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The Relationship Between Music and Emotion,

as Conveyed by Prosody, in Individuals With Williams Syndrome

by

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

This study examined the relationship between musical training and the emotional comprehension of prosodic sentences in a special population, individuals with Williams syndrome. Many of the stimuli and procedures of Thompson, Schellenberg, and Husain (2004), from their research on music and emotion, were replicated in the present study. Individuals with Williams syndrome were compared to musical and non-musical chronological age matches and musical and non-musical emotional comprehension matches. All participants were asked to identify a specific emotion (happy, sad, fearful, or angry) from facial expression pictures, English sentences, and tonal sentences. All responses were analyzed by task with a five (group) by four (emotion) mixed group ANOVA including mean accuracy and mean reaction time analyses. The study specifically addressed whether or not musical training was sufficient to overcome general emotional comprehension difficulties in individuals with Williams syndrome. Analyses revealed that accuracy and reaction time scores varied across emotion as well as group. No relationship between musical training and emotional comprehension was found and individuals with Williams syndrome performed more poorly than expected on the prosodic sentence tasks.

The Relationship Between Music and Emotion, as Conveyed by Prosody, in Individuals With Williams Syndrome

Music is a career for few, a form of relaxation for some, and an obsession for many. We listen to music in our car, while we cook, even while we walk down the street. Music is an integral part of many people's lives, whether it is listened to or performed. The therapeutic benefits of the recently evolving field of music therapy have been shown in various populations (Nayak, Wheeler, Shiflett, & Agostinelli, 2000). Music has been associated with different aspects of intelligence (see Helmbold, Rammsayter & Altenmüller, 2005; Schellenberg, 2005) such as math and science intellect, but has also been linked to creative language skills because of its emotional content and means of expression. The interpretation of music is also present in a more common form, the prosodic content of speech. The present study examined the relationship between music and emotion in prosodic language, based on the prediction that musical skill and emotional comprehension were directly related. This relationship was explored in a special population, musically talented individuals with Williams syndrome. The subsequent sections will describe each aspect of the relationship between music, emotion, and prosody, and will provide a thorough description of the characteristics of Williams syndrome.

Music and Emotion

The formation of an emotional response to musical expression has long been an important component of musical production to the performer and the listener. Several theorists and researchers have examined this relationship through introspective, physiological, and experiential means (see Dibben, 2004; Resnicow, Salovey, & Repp, 2004; Scherer & Zentner, 2001; Sloboda, 2005; Sloboda & Juslin, 2001; Sloboda & Lehmann, 2001). The present study focused on musical expression in speech to understand the complex relationship between music and emotion.

Musical training has long been associated with emotional expression as well as technical expertise. Scherer and Zentner (2001) argued that music intensifies pre-existing emotions in listeners and that certain musical techniques add to the emotional experience of a piece. Sloboda (1994) maintained that one must be proficient in musical technique and musical expression in order to qualify as a true musician. Sloboda defined technical skills as co-ordination, fluency, and intonation; and expression as “slight changes in the timing, speed, loudness, and sound quality of successive notes” (p. 2). Sloboda argued that musical expression is integral to true musicianship and musical understanding. The expressive element of musical performance often evokes an emotional experience in the listener as well as the musician.

Sloboda (2005) categorized the cognitive and emotional experience into three groups: episodic associations, iconic associations, and structural expectancies. Episodic associations are evocated by memories from past events in our lives that have associations with a specific piece of music. Iconic associations are musical expressions that imitate certain sounds, such as animal sounds or natural phenomena. Structural expectancies are more complicated, relating to the specific complexities of a piece and how musical structures interact with a listener's expectations (Sloboda, 2005). Musical suspense, unexpected outcomes, and musical resolve are examples of techniques that are intended to create specific emotions in the listener. Sloboda argued that music could not be fully appreciated unless the listener was emotionally involved. For performers and listeners alike, music often plays a large part in the regulation of our emotions and can evoke strong emotional responses.

Balkwill and Thompson (1999) explored the cross-cultural perception of emotion in music and investigated the possibility of universal cues for the identification of specific emotions. The researchers argued that composers, performers, and listeners use culturally-based cues as well as perceptual cues (that are not culture specific) to express and interpret emotion in music. They further contend that musical familiarity, i.e. musical training or frequent exposure to music, as well as musical sensitivity, may account for the listener's level of understanding of emotion in music. Balkwill and Thompson defined perceptual cues as basic characteristics of music such as tempo and complexity. They argued that these cues would allow a listener to continue to perceive emotion in an unfamiliar tonal system (Balkwill & Thompson, 1999).

Balkwill and Thompson (1999) exposed 30 participants (who were only familiar with the Western music system) to Hindustani music performances and asked each participant to identify the emotion conveyed by each piece. The emotions tested were joy, sadness, anger, and peace. Participants were asked to rate the intensity of the emotion as well as the tempo, rhythmic complexity, melodic complexity, and pitch range of each piece. Findings showed that participants were able to recognize joy, sadness, and anger in the Hindustani pieces, but not peace (which may be due to the fact that it is not a basic emotion). These results suggest that in addition to cultural cues, music contains a set of psychophysical cues that strongly influence the identification of emotion (Balkwill & Thompson, 1999). These findings support the assumption that the emotional experience of music is related both to expressive and technical qualities. Sloboda and Juslin (2001) explored the technical relationship between music and emotion and described music as cyclic, with peaks of high emotional intensity and troughs of low emotional intensity. Gembris (2006) further elaborated, “The ability to perceive and distinguish basic acoustic-musical parameters is the premise for the understanding of musical expression and its emotional meaning” (p. 135). Balkwill and Thompson’s findings, as well as arguments from other theorists, support the existence of a basic set of perceptual cues that help us to understand emotional expression in music.

Peretz (2001) also discussed the adaptive nature of music and expression, as when mothers speak in baby talk. The musical quality of this speech, as well as the ability of the infants to recognize specific emotions in music very early in life, may aid in communication between parent and child. Musical abilities often develop in young childhood and continue to develop throughout one’s lifetime. Researchers have also examined this development in relation to emotional intelligence. Resnicow et al. (2004) studied the finite differences between emotional intelligence and the identification of emotional expression in music. They found a correlation between the two, suggesting that a better understanding of emotion in music may relate to overall emotional intelligence. The present study also examined aspects of emotional understanding and compared the various findings to past research in order to present a more comprehensive understanding of emotional comprehension.

