The Effects of Personal Song Meaning, Singer Gender and Musical Training on Spontaneous Facial and Head Movement When Singing: An Exploratory Investigation

Research investigating the relationship between music and body movement is diverse and plentiful. However, research is lacking on the complex relationship between body movement and singing. This undergraduate thesis will begin to examine this complex relationship through the analysis of three separate components of the AIRS Test Battery of Singing Skill. The three components that will be the main focus for this study consist of two versions of a familiar song (Brother John/Frère Jacques), as well as a self-selected (favourite) song. These components will be examined for facial movement using a coding system that the present author specifically created for the purposes of this study. The main objective of this exploratory research is to determine if there are any particular patterns of use of facial expressions and body movements while singing. In addition, it is of interest to see how the meaningfulness of a song to a singer, gender of a singer, and level of musical training of a singer influence the extent to which these movements occur.

Advancing Interdisciplinary Research in Singing (AIRS) and the AIRS Test Battery of Singing Skills

This undergraduate honours thesis was inspired by an ongoing research project, specifically the AIRS Test Battery of Singing Skills, which is a part of Advancing Interdisciplinary Research in Singing (AIRS). AIRS is a major collaborative research initiative, funded by the Social Sciences and Humanities Research Council of Canada. This initiative began in 2008 and is composed of an international group of over 70 collaborators. The main purpose of the seven-year long initiative is to gain new

theoretical perspectives and practical knowledge about singing so as to ultimately benefit society. The research is divided into three themes, which are as follows: Theme 1 - Singing and development: Perception, production and multimodal considerations and the AIRS Test Battery of Singing Skills; Theme 2 - Singing and education: Learning to sing naturally, formal training, and using singing to teach; and Theme 3- Singing and well-being: Cultural understanding and physical and mental health (Cohen, 2012). The present study falls primarily within Theme 1, but also touches on both remaining themes.

This study will employ the AIRS Test Battery of Singing Skills, created to measure the singing skills in the general population. It provides researchers with a large body of data that is intended to help understand the individual, culturally determined, and universal factors that influence the development of singing across the lifespan (Cohen, Armstrong, Lannan, & Coady, 2009). Recently an online version of the test was developed (Pan & Cohen, 2012). At UPEI alone, the AIRS Test Battery has a solid foundation as a result of several honours projects (Coady, 2009; Gallant, 2009; Lannan, 2009; McIver, 2010; Stevenson, 2011; Pan, 2012; Ross, 2012) having been conducted using this testing instrument. Their studies have all focused on analysis of acoustic information, while the present investigation is the first to focus on the facial expressions and body movements that accompany singing. Research specifically like this has yet to be undertaken; and finding relations between singing and facial expression and body movement can have implications for all three themes of AIRS.

What is Music?

A standard language dictionary defines music as "the art or science of combining vocal or instrumental sounds (or both) to produce beauty of form, harmony, and expression of emotion" (Stevenson & Lindberg, 2010). *Grove's Online Dictionary of Music* however simply defines music as the "art of sound"; this is one of many complex and specific definitions. *Grove's Online Dictionary of Music* states that definitions of music vary greatly, depending on culture, era, and musical background. It is pointed out that there is little agreement amongst musicians, and musicologists, on a single definition; some go as far as to say that music cannot be defined (Macy, Sadie, Tyrrell, & Kernfeld, 2000). Thus, as a result of its ever-changing nature, the concept of music can be described in many different ways, but for the purpose of this thesis it will be regarded as the art of sound arising from an appreciation of the patterning of sounds.

Is music innate? It has been argued that music is a biological and innate phenomenon, based on the evidence indicating that there are universal aspects to musical structure that emerge very early in development (Hannon & Trainor, 2007). Although there are universal aspects, culture does have a significant influence on how individuals experience and interpret musical knowledge. *Musical enculturation* has been defined as the "process by which individuals acquire culture-specific knowledge about the structure of the music they are exposed to through everyday experience, such as listening to the radio, singing and dancing" (Hannon & Trainor, 2007, p. 466). To further emphasize this point, Peretz (2006) states that a common set of principles underlie the diversity in music across cultures. She goes further and interprets this as an indicator that music may be a part of human nature, "guided by innate mechanisms" (Peretz, 2006, para. 1). Based on

this idea that various biological components, such as genes, are responsible for our musical abilities, everyone should have the capability of engaging in musical activities (Peretz, 2006). Just as humans develop a particular language through everyday exposure, the development of culturally specific musical constructs occurs similarly (Hannon & Trainor, 2007). As was stated by Peretz (2006), "music appears as natural as language" (para. 1).

What is Singing?

A standard language dictionary defines singing as the act of making "musical sounds with the voice" (Stevenson & Lindberg, 2010). *Grove's Online Dictionary of Music* states that singing is a "fundamental mode of communication"; going further to say that it is "the most subtle and flexible of musical instruments" (Macy et al., 2000). According to Dalla Bella, Giguere, and Peretz (2007), "singing appears to be a universal human trait" (p. 1182). Research indicates that first songs begin to appear at one year of age and first recognizable songs at approximately 18 months. Dalla Bella et al., compared non-trained and trained singers' vocal abilities through acoustical analysis, as well as by judgments of peers. Non-trained singers tended to sing fast, and consequently had slightly less control over their pitch, in comparison to trained singers. Regardless of these small differences, the majority of non-trained singer participants' singing was reasonably in-tune and in-time. This study provides evidence to further support the idea that everyone has the ability to sing.

What is Musical Movement and Gesture?

According to Godøy and Leman (2010), as a result of their typicality, and the enthusiasm and joy people have while using them, musical gestures are seen as an expression of extreme engagement in music. Gestures also function to reinforce or even replace verbal or musical communication in some cases. One can even go as far as to say that they are a separate form of communicative code.

What is considered a gesture? A general definition of gesture is a movement of a part of the body, for example a hand or the head, with the goal of expressing an idea or emphasizing meaning. In the context of musical performance, a gesture can be defined as the movements made by performers to control the musical instrument, to coordinate gestures or to influence the audience. Gesture can also be thought of in the context of listening to music, in which case it is the movements, either spontaneous or planned, that accompany the activity of listening to music. These include, for instance, tapping one's foot or hand to the beat, swaying or dancing (Godøy & Leman, 2010).

Gestures are also frequently used as a form of communication among performers, as well as between performers and the audience. Four types of communicative gestures are identified by Dahl, Bevilacqua, Bresin, Clayton, Leante, Poggi, and Rasamimanana (2010). The first type of gesture is used for communication among performers, for instance head nods, smiles, and eyebrow movements. The second type of gesture is a result of the individual interpretation of the musical piece or a natural tendency to use movement to help portray the expressive element of the piece. The third type of gesture is a result of the performer's personal experience of the music. Finally, the fourth type of

gesture has the main purpose of aiding the performer's ability to interact with and entertain the audience (Dahl et al., 2010). For the purposes of the current study, the gesture of interest will be type three, gestures that result from the performer's personal experience of the music.

The Relationship between Music, Singing, and Movement

Prior to the advent of certain technologies, such as the radio, movement was seen whenever music was heard, typically in live performance settings. This is what Thompson, Graham and Russo (2005) believe led to a neglect of the study of movement in music, simply because it was seen as irrelevant or unimportant. They argue to the contrary, stating that movement plays a very important role in the way in which people perceive music. The authors discuss the various levels at which movement influences musical perception. At the lowest or most basic level, visual information can function as a method for directing a listener's attention to specific moments in a piece. At a higher or more complex level, movement can signal important melodic, harmonic, and rhythmic events.

According to Thompson, Russo and Livingstone (2010), in terms of viewing or performing music, "it would make sense to think that visual information is irrelevant, but it is not, rather it is extremely important" (p. 321). Body movement plays a very important role in singing or musical performances in general. It can help the audience interpret the meaning and emotion that the performer is attempting to convey. Most often, the bigger the gesture is, the more intense the meaning. There are even some gestures that have particular musical meanings. Gesture is not just used to express a particular emotion,

but also plays a role in supporting the singer's voice, for example, a louder voice is usually paired with a more exaggerated gesture and a softer voice is often paired with a gentler gesture. An additional example demonstrating the use of gestures that accompany singing could be when a performer gradually opens their arms while singing a crescendo or vice versa when singing a decrescendo (Liao & Davidson, 2007). To further emphasize this point, Thompson et al. (2005) have stated "in a music performance, emotions are conveyed not only in the sounded events but also in facial expressions and gestures" (p. 217).

Furthermore, movement allows the listener to observe how involved the musician is in the piece, as well as how the performer perceives the piece. For instance, does the musician perceive the piece as happy, sad, or neutral? Therefore, movement also has the function of conveying the affect or emotion of a piece; this can be completed through the use of full body movements or small changes in facial expression. One other interesting aspect that the authors noted was that movement is a way to connect with the audience at an interpersonal level, in one way, communicating to the audience that the performance is a "reciprocal human interaction" (Thompson et al., 2005, p. 204)

Music and movement. Janata, Tomic and Haberman (2012) conducted a study examining the relationship between music and "groove". "Groove" was defined as "that aspect of the music that induces a pleasant sense of wanting to move along with the music" (Janata et al., 2012, p. 56). They discovered that the genre and the tempo of music significantly influence perception of "groove" and that a high level of groove is related to a high pleasurable state. Of particular relevance to this study was that familiarity of song influenced perception of "groove" (Janata et al., 2012).

Madison, Gouyon, Ullén and Hörnström (2011) examined the concept of "groove". They defined "groove" as "the sensation of wanting to move some part of the body" (Madison et al., 2011, p. 1580). A review of the accumulated research pointed towards the idea that the relationship between movement and the rhythmic component of music is of biological origin, having some type of adaptive functioning. Their first piece of evidence was based on the fact that music is universal. In addition, the idea of coordinated movement to the various rhythms of music can be seen, in some form, in all cultures (e.g. through dance). Secondly, listening to music has been found to activate specific areas of the brain involved with motor movement. Finally, the experience of listening to rhythmic music has been found to activate areas of the brain associated with reward and arousal, as well as areas involved with various physiological processes, such as respiration. In general, their results indicated that "groove" is a perceptually significant part of music and that this ability to experience groove is similarly controlled for across many genres of music (Madison et al., 2011).

Music and facial expressions. Facial expressions are used as a form of complementary or supplementary communication in people's everyday lives. For instance, an angry facial expression often accompanies someone's auditory expression of anger, such as yelling. Furthermore, a smile can most likely be observed on the face of an individual who is laughing. Not only are facial expressions observed in everyday speech, but they can also be observed in a musical setting, specifically in vocal or instrumental performance. If someone imagines watching their favourite musician performing a musical piece live in a theater, one would most likely envision the artist as displaying some sort of emotional expression on their face. Be it happy, sad, calm or powerful, the

face of the performer is, most likely, not neutral and lifeless. According to Thompson et al. (2010), “facial expressions are highly relevant to the perception of music” (p. 321). This is just one, of many, points supporting the idea that facial expressions have an influence on musical perception.

Facial expressions during performance can have powerful effects and can even lead to subtle changes in the facial expressions of audience members. Research has actually indicated that the ability to experience the emotions of the singer during a musical performance are very reliant on this mimicry affect. For instance, repressing emotional facial expressions, that is holding one’s face motionless, during a very emotional situation can actually hinder the experience of empathy, making it more difficult to recognize what emotion is being emphasized (Hess & Blairy, 2000; Livingstone, Thompson, & Russo, 2009).

Thompson and Russo (2007) conducted a study to find out whether the facial expressions and head movements of singers communicate melodic information, specifically looking at the ability of viewers to judge the size of sung intervals in the absence of sound. Results indicated that, in the absence of auditory sound, participants who viewed videos of the singers were able to accurately differentiate the size of sung intervals using changes in facial expressions and head movements as their sole indicators. The researchers speculate that performers may have directly communicated pitch through their conscious or unconscious facial and head movements. In addition, they theorized that performers might have unintentionally moved their face and head to the pitch in response to their associated arousal state. Lastly, they surmised that changes in facial

expression and head position might have been a reflection of the movements vocalists used to optimize vocal production (Thompson & Russo, 2007).

Thompson, Russo and Livingstone (2010) conducted a series of experiments with the hopes of finding out which movements influenced the viewer's ability to perceive size of sung interval, in the previously discussed study. In addition, they were interested in investigating how head movements influence the perception of pitch relations. In sum, results indicated that both face and head play an important role in discriminating interval size and pitch relations, even when audio is present; thus, concluding that auditory and visual information work together to provide viewers with information on vocal pitch relations and interval size (Thompson et al., 2010).

Russo, Sandstrom, and Maksimowski (2011) looked at the influence visual information from the mouth and eyes has on the perception of sung intervals. Overall this study indicated that when there is a decrease in sound quality the mouth provides critical visual information in regards to the perception of sung interval size and that as sound quality improves, viewers turn their attention to the vocalists' eyes (Russo et al., 2011).

The Relationship between Music and Emotion

According to Grewe, Nagel, Kopiez, and Altenmüller (2007) "one of the main reasons to listen to music is its effect on our subjective feelings" (p. 775). Research also suggests that musical training can influence the emotional reaction one experiences when listening to or performing music. Furthermore, several studies have proposed that people even use music to regulate their emotional state (Grewe, et al., 2007; Juslin, Liljeström, Laukka, Västfjäll, & Lundqvist, 2011).

Juslin et al. (2011) conducted a study with the intention of explaining individual differences in emotional responses to music, as well as to formulate a theoretical model that has the ability to explain and predict emotional reactions to music. Results indicated that the majority of people experience an emotional response while listening to music. Gender differences were observed, with females experiencing an emotional response to music more often than males. Differences were also observed in regards to level of musical training. Specifically, trained listeners tended to experience an emotional response to music more frequently than untrained listeners. Furthermore, music that was linked to a personal memory was more likely to induce an emotional response. Based on their findings, Juslin et al. concluded that the actual music only plays a partial role in determining emotional reactions to music, and that individual and situational factors also have an influence.

