject thought they were listening to a mockup, the scores would be lower, considering the general opinion of mockups being inferior to live performances. It is also expected that those same mockups would have higher scores if the subjects are informed that they were recorded live. In the end, the individual example scores do not matter, but instead the averages scores for each example will be compared to see if they changed at all depending on the information provided to subjects in advance.

It may be fun for the composers of each example to read and compare the overall scores. If live recordings and mockups score equally, then people do not prefer live recordings to mockups, and mockups likely have improved enough in quality to be able to stand alongside live recordings in the media. If mockups actually score *higher* than live recordings, one can further explore why people prefer them in a future study.

Remember that half the subjects in experiment 2 were told they were hearing only mockups and the other half were told they were hearing only live recordings. There is no way to tell if this information stuck with people throughout the entire experiment, and it also cannot be ensured musicians especially did not become suspicious of some of the examples after being told they are hearing only mockups or live recordings. As can be seen in **Table 11**, when combining all results from experiment 2, Live recordings are preferred by only 0.1 on a scale from 1-7, which leads to the conclusion that people like both equally.

Table 8 compares how the scores differed based on what people were told before the experiment. Subjects were told they were going to hear either mockups or live recordings. People told they would hear only mockups scored 4.51 for all examples regardless of genre or *actual* live vs. mockup. If people were told they are hearing all live examples, the average score was 4.37 for all examples regardless of genre or *actual* live vs. mockup. These numbers are not very different from each other, so overall, either most people probably do not care whether or not they are listening to a live recording or a mockup, or people soon forgot the details in the instructions about hearing only live or only mockups and were simply rating the examples based on other factors.

Our original hypothesis was that people would rate the examples lower when told they were hearing only mockups, but the results were not significant enough to conclude this. Consistently, even though the difference was always very small, most scores from listeners who were told they were hearing mockups were higher than the scores of those who were told they were hearing live musicians. In other words, if people heard the same exact example, on average, they consistently rated that example lower if they were told it was a live recording, and consistently rated it higher if told it was a mockup. Therefore, it seems the knowledge of hearing only mockups or live recordings had a very minor effect on subjects' overall opinion of the pieces (although opposite of what was predicted, and not detected through statistical analysis), and perhaps the gap between the scores would have changed had there been more attention to the instructions where it was stated people would only hear mockups or live recordings.

It is very intriguing to point out each genre score in **Figure 8**, whether subjects were told they were hearing all live examples or all mockups. Based on what is mentioned in the above paragraphs, if people are told they are hearing a mockup, they seem to like it better by a tiny percentage than when they are told they are hearing live recordings. If you look at the overall results *without* the factors of what people were told, people actually *did* prefer the live recordings to the mockups (again, by a very small and insignificant amount).

Between the two groups where people were told they were hearing *only* mockups or *only* live recordings, the people who participated in the live recording groups were more likely to get suspicious of what they were hearing. Theoretically, the live recordings should always sound like live recordings. The mockups are *trying* to sound like live recordings and succeed to various degrees. Each subject is hearing 50% mockups and 50% live recordings. Therefore, more people were possibly recognizing the deception in the "hearing only live recordings" experiments, which would not have a positive effect on the subject, but rather a negative one, which might explain why the "told only live" scores are lower.

Notice a few other things in **Figure and Table 8** (in addition to **Figure and Table 11**), such as the pop examples being consistently rated slightly higher than either the film or classical examples, regardless of mockup vs. live. In **Figure 8**, you can see that the pop bars are taller compared to the film and classical bars above. The lowest pop score in the bar graph is 4.44, which is only surpassed by one other bar graph of another genre, being live film examples, when told they are mockups, coming in at 4.64. Every other bar is rated beneath the pop examples. You can also evidently see in **Figure 11** that the one highest scoring example was P1, topping off at an overall 5.6. This confirms some previous statements about how the majority of people are more familiar with pop music, which may lead them to favor it over the other genres and to possibly have a stronger sense of expertise within the first experiment.

Experiment 2 – Age

Figure 12 displays the older subjects enjoying the music examples overall. As can be seen by the linear line on the scatter plot of **Figure 12**, the overall average score goes up slightly as age increases. It is difficult to determine why this might be the case, but as mentioned previously, it is possible the older generation is more impressed by mockups, and therefore will rate all songs at a higher level since live examples are expected to be more liked as well.

Experiment 2 – Musicians vs. Non-Musicians

Overall, whether a subject was a musician or not, the overall scores for all examples were not significantly different. Musicians did overall prefer the classical and film examples over the pop examples, while the non-musicians were the opposite, preferring the pop examples to the classical and film examples (**See Figure 9).** This does not come as a surprise, as familiarity is often associated with preference, and musicians are more likely to be familiar with orchestral music, while non-musicians are more familiar with pop music.

Chapter 6: Conclusions/Ron Jones Interview

It is important to hear first hand from someone who has worked extensively in the film and television side of the recording industry how mockups became prominent and how they have evolved over time. I was fortunate enough to get in touch with Ron Jones, Emmy and Grammy nominated composer for popular television shows like *Star Trek, DuckTales, American Dad!,* and *Family Guy,* to name a few. He has written over 40,000 compositions for media, which in turn has given him a lot of experience with live recordings and mockups. After sharing the experiments and some preliminary results with Mr. Jones, he was able to provide some feedback and valuable information from his perspective.

First, Mr. Jones mentioned the value of conducting hearing tests on the subjects before the experiment to determine listening acuity. The frequencies can play a large role in our determining live recordings from mockups, and it especially helps in identifying specific instruments based on timbre. As is also known, older subjects will likely have inferior hearing to younger subjects, assuming young people have not done damage to their ears due to the loudness level that people listen to music these days. Furthermore, after working on live recording gigs for a couple decades and gaining valuable experience with understanding orchestral timbres, Mr. Jones concluded that only 1-2% of the adult population actually attends live orchestral concerts frequently. Attending a concert once every ten years does not qualify someone to truly understand the sound of a live orchestra from a mockup. According to Mr. Jones, it is worth remembering that many people taking this experiment have not experienced the “threat” of mockups encroaching on live performances, and therefore possibly do not understand the value of such an experiment.

Mr. Jones recalled many sessions he had done for *Family Guy* and mentioned how the executive producer always recorded live orchestra regardless of budget. Mockups would be created for each episode to simply demonstrate the music for approval. From time to time, budget would become an issue and the producers would consider where to save money. Mr. Jones would offer to eliminate the live recording session and instead use the mockups for the episodes, but in the end, they never cancelled scoring dates even after considering what it would save. This shows that the producers did really value the live recordings and found other avenues to cut the budget spending.

Mr. Jones also dove into explaining the differences in sound based on microphone setup. One qualifying aspect of a live recording is capturing the sound of the room the musicians are in. There are microphones placed high above the heads of the musicians (called a Decca tree) to record the entire group as a whole in addition to the room sounds, and there are also at times spot microphones that are placed in close proximity to instruments which allow for more control in the studio to mix different instrument groups. Mr. Jones always had assistants working with him who come from different musical backgrounds, and he would ask them to sit out amongst different orchestral sections during the recording session so they can hear the section's sound in the room and how it sounds different from the "freight train" sound you get from samples and mockups (freight train here referring to compressed digital sounds with a less special signature). In a live recording, according to Mr. Jones, strings and woodwinds float above other textures, while brass are more direct in comparison to sampled sounds. Luckily within the past decade, Vienna Pro, a famous sample library company, has released a software called MIR which allows you to position samples within a programmed room, with the intention to produce a sound similar to what you would get if recording instruments positioned in a specific way in a recording space. This innovation was one that brought mockups yet again closer to live recording quality.

In Mr. Jones's studio and compositional life, samples are still highly important and useful, regardless of his access to live musicians. We are in an age where technology is constantly moving, and it is not so much about using one or the other, but using each for its own specific purpose. The older generation musicians and music educators in our society today have the experience of obtaining live recordings for their music since they really did not have an option to use mockups during their formative years and even well into their professional careers. Music educators still emphasize the importance of getting your music performed live because they want students to experience a higher music making level (assuming we all agree that mockups are "inferior" to a certain extent). It is more difficult to obtain a live recording than it is to create a mockup, although mockup artists would note that they, too, had to develop arcane skills and spend countless hours perfecting their craft. If the producer you are trying to impress hears a terrible mockup even though the composition itself is good, you will have to do the entire thing over because the producer will not like the cue due to the poor quality. People turn to mockups because live recordings are costly. It is still important to understand the value and hard work it takes to create a live recording, while also understanding that mockups do have a place in our world, albeit not necessarily alongside live recordings.

Mr. Jones acknowledged the importance of creating professional sounding mockups, and creating a quality mockup takes experience, specifically with orchestration, engineering, and a basic understanding of the orchestra. His mockups rely on massive combinations of several sample libraries to emulate the sound you would get from a live performance. It takes a lot of money to collect so many sample libraries, and also expertise to come to know each sample library in order to combine them in a way that will produce a sound you are looking for that emulates a live performance.

Mr. Jones is extremely excited about a new audio format called "Emersion" that is unlike other audio formats we have experienced as consumers. This system has two beta sites in the world, one being with the Beijing Philharmonic who has been recording through Emersion every week, with the second location in Seattle with Mr. Jones where they have been recording percussion or other experimental recordings. He mentions the results are astounding and will allow the discovery of "a whole new planet" for audio. People who have doubts about their future musical careers should have hope for the future, because we could be nearing a "new renaissance" for live performance that will blow everyone's minds. Emersion's introduction into the industry, it would behoove us to do this mockup vs. live recording experiment again in five years because what will matter then will not be whether or not the source is synthetic, but humans will have begun to evolve to consume sound in the real world.

We conclude from this experiment that people cannot easily tell if an individual example is live or a mockup, but both Mr. Jones and I agree that if a test subject is played two identical examples back to back, one being live and the other being mockup, it would be very obvious to the listener which is live. The issue is that in the media today, we do not have the luxury of hearing both. We are presented with a single product and we often do not even consider the production or the source. But again, this is not to say people cannot tell the difference when it is presented to them effectively.

In line with the public not considering the music production they hear in media, Mr. Jones discussed Japanese videogame music from the 80s and 90s. Videogames used a very poor quality 8-bit audio and their characteristic sound is based in simple square and triangle waves produced by tone generators due to the technology's lack of sophistication. People purchased these video games and never much complained about the poor sound quality, and on the contrary, many learned to love the music that accompanied their favorite video games. This generation that played those games developed a different sound palate after listening to that specific music quality over time. This can be comparable to the study mentioned previously about the Stanford students who preferred the sound of MP3s to higher fidelity recordings due to the saturation of MP3 formats in younger generations.

Mr. Jones remembered mockups becoming prominent in the mid 90s, but the sound quality was rather inferior. He owned a Synclavier, which was state of the art at the time, yet not as high quality as the samples used today, as well as exorbitantly expensive. He programmed it a specific way so it could be treated like its own virtual orchestra. When you hire real players, the first flute player might be sharp and ahead of the beat, yet the second flute player is in tune but behind the beat. The most realistic sounding mockups are actually *imperfect*, without all the mathematical timings and intonations. The Synclavier had several tracks named after a specific person that was a live player, and it was programmed to emulate that person's tendencies with intonation and rhythm, amongst other things. Mr. Jones and his crew called the Synclavier the "Westlake Philharmonic." The sound quality led people to believe they were hearing a live orchestra, but it is important to note that it also took months to program all the performance information. When you buy a sample library today like Spitfire or Cinesamples, they often are using the same samples they have had for decades, but are becoming more sophisticated with attack, articulation, and other technique manipulation. Companies are also experimenting with microphone placements when recording their samples.