The relationship between music and emotion is complex and continues to be interpreted in many different ways. Music, emotion, and speech are all intertwined in a unique relationship that has yet to be completely unraveled by modern psychology. Neurobiological interactions, cognitive processes, and personal experiences are all integral to the experience of a musician or a listener. Musical expression, as defined by Sloboda (2005), creates a musical affect that is open to interpretation. The present study continues to examine the complicated interaction between music and emotion in prosodic speech.

Emotion and Prosody

Imagine listening to the following sentence: “The bus has already left for Hampshire College.” Consider all the processes a listener must engage in order to understand this sentence. He or she has to identify the meaning of each word within its individual context, understand grammatical rules associated with its place in the particular sentence, and connect the sentence with others in the theme of conversation. These aspects of semantic understanding have been studied thoroughly in past research (e.g. Allbritton & Ratclif, 1996; Ferreira, 1993; Lewis, Antone & Johnson, 1999). Now, imagine the sentence in the following way: “The bus has already left for Hampshire College” with a dramatic rise in tone at the end. This change, displayed in writing with a question mark, signals the listener to understand the spoken words as a question rather than a statement, which changes the meaning entirely. This difference in meaning is an example of the effect of prosody, the study of stresses and tone inflections in speech. Prosody can be manipulated in speech by a raising or lowering of tone or by an emphasis on one or more syllable(s) or word(s). Prosody is used in speech to convey specific meanings and emotions to the listener.

Past research has examined how manipulations of specific word stresses and tonal changes in speech have influenced semantic understanding and the interpretation of ambiguity in speech (Höhle & Weissenborn, 1999). As defined by Thompson, Schellenberg, and Husain (2004), “*Speech prosody* refers to musical aspects of speech, including its *melody* (intonation) and its *rhythm* (stress and timing)" (p. 48). An alternate definition is offered by Wennerstrom (2001), stating that "prosody is a general term encompassing intonation, rhythm, tempo, loudness, and pauses as these interact with syntax, lexicon meaning, and segmental phonology in spoken texts" (p. 4). The two definitions highlight the specific tonal aspects of speech that influence how each sentence may be interpreted by a listener. Prosody is often used to convey precise emotionality, either in the present or past tense of a sentence.

Prosody incorporates many elements of speech, such as tone inflections (a raising or lowering of pitch in chosen parts of speech) and prosodic cues (specifically stressed syllables or words in a sentence) to provide emphasis or feeling. An example of a prosodic cue is, "They will use either television or radio AND newspapers to announce the sale" or "They will use either television OR radio and newspapers to announce the sale" (Allbritton & Ratcliff, 1996). The simple word emphases in the previous sentences show differences in the exclusion of certain items. The prosody in the first example determines that the option is between radio and television, as newspapers are a given, and the second example provides a choice between *only* television or *both* radio and newspapers. Prosodic cueing has been widely researched (Allbritton & Ratcliff, 1996; Fernald & Mazzie, 1991; Ferreira, 1993); however, little research has examined how tone inflections can convey specific meanings or emotions.

Fernald and Mazzie (1991) examined the use of prosodic language early in life. The researchers provided mothers with a picture book to describe to an adult and their infant in individual trials. Their two storytelling experiences were recorded and later prosodically analyzed for stresses of specific words, pitch contours, and utterance lengths. Fernald and Mazzie found a higher and wider pitch range in infant-directed speech in contrast to adult-directed speech. They also found acoustic peaks associated with the introduction of new words to infants. These findings suggest that mothers use specific prosodic patterns and a consistent prosodic strategy when talking to infants. This research examined the relationship between lexical acquisition and prosody as well as the adaptive nature of prosodic emphases in very young children.

Wennerstrom (2001) argued that prosody is chiefly responsible for conveying information about the position and importance of words within a sentence. Wennerstrom mainly focused on word stress and how prosodic emphases can assist in or worsen the interpretation of information in sentences, based on the effectiveness of prosodic cueing. However, Wennerstrom also discussed the prosodic manipulation of speech and its ability to convey various emotions. She contends that an exaggeration or a change in speed or tone in specific parts of sentence will effectively express an intended emotion. Wennerstrom’s theory highlights the importance of prosodic manipulation in the communication of information and emotional content.

Ferreira (1993) argued that prosodic emphases are intentional, and that a speaker chooses a particular intonation and rhythm to convey a specific emotion. Ferreira argued that, similar to the identification and use of particular lexical and syntactic areas of speech, a speaker chooses certain prosodic cues in order to communicate most effectively. Allbritton and Ratcliff (1996) further examined this personal manipulation by testing trained and untrained speakers with prosodically ambiguous words. Examples of the sentence stimuli included, “They rose early in May” and “Although they did run in the woods they were uneasy” (p. 716). The study attempted to understand the individual creation of prosodic cues**.** The researchers found that most speakers used prosodic cues such as a change in pitch or a stress on a specific word to make sense of an ambiguous sentence. Allbritton and Ratcliff also found that most speakers were able to reliably use prosodic cues in a sentence to convey a specific meaning when instructed to do so. This provides evidence for Ferreira’s argument that prosody is mainly intentional, and that most speakers are skilled in creating appropriate prosodic emphases in speech when necessary.

Studies have found that certain emotions are more easily prosodically interpreted than others (Juslin & Laukka, 2003; Thompson et al., 2004). Thompson et al. (2004) summarized that:

> Happiness is associated with rapid tempo, high pitch, large pitch range, and bright voice quality; sadness is associated with slow tempo, low pitch, narrow pitch range, and soft voice quality; anger is associated with fast tempo, high pitch, wide pitch range, and rising pitch contours; and fear is associated with fast tempo, high pitch, wide pitch range, large pitch variability, and varied loudness (p. 48).

Thompson et al., in their study of adults and children, found that happiness and sadness were most easily identified in Tagalog sentences (a language foreign to the participants) by the children. Juslin and Laukka (2003) also reviewed literature concerning emotion in vocal and musical expression and found an overall correlation between the two. Juslin and Laukka, in contrast to Thompson et al., found that fear and happiness were the most difficult emotions to express overall. The present study followed the more recent findings by Thompson et al. and hypothesized that happiness and sadness would be more easily recognized than fear or anger.