Research Questions and Hypotheses

The main question of interest for this study focuses on the degree and kind of facial expression and body movement produced while singing a familiar, requested song (Brother John) and a self-selected (favourite) song. It is hypothesized that singing a self-selected favourite song will produce more facial expressions and body movement than an assigned familiar song because the former is more meaningful and more connected to one's emotion; intuitively and with speculation, one would think that emotions and emotional singing should tend to produce a higher frequency of facial expressions and body movements, in general. The speculation that the self-selected song will have more emotional meaning, in comparison to the requested song is supported by the research conducted by Juslin et al. (2011) who found that when music was linked to a personal

memory, it was more likely to induce an emotional response. The assumption that singing a song with more emotional meaning leads to more movement, in comparison to singing a song that has little or no meaning, is supported by research conducted by Thompson, Graham, and Russo (2005) and Kurosawa and Davidson (2005). Both of who, through the analysis of the nonverbal behaviours of performing vocalists and musicians, discovered that facial expressions and body movements convey emotion in general, as well as the emotional intentions of the song. However, no prior evidence indicates that singing an emotional song will produce a higher frequency of facial expressions and body movements, in comparison to singing a song that has little emotional meaning; it is the purpose of the present study to test this assumption.

Two sub-questions also arise in regards to whether gender or level of musical training will influence the amount of facial expressions and body movements of a singer. In regards to gender differences, it is hypothesized that females will produce more facial expressions and body movements, in general, in comparison to males. This is supported by research on differences in gender, which indicates that women tend to be more emotionally expressive, (Barrett, Lane, Sechrest, & Schwartz, 2000; Kring & Gordon, 1998), as well as tend to produce a greater degree of facial expressions (Bradley, Codispoti, Sabatinelli, & Lang, 2001; Dimberg & Lundquist, 1990; Sonnby-Borgtröm, Jönsson, & Svensson, 2008; Thunberg & Dimberg, 2000). Further support, that is more relevant to music research, comes from Juslin et al.'s (2011) finding that females tend to experience an emotional response to music more often than males.

In regards to the influence of musical training background, it is hypothesized that musicians will demonstrate more movement, in comparison to non-musicians. Research

conducted by Juslin et al. (2011) found that individuals with a higher level of musical training tend to experience an emotional response to music more often, in comparison to those with less musical training, which supports this assumption. Further support comes from the idea that people with a higher level of musical training may feel more confident, and thus will feel more comfortable expressing themselves. Furthermore, musicians will, most likely, have had more experience performing in front of an audience; which research, by Thompson et al. (2005) and Kurosawa and Davidson (2005), indicates that public performance is typically filled with nonverbal behaviours that are linked to emotional expression.

Measuring Facial Expressions and Body Movement

Facial Action Coding System (FACS). A number of observer-based systems have been created for the purpose of measuring facial expressions. Out of all of these systems, The Facial Action Coding System (FACS) (Ekman, Friesen, & Hager, 2002) has been designated as one of the most comprehensive and widely used. The standard coding process consists of video-recorded facial behaviour at a slowed down pace. These facial behaviours are reduced into what are called Action Units (AU), each of which is associated with at least one facial muscle. An action unit is defined as the "smallest visually discriminable facial movements" (Cohn, Ambadar, & Ekman, 2007, p. 203). The 2002 Revision of the FACS specifies 9 AUs in the upper face, 18 AUs in the lower face, and 5 miscellaneous AUs. There are also 14 head and 9 eye positions. In addition, there are 9 action descriptors, 9 gross body behaviours, and 5 visibility codes. There are 78 AUs in total. The FACS makes no direct connections between coded facial expressions

and their emotional meaning, but materials have been created to aid in this interpretation, such as the *FACS Investigator's Guide* (Ekman et al., 2002).

Extensively trained coders are employed to code visual material using the FACS. This system provides coders with options in regards to the level of detail they choose to use while coding. Such options include *comprehensive coding* where every AU presented is to be coded or *selective coding* where only AUs that have been predetermined are coded. Further options include coding based on presence or absence of AUs versus coding based on the intensity of AU. Furthermore, AUs can be coded on an individual basis or as a group.

The FACS is a valid and reliable system for coding facial expressions (Cohn et al., 2007). It has been demonstrated to be an appropriate tool of measurement for both infant and adult populations in North America, Europe, as well as Asia. In addition, research has demonstrated that the FACS is a valid and useful system for coding emotion in facial expressions (Cohn et al., 2007). Furthermore, the FACS has been used by multiple researchers to study emotional facial expressions (Ekman, Friesen, & Ancoli, 2001; Ekman & Rosenberg, 2005).

In consideration of the above evidence, a facial expression and movement coding system based on the FACS was created for this study. More specifically, items, such as *head tilt left*, illustrated with a photo have been taken from the FACS. The photos have also been taken from the FACS. A detailed version of the movement scale can be found in Appendix D. Out of the 78 items in the FACS, 18 were carefully selected based on their potential relevance to data collected via the AIRS Test Battery of Singing Skills.

Certain elements were not included (e.g. *nose wrinkle*) because in preliminary viewing of participant data from the AIRS Test Battery, there was no evidence for their application, while other movements (e.g. *lower lip depressor*) were not used because they were too subtle and much training would be required to use those codes systematically. In addition, a variation of one of the rating methods employed by the FACS is being used. The FACS uses a variety of coding methods, such as coding movement based on presence or absence, as well as based on intensity (Cohen & Ekman, 2005). After careful consideration it was decided that a variation of the intensity rating scale would be used for the purposes of coding movement. Specifically, item names were directly selected from this rating system; a detailed outline of the rating scale used can found in the methods section.

This honours thesis implements the use of the 18-item movement scale created based on the FACS as described above. The scale is applied to the video data from three components of the AIRS Test Battery of Singing Skills. The coders consist of the author of this thesis, as well as three other senior students. As the main purpose of this study is to see if singing a self-selected song will produce more movement than a familiar, requested song, and to see if gender or musical training will also have an influence, the thesis will report on the movement analysis of data collected from 12 singers, differing in gender and musical training, while singing two familiar, requested songs and a self-selected song. It is hypothesized that for certain movement scales, more movement will be observed for the favourite (meaningful) song as compared to both times singing the assigned Brother John song. It was also predicted that more movement would be

observed for females and for musically trained participants for reasons outlined earlier in this introduction.

Method

Participants

All participant data in the current study was obtained from a digital database that held video records of participants who had been tested with the online version of the AIRS Test Battery of Singing Skills. Testing had been carried out by previous UPEI Psychology Honours students, as well as by members of the AIRS research team, including the present author. All of these participants were recruited and tested in accordance with ethics proposals that were submitted to and approved by the UPEI Ethics Board of the Department of Psychology, as well as by the Research Ethics Board at the University of Prince Edward Island.

From the database of participants only those who had completed a Music and Language Background Survey for the AIRS Test Battery of Singing Skills were included for selection. This online survey was sent out via email following participation in the AIRS Test Battery of Singing Skills or was completed immediately following participation. Seventy - native language English - participants had completed this survey at the time of participant selection. From this group, only those who were born between 1988-1994 (36) were selected. Next, the participants were divided into two groups based on whether they were male (15) or female (21). Within each gender grouping, the participants were then divided into two groups on the basis of their answer to the question “Do you consider yourself a musician?”. For the purpose of this study, those who answered “yes” were considered to be a musician (8 females; 10 males), those who

answered “no” were considered to be a non-musician (11 females; 3 males). It is important to note that from the female non-musician group, two participants were disqualified due to their participation in this research project, leaving nine in that category. In addition, two participants from both the male-musician and female-musician group were disqualified as a result of incomplete or damaged data.

For the purpose of this study, only 12 participants in total were needed (3 female musicians; 3 male musicians; 3 female non-musicians; 3 male non-musicians). As a result, a set of selection criteria was imposed on each grouping of participants in order to choose those who had the most and the least amount of musical training. Three male musician participants were selected based on answering “yes” to the question “Have you taken private singing lessons?” (3). Those who had not taken voice lessons were excluded from the group. As a result of four out of the six female-musician participants answering “no” to the question “Have you taken private voice lessons”, absence of vocal training was not used as a primary exclusion criteria for this group. Of the remaining participants, one had answered “yes” to both questions “Have you taken private voice lessons” and “Do you play a musical instrument”, so this individual was included in the group. From the remaining four participants, reasoning for indicating why they consider themselves a musician was assessed. Only two indicated their reasoning; specifically they stated that they are majoring in Music at UPEI. Two students were eliminated because they did not indicate why they consider themselves a musician. The two that indicated they were music students at the university and the one who indicated she studied an instrument and singing were retained. There were only three male non-musician participants – so none were eliminated. To select female non-musician participants four criteria were imposed.

The first criteria was answering “no” to the question “Have you taken private voice lessons?” (10). From these 10 participants, the second criteria was answering “no” to the question “Do you play a musical instrument?” (5). From these five participants, the third criteria was answering “no” to the question “Can you read music notation?” (3). The 12 participants had a mean age of 20.75 (SD = 1.71) years. Specific information regarding each participant can be found in Table 1; more detailed information can be found in Appendix F. Averages for the number of years having participated in private voice or instrumental lessons for each grouping can be found in Table 2.

Apparatus

AIRS Test Battery of Singing Skills. The automated version of the AIRS Test Battery of Singing Skills, which was created by Dr. Bing-Yi Pan, a post-doctoral fellow of the AIRS Project working under the supervision of Dr. Annabel Cohen, had been used for acquisition of the data to be analyzed. The present author assisted in running the test battery for some of the participants whose data was analyzed for this thesis. Each participant testing session was both audio and video recorded using a webcam, as well as a Sony EMC Ms908C external microphone and Sony 3 mega pixel network handy cam video recorder. Two separate versions of the AIRS Test Battery of Singing Skills were employed, specifically, one version for female participants and one version for male participants. The versions differed only in that for the female version a female vocal model was used and for the male version a male vocal model was used.

Table 1

Specific Participant Information

Participant and Category	Birth Year	Gender	"Do you consider yourself a musician?"	"Have you taken private singing lessons?"	"Do you play a musical instrument?"	"Can you read music notation?"
1 Musician	1992	Female	Yes	Yes	Yes	Yes
2 Musician	1989	Female	Yes	No	Yes	Yes
3 Musician	1988	Female	Yes	No	Yes	Yes
4 Musician	1992	Male	Yes	Yes	Yes	Yes
5 Musician	1990	Male	Yes	Yes	Yes	Yes
6 Musician	1990	Male	Yes	Yes	Yes	Yes
7 Non-musician	1989	Female	No	No	No	No
8 Non-musician	1994	Female	No	No	No	No
9 Non-musician	1993	Female	No	No	No	No
10 Non-musician	1990	Male	No	No	Yes	No
11 Non-musician	1992	Male	No	No	Yes	No
12 Non-musician	1992	Male	No	No	No	Yes

Table 2

Average Years Private Instrumental and Vocal Training

Group	Primary Instrument (Years)	Secondary Instrument (Years)	Vocal (Years)
Female Musicians	10.00	15.33	4.33
Male Musicians	6.00	7.67	1.25
Female Non-musicians	0.00	0.00	0.00
Male Non-musicians	1.00	1.00	0.00
Musicians	8.00	11.50	2.79
Non-musicians	0.50	0.50	0

Each participant testing session took between 30 and 40 minutes. For the purpose of the present study, only three specific components were selected for analysis, specifically, Component 9 (Brother John – sung after hearing a model sing the song in its entirety), Component 13 (Favourite Song – sung on the request to sing one's favourite song), and Component 25 (Brother John – sung following the request after having just been asked to learn a short unfamiliar melody). A detailed description of the AIRS Test Battery of Singing Skills can be found in Appendix B.

Music and Language Background Survey for the AIRS Test Battery of Singing Skills. The Music and Language Background Survey was created to compliment the data collected from participants who complete the AIRS Test Battery of Singing Skills. It is important to note that this survey was developed after the test battery had begun. Essentially, it is an online survey that asks participants questions regarding their

background in language and music training and abilities. A full list of the questions can be found in Appendix C.

Movement Scale Item. The present author created a movement scale based on Ekman's (2002) Facial Action Coding System. More specifically, item names and photos were taken directly from the FACS. The movement scale consists of 18 components. Six measuring head movements, two measuring finer facial movements, five measuring mouth movements, and five measuring eye movements. Each of these movements were measured based on intensity on a scale of 1 to 4, with 1 being absent, 2 being slight, 3 being pronounced, and 4 being extreme. The scale also included 3 sections where notes could be recorded, specifically, an area that allowed for comments on intensity ratings for each movement, notes (text) on body movements, as well as an additional notes section. A copy of the Movement Scale Item can be found in Appendix D.

Testing Environment

All participants were tested alone in an Eckel double wall sound attenuated testing room (8 x 8 feet) in the CMTC/AIRS Research Facility. All participants were seated at a desk in a rotating office chair. Each participant faced a computer monitor over which they had control by means of a mouse, as they were prompted through the AIRS Test Battery Singing Skills. The room also contained audio and video recording equipment, which was located to the right of and was visible to the participants.

Testing Procedure

The testing procedure began after each participant had read and signed an information letter and consent form. Following this, any questions participants had were answered and the participants were invited to sit down in the testing room and looked at

the computer screen. Using a keyboard and mouse, the researcher opened the testing website and entered a code. This began the test battery and prompted participants to fill out demographic information (a detailed list of questions can be found in Appendix B). After filling out this information, participants were prompted to begin the test battery. Following the indication they were ready to start, an actress appeared on the screen and invited the participant to take part in the test, explaining that she would walk the participant through all components of the test battery. The participants then began the AIRS Test Battery of Singing Skills at their own pace. The researcher remained in an adjacent researcher control room throughout the entire test, where he/she took notes and made observations. The researcher also answered any questions via a microphone system that was set up between the testing room and the adjacent researcher control room. Once the participants had completed the final item of the AIRS Test Battery of Singing Skills, they hit an appropriate button on the screen that submitted their answers to the computer database. Depending on the time of year testing took place, some participants continued on to complete the *Music and Language Background Survey for the AIRS Test Battery of Singing Skills*; others received this online survey via email at a later date. Following participation, participants were sincerely thanked, asked if they had any further questions, and provided with a formal debriefing.