Another common practice used by Mr. Jones was to make hybrid recordings of both live and sampled instruments, which is still common today. To do a low budget film, they would hire a small group of string players, such as first violins and cellos, and record them live while boosting them with virtual instruments, like second violins, violas, and basses. The live and sampled sound combination created the larger orchestral sound they were looking for but at a lower cost. Everyone wants to sound like John Williams but there is rarely the budget to record that many musicians live – and yet standards have evolved so everyone expects to hear that big "orchestral" sound. Synth keyboards help jazz ensembles to sound much bigger and more varied since keyboards and synths can add an orchestral element to a jazz combo, where performance is often on a small stage where you clearly cannot fit an orchestra.

Mr. Jones believes that the issue is not whether or not the final product uses samples, but instead it is the performance quality that matters. If it is not performed well, then humans will not respond to it. High school groups performing live can sound terribly amateur and end up sounding worse than an equivalent sampled version, proving an instance where live is not necessarily better than sampled if we are analyzing final products. But when listening to the London Philharmonic, it is almost impossible to argue that a mockup of the same performance would sound the same.

One experience Mr. Jones spoke of was a 50^{th} anniversary Star Trek concert with the London Philharmonic. They wanted to bring a concert tour to the United States, but to save money, they hired a small thirty-person orchestra, mostly from the Prague Philharmonic. They toured the United States and performed the concerts with headphones and a click track while some prerecorded tracks played along with the orchestra, providing at the same time the big sound people expected and the key live performance element. People attend concerts with the expectation to not just hear a performance, but to *see* a performance. Recordings are a helpful tool for composers, as they allow you to record multiple layers. Whatever sounds great for the recording's purpose, you can accomplish it.

Mr. Jones composed the soundtrack for the movie *Fight For Space*, which also turned out to be a hybrid score. The soundtrack truly has a live orchestral effect, and is great to listen to from home, but it would not be easy to do as a live performance because there are so many samples used in the soundtrack. In hindsight, Mr. Jones now wonders how much it would have cost to record the soundtrack entirely live versus the five months it took to record a small group of live people mixed with samples, and concludes it might have been quicker, and at a similar price point, to record it entirely live. Creating actual professional sounding mockups is a huge time commitment, and time is often the ultimate commodity, which is determined by budget. Music production hierarchy for media is usually time first, followed by budget, and finally quality.

Mockup creators are often inferior orchestrators and bad engineers, because these programs are easily accessible and people without training can get them working. If these people were to pay attention more to the proper ranges and orchestrations, the mockups might be more successful. Audience will not react in a positive way to sounds that are not voiced properly.

Mr. Jones has adamantly fought for a world with live performances, and is afraid that complacency about using live recordings is a dangerous path to follow. His local Seattle musicians are feeling defeated due to lacking live performance gigs, and Los Angeles work opportunities are at 18% of what they were at their peak due to a struggling music industry and the musical work outsourcing to cheaper locations overseas. People who have dedicated their entire lives to music are being treated like rubbish. Musicians across many fields feel that their art form does not matter much anymore, and this also extends to engineers, studios, etc.

We are concerned this study could erroneously conclude that banality is okay. Japanese game producers have shown that the consumer will buy the product anyway regardless of the quality of music. It is important to reiterate that just because people cannot easily identify what they are hearing as a mockup or live recording, we do not conclude that *therefore* humans are not necessary. Mr. Jones has invested over $1 million into creating mockups over the years, paying half his earnings to others to help him make these mockups. He believes that people are simply misinformed today. They do not know, they do not care, and it does not matter to them. The real question is: should it matter? If it does not matter, what is next? Will you go to the grocery store and have no one to check you out? Will car dealerships have automated systems without salesmen? Is a digital version of Van Gogh as good as an original? Mr. Jones questions what all of us humans will do in the future, all 8 billion of us. We are asking a very scary question of what is next. Do graduate studies matter anymore because a computer can replace educated people?

Mr. Jones was recently asked by Paul Allen to talk at the Upstream Fest, a Seattle music festival with 300+ performing artists. Allen is the multi-billionaire owner of several NFL teams, and he wanted to do something to encourage the musicians to go forward and continue to be creative and strong. Mr. Jones needs to convince these people that there is a place for all in the music industry, but is the real truth that they might as well give up because the sample libraries have figured out how to recreate music for cheaper?

Generally (but not always), humans like to be in a room with other humans, for a variety of reasons. Everyone is consumed with social media and technology today, but being with other humans should be refreshing. It is exciting for humans to come together and play music, no matter what is performed or for what purpose. Endorphins are released and make people joyful, which is much harder to achieve from synthetic replacements. This is not to undermine the work it takes to be a professional musician. But if people do not know the enjoyment of being around other people, we have a big problem. Since humans are biological and we are not synthetic (yet), we still have a primordial brain. Mr. Jones is concerned we are in danger, and that people do not quite get the difference between engaging with technology and being in a room with real people, considering what has been happening recently with false news on social media. We could easily just create mockups but Mr. Jones enjoys working with real musicians and real people. For him, as someone who has both mockups and live musicians at his fingertips, he thinks there is a major difference between the two, and his opinion should bear a lot of weight considering his experience.

Does it make a difference when live musicians get together? If we are devoid of caring about these things, nothing matters in Mr. Jones's opinion. He pushes forward to fight for live performances in spite of everything. We need courage to take this forward to create a future for live musicians. Most can argue that it is so much more satisfying to watch an entire room of musicians perform versus a guy sitting in front of a laptop.[17]

Again, why does all this even matter? Truthfully, people will argue that the results of this experiment are not important. But it is worthwhile for people to simply understand how music production has been evolving over time regardless, considering how many people do not seem to quite realize how music is being produced today. It is important to understand factual

[17] Ron Jones (composer) in discussion with the author, April 2017.

information before presenting an argument, and there are several instances where people argue about a recording's quality without really knowing how it was produced. If we truly are afraid of evolving into a society that devalues human interaction and instead prioritizes technological efficiency, we should work to better understand what we are consuming today. Similar (yet possibly *very* different) issues where we are unaware of the source that may seem more familiar to us are our groceries, for instance. Do people care if they are eating eggs produced at a farm that allows miserable and inhumane living conditions for the chickens simply because it saves money? Do people care if they are wearing clothing made by a struggling child in a sweatshop in Asia? In these cases, it is not so much about the final product, but instead it is about the knowledge of a final product's production, so we can make educated decisions on what we consume. The difference here is that the hardships imposed on live musicians due to mockups replacing live recordings may not be comparable to suffering children or animal cruelty in some people's eyes, but regardless, it is valuable to understand the source of what we consume so we can make more educated decisions when participating in a global market.

Supplemental Discussion

It is important to again consider the first experiment's main goal. Can a mockup fool people into thinking they are hearing a live recording? The scale of 0-100% correct must be viewed differently than a normal grading scale one would receive for most tests or exams. If someone scores exactly 50%, they really cannot tell a difference and were guessing throughout most examples. If someone scores above 50% (with more accuracy approaching 100%), they really are hearing some differences and are applying them correctly to their corresponding mockup or live examples. If someone scores *less* than 50% (with more "accuracy" approaching 0%), it is possible that these people are ALSO hearing differences between the examples but are simply applying the differences they are hearing to the wrong medium.

The same principle, on a smaller scale, occurs with live recordings. Microphone placement is very crucial in capturing an optimal sound. The further away a microphone is placed, the less high frequencies it will pickup due to the nature of directionality with high frequency sounds. It is similar to hitting a bull's eye: the closer you are, the more likely you will hit the target, yet further away allows for a larger margin of error. The same applies to microphones: the closer you are, the more likely you will capture all frequencies, while being further away allows for more directional higher frequencies to fly by the microphone without being detected. These audible differences are very minimal and can only be heard by the most experienced listeners.

As stated above, it is possible people can in fact tell a difference, but they are not sure which differences equate to live recordings or mockups. For those who do not have a lot of musical experience, they may hear more clarity with higher frequencies and assume the clarity is due to a high quality microphone used to record the example live, when in fact these higher frequencies are often true of mockups due to the quality and control of digital sounds. Many microphones, though incredibly professional and made with impeccable quality, miss some high-end frequencies simply due to the acoustics. Low frequency sounds can travel far and wide and the human ear has a harder time pinpointing low frequency sound sources. Take thunder for example. Without visible lightning, thunder typically cannot be pinpointed and seems to envelop the entire space around your reference point. Subwoofers for home entertainment systems also tend to sound pretty good no matter where you place them in the room. It is typically much easier to detect high frequency sound origins since high frequencies are more directional than low frequencies. Consider a chirping bird. It is usually easier to locate a bird nearby in a tree than it would be to locate the exact direction thunder comes from. With samples, this directionality is more difficult to achieve, and it is common for the overall mix to seem cluttered, especially with amateur mockups.

Race/Ethnicity

For Experiment 1:

There seems to be no solid connections between certain ethnicities determining mockups or live recordings with more or less accuracy. When looking at the data, one automatically notices the large imbalance of numbers between the five races represented. Even though the general population of the United States does not have an even proportion of all races, an even representation of all races is necessary for a fair study. A spreadsheet was created comparing the test subject race percentages with that of the general population of the United States in 2010

(**Table 7B**).[18] The highest and lowest percentage populations remained the same (White and Native American respectively), and the middle three were jumbled, with the biggest significant difference as the Asian percentage being much higher for the experiment than that of the general population. This can be easily explained by the concentration of UCLA students who took the exam, and henceforth saying something about the amount of UCLA students that are Asian (29%, see bottom **Table 7B**). [19] Due to UCLA's proximity to Mexico and its location on the west coast, there is a much higher race concentration from both Latin America and Asia in comparison with other regions in the United States.

White subjects scored highest at 60% (above average), with Native Americans coming in at 58% (above average), Latinos scoring 57% (average), Blacks scoring at 54% (below average), and finally Asians coming in at 53% (below average), as can be seen in the middle chart of **Table 7A**.

There are many other aspects to include from the questionnaire to compare why different races had different scores, one being the percentage of musicians in each racial group, since it is hypothesized that musicians will score higher than non-musicians (**Table 7A bottom chart**). Our highest musicians percentage were white subjects, which is where we would expect it based on the results, with 56% white subjects being musicians, next with 50% musicians between the Native American (only one of two people in this instance), 48% Asian, 43% Latino, and finally 25% Black (only one of four people in this instance).

[18] "Population of the United States by Race and Hispanic/Latino Origin, Census 2000 and 2010," Infoplease, 2010, accessed April 25, 2017, https://www.infoplease.com/us/race-population/population-united-states-race-and-hispaniclatino-origin-census-2000-and-2010

[19] "CIS - US Colleges and Universities - University of California Los Angeles," Minnesota Career Information System.

For Experiment 2:

Again, if a certain race or ethnicity is less exposed to classical style music (orchestral instrumentation), it will be interesting to see if specific races have certain tendencies to prefer the pop tunes over the more classical instrumentations of the classical and film examples.

Current City

For Experiment 1:

Larger metropolitan areas clearly have more access to classical music concerts than small towns. If someone's current city happens to be a largely populated area, their "bourgeois" status of having the financial means to live in a large city might give them more opportunities to be exposed to classical music and therefore have a better idea what live acoustic instruments should sound like. People who live in rural areas where their greatest exposure to classical music is that which they hear on TV in commercials (which is usually mockups), they may assume that the usual mockup sound they are used to hearing is in fact live.