Music and Prosody

The ability to convey and understand emotion is an integral part of mastering musical instruments and performing; therefore, musical training may be beneficial in understanding emotion conveyed through prosodic manipulations of speech. The ability to discriminate pitches (a large component of musicality) may also play a role in interpreting emotion through tonal prosodic manipulations. Sloboda (2005) argued that there are many similarities between music and language and that it has been shown that infants understand the structure of music as well as the structure of language. Sloboda also contended that music, like language, incorporates three basic elements: phonology, syntax, and semantics. He argued that the phonology of music is similar to the element of categorization in speech; the syntax of music is the pattern or structure that music predictably follows; and the semantics of music are the specific criteria that describe its structure. Like speech, music is made up of a series of sounds with their own set of rules, some of which are similar to prosody. In fact, the musical element of speech is prosody, which follows its own set of patterns and boundaries. In the present study I examined prosodically manipulated stimuli in sentences with and without words.

This study was designed to be very similar to research by Thompson et al. (2004) that examined the relationship between emotional understanding and musical training. Thompson et al. conducted three experiments to better understand prosodic cueing as influenced by different amounts of musical experience. Experiment 1 tested adults with and without musical training on their abilities to understand emotion. College students took part in the study and the musically trained group had taken at least eight years of lessons, while the untrained group had taken none (with the exception of one participant who had taken one year of lessons). The stimuli in experiment 1 consisted of prosodically manipulated tone sequences that mimicked the prosody in English speech (these stimuli were also used in the present study). Each participant was tested on happy, sad, angry, and fearful tone sequences. All stimuli were created with a computer based on the Name Emotional Prosody Test (see materials) and were carefully altered by pitch and duration of syllables. Thompson et al. found that music lessons were positively correlated with the accurate identification of specific emotions in tone sequences.

Experiment 2 was very similar to experiment 1, except that the stimuli used were 20 prosodically manipulated English sentences (also based on the Name Emotional Prosody Test), 20 Tagalog sentences (a language spoken in the Philippines, and not understood by any of the participants) and 32 tone sequences, produced from the English and Tagalog sentences. Each stimulus in Thompson et al. (2004)’s study was devised to examine a different aspect of emotional comprehension in speech. The tone sequences were the most basic, containing only the prosodic elements of a sentence. The English sentences were most applicable to daily experiences with speech, and the Tagalog sentences tested if the participant was able to interpret prosody in an unfamiliar language. In experiment 2, Tagalog and English sentence stimuli tested the emotions happy, sad, angry, fearful, and neutral. Tone sequences did not test the neutral condition because the neutral tone stimuli would have been too difficult for participants. All stimuli were spoken by a native female voice and heard on headphones, as in experiment 1. Thompson et al. again found results that suggested a positive relationship between emotional comprehension and musical training. However, this relationship was only found in some emotions (sad, fearful and neutral).

Experiment 3 selected participants at six years of age and tested them at seven years of age. During this year, children took weekly arts lessons (keyboard, voice, or drama) with the exception of the control group, who did not take any lessons. All children were presented with English, Tagalog, and tonal stimuli at the end of their year of lessons. The age of six was selected based on studies examining the effects of age on the understanding of emotion as well as research regarding the critical age to acquire absolute pitch (Thompson et al., 2004). The children were asked to pick from two emotions at a time (e.g. happy and sad or fearful and angry) in order to make the task less difficult. As predicted, the happy and sad combination was much easier for children to understand than the fearful and angry combination. Children in the keyboard and drama groups were most successful overall, and there was little difference between the vocal group and the group that took no lessons. Thompson et al. (2004) hypothesized that the children who took voice lessons may not have performed as highly because their vocal training emphasized the non-prosodic use of their voice. The data collected in the keyboard and drama groups in experiment 3 by Thompson et al. again suggests that musical training aids in the comprehension of emotion as conveyed through prosody.

Williams syndrome

The introduction of a new population, musically talented adults with Williams syndrome, expanded on Thompson et al.'s (2004) study on typically developing adults and children. Williams syndrome is of particular interest to this study because the syndrome has been associated with musical talent by a number of researchers (Lenhoff, Perales & Hickok, 2001; Levitin & Bellugi, 1998; Levitin, Cole, Chiles, Lai, Lincoln, & Bellugi, 2004). The present study was designed to gain a better understanding of the participants' emotional comprehension and its relationship to musical training.

Williams syndrome is distinguished by a specific set of cognitive and physical differences caused by a modification of chromosome 7 (Mervis & Klein-Tasman, 2000). Individuals with Williams syndrome often display a number of physical problems, such as problems with cardiovascular functioning and an extreme sensitivity to sound (Lenhoff, Wang, Greenberg, & Bellugi, 1997). The syndrome is also associated with a specific personality profile and level of intellect, which is typically categorized as mildly to moderately mentally retarded. Individuals with Williams syndrome show relatively good language abilities (although the acquisition of language is often delayed in early childhood), but show impairments in visuo-spatial construction such as creating patterns and drawing (Lenhoff, et al., 1997).

Individuals with Williams syndrome are best known for their musical abilities. Levitin and Bellugi (1998) remarked on adults' with Williams syndrome intact musical ability despite their other cognitive difficulties. The researchers found that individuals with Williams syndrome were particularly proficient in tonal and rhythmic tasks as compared to their overall cognitive profile. The participants were able to repeat musical rhythms with incredible accuracy over a number of subjects and trials. Levitin and Bellugi concluded that their study provided evidence for the independence of musical ability in the Williams syndrome cognitive profile, yet they are careful not to generalize their findings to the entire Williams syndrome population since the study was conducted at a music camp. This insight suggests the possibility that musical training may be responsible for the talent, instead of an inborn musical trait.

Though research suggests that the musical skill of individuals with Williams syndrome is not extraordinary when compared to typically developing populations, overall musical ability is relatively intact when compared to their other cognitive domains (Don, Schellenberg & Rourke, 1999; Levitin & Bellugi, 1998). Some studies extend this theory to pair music and language skills in order to account for this preservation despite other cognitive difficulties. For example, Don, Schellenberg and Rourke (1999) argued that basic auditory processing aptitude explained the well-developed language and musical abilities of individuals with Williams syndrome. Another possibility is that the two processes are separate, yet musical experience can influence some aspects of speech (specifically prosody). These two processes were examined in the present study.