Movement Analysis Procedure

Coders. Four coders were employed to view and code for movement observed in the test battery video clips for the 12 selected participants. The coders were all fourth year University students, two were female Psychology honours students, one was a male Psychology Major, and one was a female in the Business program; all were employed as

part-time student research assistants for AIRS. One of the female Psychology honours students was the author of this thesis. Unlike the author of this thesis, these other coders were unaware of the purpose of the study, which component was being viewed, as well as the musical background of the participant. These coders were first presented with a statement of confidentiality, which they read and signed. They were then presented with an instruction sheet, 36 copies of the Movement Scale Item, as well as 36 video clips; any remaining questions were answered. Coders were given one week to complete the analysis and it took them an average of 5.33 hours to complete, for which they were compensated, using their standard student employee rate. All coding was completed independently at a location that was convenient for the coder. All completed coded Movement Scale Item sheets were returned to the present author, and all shared video data was erased.

Movement coding. Video clips for the three items of the AIRS Test Battery of Singing Skills for 12 participants were downloaded from the AIRS server for viewing using two video viewing software programs, specifically VLC Media Player and Adobe Media Player. The three components selected were components 9, 13, and 25. Item 9 was the singing of Brother John. Item 13 was the singing of a favourite song. Item 25 was the singing of Brother John. Coders viewed each component (9, 13, & 25) without sound and coded each segment using the Movement Scale Item. More specifically, each coder measured each video clip in accordance with the 18 different movement scale items. Each scale was applied only once and in the order given. This procedure was repeated for all three song components in the order Brother John 1, Brother John 2, and Favourite song. All coders judged participants in the same order. The order ensured that no one category

of participants (i.e., male musician, female musician, male non-musician, female non-musician) was judged more frequently at the beginning or ending of judging by first presenting four participants in the following order: female musician, male non-musician, female non-musician, male musician, then the next four participants representing the same categories in that order, followed by the final group of four participants.

Data Transfer to Computer

Audio-video data from the 3 components (9, 13, 25) were downloaded from the server supporting the AIRS Test Battery and were saved as a .flv movie file.

General Data Analysis Procedure

Both Microsoft Excel and the statistical analysis program SPSS were used to complete the data analysis. More specifically, the 648 ratings [54 (3 x 18 rating scales) x 12 (participants) = 648] from each of the four judges were entered into a Microsoft Excel spreadsheet. There was one line consisting of 4 judgments of the 54 ratings for each of the 12 participants. This process was repeated for each participant and component. Data was then transferred to and re-arranged in SPSS. First, concordance between the four coders' ratings for the 36 values was obtained using a cross-sectional correlation that produced Cronbach's alpha for each of the 18 measures. This analysis indicated which variables (of the 18 movement scale items) showed consistency in ratings across all four coders, and which did not. Next, averages across the four coders for each of the measures that had shown concordance was computed, a separate average for the three songs for each of the 12 participants was calculated. Following this, Analysis of Variance (ANOVA) was conducted on each averaged variable to analyze whether there were any significant differences in the ratings of movement between song conditions, and whether

or not this was observed significantly more in either gender (male/female) or level of musical training (musician/non-musician), as well as whether there was any significant interaction of these variables (gender and music training).

Results

Analysis of Coder Reliability

Inter-rater reliability between the four coders was calculated using the data from the three song conditions, which produced 36 values per judge. The resulting calculations were measured using Cronbach's alpha and can be found in Table 3. A Cronbach's alpha value of .7 or higher was acceptable, with anything lower indicating unreliability. Based on these results, *upper lip raiser*, *lip stretch*, and *lip corner depressor* were excluded from analysis due to exhibiting no reliability between judges' ratings of this movement. It was also noted that *head up* and *lip corner puller* were not as reliable as the other 13 measures; thus, they were included with caution. An average of the four coders' ratings for each of the remaining 15 movements was calculated and used for the ANOVA calculations, the results of which will now be discussed in detail.

Analysis of Movement Scale Items

The grand mean for each of the 15 movement scale items across all three song conditions, as well as the individual mean for each variable in Brother John 1, Favourite Song, and Brother John 2 separately, collapsing over the gender and musical experience variables can be found in Table 4. It can be observed that the grand means ranged from 1.25 (E1) to 2.89 (E5), as well as that for eight movements, the scale value was higher for the own song as compared to the singing of both Brother John songs. For these cases, the mean for the own song is bolded in Table 4.

Table 3

Analysis of Coder Reliability

Variable	Cronbach's Alpha
Head up (H1)	.65
Head down (H2)	.90
Head turn right (H3)	.94
Head turn left (H4)	.79
Head tilt right (H5)	.97
Head tilt left (H6)	.95
Brow raise (F1)	.94
Brow lower/gatherer (F2)	.86
Upper lip raiser (M1)	.36
Lip stretch (M2)	.00
Lip corner depressor (M3)	Could not compute (because all values were the same)
Lip corner puller (M4)	.59
Mouth stretch (M5)	.74
Eyes closed (E1)	.70
Eyes turn left (E2)	.85
Eyes turn right (E3)	.80
Eyes up (E4)	.92
Eyes down (E5)	.73

In order to determine if the differences between means for the songs were significant for each of the movement scale items, and to determine whether there were influences of gender and musical training, an ANOVA was conducted on each of the 15 movement scale items. The design of the ANOVA had one within subject factor of song with 3 levels (Brother John 1, Favourite Song, Brother John 2) and two between groups

factors of gender and musical training, each having two levels (male, female, and musician, non-musicians, respectively). Regarding the variable song type, a trend analysis was carried out that pitted the two Brother John songs against the Favourite song (a quadratic trend) and also tested the linear trend that reflects a pattern associated with the order of carrying out the components (Brother John, followed by the Favourite song, and Brother John again). This linear trend could be regarded as reflecting general effects of the procedure, such as fatigue, or effects associated with gaining overall comfort in the task. The significant quadratic effect on the other hand would indicate that the amount of movement for the particular scale was significantly different from the average amount of movement for that scale item for the familiar, Brother John, songs. The ANOVA's were conducted for all 15 scale items. Results for each scale item are included below.

Table 4

Variable Means

Variable	Grand Mean (Std. Error)	Mean – Brother John 1 (Std. Error)	Mean – Favourite Song (Std. Error)	Mean – Brother John 2 (Std. Error)
Head up (H1)	1.30 (0.10)	1.13 (0.06)	**1.48** (0.20)	1.29 (0.11)
Head down (H2)	2.04 (0.20)	1.98 (0.25)	**2.19** (0.33)	1.96 (0.21)
Head turn right (H3)	1.54 (0.17)	1.71 (0.28)	1.67 (0.26)	1.23 (0.13)
Head turn left (H4)	1.48 (0.11)	1.33 (0.13)	**1.67** (0.22)	1.44 (0.08)
Head tilt right (H5)	1.57 (0.28)	1.52 (0.28)	**1.67** (0.33)	1.52 (0.31)
Head tilt left (H6)	2.02 (0.16)	1.92 (0.14)	2.04 (0.27)	2.10 (0.20)
Brow raise (F1)	1.53 (0.23)	1.44 (0.26)	**1.60** (0.23)	1.54 (0.30)
Brow lower/gatherer (F2)	1.28 (0.19)	1.21 (0.17)	1.31 (0.21)	1.31 (0.20)
Lip corner puller (M4)	1.27 (0.09)	1.29 (0.09)	**1.46** (0.22)	1.06 (0.03)
Mouth stretch (M5)	1.78 (0.13)	1.96 (0.12)	1.85 (0.20)	1.52 (0.13)
Eyes closed (E1)	1.25 (0.10)	1.21 (0.10)	**1.44** (0.23)	1.10 (0.07)
Eyes turn left (E2)	2.19 (0.23)	2.35 (0.21)	2.19 (0.30)	2.02 (0.29)
Eyes turn right (E3)	2.81 (0.14)	3.02 (0.11)	2.94 (0.23)	2.48 (1.88)
Eyes up (E4)	1.64 (0.21)	2.00 (0.28)	1.58 (0.28)	1.33 (0.19)
Eyes down (E5)	2.89 (0.14)	2.67 (0.18)	**3.17** (0.16)	2.83 (0.20)

Eye Movement

Eyes down. The main effect of song type is plotted in Figure 1 demonstrating a higher rating for the *eyes down* movement for the Favourite song, in comparison to the two Brother John songs.

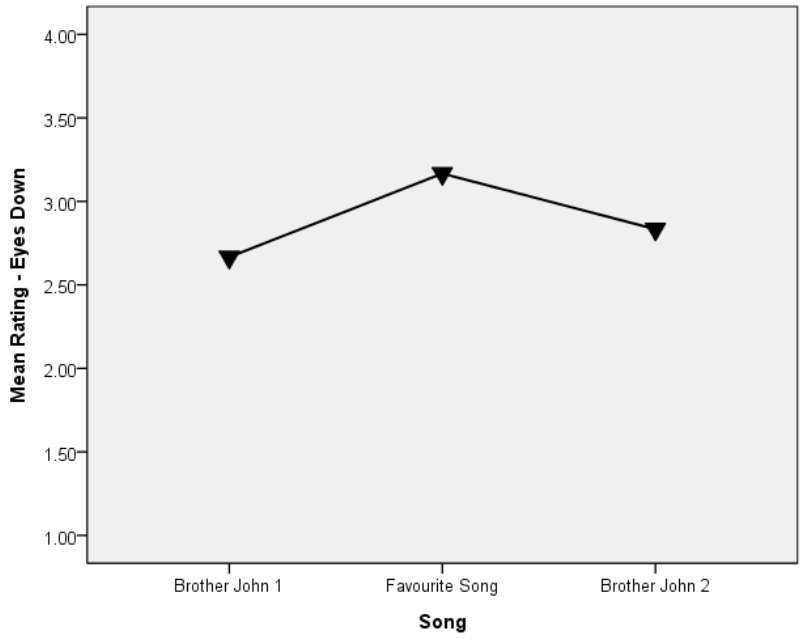

Figure 1. Mean ratings for the *Eyes down* scale item as a function of song.

The ANOVA revealed a marginally significant main effect of song, $F(2,16) = 3.41$, $p = .06$, with a marginally significant quadratic effect of song, $F(1,8) = 5.06$, $p = .06$. Pairwise comparisons indicated a significant difference between songs 1 and 2, $p = .05$, $\sigma = 0.16$.

Figure 2 shows the interaction between song and gender. Ratings for females and males moved, in general, in different directions as a function of song. A quadratic pattern is apparent for females and a linear pattern is evident for males.

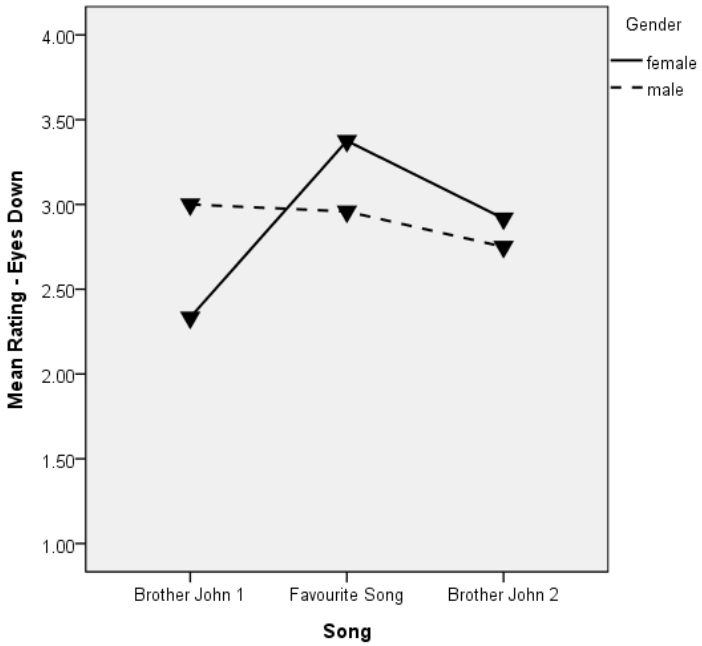

Figure 2. Mean ratings for the *Eyes down* scale item as a function of song and gender.

The effect of song significantly interacted with gender, $F(2,16) = 4.23$, $p = .03$, with a significant linear effect, $F(1,8) = 5.71$, $p = .04$.

Figures 3a and 3b demonstrate a triple interaction between song, gender, and experience. Female musicians and non-musicians, as well as male non-musicians shared a similar pattern, demonstrating higher ratings for the Favourite song, in comparison to both Brother John songs. Male musicians showed a completely opposite pattern, showing their lowest ratings for the Favourite song.

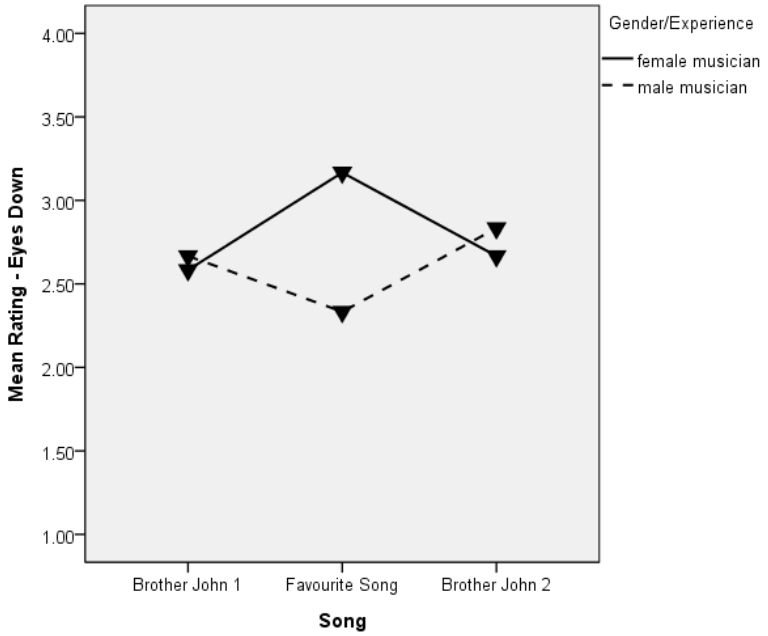

Figure 3a. Mean ratings for the *Eyes down* scale item as a function of song, gender, and experience.