For Experiment 2:

It is possible that smaller towns with less exposure to classical music may prefer pop music, which is highly accessible in our society today.

City/cities lived in from birth – 18 years (if more than two, only list two most recent)
For Experiment 1:

With a similar approach to the previous question, larger metropolitan areas clearly have more access to classical music concerts than small towns. With music, a musician's experience and abilities are often attributed to their early formative years, meaning from birth through the age of 18 (average age of high school graduation). If someone grows up in a highly populated area, it is more likely that they have been exposed to classical music than someone who grew up in a rural area without a professional orchestra. You can consider two aspects for a rural person, either being clueless to live orchestral instrument sounds, or being accustomed to only old analog recordings (since many rural towns are less "up to date" with entertainment formats). With respect to the former of being clueless to live orchestral instrument sounds, it is possible that the young person growing up in a rural area hears a mockup and simply assumes that live orchestral instruments must sound that way (and likely does not even think it is possible that the recording is computerized). It is also possible that the young rural person is aware of mockups existing and then listens to a musical example that sounds much crisper and full of high frequencies than usual and simply assumes that this new fresh sound must accompany the new and unfamiliar mockup they have yet to really understand, after growing up with older formats of music with a rounder sound.

For Experiment 2:

Similar concepts can be derived for experiment 2. By taking the stance that rural areas are more secluded from modern technology, a subject may be impressed with mockup sound quality and might rate all examples higher after being told they will hear only mockups (even though half the examples they hear are truly live). It is important here to compare the rural results with the non-rural results instead of simply comparing the rural subjects' ratings between mockups and live examples within their own corresponding ratings. I predict we could see similar results between both rural subjects and older subjects. Rural areas and older generations have similar possibilities to be less exposed to mockups than populated areas and younger generations.

Approximate current household income (circle one – if dependent, estimate parental income)

For Experiment 1:

This question ties in with some previous assumptions about different incomes corresponding to different exposure levels to both mockups and live music. Lower incomes may not have the money to attend classical music concerts and are simply less familiar with live orchestral sounds (or even simply less familiar with classical music or film music and instead listen to mainly pop music). Lower incomes may be exposed less to art in general and perhaps will not have as much experience with classical and film music as higher incomes will. We can compare low-income scores between the pop examples and the more classically oriented film and classical examples. On the contrary, higher incomes might display higher scores with the film and classical examples, and possibly the pop examples as well.

For Experiment 2:

Again, we expected to see an overall decline in preference when presented as all mockups, but it was interesting to see if subjects with lower incomes tended to rate the pop tunes higher than the classical or film examples. Although preferring pop tunes will likely not have any effect on our main hypothesis, it might be interesting to see if low-income people who prefer pop tunes also score poorly with accuracy on the first experiment in conjunction with the experiment 1's lower income subjects.

On a scale from 1 – 7 (1 being poverty and 7 being wealthy), circle the description that best describes how you remember the financial security of your family's household from birth – 18 years (circle one)

See explanations for both experiments back in questions 5 and 6.

Highest level of Education (circle one)

For Experiment 1:

Higher education levels may increase someone's odds of being exposed to classical music. Educational programs very often have music programs students can participate in, and oftentimes also have music courses available for either music majors or even non music majors who simply want a music course as an elective. It was predicted that higher education levels could produce more accuracy with determining mockups from live recordings.

For Experiment 2:

Just as higher education levels could expose people to music more often, it gives them a chance to learn more about it and come to appreciate it more than someone who is less familiar. We can examine the overall scores with lower education levels to see if they prefer pop music over classical/film music, and we can compare other subjects with similar education in the first experiment to see if they also score more poorly on the classical/film examples compared to the pop examples.

Are you currently a student?

This question relates almost directly to question 8 for both experiments. Students are likely to spend more time near music at their respective institutions and could possibly score higher due to familiarity during this point in their lives.

Are there any of the following genres of music that you *prefer* over others? (circle all that apply)

For Experiment 1:

If someone claims to enjoy classical music, it is likely they are familiar with all sounds associated with live performances and classical music recordings, making it possible for them to score more highly on the classical and film examples as opposed to the pop/mainstream examples, and vice versa. The same applies for the following question number 12, where we can predict that someone will score more poorly on genres they dislike.

For Experiment 2:

We can expect that if someone prefers a specific genre, they will likely rate those genres higher in the experiment, regardless of whether or not they are told it is a mockup or a live recording. Having a preference or dislike for a specific genre creates a bias we should consider when analyzing the results.

Finally, did you recognize any of the musical examples?

For Experiment 1:

If someone is inherently familiar with one of the musical examples, it is likely they will be able to identify if it is a mockup or a live recording much easier than someone who is hearing the example for the first time. Effort was made to choose musical examples that were not obviously recognizable to the listener, with the exception to the two classical orchestral examples that likely were more widely known (Beethoven's 5th symphony 4th movement and Ravel's Bolero).

For Experiment 2:

Since experiment 2 involves deception, it is possible someone might be able to penetrate the deception if they are told they are hearing only live recordings and suddenly hear a familiar song that definitely sounds different from the live recordings they are used to hearing. We asked subjects to make comments at the end of the questionnaire if they noticed anything they would like to comment on, in hopes that if someone catches on to the deception, they may mention it.

Appendix A: Corresponding Tables to Existing Figures

Table 1A - Accuracy for each example based on mockups or live recordings.

Piece		Mock	Real
C1	Mean	.3784	.4444
	N	1	1
	Std. Deviation	.	.
C2	Mean	.3333	.8378
	N	1	1
	Std. Deviation	.	.
Ch	Mean	.5135	.6944
	N	1	1
	Std. Deviation	.	.
F1	Mean	.6757	.7222
	N	1	1
	Std. Deviation	.	.
F10	Mean	.4054	.6944
	N	1	1
	Std. Deviation	.	.
F11	Mean	.5000	.3514
	N	1	1
	Std. Deviation	.	.
F2	Mean	.2778	.8378
	N	1	1
	Std. Deviation	.	.
F3	Mean	.4595	.6667
	N	1	1
	Std. Deviation	.	.
F4	Mean	.5556	.5405
	N	1	1
	Std. Deviation	.	.
F5	Mean	.4595	.7222
	N	1	1
	Std. Deviation	.	.
F6	Mean	.5278	.6486
	N	1	1
	Std. Deviation	.	.
F7	Mean	.4865	.5278
	N	1	1
	Std. Deviation	.	.
F8	Mean	.5556	.5946
	N	1	1
	Std. Deviation	.	.
F9	Mean	.4444	.6216
	N	1	1
	Std. Deviation	.	.
H	Mean	.5833	.6486
	N	1	1
	Std. Deviation	.	.
P1	Mean	.7838	.4722
	N	1	1
	Std. Deviation	.	.
P2	Mean	.8611	.2162
	N	1	1
	Std. Deviation	.	.
P3	Mean	.8649	.6389
	N	1	1
	Std. Deviation	.	.
P4	Mean	.7778	.4595
	N	1	1
	Std. Deviation	.	.
P5	Mean	.7568	.6389
	N	1	1
	Std. Deviation	.	.
P6	Mean	.7222	.4595
	N	1	1
	Std. Deviation	.	.
Pn	Mean	.2703	.6389
	N	1	1
	Std. Deviation	.	.
Q1	Mean	.4324	.4167
	N	1	1
	Std. Deviation	.	.
Q2	Mean	.4167	.8108
	N	1	1
	Std. Deviation	.	.
Total	Mean	.5434	.5960
	N	24	24
	Std. Deviation	.17544	.15473

Mean = Average Percentage Correct for each example

Table 1B - Overall accuracy by example

M = Mockup
C = Classical
Ch = Choral
F = Film

R = Recording
H = Harp
P = Pop
Pn = Piano
Q = Quartet

Report

Hit

Piece	Mean	N	Std. Deviation
MC1	.38	37	.492
MC2	.33	36	.478
MCh	.51	37	.507
MF1	.68	37	.475
MF10	.41	37	.498
MF11	.50	36	.507
MF2	.28	36	.454
MF3	.46	37	.505
MF4	.56	36	.504
MF5	.46	37	.505
MF6	.53	36	.506
MF7	.49	37	.507
MF8	.56	36	.504
MF9	.44	36	.504
MH	.58	36	.500
MP1	.78	37	.417
MP2	.86	36	.351
MP3	.86	37	.347
MP4	.78	36	.422
MP5	.76	37	.435
MP6	.72	36	.454
MPn	.27	37	.450
MQ1	.43	37	.502
MQ2	.42	36	.500
RC1	.44	36	.504
RC2	.84	37	.374
RCh	.69	36	.467
RF1	.72	36	.454
RF10	.69	36	.467
RF11	.35	37	.484
RF2	.84	37	.374
RF3	.67	36	.478
RF4	.54	37	.505
RF5	.72	36	.454
RF6	.65	37	.484
RF7	.53	36	.506
RF8	.59	37	.498
RF9	.62	37	.492
RH	.65	37	.484
RP1	.47	36	.506
RP2	.22	37	.417
RP3	.64	36	.487
RP4	.46	37	.505
RP5	.64	36	.487
RP6	.46	37	.505
RPn	.64	36	.487
RQ1	.42	36	.500
RQ2	.81	37	.397
Total	.57	1752	.495

Table 1C

Accuracy Sorted by Texture

Mockups	% correct (M)	% correct (R)	Real	Texture	M	R
MC1	0.38	0.44	RC1	F		<
MC2	0.33	0.84	RC2	F		<
MCh	0.51	0.69	RCh	F		<
MF1	0.68	0.72	RF1	F		<
MF11	0.5	0.35	RF11	F	>	
MF3	0.46	0.67	RF3	F		<
MF5	0.46	0.72	RF5	F		<
MF8	0.56	0.59	RF8	F		<
MF9	0.44	0.62	RF9	F		<
MP1	0.78	0.47	RP1	F	>	
MP2	0.86	0.22	RP2	F	>	
MP3	0.86	0.64	RP3	F	>	
MP4	0.78	0.46	RP4	F	>	
MP5	0.76	0.64	RP5	F	>	
MP6	0.72	0.46	RP6	F	>	
MF10	0.41	0.69	RF10	S		<
MF2	0.28	0.84	RF2	S		<
MF4	0.56	0.54	RF4	S	>	
MF7	0.49	0.53	RF7	S		<
MH	0.58	0.65	RH	S		<
MPn	0.27	0.64	RPn	S		<
MQ1	0.43	0.42	RQ1	S	>	
MQ2	0.42	0.81	RQ2	S		<
MF6	0.53	0.65	RF6	S/F		<
					9	15

Table 1D
Sorted by Mockup Accuracy

Mockups	% correct (M)	% correct (R)	Real	Texture	M	R
MPn	0.27	0.64	RPn	S		<
MF2	0.28	0.84	RF2	S		<
MC2	0.33	0.84	RC2	F		<
MC1	0.38	0.44	RC1	F		<
MF10	0.41	0.69	RF10	S		<
MQ2	0.42	0.81	RQ2	S		<
MQ1	0.43	0.42	RQ1	S	>	
MF9	0.44	0.62	RF9	F		<
MF3	0.46	0.67	RF3	F		<
MF5	0.46	0.72	RF5	F		<
MF7	0.49	0.53	RF7	S		<
MF11	0.5	0.35	RF11	F	>	
MCh	0.51	0.69	RCh	F		<
MF6	0.53	0.65	RF6	S/F		<
MF8	0.56	0.59	RF8	F		<
MF4	0.56	0.54	RF4	S	>	
MH	0.58	0.65	RH	S		<
MF1	0.68	0.72	RF1	F		<
MP6	0.72	0.46	RP6	F	>	
MP5	0.76	0.64	RP5	F	>	
MP1	0.78	0.47	RP1	F	>	
MP4	0.78	0.46	RP4	F	>	
MP2	0.86	0.22	RP2	F	>	
MP3	0.86	0.64	RP3	F	>	
					9	15