Lenhoff, Perales and Hickok (2001) studied the prevalence of absolute pitch in individuals with Williams syndrome. They found that all individuals with Williams syndrome performed at ceiling levels when tested for absolute pitch. Though the participant number was very low (n = 5), the finding of this study, in comparison to the general population statistics on absolute pitch frequency (1 in 10,000) suggests that individuals with Williams syndrome are more likely to have absolute pitch than typically developing individuals. While Lenhoff et al. (2001) suggest that this finding is a product of genetic factors, it is not clear whether or not participants have participated in musical training that may have affected these results. Individuals with Williams syndrome are known for their musical abilities, yet as discussed above, it is unclear if these abilities are inborn or developed with increased exposure to music.

Research has shown that individuals with Williams syndrome have a remarkable ability to identify faces and have been shown to accurately interpret the intent of specific eye gazes (Karmiloff-Smith, Klima, Bellugi, Grant, & Baron-Cohen, 1995). Karmiloff-Smith et al. (1995) examined how individuals with Williams syndrome responded to photographs of children's faces that displayed different mental states. The participants were tested on their ability to infer the intentions and goals of the individuals in the photographs. The researchers also examined the participants' abilities to determine the specific direction of eye gazes (i.e., if the individual was looking at the participant or not) and used facial expression photographs to determine the participants' accuracy at identifying emotions from differences in facial features such as mouth shape. The high accuracy rates in Karmiloff-Smith et al.'s study were surprising. "Not only did they [participants with Williams syndrome] score almost at ceiling on emotional and nonsocial clues, but they were indistinguishable from the normal controls and very significantly better than the group with autism on inferring intentions and goals on the basis of eye gaze direction" (Karmiloff-Smith et al., p. 201). The research conducted by Karmiloff-Smith et al. suggests an intact ability to recognize emotion in facial expression, but studies have not thoroughly investigated individuals' with Williams syndrome abilities in recognizing emotions in speech. The present study examined this capability with prosodically manipulated stimuli.

Karmiloff-Smith et al. (1995) also tested Williams syndrome participants with a variety of theory of mind (i.e., the cognitive ability to understand that others' thoughts and beliefs differ from one's own) tests. Karmiloff-Smith et al.

used false belief tasks to examine these theory of mind abilities. False belief tasks test one's representational theory of mind, specifically one's ability to understand that others have beliefs that differ from one's own and that these beliefs influence their actions. The researchers showed that participants with Williams syndrome greatly outperformed children with autism. However, the Karmiloff-Smith et al. results on theory of mind in individuals with Williams syndrome have since been contested by Tager-Flusberg and Sullivan (2000) based on the control groups that were chosen for comparison. Tager-Flusberg and Sullivan found a much lower percentage of accuracy levels on false belief tasks in individuals with Williams syndrome than Karmiloff-Smith et al.

Tager-Flusberg and Sullivan (2000) proposed that there are two components of theory of mind: social-cognitive, studied mainly with false belief tasks, and social-perceptual, which includes general knowledge and perception of others. The researchers argue that participants with Williams syndrome are more proficient in the social-perceptual component than social-cognitive. Tager-Flusberg and Sullivan tested individuals with Williams syndrome on a variety of theory of mind tasks as well as emotional comprehension tasks. The researchers tested participants with false belief tests based on location changes of an object and predictions of others' behavior. Tager-Flusberg and Sullivan found that participants with Williams syndrome were impaired in this area of cognition (social-cognitive), in contrast to theory of mind findings by Karmiloff-Smith et al. (1995). Tager-Flusberg and Sullivan explained the difference in findings as a result of participant age differences as well as control group differences. Karmiloff-Smith et al. tested participants based on the mental age appropriate for such tasks, and Tager-Flusberg and Sullivan tested participants based on the chronological age appropriate for such tasks. This difference suggests that theory of mind in individuals with Williams syndrome is somewhat intact in comparison to their overall cognitive profile, but not in contrast to typically developing individuals. A more fine-grained analysis of theory of mind, as proposed by Tager-Flusberg and Sullivan, reveals intact social-perceptual knowledge in contrast to the impaired social-cognitive domain.

Tager-Flusberg and Sullivan (2000) also tested individuals with Williams syndrome on the social-perceptual component of theory of mind, similar to Karimiloff-Smith et al.'s (2005) eye gaze tasks, and found that the abilities of individuals with Williams syndrome were relatively intact. As cited in Tager-Flusberg and Sullivan, participants with Williams syndrome fared particularly well in past studies conducted by Tager-Flusberg, Boshart and Baron-Cohen (1998) that examined the mental state of others through eye gazes. In the more recent emotion-matching task by Tager-Flusberg and Sullivan, participants with Williams syndrome did not perform as highly as in the earlier eye gaze task. As a result, the researchers argued that the more recent task had not measured social-perceptual abilities as directly as their past eye-matching task. They suggested that the recent task had also included aspects of social-cognitive knowledge in contrast to the eye gaze task, which solely tested the social-perceptual component.

Tager-Flusberg and Sullivan argued, based on their overall findings, that individuals with Williams syndrome had a more intact social-perceptual knowledge than social-cognitive knowledge.

Individuals with Williams syndrome display a relatively intact ability to recognize outwardly displayed emotion (i.e. facial expressions), (Tager-Flusberg and Sullivan, 2000). Research by Tager-Flusberg and Sullivan (2000) showed that participants with Williams syndrome were equal to participants matched on mental age (who had similar neurobiological disorders) in their abilities to recognize facial expressions. Tager-Flusberg and Sullivan found that individuals with Williams syndrome exhibited relatively intact emotional comprehension compared to individuals with other developmental disabilities (such as Prader-Willi syndrome and non-specific mental retardation), but were less accurate than typically developing individuals. This research shows that although these abilities are somewhat preserved, the level of comprehension is still impaired when compared to a typically developing population. The extent of emotional comprehension abilities of individuals with Williams syndrome is not yet determined, and much further research is needed to understand the range of emotions that individuals with Williams syndrome can comprehend and synthesize.

Individuals with Williams syndrome are often remarkably social as well as proficient in conversational skills. From early development, children with Williams syndrome are shown to be “friendly” to both friends and strangers

(Lenhoff et al., 1997; Mervis & Klein-Tasman, 2000). As shown in a recent visit to Berkshire Hills Music Academy (a school mostly for individuals with Williams syndrome), adults with Williams syndrome were very interested in holding a conversation and were extremely helpful and sociable in their demeanor. This trait is often described as a hyper social personality. Often, this extroverted personality is assumed to be related to conversational skills such as the ability to interpret others' body language. I argue that the hyper sociability of individuals with Williams syndrome does not imply full emotional comprehension of others' emotions, as is often assumed. I contend that emotional understanding is not a part of this hyper social personality and that the language and conversational skills displayed do not imply a comprehensive understanding of the underlying meaning in others' responses. I argue that individuals with Williams syndrome have good perceptual understanding but do not have a deeper emotional understanding of social interactions. The emotional abilities of individuals with Williams syndrome, as shown in the research discussed above, have been highly contested and I hope to further understand these abilities in the present study.