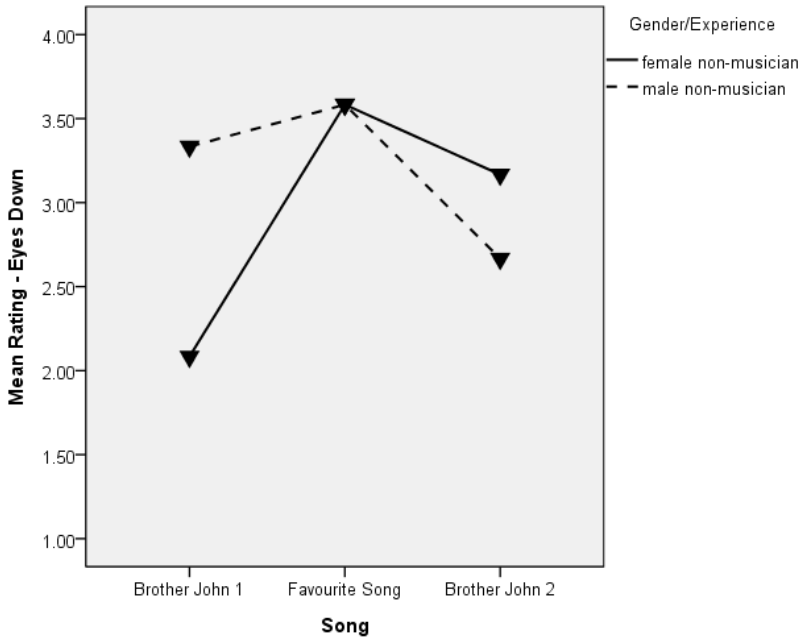

Figure 3b. Mean ratings for the *Eyes down* scale item as a function of song, gender, and experience.

Song, gender and experience interacted at a level approaching significance, $F(2,16) = 3.13$, $p = .07$, showing a significant linear effect, $F(1,8) = 6.91$, $p = .03$.

Eyes up. The main effect of song type is plotted in Figure 4 demonstrating a higher rating for the *eyes up* movement for the first Brother John song, with a decreasing amount of this movement for the Favourite song and second Brother John song.

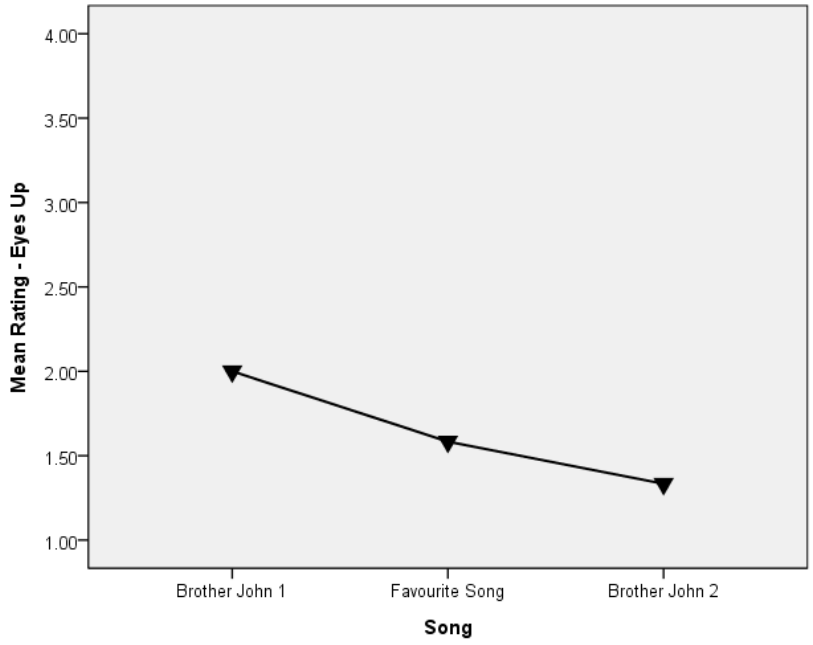

Figure 4. Mean ratings for the *Eyes up* scale item as a function of song.

The ANOVA revealed a significant main effect of song, $F(2,16) = 3.96$, $p = .04$, showing a significant linear effect of song, $F(1,8) = 5.75$, $p = .04$. In addition, across all song conditions, musicians ($\bar{x} = 2.08$, $\sigma = 0.30$) displayed a higher rating for the *eyes up* movement, in comparison to non-musicians ($\bar{x} = 1.19$, $\sigma = 0.30$) at a level approaching significance, $F(1,8) = 5.75$, $p = .07$.

Eyes turn right. The main effect of song type is plotted in Figure 5 demonstrating a higher rating for the *eyes turn right* movement for the first Brother John song, with decreasing ratings for the Favourite song and second Brother John song.

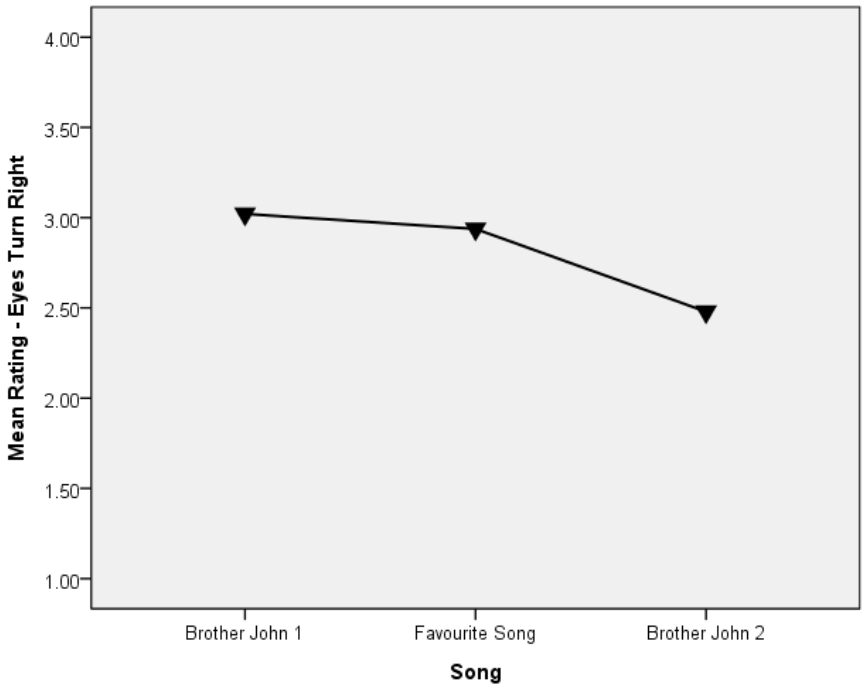

Figure 5. Mean ratings for the *Eyes turn right* scale item as a function of song.

The ANOVA revealed a significant linear effect of song, F (1,8) = 5.45, p = .05. In addition, across all song conditions, musicians ($\bar{x}$ = 3.18, σ = 0.20) displayed a significantly higher rating for the *eyes turn right* movement, in comparison to non-musicians ($\bar{x}$ = 2.44, σ = 0.20), F (1,8) = 6.75, p = .03.

Eyes turn left. Figure 6 shows an interaction between song and experience, with a linear pattern evident for both musicians and non-musicians. Musicians and non-musicians had opposing rating patterns for the *eyes turn left* movement, with musicians showing a slight decrease in ratings and non-musicians showing a slight increase in ratings.

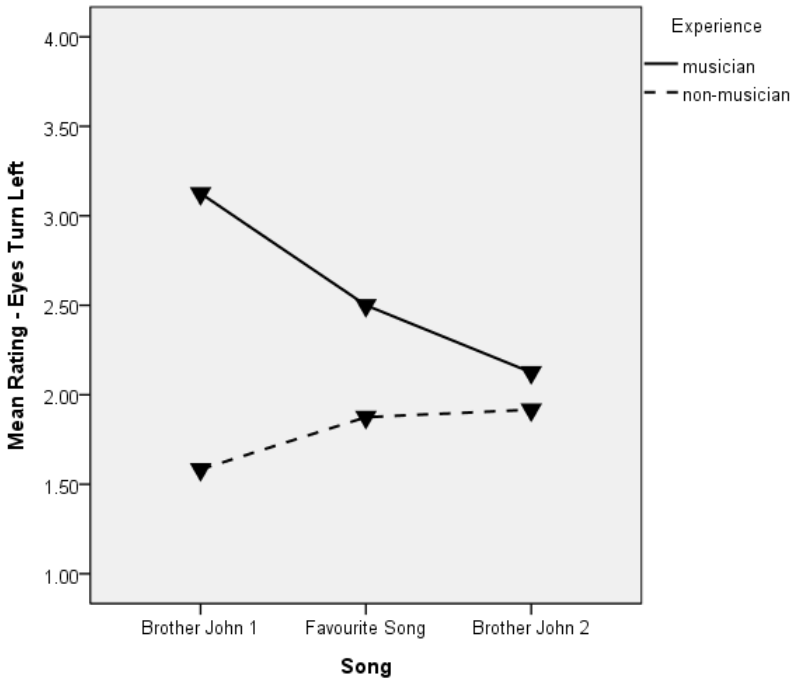

Figure 6. Mean ratings for the *Eyes turn left* scale item as a function of song and experience.

The effect of song significantly interacted with experience, F (2,16) = 4.21, p = .03, with a significant linear effect, F (1,8) = 5.99, p = .04.

Figure 7 shows an interaction between song and gender, with opposing quadratic patterns evident for both females and males. Females had their highest ratings for the Favourite song, whereas males had their lowest and similar ratings for the Favourite song and second Brother John.

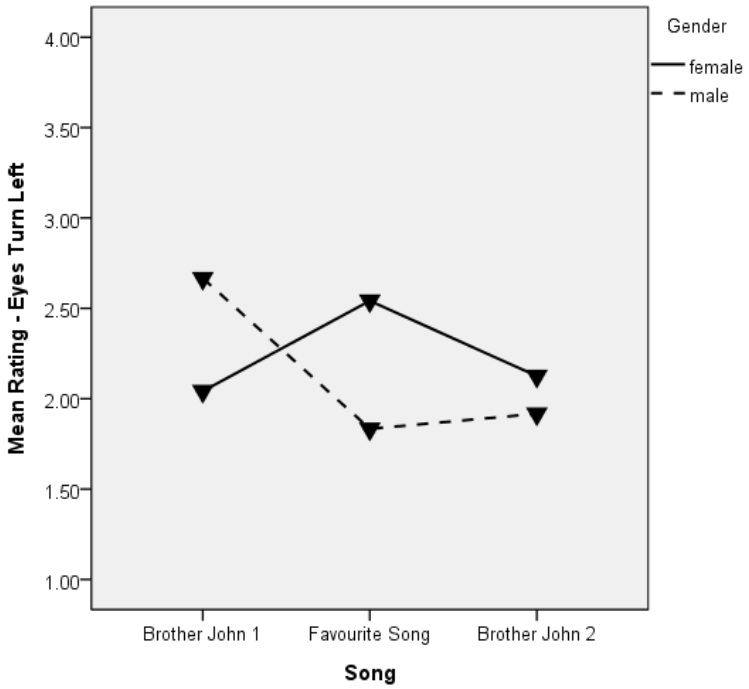

Figure 7. Mean ratings for the *Eyes turn left* scale item as a function of song and gender.

The effect of song significantly interacted with gender, F (2,16) = 4.11, p = .04, with a significant quadratic effect, F (1,8) = 7.71, p = .02.

Eyes closed. Across all song conditions, male non-musicians ($\bar{x}$ = 1.58, σ = 0.20) and female musicians ($\bar{x}$ = 1.42, σ = 0.20) demonstrated significantly higher ratings for the eyes closed movement, in comparison to male musicians ($\bar{x}$ = 1.00, σ = 0.20) and female non-musicians ($\bar{x}$ = 1.00, σ = 0.20), F (1,8) = 6.17, p = .04.

Mouth Movement

Mouth stretch. The main effect of song type is plotted in Figure 8 demonstrating a higher rating for the *mouth stretch* movement for the first Brother John, with ratings decreasing for the Favourite song and second Brother John.

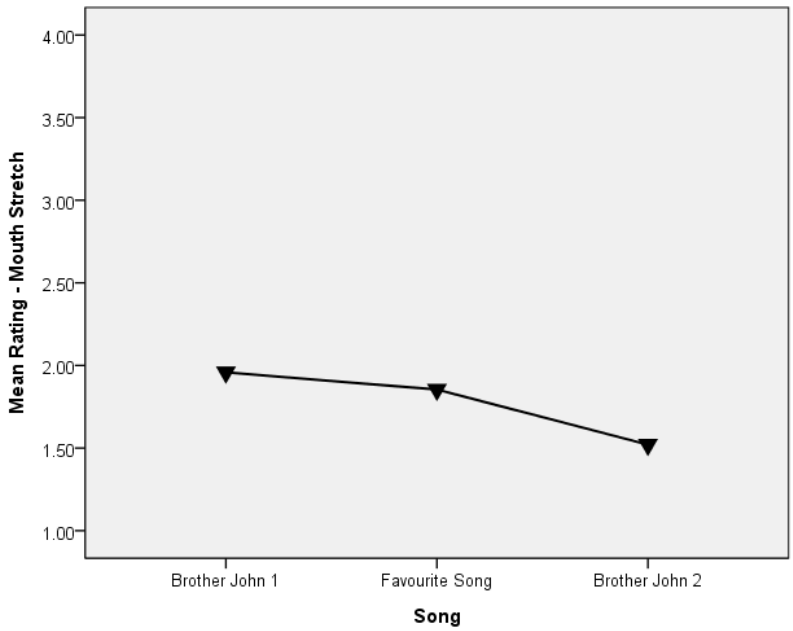

Figure 8. Mean ratings for the *Mouth stretch* scale item as a function of song.

The ANOVA revealed a significant main effect of song, F (2,16) = 4.66, p = .03, with a significant linear effect of song, F(1,8) = 13.36, p = .006. Pairwise comparisons indicated a significant difference between songs 1 and 3, p = .19, σ = 0.12.