Table 1E

Sorted by Real (Live) Accuracy

Mockups	% correct (M)	% correct (R)	Real	Texture	M	R
MP2	0.86	0.22	RP2	F	>	
MF11	0.5	0.35	RF11	F	>	
MQ1	0.43	0.42	RQ1	S	>	
MC1	0.38	0.44	RC1	F		<
MP6	0.72	0.46	RP6	F	>	
MP4	0.78	0.46	RP4	F	>	
MP1	0.78	0.47	RP1	F	>	
MF7	0.49	0.53	RF7	S		<
MF4	0.56	0.54	RF4	S	>	
MF8	0.56	0.59	RF8	F		<
MF9	0.44	0.62	RF9	F		<
MPn	0.27	0.64	RPn	S		<
MP5	0.76	0.64	RP5	F	>	
MP3	0.86	0.64	RP3	F	>	
MF6	0.53	0.65	RF6	S/F		<
MH	0.58	0.65	RH	S		<
MF3	0.46	0.67	RF3	F		<
MF10	0.41	0.69	RF10	S		<
MCh	0.51	0.69	RCh	F		<
MF5	0.46	0.72	RF5	F		<
MF1	0.68	0.72	RF1	F		<
MQ2	0.42	0.81	RQ2	S		<
MF2	0.28	0.84	RF2	S		<
MC2	0.33	0.84	RC2	F		<
					9	15

Table 1F

Sorted by Leanings Towards M or R

Mockups	% correct (M)	% correct (R)	Real	Texture	M	R
MC1	0.38	0.44	RC1	F		<
MC2	0.33	0.84	RC2	F		<
MCh	0.51	0.69	RCh	F		<
MF1	0.68	0.72	RF1	F		<
MF10	0.41	0.69	RF10	S		<
MF2	0.28	0.84	RF2	S		<
MF3	0.46	0.67	RF3	F		<
MF5	0.46	0.72	RF5	F		<
MF6	0.53	0.65	RF6	S/F		<
MF7	0.49	0.53	RF7	S		<
MF8	0.56	0.59	RF8	F		<
MF9	0.44	0.62	RF9	F		<
MH	0.58	0.65	RH	S		<
MPn	0.27	0.64	RPn	S		<
MQ2	0.42	0.81	RQ2	S		<
MF11	0.5	0.35	RF11	F	>	
MF4	0.56	0.54	RF4	S	>	
MP1	0.78	0.47	RP1	F	>	
MP2	0.86	0.22	RP2	F	>	
MP3	0.86	0.64	RP3	F	>	
MP4	0.78	0.46	RP4	F	>	
MP5	0.76	0.64	RP5	F	>	
MP6	0.72	0.46	RP6	F	>	
MQ1	0.43	0.42	RQ1	S	>	
					9	15

Table 1G - Standard Deviation

Group Statistics

	Condition	N	Mean	Std. Deviation	Std. Error Mean
Hit_mean	Mock-up	73	.5434	.15030	.01759
	Live	73	.5959	.12552	.01469

Table 2A - Accuracy based on genre

Descriptive Statistics

Dependent Variable: Hit

Genre	Mean	Std. Deviation	N
Classical	.52	.500	438
Film	.56	.496	876
Pop	.64	.481	438
Total	.57	.495	1752

Mean = Average Percentage Correct in each genre category

Table 2B - Response rate based on genre

Mean = Direction people were leaning in each genre category (regardless of accuracy)
1.0 = Live
0.0 = Mockup

Dependent Variable: Response

Genre	Mean	Std. Deviation	N
Classical	.62	.487	438
Film	.57	.495	876
Pop	.34	.475	438
Total	.53	.499	1752

Table 3 - Accuracy based on Musicians status, performance, and genre

7. Musician * Performance * Genre

Measure: MEASURE_1

Musician	Performance	Genre	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
0	1	1	.315	.046	.223	.407
		2	.403	.036	.331	.474
		3	.722	.038	.646	.799
	2	1	.657	.052	.554	.761
		2	.625	.035	.555	.695
		3	.454	.053	.349	.559
1	1	1	.486	.046	.396	.577
		2	.572	.035	.502	.642
		3	.865	.038	.789	.940
	2	1	.613	.051	.511	.715
		2	.644	.035	.575	.713
		3	.505	.052	.401	.608

T-Test - Are you a musician?

Table 4A - Number of musicians in Exp. 1

Group Statistics

	musician	N	Mean	Std. Deviation	Std. Error Mean
Hit_mean	No	36	.5255	.06628	.01105
	Yes	37	.6126	.10930	.01797

T-Test - Have you studied music academically?

Table 4B - Music Education in Exp. 1

Group Statistics

	music_ed	N	Mean	Std. Deviation	Std. Error Mean
Hit_mean	No	45	.5435	.08565	.01277
	Yes	23	.6178	.11490	.02396

Table 4C - Combinations of Scores

4. Musician * Performance

Measure: MEASURE_1

Musician	Performance	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
0	1	.480	.021	.438	.522
	2	.579	.023	.533	.625
1	1	.641	.021	.600	.683
	2	.587	.023	.542	.633

5. Musician * Genre

Measure: MEASURE_1

Musician	Genre	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
0	1	.486	.034	.418	.554
	2	.514	.020	.475	.553
	3	.588	.030	.528	.648
1	1	.550	.034	.483	.616
	2	.608	.019	.569	.647
	3	.685	.030	.625	.744

6. Performance * Genre

Measure: MEASURE_1

Performance	Genre	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	1	.401	.032	.336	.465
	2	.487	.025	.437	.538
	3	.794	.027	.740	.847
2	1	.635	.036	.562	.708
	2	.635	.025	.585	.684
	3	.479	.037	.406	.553

Between-Subjects Factors

		N
Musician	0	36
	1	37

Table 4D - Accuracy based on Musician status, instruction, and genre

Descriptive Statistics

	Musician	Mean	Std. Deviation	N
Mock_Class_mean	0	.3148	.26361	36
	1	.4865	.28968	37
	Total	.4018	.28846	73
Mock_Film_mean	0	.4028	.20845	36
	1	.5721	.22062	37
	Total	.4886	.22961	73
Mock_Pop_mean	0	.7222	.27021	36
	1	.8649	.18358	37
	Total	.7945	.23979	73
Live_Class_mean	0	.6574	.29262	36
	1	.6126	.32880	37
	Total	.6347	.31014	73
Live_Film_mean	0	.6250	.22316	36
	1	.6441	.19705	37
	Total	.6347	.20909	73
Live_Pop_mean	0	.4537	.29976	36
	1	.5045	.32981	37
	Total	.4795	.31420	73

T-Test- Sex difference

Table 6A - Accuracy based on gender

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Hit_mean	Male	29	.5891	.11823	.02196
	Female	44	.5568	.08529	.01286

Report

Hit_mean

musician	Sex	Mean	N	Std. Deviation
No	Male	.5208	12	.04530
	Female	.5278	24	.07541
	Total	.5255	36	.06628
Yes	Male	.6373	17	.13074
	Female	.5917	20	.08507
	Total	.6126	37	.10930
Total	Male	.5891	29	.11823
	Female	.5568	44	.08529
	Total	.5696	73	.10017

Table 6B - UCLA gender population

US Colleges and Universities
University of California

Student Body

Enrollment

	Men	Women	Total
Freshmen			
Full time	2,377	3,294	5,671
Part time	3	5	8
Total	2,380	3,299	5,679
All undergraduates (including freshmen)			
Full time	12,684	16,320	29,004
Part time	312	269	581
Total	12,996	16,589	29,585
Graduate students	6,503	5,501	12,004
Total all students	19,499	22,090	41,589

Table 7A - Accuracy based on race

Between-Subjects Factors

		Value Label	N
Race	1	Latino	7
	2	White	39
	3	Black	4
	4	Asian	21
	5	Native Amer	2

Descriptive Statistics

Dependent Variable: Hit_mean

Race	Mean	Std. Deviation	N
Latino	.5655	.06299	7
White	.5951	.11783	39
Black	.5417	.03402	4
Asian	.5278	.06632	21
Native Amer	.5833	.11785	2
Total	.5696	.10017	73

Report

musician

Race	Mean	N	Std. Deviation
Latino	.43	7	.535
White	.56	39	.502
Black	.25	4	.500
Asian	.48	21	.512
Native Amer	.50	2	.707
Total	.51	73	.503

Table 7B - United States vs UCLA racial populations

	Experiment Percentage	2010 US Population	
Native American	2.8%	0.7%	Native American
Black	5.5%	4.7%	Asian
Latin	9.6%	12.2%	Black
Asian	28.9%	16.3%	Latin
White	53.4%	63.7%	White

	UCLA Population
Native American	<1%
Black	2%
Latin	20%
Asian	29%
White	27%

Table 8 - Preferences

Performance	Instruction	Genre	Mean	Std. Deviation	N
Mock	Mock	Classical	4.24	1.624	177
	(told all mockups)	Film	4.37	1.650	354
		Pop	4.58	1.782	177
Actual Mockups		Total	4.39	1.680	708
	Live	Classical	4.20	1.489	177
		Film	4.38	1.671	354
	(told all live)	Pop	4.44	1.735	177
		Total	4.35	1.644	708
	Total	Classical	4.22	1.556	354
		Film	4.38	1.659	708
		Pop	4.51	1.758	354
		Total	4.37	1.662	1416
Live	Mock	Classical	4.30	1.697	177
	(told all mockups)	Film	4.64	1.674	354
		Pop	4.93	1.633	177
Actual Live		Total	4.63	1.682	708
	Live	Classical	4.25	1.664	177
		Film	4.43	1.719	354
	(told all live)	Pop	4.45	1.602	177
		Total	4.39	1.676	708
	Total	Classical	4.28	1.679	354
		Film	4.54	1.699	708
		Pop	4.69	1.633	354
		Total	4.51	1.683	1416
Total	Mock	Classical	4.27	1.659	354
	(told all mockups)	Film	4.51	1.666	708
		Pop	4.76	1.716	354
ALL		Total	4.51	1.685	1416
	Live	Classical	4.23	1.577	354
		Film	4.41	1.694	708
	(told all live)	Pop	4.45	1.667	354
		Total	4.37	1.660	1416
	Total	Classical	4.25	1.618	708
		Film	4.46	1.680	1416
		Pop	4.60	1.698	708
		Total	4.44	1.673	2832

Table 9 - Ratings of music compositions by different instruction condition, musicianship, and genre.