The Present Study

Based on the relationship between music and emotion, the goal of the current study was to examine whether or not musical training was sufficient to overcome the difficulties that individuals with Williams syndrome experience in the interpretation of emotion and in certain domains of theory of mind. This question was addressed by comparing five groups: individuals with Williams syndrome, musical and non-musical chronological age match groups and musical and non-musical emotional comprehension match groups. Each group was designed to provide a comparison to the individuals with Williams syndrome in correspondence with their specific areas of cognitive understanding. The chronological age match group was chosen in order to provide a group of typically developing individuals and the emotional comprehension group functioned similar to a mental age match group, where the individuals with Williams syndrome were matched to children based on their emotional comprehension abilities.

Three tasks were used to measure different aspects of emotional understanding in this study. The facial expression task was designed to measure the social-perceptual aspect of emotional understanding, as well as provide a measure that was used for emotional comprehension matching. The facial expression stimuli provided a more comprehensive sense of what is generally thought of as emotional understanding: the interpretation of others' body language. The English sentence task was designed to measure emotional comprehension of prosody in speech, and the tonal sentence (formerly called tone sequences by Thompson et al. (2004)) task was designed to measure prosody in the absence of speech. While the English sentence stimuli are most directly related to speech prosody, understanding of tonal sentences implies the understanding of the pitch alone. The tonal sentences isolated prosody and examined whether or not participants were able to emotionally comprehend prosodic emphases without semantic information.

All stimuli were designed to represent four separate emotions: happiness, sadness, anger, and fear, and participants were asked to choose the emotion that corresponded best to each stimulus. Each emotion tested a specific range of affect: happiness as a feeling of elation or joy, sadness as a feeling of despair or sorrow, anger as a feeling of displeasure or rage, and fear as a feeling of great apprehension or anxiety. Consistent with research by Thompson et al. (2004), I predicted that participant responses across all tasks would be more accurate in the happy and sad conditions than the angry and fearful conditions.

In the present study, I hypothesized that musical training would increase exposure to emotional understanding and therefore be associated with a better understanding of emotion as conveyed through prosody. Consistent with results from Thompson et al. (2004), I expected that groups with musical experience would outperform groups without musical training. Specifically, I expected the musically trained chronological age match group to outperform all other groups. I expected the musical emotional comprehension match group and the group of individuals with Williams syndrome to follow, performing equally due to the facial expression task matching of the two groups.

This research specifically addressed whether or not the musical abilities of individuals with Williams syndrome were sufficient to overcome theory of mind and emotional comprehension difficulties as described by Tager-Flusberg and Sullivan (2000) and Karmiloff-Smith et al. (1995). I expected that the musically trained individuals with Williams syndrome would outperform the non-musically trained emotional comprehension matches and the non-musical chronological age matches on the English sentence and tonal sentence tasks.

METHOD

Participants

Individuals were recruited to participate in either the group of adults with Williams syndrome or in one of four control groups: non-musical chronological age match, musical chronological age match, non-musical emotional comprehension match, and musical emotional comprehension match. Participants were selected from three distinct demographics: Berkshire Hills Music Academy (BHMA), Mount Holyoke College (MHC), and Newman Elementary School (NES). BHMA students made up the group of individuals with Williams syndrome, MHC students participated in the non-musical and musical chronological age match groups, and NES students formed the non-musical and musical emotional comprehension match groups.

Berkshire Hills Music Academy students were recruited for participation in the group of individuals with Williams syndrome. Eleven students at the academy participated (three females and eight males) and participants ranged in age from 19-26 years (see Table 1). BHMA is an institute comprised primarily of individuals with Williams syndrome who possess musical talent. BHMA serves 30 students ages 18-26 and teaches music and basic living skills. All students tested had partaken in musical training through the academy and most had taken lessons previous to their matriculation at BHMA. Students often played multiple

Table 1

Demographic Information for All Groups

Group	Age	Gender	Years of Lessons
Individuals with WS	19-26 years	3 Female, 8 Male	1-10 years
Musical Age Match	19-25 years	11 Female, 0 Male	3-15 years
Non-Musical Age Match	19-27 years	9 Female, 2 Male	> 6 months
Musical Emotion Match	8-10 years	6 Female, 5 Male	1-3 years
Non-Musical Emotion Match	8-10 years	8 Female, 3 Male	0 years

instruments and had previously received music lessons from 1-10 years. The main instruments represented were percussion, guitar, piano, and voice. Many students also participated in musical ensembles such as choirs or bands and most students took music appreciation classes.

Parents/guardians of all BHMA students were sent a parental consent form (see Appendix A) to sign and return (previous to the start of testing), and all participants who received parental permission and were tested in accordance with ethical guidelines established by the Department of Mental Retardation. Although every student at BHMA was asked to participate, only data on individuals with Williams syndrome were included in data analyses. All activities at BHMA were coordinated with Thomas Gajewski, Program Director of BHMA. Individuals with Williams syndrome were matched to typically developing individuals on the basis of age, emotional comprehension, and amount of musical training (see materials).

Mount Holyoke students and a few friends of students and faculty provided chronological age matches for the individuals with Williams syndrome. Musical and non-musical MHC student matches were found for each age represented in the group of individuals with Williams syndrome. If a specific age match could not be found for a particular individual with Williams syndrome, MHC students who were either a year younger or a year older than the individual would be included in analyses. Musical participants were defined as individuals who had taken more than one year of formal instrumental lessons, while participants were classified as non-musical if they had taken less than six months of instrumental lessons (musical backgrounds were self-reported). Participants who classified as musical had 3-15 years of lessons and non-musical participants had 0-6 months of lessons. Participants ranged in age from 19-27 and t-tests were run to ensure that there were no significant age differences between the individuals with Williams syndrome and each chronological age match group. There was no significant age difference found between the musical chronological age match group and the group of individuals with Williams syndrome, $t(20) = -.31$, $p > .05$ or the non-musical chronological age match group and the group of individuals with Williams syndrome, $t(20) = -.25$, $p > .05$. Participants were recruited through courses and musical organizations on campus. Twenty-two participants (20 females, 2 males) were recruited for each group: musical and non-musical (see Table 1). All chronological age match participants received either psychology research credit or candy for their participation.