An interaction between song and experience is plotted in Figure 9, with musicians showing their highest ratings for the *mouth stretch* movement for the first Brother John and non-musicians showing their highest ratings of this movement for the Favourite Song.

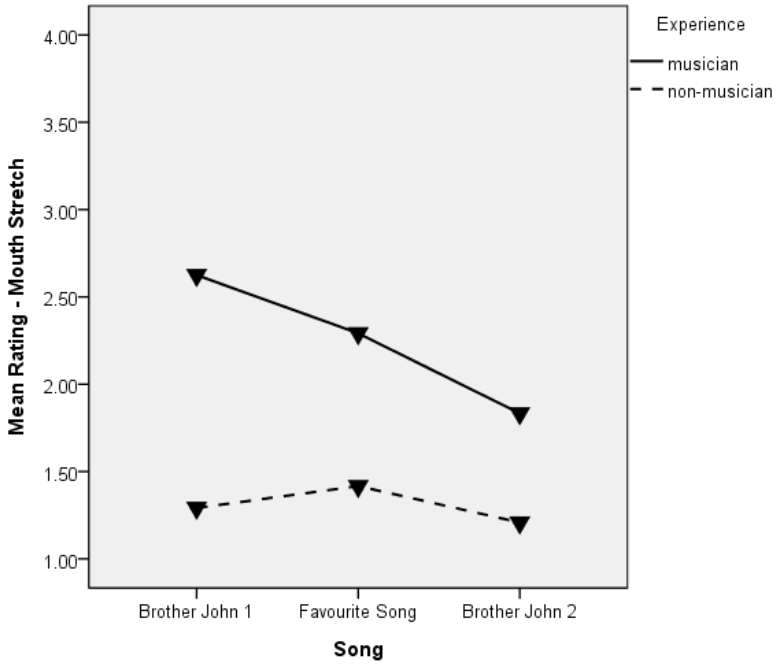

Figure 9. Mean ratings for the *Mouth stretch* scale item as a function of song and experience.

There was a significant linear interaction between song and experience, $F = (1,8) = 8.76$, $p = .02$.

Figures 10a and 10b demonstrate a triple interaction between song, gender, and experience. Male musicians and female non-musicians show their highest rating for the first Brother John, and similar ratings for the Favourite song and second Brother John. Female musicians show their highest ratings for the first Brother John and Favourite song and lowest rating for the second Brother John. Male musicians demonstrate a quadratic effect, with their highest rating for the Favourite song.

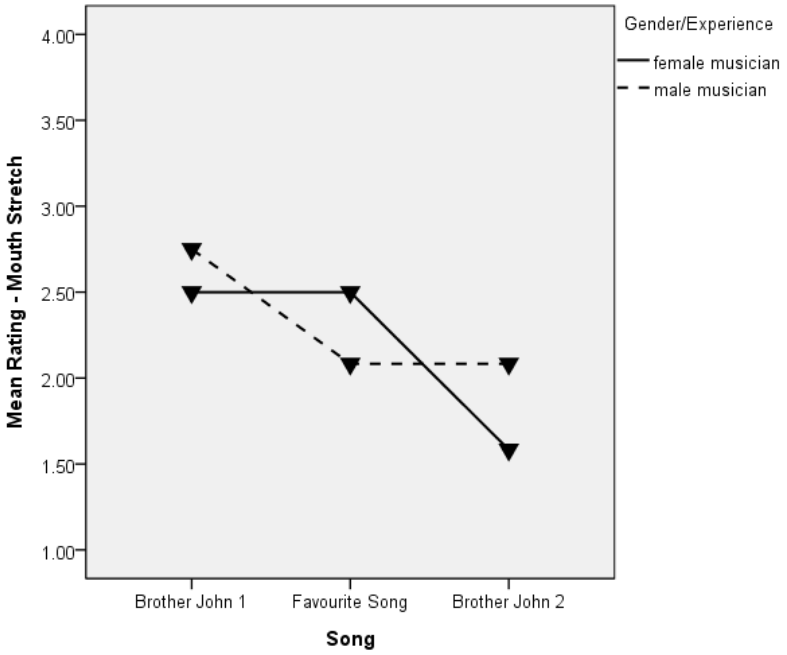

Figure 10a. Mean ratings for the *Mouth stretch* scale item as a function of song, gender and experience.

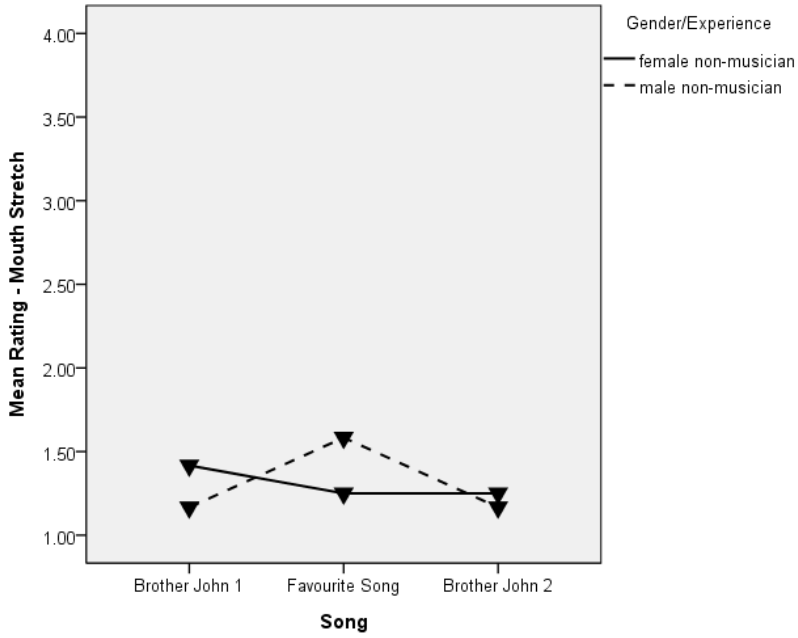

Figure 10b. Mean ratings for the *Mouth stretch* scale item as a function of song, gender and experience.

Song, experience and gender interacted at a marginally significant level, $F(2,16) = 3.11$, $p = .07$, with quadratic effect that approached significance, $F(1,8) = 4.56$, $p = .065$. In addition, across all song conditions, musicians ($\bar{x} = 2.25$, $\sigma = 0.18$) demonstrated significantly higher ratings for the *mouth stretch* movement, in comparison to non-musicians ($\bar{x} = 1.31$, $\sigma = 0.18$), $F(1,8) = 13.48$, $p = .01$.

Lip corner puller. The main effect of song type is plotted in Figure 11 demonstrating a slightly higher rating for the *lip corner puller* movement for the Favourite song, in comparison to both Brother Johns.

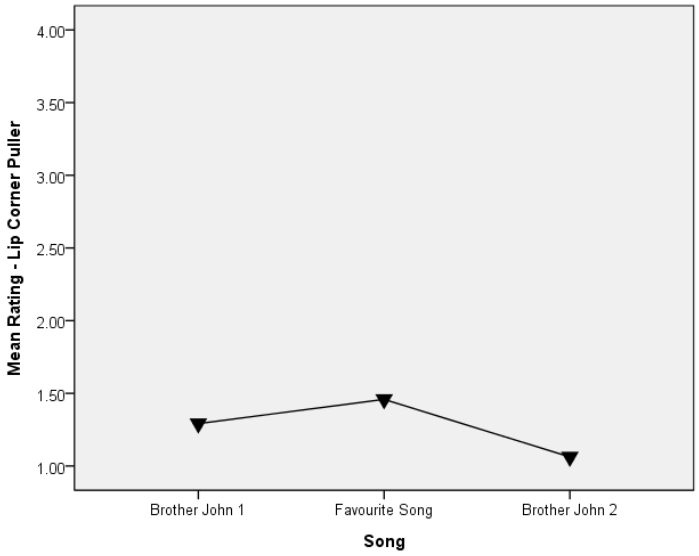

Figure 11. Mean ratings for the *Lip corner puller* scale item as a function of song.

There was a marginally significant linear effect of song, $F(1,8) = 5.26$, $p = .05$.

Head Movement

Head tilt left. Figure 12 shows an interaction between song and gender, with males and females demonstrating opposing rating patterns. Males show their lowest rating for the Favourite song, and females show their highest rating for the Favourite song.

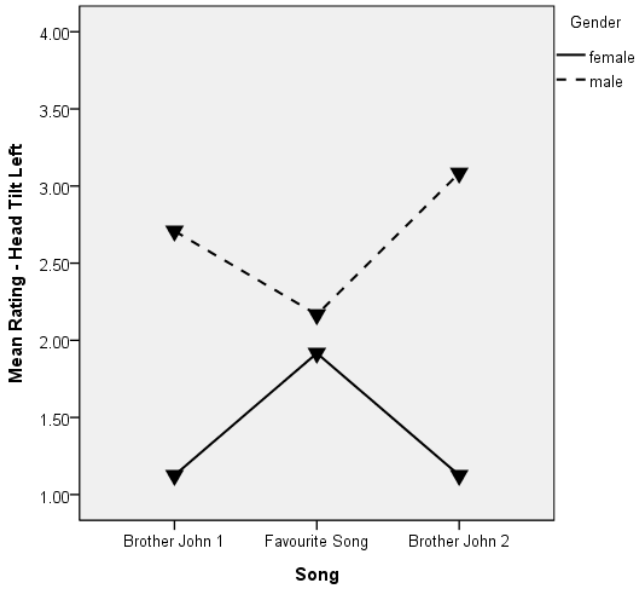

Figure 12. Mean ratings for the *Head tilt left* scale item as a function of song and gender.

The interaction between song and gender was significant, $F(2,16) = 7.59$, $p = .01$, with a significant quadratic effect, $F(1,8) = 12.54$, $p = .01$.

Figures 13a and 13b demonstrate a triple interaction between song, gender, and experience. Male and female musicians show opposing rating patterns for the *head tilt left* movement, with males lowest rating for the Favourite song, and females highest rating for the Favourite song. Female non-musicians show a similar rating pattern to that

of female musicians. Male non-musicians show a dissimilar pattern, with the second Brother John being their highest rating.

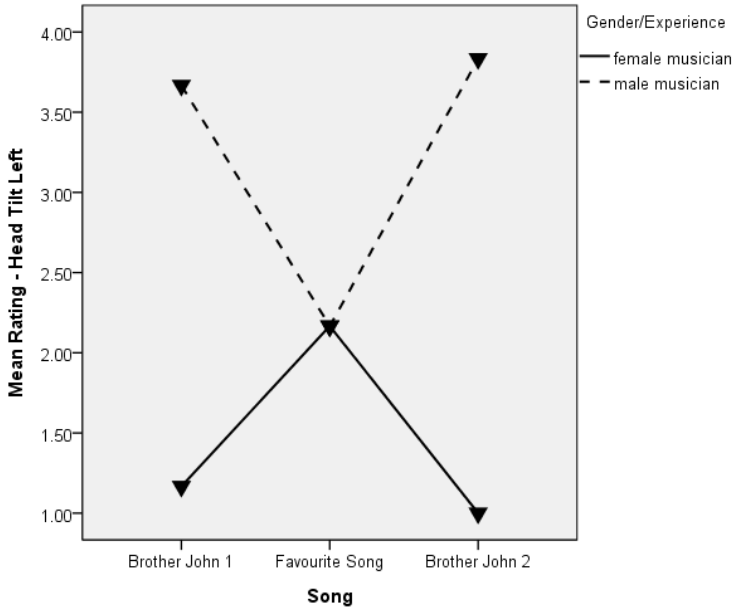

Figure 13a. Mean ratings for the *Head tilt left* scale item as a function of song, gender, and experience.

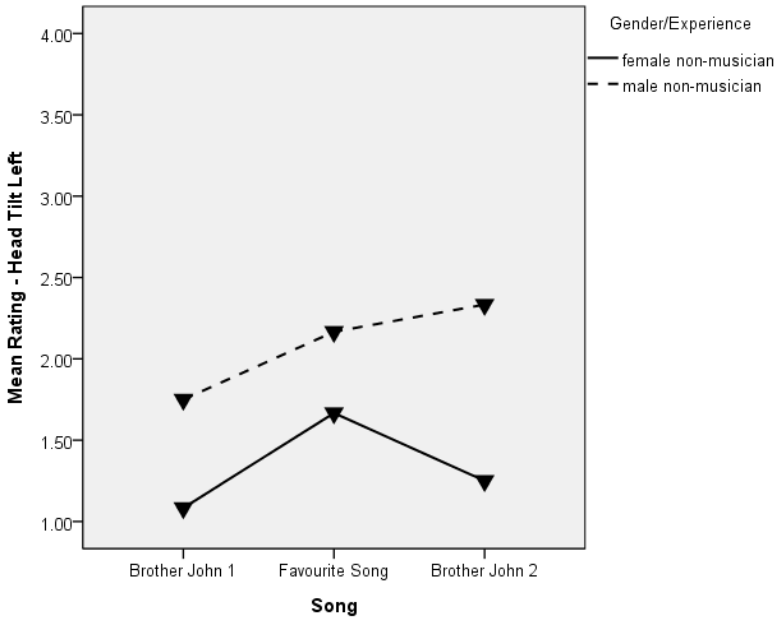

Figure 13b. Mean ratings for the *Head tilt left* scale item as a function of song, gender, and experience.

Song, gender, and experience interacted at a significant level, $F(2,16) = 4.13$, $p = .04$, with a significant quadratic effect, $F(1,8) = 7.12$, $p = .03$. In addition, across all song conditions, males ($\bar{x} = 2.65$, $\sigma = 0.23$) demonstrated significantly higher ratings for the *head tilt left* movement, in comparison to females ($\bar{x} = 1.39$, $\sigma = 0.23$), $F(1,8) = 15.28$, $p = .004$.

Head up. A quadratic pattern as a function of song type was found for the *head up* movement; however, the effect was not significant, F (2,16) = 2.36, $p = .13$. See Appendix E, Figure 14 for graph.

Head down. A quadratic pattern as a function of song type was found for the *head up* movement; however, the effect was not significant, F (2,16) = 0.36, $p = .70$. See Appendix E, Figure 15 for graph.

Head turn right. A linear pattern as a function of song type was found for the *head up* movement; however, the effect was not significant, F (2,16) = 1.83, $p = .19$.