Report

Instruction	Musician		Mock_Class_mean	Mock_Film_mean	Mock_Pop_mean	Live_Class_mean	Live_Film_mean	Live_Pop_mean
Mock-up	Non-Musician	Mean	3.9130	4.2319	4.5652	4.1304	4.3696	5.0580
		N	23	23	23	23	23	23
		Std. Deviation	1.17730	.95179	1.15223	1.14477	1.06120	1.01828
	Musician	Mean	4.3833	4.5458	4.5667	4.5167	4.8708	4.7583
		N	40	40	40	40	40	40
		Std. Deviation	1.15606	1.19411	1.51197	1.48487	1.22153	1.38364
	Total	Mean	4.2116	4.4312	4.5661	4.3757	4.6878	4.8677
		N	63	63	63	63	63	63
		Std. Deviation	1.17669	1.11427	1.38170	1.37371	1.18211	1.26227
Live	Non-Musician	Mean	4.1481	4.1481	4.6296	3.8519	4.1019	4.7778
		N	18	18	18	18	18	18
		Std. Deviation	1.13312	.96658	1.26227	1.24314	1.35055	1.27827
	Musician	Mean	4.2946	4.5465	4.3488	4.4574	4.6357	4.3566
		N	43	43	43	43	43	43
		Std. Deviation	1.22195	1.25321	1.23218	1.18639	1.27203	1.12780
	Total	Mean	4.2514	4.4290	4.4317	4.2787	4.4781	4.4809
		N	61	61	61	61	61	61
		Std. Deviation	1.18892	1.18222	1.23730	1.22502	1.30755	1.17934
Total	Non-Musician	Mean	4.0163	4.1951	4.5935	4.0081	4.2520	4.9350
		N	41	41	41	41	41	41
		Std. Deviation	1.14976	.94715	1.18676	1.18201	1.18856	1.13338
	Musician	Mean	4.3373	4.5462	4.4538	4.4859	4.7490	4.5502
		N	83	83	83	83	83	83
		Std. Deviation	1.18424	1.21762	1.37000	1.33059	1.24596	1.26602
	Total	Mean	4.2312	4.4301	4.5000	4.3280	4.5847	4.6774
		N	124	124	124	124	124	124
		Std. Deviation	1.17807	1.14352	1.30906	1.29831	1.24477	1.23260

Table 11 - Average ratings per example based on performance

Rating

Piece	Type	Mean	N	Std. Deviation
C1	Mock	4.207	1	.
	Live	4.300	1	.
	Total	4.253	2	.0658
C2	Mock	4.150	1	.
	Live	4.293	1	.
	Total	4.222	2	.1012
Ch	Mock	4.121	1	.
	Live	4.217	1	.
	Total	4.169	2	.0679
F1	Mock	3.397	1	.
	Live	4.017	1	.
	Total	3.707	2	.4385
F10	Mock	4.897	1	.
	Live	5.000	1	.
	Total	4.948	2	.0731
F11	Mock	4.767	1	.
	Live	4.897	1	.
	Total	4.832	2	.0918
F2	Mock	4.667	1	.
	Live	4.586	1	.
	Total	4.626	2	.0569
F3	Mock	5.017	1	.
	Live	5.117	1	.
	Total	5.067	2	.0703
F4	Mock	4.800	1	.
	Live	4.983	1	.
	Total	4.891	2	.1292
F5	Mock	4.672	1	.
	Live	4.733	1	.
	Total	4.703	2	.0431
F6	Mock	3.583	1	.
	Live	3.621	1	.
	Total	3.602	2	.0264
F7	Mock	4.052	1	.
	Live	4.583	1	.
	Total	4.318	2	.3759
F8	Mock	4.650	1	.
	Live	4.845	1	.
	Total	4.747	2	.1378
F9	Mock	3.900	1	.
	Live	3.810	1	.
	Total	3.855	2	.0634
H	Mock	4.150	1	.
	Live	3.914	1	.
	Total	4.032	2	.1670
P1	Mock	5.603	1	.
	Live	5.633	1	.
	Total	5.618	2	.0211
P2	Mock	4.100	1	.
	Live	4.207	1	.
	Total	4.153	2	.0756
P3	Mock	3.672	1	.
	Live	4.250	1	.
	Total	3.961	2	.4084
P4	Mock	4.733	1	.
	Live	4.483	1	.
	Total	4.608	2	.1772
P5	Mock	4.897	1	.
	Live	5.033	1	.
	Total	4.965	2	.0967
P6	Mock	4.083	1	.
	Live	4.517	1	.
	Total	4.300	2	.3068
Pn	Mock	3.879	1	.
	Live	4.317	1	.
	Total	4.098	2	.3093
Q1	Mock	4.224	1	.
	Live	4.650	1	.
	Total	4.437	2	.3011
Q2	Mock	4.683	1	.
	Live	4.172	1	.
	Total	4.428	2	.3613
Total	Mock	4.371	24	.5235
	Live	4.507	24	.4699
	Total	4.439	48	.4969

Appendix B:
Additional Supplemental Tables and Figures

Descriptive Statistics

	Mean	Std. Deviation	N
Mock_Class_mean	.4018	.28846	73
Mock_Film_mean	.4886	.22961	73
Mock_Pop_mean	.7945	.23979	73
Live_Class_mean	.6347	.31014	73
Live_Film_mean	.6347	.20909	73
Live_Pop_mean	.4795	.31420	73

Estimated Marginal Means

1. condition

Estimates

Measure: MEASURE_1

condition	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	.562	.018	.527	.597
2	.583	.016	.551	.615

Pairwise Comparisons

Measure: MEASURE_1

(I) condition	(J) condition	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	95% Confidence Interval for Difference[a] Upper Bound
1	2	-.021	.022	.346	-.066	.023
2	1	.021	.022	.346	-.023	.066

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

2. genre

Estimates

Measure: MEASURE_1

genre	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	.518	.024	.470	.566
2	.562	.015	.532	.591
3	.637	.022	.593	.681

Pairwise Comparisons

Measure: MEASURE_1

(I) genre	(J) genre	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-.043	.028	.125	-.099	.012
	3	-.119*	.032	.000	-.183	-.054
2	1	.043	.028	.125	-.012	.099
	3	-.075*	.024	.003	-.124	-.027
3	1	.119*	.032	.000	.054	.183
	2	.075*	.024	.003	.027	.124

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

3. condition * genre

Measure: MEASURE_1

condition	genre	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1	1	.402	.034	.335	.469
	2	.489	.027	.435	.542
	3	.795	.028	.739	.850
2	1	.635	.036	.562	.707
	2	.635	.024	.586	.683
	3	.479	.037	.406	.553

Correlations

Correlations

		Hit_mean	Age_months
Hit_mean	Pearson Correlation	1	-.094
	Sig. (2-tailed)		.429
	N	73	73
Age_months	Pearson Correlation	-.094	1
	Sig. (2-tailed)	.429	
	N	73	73

Correlations

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Hit * Piece	1752	100.0%	0	0.0%	1752	100.0%

Report

Hit

Piece	Mean	N	Std. Deviation
MC1	.38	37	.492
MC2	.33	36	.478
MCh	.51	37	.507
MF1	.68	37	.475
MF10	.41	37	.498
MF11	.50	36	.507
MF2	.28	36	.454
MF3	.46	37	.505
MF4	.56	36	.504
MF5	.46	37	.505
MF6	.53	36	.506
MF7	.49	37	.507
MF8	.56	36	.504
MF9	.44	36	.504
MH	.58	36	.500
MP1	.78	37	.417
MP2	.86	36	.351
MP3	.86	37	.347
MP4	.78	36	.422
MP5	.76	37	.435
MP6	.72	36	.454
MPn	.27	37	.450
MQ1	.43	37	.502
MQ2	.42	36	.500
RC1	.44	36	.504
RC2	.84	37	.374

Report

Hit

Piece	Mean	N	Std. Deviation
RCh	.69	36	.467
RF1	.72	36	.454
RF10	.69	36	.467
RF11	.35	37	.484
RF2	.84	37	.374
RF3	.67	36	.478
RF4	.54	37	.505
RF5	.72	36	.454
RF6	.65	37	.484
RF7	.53	36	.506
RF8	.59	37	.498
RF9	.62	37	.492
RH	.65	37	.484
RP1	.47	36	.506
RP2	.22	37	.417
RP3	.64	36	.487
RP4	.46	37	.505
RP5	.64	36	.487
RP6	.46	37	.505
RPn	.64	36	.487
RQ1	.42	36	.500
RQ2	.81	37	.397
Total	.57	1752	.495

T-Test

Univariate Analysis of Variance

Between-Subjects Factors

		N
Genre	Classical	438
	Film	876
	Pop	438

Descriptive Statistics

Dependent Variable: Hit

Genre	Mean	Std. Deviation	N
Classical	.52	.500	438
Film	.56	.496	876
Pop	.64	.481	438
Total	.57	.495	1752

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Hit

F	df1	df2	Sig.
28.196	2	1749	.000

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Genre

Tests of Between-Subjects Effects

Dependent Variable: Hit

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3.199[a]	2	1.599	6.561	.001	.007
Intercept	516.442	1	516.442	2118.800	.000	.548
Genre	3.199	2	1.599	6.561	.001	.007
Error	426.306	1749	.244			
Total	998.000	1752				
Corrected Total	429.505	1751				

a. R Squared = .007 (Adjusted R Squared = .006)

Estimated Marginal Means

Grand Mean

Dependent Variable: Hit

Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
.572	.012	.548	.597

Univariate Analysis of Variance - Response bias

Between-Subjects Factors

		Value Label	N
Genre	1	Classical	438
	2	Film	876
	3	Pop	438

Descriptive Statistics

Dependent Variable: Response

Genre	Mean	Std. Deviation	N
Classical	.62	.487	438
Film	.57	.495	876
Pop	.34	.475	438
Total	.53	.499	1752

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Response

F	df1	df2	Sig.
19.567	2	1749	.000

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Genre

Tests of Between-Subjects Effects

Dependent Variable: Response

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	20.276[a]	2	10.138	42.571	.000	.046
Intercept	411.179	1	411.179	1726.589	.000	.497
Genre	20.276	2	10.138	42.571	.000	.046
Error	416.516	1749	.238			
Total	922.000	1752				
Corrected Total	436.792	1751				

a. R Squared = .046 (Adjusted R Squared = .045)

Estimated Marginal Means

Grand Mean

Dependent Variable: Response

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
.511	.012	.487	.535

T-Test - Have you studied music academically?

Group Statistics

	music_ed	N	Mean	Std. Deviation	Std. Error Mean
Hit_mean	No	45	.5435	.08565	.01277
	Yes	23	.6178	.11490	.02396

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	df
Hit_mean	Equal variances assumed	2.564	.114	-3.005	66
	Equal variances not assumed			-2.734	34.863

Independent Samples Test

		t-test for Equality of Means			
		Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence ... Lower
Hit_mean	Equal variances assumed	.004	-.07424	.02471	-.12356
	Equal variances not assumed	.010	-.07424	.02715	-.12936

Independent Samples Test

		t-test for Equality of Means 95% Confidence Interval of the ... Upper
Hit_mean	Equal variances assumed	-.02491
	Equal variances not assumed	-.01911

T-Test - Are you a musician?