The individuals with Williams syndrome were also matched by emotional comprehension based on facial expression identification accuracy (see materials). The overall accuracy of the individuals with Williams syndrome on the facial expression task was matched directly to the accuracy levels of Newman Elementary School students. Fifty-six NES students were tested in order to have many emotional comprehension scores to match to individuals with Williams syndrome. If possible, each accuracy score for a participant with Williams syndrome was matched to the exact accuracy score of both a musical and a non-musical NES participant. When necessary, a similar accuracy score (instead of an exact score) was matched to the particular individual with Williams syndrome. If there were multiple accuracy scores of the same value (within each category, musical or non-musical), the students with the most musical experience were selected for the musical match and the non-musical students would be selected randomly. This practice was used in an effort to have as wide a margin of musical experience as possible between the two emotional comprehension match groups. Any data that did not provide an emotional match for an individual with Williams syndrome was discarded and was not used the analyses or description of participants.

NES students were used as emotional matches based on findings in past research that emotional understanding in individuals with Williams syndrome is slightly lower than typically developing controls (Tager-Flusberg & Sullivan, 2000). A t-test was run to ensure that there were no significant differences between the emotional comprehension levels of the group of individuals with Williams syndrome and the musical and non-musical emotional comprehension match groups. There was no significant difference found in the facial expression overall accuracy data between the musical emotional comprehension match group and the group of individuals with Williams syndrome, $t(20) = .21$, $p > .05$ or the non-musical emotional comprehension match group and the group of individuals with Williams syndrome, $t(20) = -.42$, $p > .05$.

Students from two third grade classrooms and two fourth grade classrooms were asked to participate, in collaboration with Mr. Robert Abbey, principal of NES, and the four classroom teachers. NES students ranged in age from 8 years to 10 years and there were 22 total participants (13 female and 9 male) selected for analysis. Many students had participated in school bands or choruses and musical training ranged from 0 to 3 years (see Table 1). Musical participants were defined as having a year or more of music lessons and non-musical participants were defined as having six months or less of music lessons. All emotional comprehension match participants were enrolled in a school-wide music class in which they learned to play the recorder and studied general music principles. All emotional comprehension match participants were given a “special pencil” in appreciation for their participation.

Materials

Participants were asked to answer a short questionnaire prior to testing (see Appendix F). The questionnaire asked for each participant’s age and gender as well as information about their musical background. Specifically, participants were asked if they play a musical instrument, have taken formal music lessons (and if yes, for how long), and whether they had participated in any music classes, ensembles, or had any other relevant musical experience.

A computer program was created to display all stimuli to participants and to record responses and reaction time for each response. Three tasks were set up: facial expression photos, English sentences, and tonal sentences, each with its own set of stimuli. Black and white photos, chosen from Ekman's (1975) studies on emotion, were used to provide facial expression stimuli corresponding to happy, sad, angry, and fearful emotions (see Figure 1 for an example of each emotion and Appendix H for all facial expression stimuli). Four photos were chosen to correspond to each emotion, two female and two male faces. Each emotion was displayed with a variety of striking facial features such as a smile for happiness, a down-turned mouth for sadness, squinting eyes to show anger, and wide eyes to show fear.

Sixteen English sentences were obtained from Thompson et al. (2004) corresponding to the four emotions tested: happy, sad, angry, and fearful. Four examples of each emotion were presented. Each sentence was neutrally worded so that the emotion would only be displayed through prosodic differences, rather than semantic cues (see Appendix G). Each sentence was designed to imitate prosodic cues in spoken language based on the Name Emotional Prosody test of the Florida Affect Battery (Bowers, Blonder, & Heilman, 1991 as cited in Thompson et al.).

Similarly, 16 tonal sentences (tone sequences) were obtained from Thompson et al., four for each emotion. All tonal sentences were created by calculating the pitch and duration of each syllable of the previously described English sentences. These calculations were used to produce tonal sentences that were essentially spoken sentences with the words removed and only the tone remaining. Each sentence had specific characteristics according to its

Figure 1. Happy (top left), sad (top right), angry (bottom left), and fearful (bottom right) stimuli in the facial expression task (Ekman, 1975).