Head turn left. A quadratic pattern as a function of song type was found for the head up movement; however, the effect was not significant, F (2,16) = 1.65, p = .22. See Appendix E, Figure 16 for graph.

Head tilt right. A quadratic pattern as a function of song type was found for the head up movement; however, the effect was not significant, F (2,16) = 0.35, p = .71. See Appendix E, Figure 17 for graph.

Finer Facial Movement

Brow raise. A quadratic pattern as a function of song type was found for the *head up* movement; however, the effect was not significant, F (2,16) = 0.30, $p = .74$. See Appendix E, Figure 18 for graph.

Brow lower/gatherer. A linear pattern as a function of song type was found for the head up movement; however, the effect was not significant, $F(2,16) = 0.76$, $p = .49$.

Discussion

The purpose of this thesis was to carry out an exploratory study that investigates the facial expressions and body movements that occur while people sing. More specifically, it was of interest to see how the meaning of a song would influence the use of facial expressions and body movements. Furthermore, it was expected that gender and level of musical training would have an influence on the use of facial expression and body movement while singing. The research findings both support and contradict the hypotheses.

Inter-coder Reliability

Inter-coder reliability was obtained for 15 of the 18 measures, with 13 of these 15 demonstrating strong reliability. Multiple coders were employed for the purposes of this study with the hopes of controlling for observer bias, as well as controlling for the fact that the main researcher was aware of the musical background of each participant, as well as the purposes of the study. Achievement of inter-coder reliability was an important component for this study and increased the reliability and validity of the results.

Linking the Present Study with Previous Research

Two studies outlined in the introduction section (Thompson & Russo, 2007; Thompson et al., 2008) discovered that facial expressions and head movements provide useful information about sung interval size and pitch relations. Furthermore, research conducted by Russo et al. (2011) investigated the usefulness of mouth size and eye movements in providing information about interval size. The present study provides

evidence that head, mouth, and eye movement differ under certain conditions (i.e., song), thus adding complexity to the idea of what these movements might mean.

In addition, all prior research that employed the use of the AIRS Test Battery of Singing Skills has looked at the acoustical aspects of performance, as a function of age, native language, or mental capacity. While it is acknowledged that the act of singing engages much of the body, the present study is the first to examine evidence of particular spontaneous movements of the face and body that are associated with specific components of the AIRS Test Battery.

General Findings

Influence of song. The main question of interest was to find out whether or not song type had an influence on the amount of facial expressions and body movements exhibited by a vocalist. It was hypothesized that participants would exhibit more movement while singing a self-selected song, in comparison to singing a requested song. Results both supported and contradicted this assumption.

While singing their Favourite song, participants' demonstrated a significant increase in the use of the *eyes down* movement. The *eyes down* movement is equivalent to looking down..Participants may have looked down more while singing their Favourite Song because they felt embarrassed, in comparison to when they sung both versions of the Brother John song. This interpretation is supported by research indicating that shame and humiliation are related to looking down (Argyle & Cook, 1976). Participants also demonstrated a pattern of increased use of the lip corner puller movement, which is equivalent to smiling, while singing their Favourite song. However, this quadratic effect was not significant. This slight increase in smiling could be attributable to them having

an emotional reaction due to the personal meaning of the song they chose to sing. This interpretation is supported by Juslin et al.'s (2011) finding that music can hold personal and emotional value.

An unexpected significant pattern was observed for the *eyes up*, *eyes turn right*, and *mouth stretch* movements. Specifically, the highest ratings were observed when participants had sung the first Brother John. Subsequently, there was a decrease in this rating when participants had sung their Favourite song and the second Brother John. In general, it was surprising that participants were rated as exhibiting more movement while singing the first Brother John, rather than their Favourite song; this contradicted what had been hypothesized. A possible explanation for the increased use of eye movement during the first Brother John comes from research indicating that eye movement is related to cognitive processes, for instance, information recall tasks (Ehrlichman & Micic, 2012). Prior to the presentation of the first Brother John, participants were asked to listen to a recording of someone singing this song. As a result, they may have been making an extra effort to remember the version of the song they had just heard. This concentration may not have been required while singing their Favourite song, perhaps due to familiarity and previous practice singing it. Lastly, this concentration may not have applied to the second Brother John, because at this point the participants would have sung it at least 4-5 times, making it more familiar to them.

The *mouth stretch* movement is equivalent to opening the mouth wide. It was unexpected that participants would open their mouths less while singing their Favourite song, in comparison to the first Brother John, with a possible explanation being that participants were experiencing fatigue; although, participants were only about 10-15

minutes into the test battery. It was not surprising that the second requested song yielded the least amount of movement, as a result of its placement in the AIRS Test Battery of Singing Skills. More specifically, by the time the participants had sung this version of the song, they would have been approximately 20-25 minutes into the test, which may have led to fatigue and a lack of enthusiasm for singing. In addition, at this point participants would have listened to and have sung this same requested song approximately 4-5 times, which could have possibly led to boredom and a lack of enthusiasm for singing. Furthermore, this version of the requested song was completed following a task that required participants to learn a song not of their native language. This might have resulted in a reduced level of confidence or feelings of anxiousness. Possibly leaving participants feeling less comfortable in fully expressing themselves while singing.

It is important to note that although there were few significant findings of the expected pattern for the main effect of song (i.e. increased use of movement for Favourite song), there were several insignificant appearances of this pattern. For instance, the following movements were exhibited by participants in the expected pattern, but were insignificant: *head up, head down, head turn right, head turn left, head tilt right,* and *brow raise.*

Influence of gender. It was hypothesized that females and males would exhibit different degrees of movement while singing; thus, displaying a different rating pattern. More specifically, it was assumed that females would exhibit more movement in comparison to males. Results indicated that females and males exhibited varying degrees of movement across song conditions, with significant differences occurring between the two genders.

Supporting evidence comes from rating patterns for the *eyes down* movement. Females looked down the most while singing their Favourite song, whereas males looked down the most while singing the first Brother John. However, both females and males looked down the least while singing the second Brother John. Females and males also differed in their rating patterns for the *eyes turn left* movement. Specifically, females looked to the left the most while singing their Favourite song; contrastingly, males looked to the left the least while singing this song. Similarly, in regards to the *head tilt left* movement, females tilted their head to the left the most while singing their favourite song and males participated in this movement the least while singing this song.

One finding that contradicts the hypothesis comes from a difference found between males and females use of the *head tilt left* movement. Specifically, for all song conditions males showed significantly higher ratings for this movement in comparison to females. It was not surprising that males and females differed on this movement, however it was unexpected that, in general, males exhibited this movement at a greater intensity.

Influence of experience. It was hypothesized that musicians would exhibit more movement, in comparison to non-musicians. Results indicated that musicians and non-musicians rating patterns for both the *eyes turn left* and the *mouth stretch* movements significantly differed. Further, support for the hypothesis comes from the finding that musicians received significantly higher ratings on the *eyes up, eyes turn right* and *mouth stretch* movements, in comparison to non-musicians. This higher use of movement could have been the result of an increased level of confidence, as well as an increased emotional response to the music, which is partially supported by research conducted by

Juslin et al. (2011), who found that musical training led to a heightened emotional response to music.

Interactions between song, gender, & experience. Significant interactions between song, gender, and experience were also found. For instance, male and female musicians exhibited opposing rating patterns for the *eyes down* movement. In addition, both female musicians and non-musicians, as well male non-musicians demonstrated similar rating patterns for this movement. Similarly, male musicians and female non-musicians showed a similar rating pattern for the *mouth stretch* movement and female musicians and male non-musicians also demonstrated similar patterns

The *head tilt left* movement also yielded significant interactions, specifically male and female musicians showed opposing patterns, with males receiving the lowest rating while singing their Favourite song, and females receiving the highest. Interestingly, female non-musicians demonstrated a similar pattern of movement to that of female musicians. Male non-musicians showed a completely different pattern, exhibiting this movement most while singing the second Brother John song.

These interactions between song, gender, and experience both contradict and support the hypotheses. It was assumed that musicians and non-musicians would show opposing rating patterns when in fact they demonstrate similar patterns for the *eyes down, mouth stretch* and *head tilt left* movements. However, findings for these three movements support the hypothesis regarding gender, in that within the musician and non-musician categories males and females showed dissimilar rating patterns.

There was also a significant interaction between gender and experience. More specifically, male non-musicians and female musicians closed their eyes significantly more than their gender counterparts.

Limitations and Suggestions for Future Research

This was an exploratory study, where little to no research had been previously conducted. As a result, there were a number of limitations; however, results do provide a basis for future research in this area using the AIRS Test Battery of Singing Skills or other audio-visual recordings of singing.

A limitation that may have influenced results comes from an issue with the methodology used to organize the video data. More specifically, all four judges examined the data in the same order, which may have confounded results. It would have been beneficial if a computer program were used to present the videos in random order, so that each judge viewed the 54 clips per participant in a different order.

As a result of time constraints, only the data obtained from 12 participants were used (3 in each category). This increases the risk of the data being influenced by one participant. If given more time, it would have been useful to analyze the videos of a larger number of participants, which may have increased the number of significant variables or, of course, even yielded different results. In addition, there are possible issues with labeling participants as musician or non-musician based on their self-identification as either. A more accurate method could have been employed, for instance using scores on the Music and Language Background Survey. Furthermore, the label musician does not necessarily relate to increased vocal training and experience, thus it is important to differentiate between labeling someone as singer and musician. This may

have also influenced how participants responded to the questions “Do you consider yourself a musician?” on the Music and Language Background Survey; therefore influencing which participants were included in the musician or non-musician category.

The author of this thesis specifically created the movement scale used for the purposes of this study; thus, several ideas for change arose as its usefulness was put to test. The first issue was that there was mixture of male and female images provided to the coders; it might be useful to use male images for male participants and female images for female participants or a gender neutral image, if such could be obtained. Furthermore, different models are used throughout the scale; it would be better if only one person, per gender, were used for the entire scale. It would have also been beneficial if a different image were provided for each of the four intensity ratings, rather than judging intensity rating based on one image. It is also important to consider the fact that static images are being used as a model to code for dynamic movement. A possible future study could entail training the coders using video examples of the expected movements.

In regards to measuring movement, it would be interesting to use both a coding method and a more scientific form of physiological measurement, such as electromyography, which measures muscle movement and has been previously used in research that measures facial expression (Hess & Trainor, 2007; Livingstone et al., 2009). Both the judged movement ratings, as well as the technologically measured results could be compared. It would also be beneficial to look at the relationship between gross body movements (e.g. arm and leg movements) and singing in future research. In addition, it is important to note that intensity, not frequency, of movement was rated; therefore, a useful future study could measure frequency of each movement, in addition to intensity.

If given more time, scores for some of the 15 variables might have been averaged within their respective movement categories and analyzed with the main variables of interest (i.e., song, gender, and level of musical experience). For instance, scores for the 6 head movements could have been averaged and ANOVA analysis could have been conducted on these averaged scores. This may have yielded different results and would be a useful step to take to add to the present findings.

It would also be useful to employ another familiar, requested song, in addition to Brother John, to see if it may result in more or less use of certain scale items in comparison. For instance, it would be interesting to see how a more popular song would influence intensity of movement, in comparison to the participant's Favourite song and Brother John. The use of another familiar, requested song could also control for the effects that genre may have on the amount of movement and facial expression used.

Finally, it should be noted that the AIRS Test Battery of Singing Skills is set up so that participants are seated in front of a computer screen, which may have influenced the amount of movement participants exhibited. Future research could request that participants remain standing while participating in the test battery. Another option could include coding for movement during live or video recorded vocal performances, using the current movement scale.

Conclusion

This undergraduate thesis has provided evidence that people use specific facial expressions and movements while they sing, and that the meaning of a song for a singer, gender of the singer, and musical experience of the singer all influence use of movement. The particular movements that were found to be affected by some of these variables

were: *head tilt left, lip corner puller, mouth stretch, eyes down, eyes up, eyes turn right, eyes turn left, and eyes closed.* Furthermore, this thesis has provided a useful measurement scale upon which future research investigating the relationship between movement and singing using the AIRS Test Battery of Singing Skills can be conducted.

The findings from this research project have implications for all three themes of AIRS – Development, Education and Well-being. In regards to the theme Development, findings provide evidence that a group of 12 participants, with a mean age of 20.75 (SD = 1.71), who have taken the test battery exhibit specific facial expressions and movements while singing. A useful future study could look at the use of these movements in different age groups, with the goal of providing a lifespan trajectory for use of movement while singing. If such a study were conducted, it would be expected that children would use body movements and facial expressions to help express emotion in song. In addition, there might be a decrease in use of movement while singing as age increases (Adachi & Trehub, 1998). In addition, the present study has implications for the idea that musicians and non-musicians may show differences in regards to musical development.

In regards to the theme Education, although the type of movement observed in the present study, spontaneous, differs from that which is used in music education, these findings provide evidence that singing and movement coincide. Thus, providing some support for previous research that advocates for the use of movement to aid in music education on the basis that music and movement are interconnected (Cook & Goldin-Meadow, 2006; Liao & Davidson, 2007; Liao, 2008; Nafsi, 2008).

The finding that certain movements occur at a greater intensity when people are singing their own song, in comparison to a control, in conjunction with research indicating that nonverbal behaviours are used to convey emotion while singing (Thompson et al., 2005; Kurosawa & Davidson, 2005), support the interpretation that singing a favourite song can lead to a pleasurable state. This interpretation supports the theme Well-being, under which research is being conducted to demonstrate the relationship between singing and well-being. Of course, more research is required in order to solidify these interpretations, but this honours thesis provides a basis upon which future research could be completed.

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Appendix A:

Participant Information Letter, Participant Consent Form, and Statement of Confidentiality

Participant Information Letter

The purpose of this study is to study behaviour of singing using a new short battery of singing tests developed by Dr. Cohen working with two previous honours students.