Group Statistics

	musician	N	Mean	Std. Deviation	Std. Error Mean
Hit_mean	No	36	.5255	.06628	.01105
	Yes	37	.6126	.10930	.01797

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	df
Hit_mean	Equal variances assumed	8.329	.005	-4.105	71
	Equal variances not assumed			-4.132	59.596

Independent Samples Test

		t-test for Equality of Means			
		Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence ... Lower
Hit_mean	Equal variances assumed	.000	-.08715	.02123	-.12948
	Equal variances not assumed	.000	-.08715	.02109	-.12935

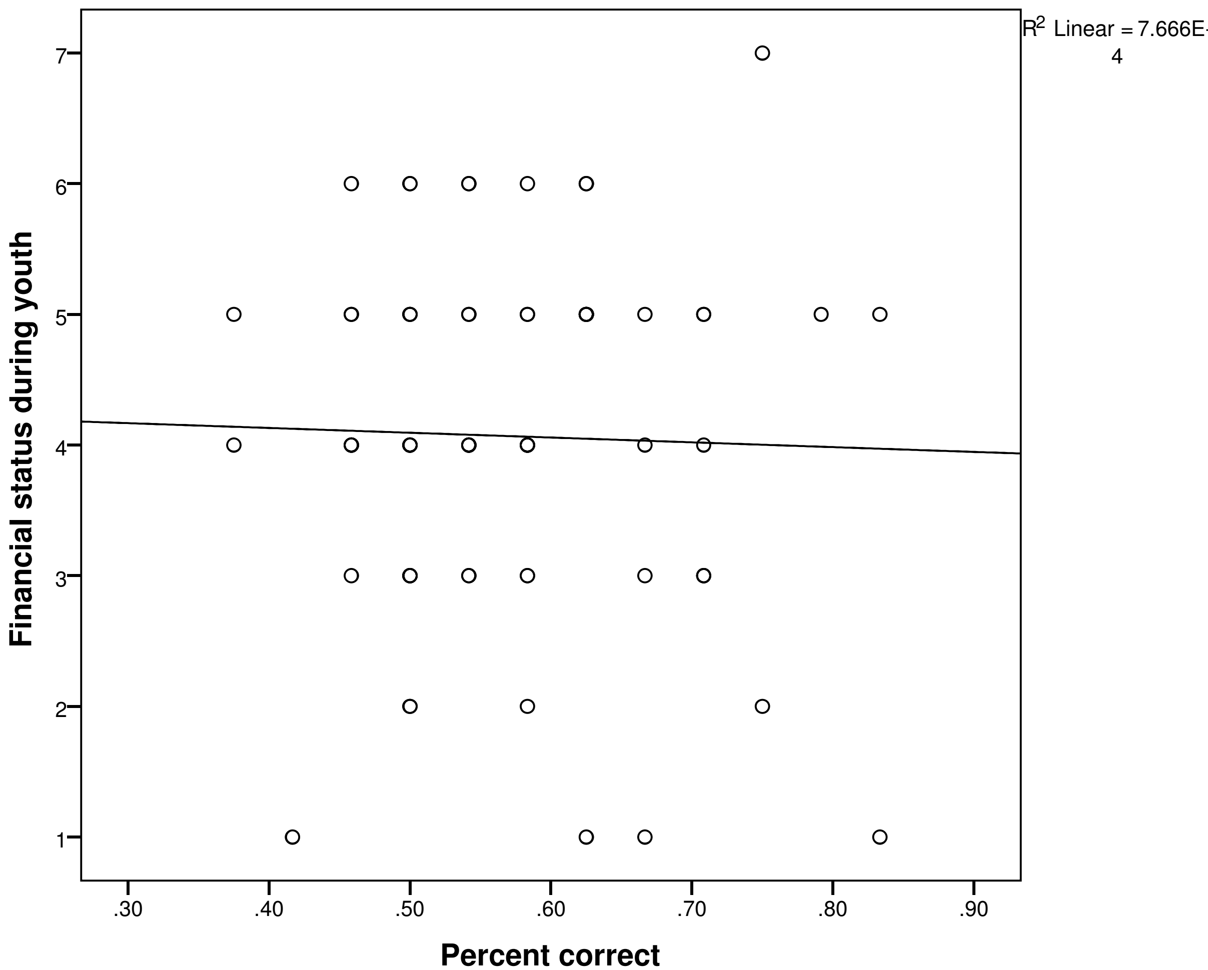
Independent Samples Test

		t-test for Equality of Means 95% Confidence Interval of the ... Upper
Hit_mean	Equal variances assumed	-.04482
	Equal variances not assumed	-.04495

Correlations

Correlations

		Hit_mean	Fincl_young
Hit_mean	Pearson Correlation	1	-.028
	Sig. (2-tailed)		.816
	N	73	73
Fincl_young	Pearson Correlation	-.028	1
	Sig. (2-tailed)	.816	
	N	73	73



T-Test- Sex difference

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Hit_mean	Male	29	.5891	.11823	.02196
	Female	44	.5568	.08529	.01286

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	df
Hit_mean	Equal variances assumed	3.957	.051	1.354	71
	Equal variances not assumed			1.268	46.909

Independent Samples Test

		t-test for Equality of Means			
					95% Confidence ...
		Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower
Hit_mean	Equal variances assumed	.180	.03226	.02382	-.01524
	Equal variances not assumed	.211	.03226	.02544	-.01893

Independent Samples Test

		t-test for Equality of Means
		95% Confidence Interval of the ...
		Upper
Hit_mean	Equal variances assumed	.07976
	Equal variances not assumed	.08345

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Race	1	Latino	7
	2	White	39
	3	Black	4
	4	Asian	21
	5	Native Amer	2

Descriptive Statistics

Dependent Variable: Hit_mean

Race	Mean	Std. Deviation	N
Latino	.5655	.06299	7
White	.5951	.11783	39
Black	.5417	.03402	4
Asian	.5278	.06632	21
Native Amer	.5833	.11785	2
Total	.5696	.10017	73

Tests of Between-Subjects Effects

Dependent Variable: Hit_mean

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.066[a]	4	.016	1.700	.160	.091
Intercept	8.192	1	8.192	848.270	.000	.926
Race	.066	4	.016	1.700	.160	.091
Error	.657	68	.010			
Total	24.410	73				
Corrected Total	.722	72				

a. R Squared = .091 (Adjusted R Squared = .037)

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
musician * Race	73	100.0%	0	0.0%	73	100.0%

Report

musician

Race	Mean	N	Std. Deviation
Latino	.43	7	.535
White	.56	39	.502
Black	.25	4	.500
Asian	.48	21	.512
Native Amer	.50	2	.707
Total	.51	73	.503

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

Performance	Genre	Dependent Variable
1	1	Mock_Class_mean
	2	Mock_Film_mean
	3	Mock_Pop_mean
2	1	Live_Class_mean
	2	Live_Film_mean
	3	Live_Pop_mean

Between-Subjects Factors

		N
Musician	0	36
	1	37

Descriptive Statistics

	Musician	Mean	Std. Deviation	N
Mock_Class_mean	0	.3148	.26361	36
	1	.4865	.28968	37
	Total	.4018	.28846	73
Mock_Film_mean	0	.4028	.20845	36
	1	.5721	.22062	37
	Total	.4886	.22961	73
Mock_Pop_mean	0	.7222	.27021	36
	1	.8649	.18358	37
	Total	.7945	.23979	73
Live_Class_mean	0	.6574	.29262	36
	1	.6126	.32880	37
	Total	.6347	.31014	73
Live_Film_mean	0	.6250	.22316	36
	1	.6441	.19705	37
	Total	.6347	.20909	73
Live_Pop_mean	0	.4537	.29976	36
	1	.5045	.32981	37
	Total	.4795	.31420	73

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df
Performance	Pillai's Trace	.016	1.164[b]	1.000	71.000
	Wilks' Lambda	.984	1.164[b]	1.000	71.000
	Hotelling's Trace	.016	1.164[b]	1.000	71.000
	Roy's Largest Root	.016	1.164[b]	1.000	71.000
Performance * Musician	Pillai's Trace	.161	13.592[b]	1.000	71.000
	Wilks' Lambda	.839	13.592[b]	1.000	71.000
	Hotelling's Trace	.191	13.592[b]	1.000	71.000
	Roy's Largest Root	.191	13.592[b]	1.000	71.000
Genre	Pillai's Trace	.175	7.417[b]	2.000	70.000
	Wilks' Lambda	.825	7.417[b]	2.000	70.000
	Hotelling's Trace	.212	7.417[b]	2.000	70.000
	Roy's Largest Root	.212	7.417[b]	2.000	70.000
Genre * Musician	Pillai's Trace	.005	.166[b]	2.000	70.000
	Wilks' Lambda	.995	.166[b]	2.000	70.000
	Hotelling's Trace	.005	.166[b]	2.000	70.000
	Roy's Largest Root	.005	.166[b]	2.000	70.000
Performance * Genre	Pillai's Trace	.457	29.476[b]	2.000	70.000
	Wilks' Lambda	.543	29.476[b]	2.000	70.000
	Hotelling's Trace	.842	29.476[b]	2.000	70.000
	Roy's Largest Root	.842	29.476[b]	2.000	70.000
Performance * Genre * Musician	Pillai's Trace	.010	.370[b]	2.000	70.000
	Wilks' Lambda	.990	.370[b]	2.000	70.000
	Hotelling's Trace	.011	.370[b]	2.000	70.000
	Roy's Largest Root	.011	.370[b]	2.000	70.000

Multivariate Tests[a]

Effect		Sig.	Partial Eta Squared
Performance	Pillai's Trace	.284	.016
	Wilks' Lambda	.284	.016
	Hotelling's Trace	.284	.016
	Roy's Largest Root	.284	.016
Performance * Musician	Pillai's Trace	.000	.161
	Wilks' Lambda	.000	.161
	Hotelling's Trace	.000	.161
	Roy's Largest Root	.000	.161
Genre	Pillai's Trace	.001	.175
	Wilks' Lambda	.001	.175
	Hotelling's Trace	.001	.175
	Roy's Largest Root	.001	.175
Genre * Musician	Pillai's Trace	.847	.005
	Wilks' Lambda	.847	.005
	Hotelling's Trace	.847	.005
	Roy's Largest Root	.847	.005
Performance * Genre	Pillai's Trace	.000	.457
	Wilks' Lambda	.000	.457
	Hotelling's Trace	.000	.457
	Roy's Largest Root	.000	.457
Performance * Genre * Musician	Pillai's Trace	.692	.010
	Wilks' Lambda	.692	.010
	Hotelling's Trace	.692	.010
	Roy's Largest Root	.692	.010

a. Design: Intercept + Musician
Within Subjects Design: Performance + Genre + Performance * Genre

b. Exact statistic

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser
Performance	1.000	.000	0	.	1.000
Genre	.895	7.758	2	.021	.905
Performance * Genre	.978	1.593	2	.451	.978

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

	Epsilon[b]	
Within Subjects Effect	Huynh-Feldt	Lower-bound
Performance	1.000	1.000
Genre	.940	.500
Performance * Genre	1.000	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Musician
Within Subjects Design: Performance + Genre + Performance * Genre