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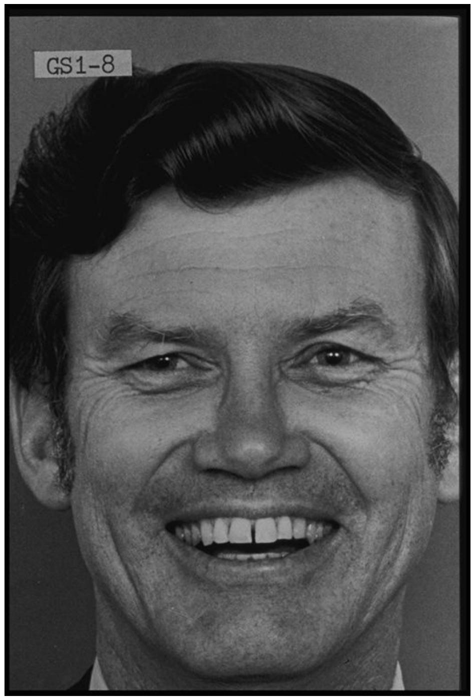
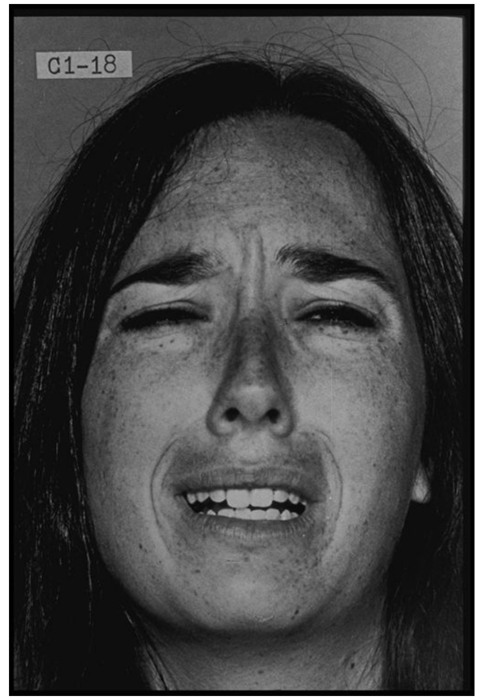
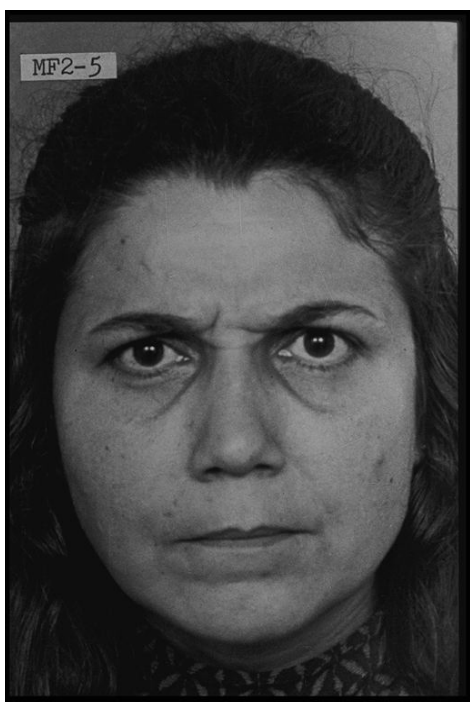
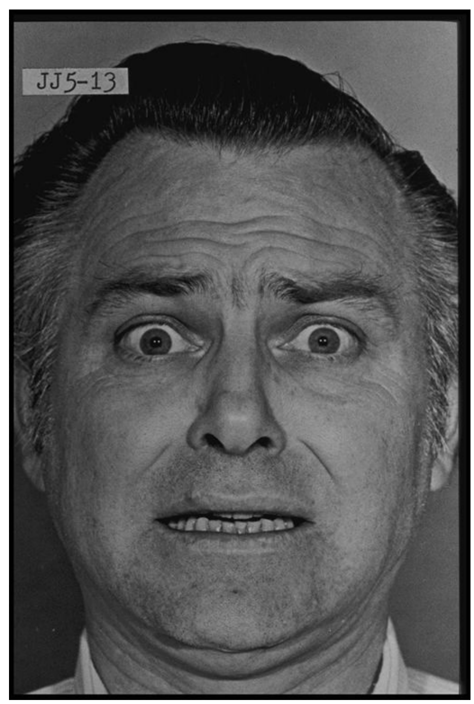

GS1-8

C1-18

MF2-5

JJ5-13

corresponding emotion, i.e. a high and wide pitch range to display happiness in contrast to a low and narrow pitch range to display sadness.

Procedure

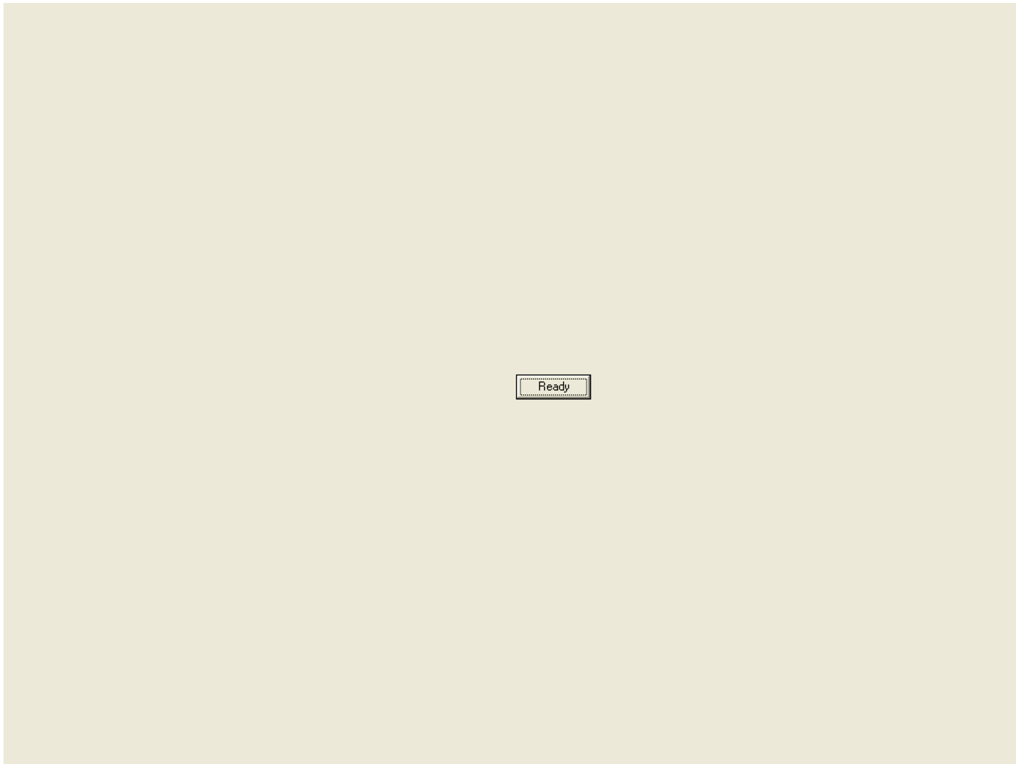
All participants were informed of their rights according to the American Psychological Association guidelines, with emphasis on the right to terminate participation at any time. Each participant was also asked to provide verbal or written consent before participating in any testing. Individuals with Williams syndrome and the emotional age match groups were required to have parent/guardian permission prior to testing (see Appendix A and Appendix B). The emotional match groups only provided verbal consent at testing because of procured parental permission and ethical guidelines. Individuals with Williams syndrome, in addition to parental permission, also provided written consent, researcher consent, and witness consent based on the Department of Mental Retardation guidelines. A separate consent form and/or parent permission form was created for each demographic group following the Department of Mental Retardation and Mount Holyoke College Institutional Review board guidelines (See Appendix C and Appendix D).

After providing consent, participants responded to a short verbal questionnaire, as described earlier. Participants were shown to a computer and told to complete each task as accurately and as quickly as possible without losing accuracy. All participants were encouraged to ask questions, and explanations differed slightly depending on the age of each participant. For example, emotional comprehension participants were reminded that “fearful” meant “afraid”; chronological age match participants were not.