In this study, participants will be asked to participate in an interview consisting of short singing "games" such as repeating a short melody or a pattern of two or three notes. Each session will last approximately one half hour and will consist of 11 phases, each lasting between 1-3 minutes. The 11 components are identified below:

There are 11 short signing tasks involved:

1. Opening conversation
2. Familiar song
3. Repeated sentences
4. Simple melody warm up
5. Voice range
6. Favourite song
7. Music elements
8. Improvise an ending
9. Creation of a song from a picture prompt
10. Unfamiliar song
11. Creation of a story from a picture prompt

The participants will then be asked to fill out the online survey about language and music background, which will take about 5 minutes.

PARTICIPANT CONSENT FORM

AIRS Test Battery of Singing Skills

I consent to participate in research on singing abilities. I understand that my participation involves completing the AIRS test battery of singing skills. Testing will take place in the AIRS/CMTC laboratory in the Robertson Library at UPEI. I have read and understood the material about this study in the Information Letter, and understand that:

1. My participation in the study is entirely voluntary;
2. I may discontinue my participation at any time without any adverse consequence;
3. My responses will be kept confidential and anonymous, except where the researcher is required by law to report them;
4. Once all data have been submitted and identifiers removed, I will no longer have the opportunity to request that my data be removed from the study;
5. I have the freedom not to answer any question included in the research;
6. I may have a copy of the signed and dated consent form to keep.
7. I understand that my data will be stored in the AIRS database for the research team to analyze.

The testing is being conducted by Bing-Yi Pan (Post-doctoral Fellow), Gillian MacDonald (Research Assistant/Psychology Honours Student) and Marley MacInnis (Research Assistant/Psychology Honours Student) under the supervision of Dr. Annabel Cohen. Any questions or concerns about this study can be directed to Dr. Annabel Cohen, (902) 628-4325, email: acohen@upei.ca or Dr. Phillip Smith, Chair o the Psychology Department, (902) 566-0549, email: smithp@upei.ca.

This research project has been approved by the Research Ethics Committee of the Department of Psychology, as a sub committee of the UPEI Research Ethics Board, as well as the UPEI Research Ethics Board. You may contact Lynn MacDonald at the UPEI Research Ethics Board at (902) 620-5104, email: lynnmacdonald@upei.ca, if you have any concerns with the ethical conduct of this study.

____Yes, I would like to participate in this study.

____Yes, I grant permission for my interview to be videotaped.

____Yes, I agree to allow my video examples to be shown in a professional meeting in which a report of the study would be presented by Dr. Pan, Marley MacInnis, Gillian MacDonald, or Dr. Cohen.

____Yes, I agree to allow my video examples to be shown in a professional meeting in which a report of the study would be presented by Dr. Pan, Marley MacInnis, Gillian MacDonald, or Dr. Cohen, however, I would like to be contacted and informed of the details in advance.

We hope you have enjoyed your experience with us, and we appreciate your participation in this study, and value the important information that you have provided to us.

Please consider one more way of helping us with further participation, as we may be conducting further studies of this type.

____ I would be willing to be contacted again for follow-up information or further studies. I understand that I am under no obligation to participate in a further study if I do not wish to do so.

Participant's name (please print): _____

Participant's Signature_____

Contact information (phone number/email address): _____

_____

Date: _____

Statement of Confidentiality

I_____ **(***Student Name***),** in conducting data analysis for research within the context of the Psychology honours program, Psychology 480/490 agree to the following:

Treating with respect the information that is shared with me and not discussing any of the video recordings viewed during my participation in the data analysis, therefore protecting participant confidentiality AT ALL TIMES.

This research is being conducted by Gillian MacDonald under the supervision of Dr. Annabel Cohen in completion of the Psychology Honours program at UPEI. Any questions about this study, and/or your participation in this study should be directed to Gillian MacDonald, grmacdonald@upei.ca, or Dr. Annabel Cohen, (902) 368-4325, acohen@upei.ca.

This research project has been approved by the Research Ethics Committee of the Department of Psychology, as a sub committee of the UPEI Research Ethics Board.

Researcher's Name (please print):

_____

Researcher's Signature:

_____

Date: ____/____/____

Appendix B:

Detailed Description of the AIRS Test Battery of Singing Skills

Participants will first be asked to complete a short demographical questionnaire:

Name: _____

Age: _____ Date of Birth: _____

City and Country of birth: _____

If you weren't born in Canada, how many years have you been living in Canada? _____

Do you have musical training? YES_____ NO _____

If yes, please elaborate (i.e. Number of years of training, instrumental, vocal, are you still actively participating in music? …)

_____

_____

_____

Component 1 – Welcome:

Welcome to the AIRS Test Battery of Singing Skills. My name is *****, and I will be your guide for this singing interview. The interview will ask a number of questions or give you short singing tasks. Throughout the interview, I will provide instructions for each task.

In a number of the tasks, your voice response will be recorded. The recording is carried in two different ways, depending on the type of task. Some tasks require you to start the video recording of your response. In this case, you will need to use the mouse to click the record button. The record button is a red circle located on the bottom left side of the screen. Clicking the record button starts the recording of your response. Please make sure

that you are prepared for your response to be recorded prior to clicking the record button. After you click the record button, it changes to a grey square. If you click on this grey square, it will stop the recording of your response.

Some tasks however automatically record your response. You won't have to click any buttons during these tasks. I will tell you when your responses are going to be recorded automatically. In this type of task you will see a video of headphones as well as a microphone. When you see the headphones (which are always green), it means that you should listen to the audio that is playing. When you see the microphone (which is always red), it means that you should produce your response, either by singing or speaking, depending on the task. For this type of task, you should click the next button, which is a triangle (like an arrow head). Clicking the next button will then move to the following task.

Please note that your response for each task can only be recorded once. You will not have multiple opportunities to re-record your responses.

Your participation in the AIRS test battery of singing skills will take less than 30 minutes of your time.

We thank you for your participation in this research project.

Please click the next button to start the AIRS test battery of singing skills.

Component 2 – Record of the speaking voice:

Although this is a singing interview, I would like to hear your speaking voice first

Once you feel comfortable, please say a few words by answering at least one of the following questions.

Question 1:Do you have a favourite type of music, and if so, can you say a few things about it.

Question 2: Music is becoming very accessible. What role does music play in your life?

Question 3: Do you enjoy singing? Just say a few things so that we get an idea of what you like.

To start recording your introduction, please click the red record button. When you have finished answering, please move on to the next task by clicking the "next" button.

Component 3 – Brother John:

Do you know the song *Brother John*?

Please start to sing this song with the help of a few words of the song on the screen. If you are not sure of the whole melody, just sing the parts that you know.

Click the red “record” button to start. When you have finished, please move on to the next task.

Component 4 – Repeat an English sentence

Now I am going play an English sentence that will appear on the screen.

I will play it once and ask you to repeat it. Then, I will replay it and ask you to repeat it one more time.

When you repeat it, please do your best to imitate exactly what you hear. When you are ready, click the “next” button to start. Your response will be recorded automatically

Component 5 – Repeat a non-English sentence:

Now I am going to play a very short non-English. I will play it once and ask you to repeat it. Then, I will play it again and ask you to repeat it one more time.

When you are repeating the phrase, don't worry about the meaning; just do your best to imitate exactly what you have heard.

When you are ready, click the "next" button to start. Your response will be recorded automatically.

Component 6 – Minor third song:

Now, I am going to play a short melody for you and ask you to repeat it back on the syllable "la", just as you hear it.

When you are ready, click the "next" button to start. Your response will be recorded automatically.

Component 7 – Highest voice range:

Now I am going to find the highest note your voice can sing.

Please use whatever sound and method you are most comfortable with to sing your highest note. Take your time and don't worry if at first you don't do the best. Just keep trying until you do your best.

When you are ready, please click the record button to start. Try as long as you want to sing your highest note. Then move to the next task by clicking the next button.

Component 8 - Lowest voice range:

Now I am going to find the lowest note your voice can sing.

Please use whatever sound and method you are most comfortable with to sing your lowest note. Take your time and don't worry if at first you don't do the best. Just keep trying until you do your best.

When you are ready, please click the record button to start. Try as long as you want to sing your lowest note. Then move to the next task by clicking the next button.

Component 9 – Brother John (first training of entire Brother John song):

Now, I am going to play the song *Brother John* for you and ask you to sing it back.

When you are ready, click the “next” button to start. Your response will be recorded automatically.

Component 10 - Brother John (section by section training of Brother John):

I am going to present the song *Brother John* in sections and ask you to repeat each section immediately after.

When you are ready click the “next” button to start. Your response will be recorded automatically.

Component 11 – Brother John:

Now, I am going to play the song *Brother John* for you again. Please listen carefully and do your best to remember it.

Please click the NEXT button to move on.

Component 12 – Favourite Song 1:

I am going to ask you to sing your favourite song or one of your favourite songs.

It doesn’t have to be the whole song, but at least an entire section is encouraged.

Please take some time to think about and choose your favourite song. Click on the “next" button when you have made your choice.

Component 13 – Favourite Song 2:

It’s time to sing your favourite song!

Please click the “record” button to start singing. Please click the “stop” button after you have finished and click next to go on.

Component 14 – Favourite Song 3:

Now that you have sung your song aloud, could you please tell me about this song by answering the following questions:

Please type your answers in the blank you see on the screen.

-The name of the song.

-The composer, the performer.

-The genre or type of song.

-What year do you think it was composed?

-How old were you when you first heard it

-Does it remind you of anything?

-Why is it your favourite song?

-Anything else you would like to add.

Please feel free to share as much information as you are comfortable with.

Please click next to move on.

Component 15 – Musical Elements:

Now, I am going to play several short melodies, and after each melody, I would like you to repeat back what you heard.

When you are ready, please click the “next” button to start recording.

Component 16 – Improving an ending:

I am going to play the beginning of a melody. This melody doesn't have an ending, so I'm asking you to create an ending for it.

I’ll let you hear the beginning twice, and then you must repeat this beginning and then continue the melody to end it. In other words, please repeat the melody that you heard before you create an ending.

Click “next” button when you are ready to start.

Component 17 – Create a song from a picture prompt 1:

Now you see four pictures. There is a circle beside each picture. Please select the circle beside the picture you like the most, and click the "next" button to continue.

Component 18 - Create a song from a picture prompt 2:

Please create an original song for the picture you chose.

Your song can last as long as you like.

Please take some time to think about and prepare your song (in your head). Click the next button when you have prepared a song.

Component 19 – Create a song from a picture prompt 3:

Now I would like you to sing the song you just prepared!

Click the record button to start and the stop button when you have finished singing. Then move to the following task by clicking the next button.

Component 20 – Create a song from a picture prompt 4:

Now you can see the same four pictures on the screen. Please select the circle beside a picture for another song, and click the "next" button to continue

Component 21 – Create a song from a picture prompt 5:

Please take some time to think about and prepare a song (in your head) for the picture you chose. The song can have words and a melody, or the song can have only a melody.

If there was only a melody in your last song, please create a song with words. If you used words and a melody for your last song, please create a song without words.

When you have prepared your song, click the next button.

Component 22 – Create a song from a picture prompt 6:

Now I would like you to sing the song you just created!

Click the record button to start and the stop button when you have finished singing. Then move to the following question by clicking the next button.

Component 23 – Unfamiliar song (melody only):

I have another song for you, but this one probably won't be as familiar as the *Brother John* song. The words may sound strange.

I'll play it twice and then ask you to sing it to the best of your ability.

I would like you to sing just the melody using "la". D**o**n't sing any words. Remember just sing "la" to the melody.

Click the "next" button to start. Your response will be recorded automatically.

Component 24 - Unfamiliar song (melody and words):

I'll play the same song twice again and then ask you to sing it to the best of your ability.

I would like you to sing the melody and the words, even if they seem strange. Remember: sing the words.

Click the "next" button to start. Your response will be recorded automatically.

Component 25 – Brother John:

Do you still remember the song *Brother John*? Please sing *Brother John* again. It begins with:

Are you sleeping?

If you are not sure about all of it, just sing the parts that you know.

Click the "record" button to start, and the "stop" button when you have finished. Please move to the next task by clicking the "next" button.

Component 26 – Tell a story from a picture prompt 1:

Please choose which of the pictures you like the most.

Click the circle beside the picture to make your selection.

After you have made your selection, click the “next” button to continue.

Component 27 – Tell a story from a picture prompt 2:

Please take some time to think about and create a story for the picture you chose. Your story should have a beginning, middle and an ending.

Click the “next” button when you are ready to tell the story.

Component 28 – Tell a story from a picture prompt 3:

Please tell the story you have created about the picture.

Click the “Record” button to start and the “stop” button when you have finished. When you have finished, please move to the following task by clicking the "next" button.

Component 29 – Brother John:

Now, and finally, I am going to ask you to sing back the entire song of Brother John, this time without any clues.

When you are ready, please click the “record” button to start.

Component 30 - Final words:

You have now completed the AIRS test battery of singing skills. I would like to thank you for your participation in our research project. I appreciate you taking the time to help us out. If you have any questions or concerns about this interview please feel free to ask. All of your information will be kept confidential, and used only for our research. Before you leave, please click the submit button. Thanks again.

Appendix C: Detailed Description of the Music and Language Background Survey for the AIRS Test Battery of Singing Skills

Enter participant ID for AIRS Test Battery of Singing Skills

Demographic Questions:

1) Your contact information

2) Your gender

3) Your birthday

4) Your native language(s)

Survey Questions:

What is your 1st foreign language?

Please indicate your proficiency of this language. [Speaking]

Please indicate your proficiency of this language. [Reading]

Please indicate your proficiency of this language. [Writing]

Do you speak other language(s) other than above?

What is your 2nd foreign language?

Please indicate your proficiency of this language. [Speaking]

Please indicate your proficiency of this language. [Reading]

Please indicate your proficiency of this language. [Writing]

Do you speak other language(s) other than above?

What is your 3rd foreign language?

Please indicate your proficiency of this language. [Speaking]

Please indicate your proficiency of this language. [Reading]

Please indicate your proficiency of this language. [Writing]

Do you speak other language(s) other than above?

What is your 4th foreign language?

Please indicate your proficiency of this language. [Speaking]

Please indicate your proficiency of this language. [Reading]

Please indicate your proficiency of this language. [Writing]

Do you consider yourself a musician?

Please comment on the last question if you wish (the reason(s) of your answer)

Do you believe you have absolute pitch?