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F
Performance	Sphericity Assumed	.055	1	.055	1.164
	Greenhouse-Geisser	.055	1.000	.055	1.164
	Huynh-Feldt	.055	1.000	.055	1.164
	Lower-bound	.055	1.000	.055	1.164
Performance * Musician	Sphericity Assumed	.639	1	.639	13.592
	Greenhouse-Geisser	.639	1.000	.639	13.592
	Huynh-Feldt	.639	1.000	.639	13.592
	Lower-bound	.639	1.000	.639	13.592
Error(Performance)	Sphericity Assumed	3.339	71	.047	
	Greenhouse-Geisser	3.339	71.000	.047	
	Huynh-Feldt	3.339	71.000	.047	
	Lower-bound	3.339	71.000	.047	
Genre	Sphericity Assumed	1.050	2	.525	8.852
	Greenhouse-Geisser	1.050	1.810	.580	8.852
	Huynh-Feldt	1.050	1.881	.558	8.852
	Lower-bound	1.050	1.000	1.050	8.852
Genre * Musician	Sphericity Assumed	.025	2	.013	.211
	Greenhouse-Geisser	.025	1.810	.014	.211
	Huynh-Feldt	.025	1.881	.013	.211
	Lower-bound	.025	1.000	.025	.211
Error(Genre)	Sphericity Assumed	8.421	142	.059	
	Greenhouse-Geisser	8.421	128.518	.066	
	Huynh-Feldt	8.421	133.543	.063	
	Lower-bound	8.421	71.000	.119	
Performance * Genre	Sphericity Assumed	6.348	2	3.174	33.013
	Greenhouse-Geisser	6.348	1.956	3.245	33.013
	Huynh-Feldt	6.348	2.000	3.174	33.013
	Lower-bound	6.348	1.000	6.348	33.013
Performance * Genre * Musician	Sphericity Assumed	.071	2	.035	.369
	Greenhouse-Geisser	.071	1.956	.036	.369
	Huynh-Feldt	.071	2.000	.035	.369
	Lower-bound	.071	1.000	.071	.369
Error(Performance*Genre)	Sphericity Assumed	13.652	142	.096	
	Greenhouse-Geisser	13.652	138.876	.098	

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Sig.	Partial Eta Squared
Performance	Sphericity Assumed	.284	.016
	Greenhouse-Geisser	.284	.016
	Huynh-Feldt	.284	.016
	Lower-bound	.284	.016
Performance * Musician	Sphericity Assumed	.000	.161
	Greenhouse-Geisser	.000	.161
	Huynh-Feldt	.000	.161
	Lower-bound	.000	.161
Error(Performance)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
	Lower-bound		
Genre	Sphericity Assumed	.000	.111
	Greenhouse-Geisser	.000	.111
	Huynh-Feldt	.000	.111
	Lower-bound	.004	.111
Genre * Musician	Sphericity Assumed	.810	.003
	Greenhouse-Geisser	.788	.003
	Huynh-Feldt	.796	.003
	Lower-bound	.647	.003
Error(Genre)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
	Lower-bound		
Performance * Genre	Sphericity Assumed	.000	.317
	Greenhouse-Geisser	.000	.317
	Huynh-Feldt	.000	.317
	Lower-bound	.000	.317
Performance * Genre * Musician	Sphericity Assumed	.692	.005
	Greenhouse-Geisser	.687	.005
	Huynh-Feldt	.692	.005
	Lower-bound	.546	.005
Error(Performance*Genre)	Sphericity Assumed		
	Greenhouse-Geisser		

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F
	Huynh-Feldt	13.652	142.000	.096	
	Lower-bound	13.652	71.000	.192	

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Sig.	Partial Eta Squared
	Huynh-Feldt		
	Lower-bound		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Performance	Genre	Type III Sum of Squares	df	Mean Square
Performance	Linear		.055	1	.055
Performance * Musician	Linear		.639	1	.639
Error(Performance)	Linear		3.339	71	.047
Genre		Linear	1.025	1	1.025
		Quadratic	.025	1	.025
Genre * Musician		Linear	.020	1	.020
		Quadratic	.005	1	.005
Error(Genre)		Linear	5.451	71	.077
		Quadratic	2.970	71	.042
Performance * Genre	Linear	Linear	5.496	1	5.496
		Quadratic	.852	1	.852
Performance * Genre * Musician	Linear	Linear	.071	1	.071
		Quadratic	9.751E-5	1	9.751E-5
Error(Performance*Genre)	Linear	Linear	6.950	71	.098
		Quadratic	6.703	71	.094

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Performance	Genre	F	Sig.	Partial Eta Squared
Performance	Linear		1.164	.284	.016
Performance * Musician	Linear		13.592	.000	.161
Error(Performance)	Linear				
Genre		Linear	13.348	.000	.158
		Quadratic	.601	.441	.008
Genre * Musician		Linear	.263	.609	.004
		Quadratic	.116	.734	.002
Error(Genre)		Linear			
		Quadratic			
Performance * Genre	Linear	Linear	56.144	.000	.442
		Quadratic	9.030	.004	.113
Performance * Genre * Musician	Linear	Linear	.724	.398	.010
		Quadratic	.001	.974	.000
Error(Performance*Genre)	Linear	Linear			
		Quadratic			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	143.138	1	143.138	2435.135	.000	.972
Musician	.787	1	.787	13.391	.000	.159
Error	4.173	71	.059			

Estimated Marginal Means

1. Musician

Estimates

Measure: MEASURE_1

Musician	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
0	.529	.016	.496	.562
1	.614	.016	.582	.647

Pairwise Comparisons

Measure: MEASURE_1

(I) Musician	(J) Musician	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
0	1	-.085*	.023	.000	-.131	-.039
1	0	.085*	.023	.000	.039	.131

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	.131	1	.131	13.391	.000	.159
Error	.696	71	.010			

The F tests the effect of Musician. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. Performance

Estimates

Measure: MEASURE_1

Performance	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.561	.015	.531	.590
2	.583	.016	.551	.615

Pairwise Comparisons

Measure: MEASURE_1

(I) Performance	(J) Performance	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence ...[a]
					Lower Bound
1	2	-.022	.021	.284	-.064
2	1	.022	.021	.284	-.019

Pairwise Comparisons

Measure: MEASURE_1

(I) Performance	(J) Performance	95% Confidence Interval for ...[a]
		Upper Bound
1	2	.019
2	1	.064

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.016	1.164[a]	1.000	71.000	.284	.016
Wilks' lambda	.984	1.164[a]	1.000	71.000	.284	.016
Hotelling's trace	.016	1.164[a]	1.000	71.000	.284	.016
Roy's largest root	.016	1.164[a]	1.000	71.000	.284	.016

Each F tests the multivariate effect of Performance. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

3. Genre

Estimates

Measure: MEASURE_1

Genre	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	.518	.024	.470	.565
2	.561	.014	.533	.589
3	.636	.021	.594	.679

Pairwise Comparisons

Measure: MEASURE_1

(I) Genre	(J) Genre	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	95% Confidence Interval for Difference[b] Upper Bound
1	2	-.043	.028	.128	-.099	.013
	3	-.118*	.032	.000	-.183	-.054
2	1	.043	.028	.128	-.013	.099
	3	-.075*	.024	.003	-.124	-.027
3	1	.118*	.032	.000	.054	.183
	2	.075*	.024	.003	.027	.124

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.175	7.417[a]	2.000	70.000	.001	.175
Wilks' lambda	.825	7.417[a]	2.000	70.000	.001	.175
Hotelling's trace	.212	7.417[a]	2.000	70.000	.001	.175
Roy's largest root	.212	7.417[a]	2.000	70.000	.001	.175

Each F tests the multivariate effect of Genre. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

4. Musician * Performance

Measure: MEASURE_1

Musician	Performance	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
0	1	.480	.021	.438	.522
	2	.579	.023	.533	.625
1	1	.641	.021	.600	.683
	2	.587	.023	.542	.633

5. Musician * Genre

Measure: MEASURE_1

Musician	Genre	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
0	1	.486	.034	.418	.554
	2	.514	.020	.475	.553
	3	.588	.030	.528	.648
1	1	.550	.034	.483	.616
	2	.608	.019	.569	.647
	3	.685	.030	.625	.744

6. Performance * Genre

Measure: MEASURE_1

Performance	Genre	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1	1	.401	.032	.336	.465
	2	.487	.025	.437	.538
	3	.794	.027	.740	.847
2	1	.635	.036	.562	.708
	2	.635	.025	.585	.684
	3	.479	.037	.406	.553

7. Musician * Performance * Genre

Measure: MEASURE_1

Musician	Performance	Genre	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
0	1	1	.315	.046	.223	.407
		2	.403	.036	.331	.474
		3	.722	.038	.646	.799
	2	1	.657	.052	.554	.761
		2	.625	.035	.555	.695
		3	.454	.053	.349	.559
1	1	1	.486	.046	.396	.577
		2	.572	.035	.502	.642
		3	.865	.038	.789	.940
	2	1	.613	.051	.511	.715
		2	.644	.035	.575	.713
		3	.505	.052	.401	.608

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Hit * Condition	1752	100.0%	0	0.0%	1752	100.0%

Report

Hit

Condition	Mean	N	Std. Deviation
Mock-up	.54	876	.498
Live	.60	876	.491
Total	.57	1752	.495

Between-Subjects Factors

		Value Label	N
Instruction	0	Mock-up	63
	1	Live	61
Musician	0	Non-Musician	41
	1	Musician	83

Descriptive Statistics

	Instruction	Musician	Mean	Std. Deviation	N
Mock_Class_mean	Mock-up	Non-Musician	3.9130	1.17730	23
		Musician	4.3833	1.15606	40
		Total	4.2116	1.17669	63
	Live	Non-Musician	4.1481	1.13312	18
		Musician	4.2946	1.22195	43
		Total	4.2514	1.18892	61
	Total	Non-Musician	4.0163	1.14976	41
		Musician	4.3373	1.18424	83
		Total	4.2312	1.17807	124
Mock_Film_mean	Mock-up	Non-Musician	4.2319	.95179	23
		Musician	4.5458	1.19411	40
		Total	4.4312	1.11427	63
	Live	Non-Musician	4.1481	.96658	18
		Musician	4.5465	1.25321	43
		Total	4.4290	1.18222	61
	Total	Non-Musician	4.1951	.94715	41
		Musician	4.5462	1.21762	83
		Total	4.4301	1.14352	124
Mock_Pop_mean	Mock-up	Non-Musician	4.5652	1.15223	23
		Musician	4.5667	1.51197	40
		Total	4.5661	1.38170	63
	Live	Non-Musician	4.6296	1.26227	18
		Musician	4.3488	1.23218	43
		Total	4.4317	1.23730	61
	Total	Non-Musician	4.5935	1.18676	41
		Musician	4.4538	1.37000	83
		Total	4.5000	1.30906	124
Live_Class_mean	Mock-up	Non-Musician	4.1304	1.14477	23
		Musician	4.5167	1.48487	40
		Total	4.3757	1.37371	63
	Live	Non-Musician	3.8519	1.24314	18
		Musician	4.4574	1.18639	43
		Total	4.2787	1.22502	61

Descriptive Statistics

	Instruction	Musician	Mean	Std. Deviation	N
	Total	Non-Musician	4.0081	1.18201	41
		Musician	4.4859	1.33059	83
		Total	4.3280	1.29831	124
Live_Film_mean	Mock-up	Non-Musician	4.3696	1.06120	23
		Musician	4.8708	1.22153	40
		Total	4.6878	1.18211	63
	Live	Non-Musician	4.1019	1.35055	18
		Musician	4.6357	1.27203	43
		Total	4.4781	1.30755	61
	Total	Non-Musician	4.2520	1.18856	41
		Musician	4.7490	1.24596	83
		Total	4.5847	1.24477	124
Live_Pop_mean	Mock-up	Non-Musician	5.0580	1.01828	23
		Musician	4.7583	1.38364	40
		Total	4.8677	1.26227	63
	Live	Non-Musician	4.7778	1.27827	18
		Musician	4.3566	1.12780	43
		Total	4.4809	1.17934	61
	Total	Non-Musician	4.9350	1.13338	41
		Musician	4.5502	1.26602	83
		Total	4.6774	1.23260	124