Please comment of the last question if you wish.

Do you play any musical instruments?

Please list some or all of your instruments and tell the learning/playing history. [1][Name of the instrument]

Please list some or all of your instruments and tell the learning/playing history. [1][Starting age]

Please list some or all of your instruments and tell the learning/playing history. [1][Have you taken private lessons? (Y/N)]

Please list some or all of your instruments and tell the learning/playing history. [1][Starting age of private lessons (if you have taken lessons)]

Please list some or all of your instruments and tell the learning/playing history. [1][Number of years of taking private lessons (if you have taken lessons)]

Please list some or all of your instruments and tell the learning/playing history. [2][Name of the instrument]

Please list some or all of your instruments and tell the learning/playing history.

[2][Starting age]

Please list some or all of your instruments and tell the learning/playing history. [2][Have you taken private lessons? (Y/N)]

Please list some or all of your instruments and tell the learning/playing history.

[2][Starting age of private lessons (if you have taken lessons)]

Please list some or all of your instruments and tell the learning/playing history.

[2][Number of years of taking private lessons (if you have taken lessons)]

Please list some or all of your instruments and tell the learning/playing history. [3][Name of the instrument]

Please list some or all of your instruments and tell the learning/playing history.

[3][Starting age]

Please list some or all of your instruments and tell the learning/playing history. [3][Have you taken private lessons- (Y/N)]

Please list some or all of your instruments and tell the learning/playing history.

[3][Starting age of private lessons (if you have taken lessons)]

Please list some or all of your instruments and tell the learning/playing history.

[3][Number of years of taking private lessons (if you have taken lessons)]

Please list some or all of your instruments and tell the learning/playing history. [4][Name of the instrument]

Please list some or all of your instruments and tell the learning/playing history.

[4][Starting age]

Please list some or all of your instruments and tell the learning/playing history. [4][Have you taken private lessons? (Y/N)]

Please list some or all of your instruments and tell the learning/playing history. [4][Starting age of private lessons (if you have taken lessons)]

Please list some or all of your instruments and tell the learning/playing history. [4][Number of years of taking private lessons (if you have taken lessons)]

Please move the sliders below to indicate how much do you like singing. [Do you like to listen to singing in concert or on recordings-|DISLIKE greatly|LIKE greatly]

Please move the sliders below to indicate how much do you like singing. [Do you like to sing in front of an audience-|DISLIKE greatly|LIKE greatly]

Please move the sliders below to indicate how much do you like singing. [Do you like to sing by yourself-|DISLIKE greatly|LIKE greatly]

Have you taken private singing lessons?

[How many years have you been taking singing lessons?]

[At what age did you start taking your singing lessons?]

[What genre(s) (style, e.g. classic, pop, and folk) have you learnt?]

Have you ever sung in a choir?

How many choirs have you sung in?

Do you remember the first choir you have sung in- Please tell us about your history singing in this choir. [On what age did you start singing in this choir?]

Do you remember the first choir you have sung in- Please tell us about your history singing in this choir. [How long did you sing in this choir?]

Which part do you sing in the above choir?

Which part do you sing in the above choir- - comment

Is above choir the longest one you have sung in?

Please tell us about your history singing in the choir you have sung in for the longest time. [On what age did you start singing in this choir?]

Please tell us about your history singing in the choir you have sung in for the longest time. [How long did you sing in this choir-]

Which part do you sing in the above choir?

Which part do you sing in the above choir- - comment

Is there another choir you want to talk about?

Please tell us about your history singing in this choir. [On what age did you start singing in this choir?]

Please tell us about your history singing in this choir. [How long did you sing in this choir-]

Which part do you sing in the above choir?

Which part do you sing in the above choir- - comment

Can you read music notation?

Please identify the following notes.

Please identify the following notes.

Please choose the name of this chord from the following choices or answer “don’t know”.

Please choose the name of this chord from the following choices or answer “don’t know”.

Please choose the name of this chord from the following choices or answer “don’t know”.

Can you identify this melody?

What is the name of a piece that begins like this?

What does V—I refer to?

What does V—I refer to? [Other]

Can you identify this melody?

What is the name of a piece that begins like this?

Is there anything you would like to add about your musical background?

Appendix D: Movement Scale Item

Movement Scale Item	Intensity	Comments
Head Movement		
Head Up	1 2 3 4	
Head Down	1 2 3 4	

Head Turn Right	1 2 3 4	
Head Turn Left	1 2 3 4	
Head Tilt Right	1 2 3 4	

Head Tilt Left	1 2 3 4	
Finer Facial Movement		
Brow Raise	1 2 3 4	
Brow Lower/Gatherer	1 2 3 4	

Mouth Movement **Naturally, singing will generate some mouth movement in every case, but the degree/types of mouth movements may differ.*		
Upper Lip Raiser	1 2 3 4	
Lips Stretch	1 2 3 4	
Lip Corner Depressor	1 2 3 4	

Lip Corner Puller **Open mouth version acceptable*	1 2 3 4	
Mouth Stretch	1 2 3 4	
Eye Movement		
Eyes Closed **Excluding blinking movements of the eyes. For instance, many singers close their eyes when they become engrossed in singing a song or blink for a longer than normal period of time*	1 2 3 4	

Eyes Turn Left	1 2 3 4	
Eyes Turn Right	1 2 3 4	
Eyes Up	1 2 3 4	
Eyes down	1 2 3 4	

Body Movement **Upper, lower, limbs, etc.*		
Additional Notes		

Appendix E: Graphs for Insignificant Findings

Head up

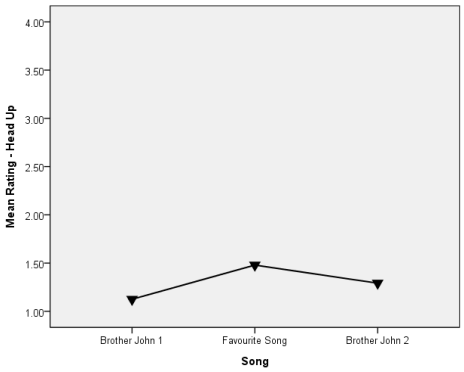

Figure 14. Mean ratings for the *Head up* scale item as a function of song.

Head down

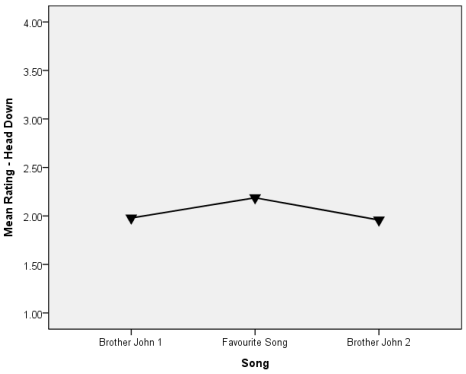

Figure 15. Mean ratings for the *Head down* scale item as a function of song.

Head turn left

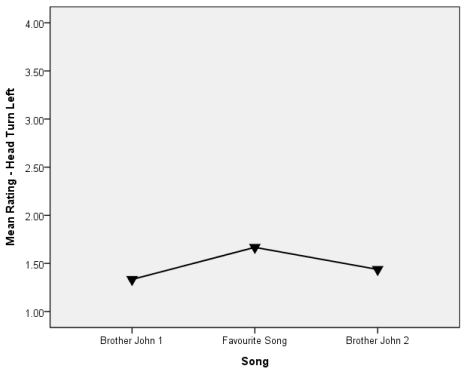

Figure 16. Mean ratings for the *Head turn left* scale item as a function of song.

Head tilt right

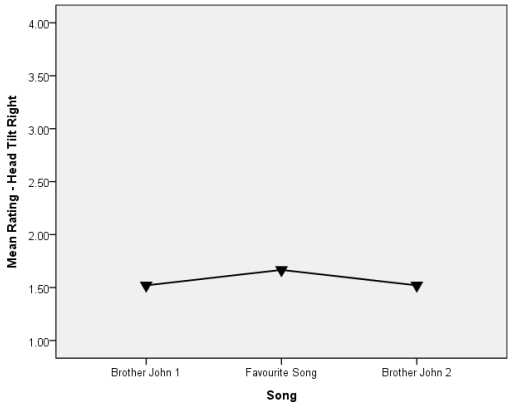

Figure 17. Mean ratings for the *Head tilt right* scale item as a function of song.

Brow raise

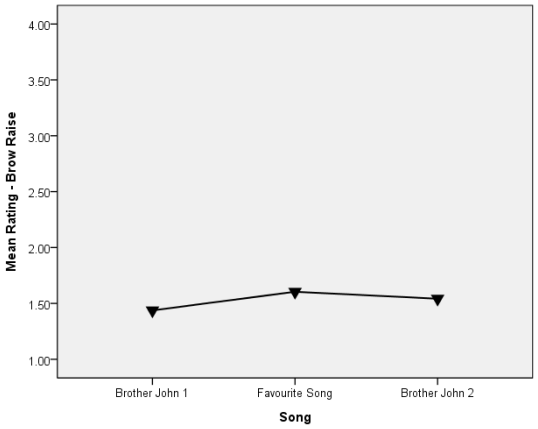

Figure 18. Mean ratings for the *Brow raise* scale item as a function of song

Appendix F: Additional Participant Information

Table 5

Female Musicians

Characteristic	Participant #1	Participant #2	Participant #3
Gender	Female	Female	Female
Birth Year	1992	1989	1988
Age	20	22	24
Native Language	English	English	English
Handedness	Right	Right	Right
"Do you consider yourself a musician?"	Yes	Yes	Yes
Comment	"I have taken piano and voice lessons since I was very young. I now teach piano and still sing in choirs and various benefits. I also play guitar and drums."	"I am a Music Major at UPEI."	"I am finishing my last year of my undergrad as a music major."
"Do you believe you have absolute pitch?"	No	No	Yes

"Do you play any musical instruments"	Yes	Yes	Yes
Instrument #1 (Years private training)	Piano (13)	Saxophone (6)	Flute (11)
Instrument #2 (Years private training)	Guitar (4)	Guitar (2)	Violin (6)
Instrument #3 (Years private training)	Drums (0)	NA	Tenor Sax (0)
Instrument #4 (Years private training)	NA	NA	Piano (4)
"Do you like to listen to singing in concert or on recordings?"	Like Greatly	Like Greatly	Like Greatly
"Do you like to sing in front of an audience?"	Like Greatly	Like	Like
"Do you like to sing by yourself?"	Like Greatly	Like Greatly	Like Greatly

"Have you taken private singing lessons?" (Years)	Yes (13)	No	No
"Have you ever song in a choir?"	Yes	Yes	Yes
"How many choirs have you sung in?"	3	3	1
"Can you read music notation?"	Yes	Yes	Yes
Survey Score	8/10	10/10	10/10

Table 6

Male Musicians

Characteristic	Participant #4	Participant #5	Participant #6
Gender	Male	Male	Male
Birth Year	1992	1990	1990
Age	19	22	22
Native Language	English	English	English
Handedness	Ambidextrous	Right	Right
"Do you consider yourself a musician?"	Yes	Yes	Yes

Comment	"I play piano and am receiving training in classical voice."	NA	"I am taking music at UPEI and hope to be a music educator. I also play with or have played with many different musicians around town."
"Do you believe you have absolute pitch?"	No	No	No
"Do you play any musical instruments"	Yes	Yes	Yes
Instrument #1 (Years private training)	Piano (10)	Percussion (6)	Drums (2)
Instrument #2 (Years private training)	French Horn (0)	Clarinet (0)	Percussion (5)
"Do you like to listen to singing in concert or on recordings?"	Like Greatly	Like Greatly	Like Greatly
"Do you like to sing in front of an audience?"	Like Slightly	Like	Like Greatly

"Do you like to sing by yourself?"	Like Greatly	Like Greatly	Like Greatly
"Have you taken private singing lessons?" (Years)	Yes (2.5)	Yes (1)	Yes (0.25)
"Have you ever song in a choir?"	Yes	Yes	Yes
"How many choirs have you sung in?"	6	1	2
"Can you read music notation?"	Yes	Yes	Yes
Survey Score	10/10	10/10	10/10

Table 7

Female Non-musicians

Characteristic	Participant #7	Participant #8	Participant #9
Gender	Female	Female	Female
Birth Year	1989	1994	1993
Age	22	18	19
Native Language	English	English	English
Handedness	Right	Right	Right

"Do you consider yourself a musician?"	No	No	No
Comment	NA	"I am not very good at keeping rhythm or remembering how to read musical notes."	NA
"Do you play any musical instruments"	No	No	No
"Do you like to listen to singing in concert or on recordings?"	Like Greatly	Like Greatly	Like Greatly
"Do you like to sing in front of an audience?"	Dislike Greatly	Dislike Greatly	Dislike Greatly
"Do you like to sing by yourself?"	Like Greatly	Like Greatly	Neutral
"Have you taken private singing lessons?" (Years)	No	No	No
"Have you ever song in a choir?"	Yes	Yes	No

“How many choirs have you sung in?”	5	1	NA
“Can you read music notation?”	No	No	No
Survey Score	0/10	0/10	0/10

Table 8

Male Non-musicians

Characteristic	Participant #10	Participant #11	Participant #12
Gender	Male	Male	Male
Birth Year	1990	1992	1992
Age	21	20	20
Native Language	English	English	English
Handedness	Ambidextrous	Right	Right
“Do you consider yourself a musician?”	No	No	No
Comment	“I play a bit of guitar, but not to perform or create. Just for fun.”	“I play bass in my free time, just with friends, so not really.”	NA

“Do you play any musical instruments”	Yes	Yes	No
Instrument #1 (Years private training)	Guitar (3)	Bass (0)	NA
“Do you like to listen to singing in concert or on recordings?”	Like	Like Greatly	Like
“Do you like to sing in front of an audience?”	NA	Dislike Greatly	Dislike Greatly
“Do you like to sing by yourself?”	NA	Like Greatly	Like
“Have you taken private singing lessons?” (Years)	No	No	No
“Have you ever song in a choir?”	Yes	No	No
“How many choirs have you sung in?”	1	NA	NA
“Can you read music notation?”	No	No	Yes
Survey Score	0/10	0/10	5/10