Estimated Marginal Means

1. Instruction

Estimates

Measure: MEASURE_1

Instruction	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Mock-up	4.492	.116	4.263	4.722
Live	4.358	.124	4.112	4.604

Pairwise Comparisons

Measure: MEASURE_1

(I) Instruction	(J) Instruction	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
Mock-up	Live	.134	.170	.430	-.202	.471
Live	Mock-up	-.134	.170	.430	-.471	.202

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	.491	1	.491	.627	.430	.005
Error	93.950	120	.783			

The F tests the effect of Instruction. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. Musician

Estimates

Measure: MEASURE_1

Musician	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Non-Musician	4.327	.139	4.051	4.603
Musician	4.523	.097	4.331	4.716

Pairwise Comparisons

Measure: MEASURE_1

(I) Musician	(J) Musician	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
Non-Musician	Musician	-.196	.170	.250	-.532	.140
Musician	Non-Musician	.196	.170	.250	-.140	.532

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

3. Performance

Estimates

Measure: MEASURE_1

Performance	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	4.360	.088	4.185	4.535
2	4.490	.089	4.314	4.667

Pairwise Comparisons

Measure: MEASURE_1

(I) Performance	(J) Performance	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence [b]... Lower Bound
1	2	-.130*	.052	.013	-.232
2	1	.130*	.052	.013	.028

Pairwise Comparisons

Measure: MEASURE_1

(I) Performance	(J) Performance	95% Confidence Interval for [b]... Upper Bound
1	2	-.028
2	1	.232

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

4. Genre

Pairwise Comparisons

Measure: MEASURE_1

(I) Genre	(J) Genre	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	-.219*	.078	.006	-.373	-.066
	3	-.421*	.129	.001	-.676	-.166
2	1	.219*	.078	.006	.066	.373
	3	-.201	.136	.142	-.471	.068
3	1	.421*	.129	.001	.166	.676
	2	.201	.136	.142	-.068	.471

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

5. Instruction * Musician

Measure: MEASURE_1

Instruction	Musician	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Mock-up	Non-Musician	4.378	.184	4.013	4.743
	Musician	4.607	.140	4.330	4.884
Live	Non-Musician	4.276	.209	3.863	4.689
	Musician	4.440	.135	4.173	4.707

6. Instruction * Performance

Measure: MEASURE_1

Instruction	Performance	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Mock-up	1	4.368	.120	4.129	4.606
	2	4.617	.122	4.377	4.858
Live	1	4.353	.129	4.097	4.608
	2	4.364	.130	4.105	4.622

7. Musician * Performance

Measure: MEASURE_1

Musician	Performance	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Non-Musician	1	4.273	.145	3.986	4.559
	2	4.382	.146	4.092	4.671
Musician	1	4.448	.101	4.247	4.648
	2	4.599	.102	4.397	4.801

8. Musician * Genre

Measure: MEASURE_1

Musician	Genre	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Non-Musician	1	4.011	.174	3.667	4.354
	2	4.213	.179	3.859	4.567
	3	4.758	.182	4.398	5.117
Musician	1	4.413	.121	4.173	4.653
	2	4.650	.125	4.403	4.897
	3	4.508	.127	4.257	4.759

9. Performance * Genre

Measure: MEASURE_1

Performance	Genre	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	1	4.185	.113	3.961	4.409
	2	4.368	.110	4.151	4.586
	3	4.528	.127	4.277	4.778
2	1	4.239	.124	3.994	4.484
	2	4.494	.118	4.261	4.728
	3	4.738	.117	4.506	4.969

10. Instruction * Musician * Performance

Measure: MEASURE_1

Instruction	Musician	Performance	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Mock-up	Non-Musician	1	4.237	.192	3.857	4.617
		2	4.519	.194	4.136	4.903
	Musician	1	4.499	.146	4.210	4.787
		2	4.715	.147	4.424	5.006
Live	Non-Musician	1	4.309	.217	3.879	4.738
		2	4.244	.219	3.810	4.677
	Musician	1	4.397	.140	4.119	4.675
		2	4.483	.142	4.203	4.764

Correlations

Correlations

		Rating	Age
Rating	Pearson Correlation	1	.195*
	Sig. (2-tailed)		.030
	N	124	124
Age	Pearson Correlation	.195*	1
	Sig. (2-tailed)	.030	
	N	124	124

*. Correlation is significant at the 0.05 level (2-tailed).

T-Test - No sex difference

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Rating	Male	51	4.613	.8063	.1129
	Female	73	4.372	.9746	.1141

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	df
Rating	Equal variances assumed	1.036	.311	1.453	122
	Equal variances not assumed			1.503	118.461

Independent Samples Test

		t-test for Equality of Means				t-test for Equality of Means
					95% Confidence ...	95% Confidence Interval of the ...
		Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Rating	Equal variances assumed	.149	.2412	.1660	-.0874	.5697
	Equal variances not assumed	.136	.2412	.1605	-.0766	.5590

Appendix C - Experiment Questionnaire

“Perceiving Real and Synthesized Instruments” Questionnaire:

1. Age in years and months

   ____

2. Identifying Gender (circle one)

   M / F

3. Race/Ethnicity (circle one)

   American Indian or Alaska Native

   Asian

   Black or African American

   Hispanic or Latino

   Native Hawaiian or Other Pacific Islander

   White

4. Current City

   ____

5. City/cities lived in from birth – 18 years (if more than two, only list two most recent)

   ____

6. Approximate current household income (circle one - if dependent, estimate parental income)

   < $10,000

   $10,000 - $35,000

   $35,000 – $70,000

   $70,000 - $100,000

   >$100,000

   a. Number of people in current household

      ____

7. On a scale from 1 – 7 (1 being poverty and 7 being wealthy), circle the description that best describes how you remember the financial security of your family's household from birth – 18 years (circle one)

   1 2 3 4 5 6 7

8. Highest level of Education (circle one)

   Less than High School

   High School Diploma

   GED

   Associate's Degree

   Bachelor's Degree

   Master's Degree

   Doctorate Degree

9. Are you currently a student?

   Y / N

10. Are you currently or have you in the past been a musician?

Y / N

a. If yes, at what age in years did you begin your involvement with music?

____

i. What was your initial involvement with music? (circle one)

Performer (list instrument(s))______________________________

Composer/Writer

Conductor

Other (please specify) _______________________________________

b. If still a practicing musician, are you a hobbyist or a professional (earning money)?

Hobbyist (please provide current instrument(s)/role(s)

____

(please also provide how many hours per month you play/participate) ________________________________

Professional (please provide current instrument(s)/role(s)

Performer (list instrument (s)________________________________

Composer/Writer

Conductor

Other (please specify) _______________________________________

c. Have you ever studied music academically or as a serious hobby?

   Y / N

   i. Do you have a music degree?

      Y / N

   ii. List highest level of music degree (circle one)

      Bachelor's Degree

      Master's Degree

      Doctorate Degree

d. Growing up, how many other members of your immediate family participated in music?

   ____

11. Are there any of the following genres of music that you *prefer* over others? (circle all that apply)

Blues	**Classical**	**Country**	**Electronic**	**Folk**
Jazz	**New Age**	**Pop**	**Reggae**	**Rock**

12. Are there any of the following genres of music that you *dislike* over others?

Blues	**Classical**	**Country**	**Electronic**	**Folk**
Jazz	**New Age**	**Pop**	**Reggae**	**Rock**

13. Finally, did you recognize any of the musical examples?

    Y / N

    a. If yes, please list the titles and artists below, if possible.

Appendix D: SuperLab 4.5 Instructions

Experiment 1 - Instructions

Live musicians, both performers and singers using acoustic instruments and voices, can be emulated today through the use of digital sample libraries. These sample libraries are highly accessible and have been continually improving to mock the sound of live performances in many different genres of music.

In this experiment you will be asked to listen to original musical works and determine whether the instrumental sounds were played by people in real time, or were generated using only a computer program.

The musical works you will hear are all about 20 seconds long. Let the piece finish playing, and then press 0 if you think the music performance was generated using only a computer program, and press 1 if you think the music performance was performed by live musicians. Listen carefully, the technology used to create mockup versions of real performances is quite sophisticated.

Experiment 2 - Instructions

People all around the world enjoy listening to music, but little is known about what features of music contribute to people's preferences.

In this experiment you will be asked to listen to original musical works recorded by live musicians in a studio. *

The musical works you will hear are all about 20 seconds long. Let the music finish playing, and then using a scale of 1 to 7, rate how much you liked each piece with 1 being "Not at all" and 7 being "Very much."

Press the space bar to hear a practice trial.

* Other group instructions read:

In this experiment you will be asked to listen to original musical works created on a computer using a program.

Bibliography

"American Federation of Musicians Sound Recording Scales (Non-Symphonic)." American Federation of Musicians. July 14, 2015. Accessed April 25, 2017. http://www.afm.org/wp-content/uploads/2016/03/Sound-Recording-Scales.pdf

Andrews, Evan. "Who were the Luddites?" History.com. August 07, 2015. Accessed May 16, 2017. http://www.history.com/news/ask-history/who-were-the-luddites

Auslander, Philip. *Liveness: performance in a mediatized culture*. London: Routledge, 2011.

Beauchamp, James W. "James W. Beauchamp." Prof. James W. Beauchamp Home Page. Accessed May 10, 2017. http://ems.music.uiuc.edu/beaucham/

Fink, Robert. "Elvis Everywhere: Musicology and Popular Music Studies at the Twilight of the Canon." *American Music* 16, no. 2 (1998): 135-79. doi:10.2307/3052563

Furduj, Boris. "Acoustic Instrument Simulation In Film Music Contexts." PhD diss., MacQuarie University, 2014.

"CIS - US Colleges and Universities - University of California Los Angeles." Minnesota Career Information System. 2016. Accessed April 25, 2017. https://mncis.intocareers.org/SchInfo.aspx?FileID=NSch&SchID=840297&TopicNum=2&SourceState=MN

Massaro, D. W. *Experimental psychology: An information processing approach*. Harcourt Brace Jovanovich, 1989.

McAdams, Stephen, James W. Beauchamp, and Suzanna Meneguzzi. "Discrimination of musical instrument sounds resynthesized with simplified spectrotemporal parameters." The Journal of the Acoustical Society of America 105, no. 2 (February 1999): 882-97. doi:10.1121/1.426277.

Player, Tom. "Real Orchestra vs Synth Mockup – Parts 1-6." Audio Cookbook. November 27 - December 19, 2014. Accessed May 10, 2017. http://audiocookbook.org/real-orchestra-vs-synth-mockup-part-16/

"Population of the United States by Race and Hispanic/Latino Origin, Census 2000 and 2010." Infoplease. 2010. Accessed April 25, 2017. https://www.infoplease.com/us/race-population/population-united-states-race-and-hispaniclatino-origin-census-2000-and-2010

Spence, Nick. "iPod generation prefer MP3 fidelity to CD says study." Macworld UK. November 06, 2012. Accessed April 25, 2017. http://www.macworld.co.uk/news/apple/ipod-generation-prefer-MP3-fidelity-cd-says-study-25288/

St. John, Lara. "Addendum to Game of Thrones." Saurian Saint. February 23, 2014. Accessed April 25, 2017. https://sauriansaint.wordpress.com/2014/02/23/addendum-to-game-of-thrones/

St. John, Lara. "Lara Takes On HBO and Game of Thrones in an Open Letter." Saurian Saint. May 08, 2014. Accessed April 25, 2017. https://sauriansaint.wordpress.com/2014/02/15/lara-takes-on-hbo-in-an-open-letter/