A computer program was created to present all stimuli to each participant. The computer program was designed to randomize the order of the stimuli within each task, and the experimenter randomized the order of the tasks. Participants were first presented with a rectangular “Ready” button in the center of the screen (see Figure 2). The “Ready” button activated each set of stimuli with the click of the mouse. After each stimulus (facial, English, or tonal) was presented, the participant was given the choice of four emotion buttons: happy, sad, angry, and fearful (see Figures 2 and 3). All tasks tested these same four emotions. The emotion buttons were designed to be equidistant from the ready button in order to minimize response time differences across emotions (participants were not instructed of this). Response time was measured after the presentation of each stimulus. The timer started at the beginning of the presentation of a facial stimulus or at the end of the English or tonal sentence. The timer stopped as soon as an emotion button was clicked with the mouse. The response was also recorded electronically for each stimulus.

Participants completed the facial expression task to examine emotional understanding and provide a simple accuracy task to determine emotional comprehension matches. An example of the computer screen displays for this task is displayed in Figure 3. Participants determined the emotion displayed in each of the sixteen black and white photos presented (see materials). Participants were

Figure 2. Computer screen display before the presentation of the stimulus (top) and at the completion of the stimulus (bottom) in the English and tonal sentence tasks.


Ready

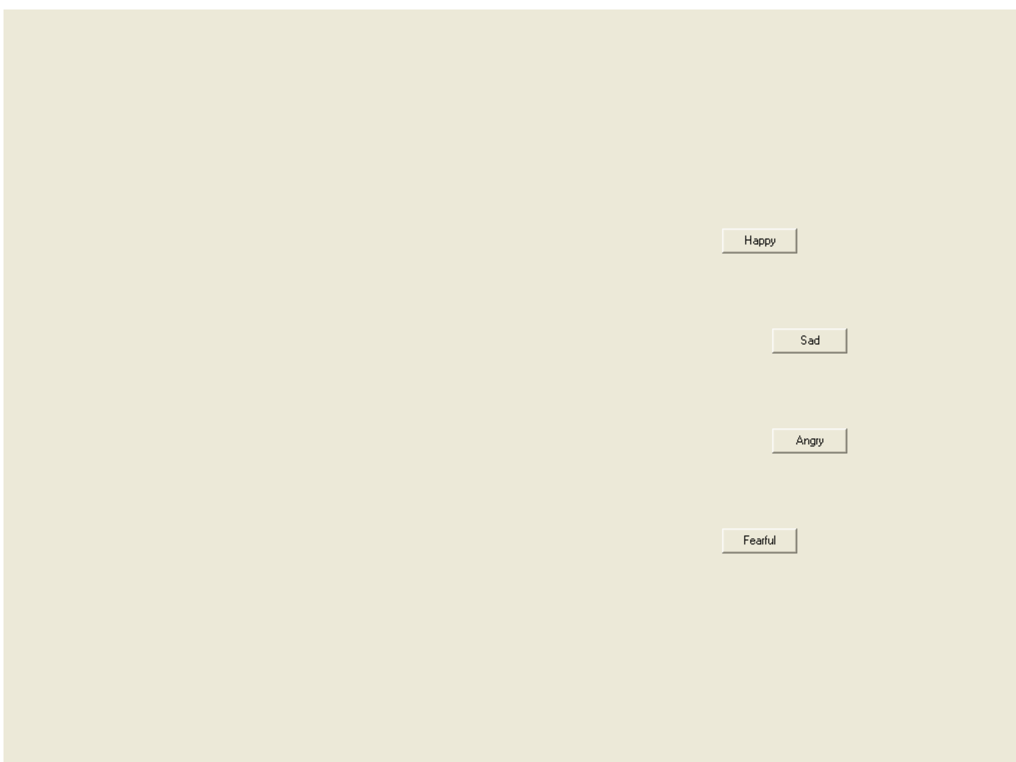
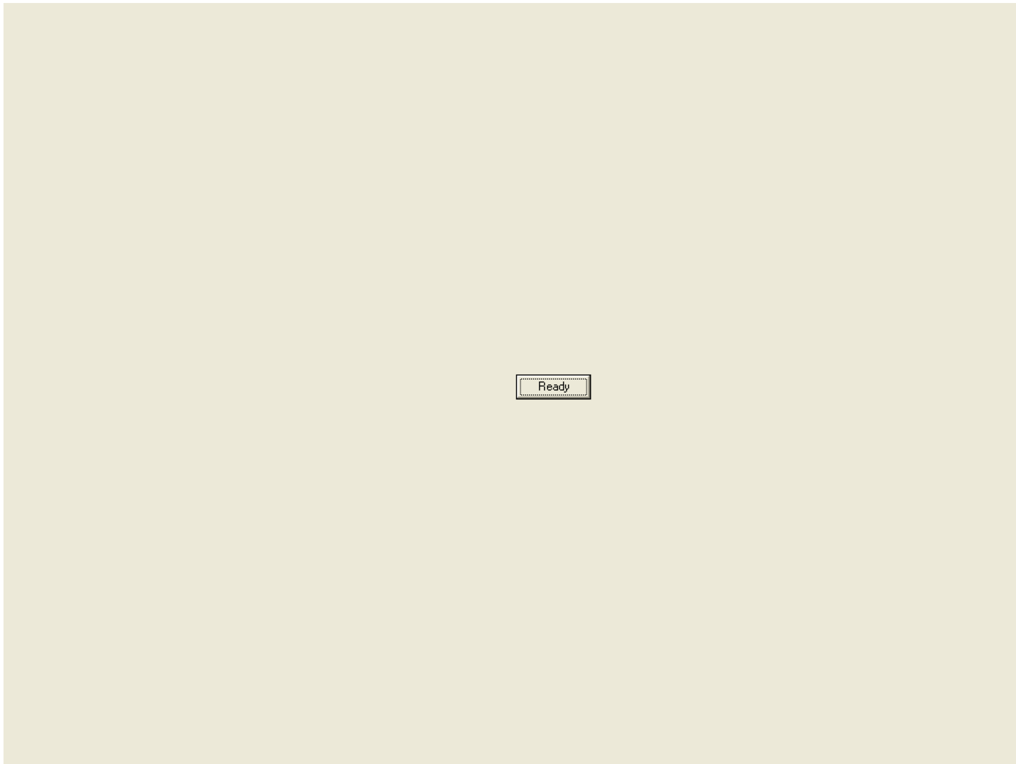
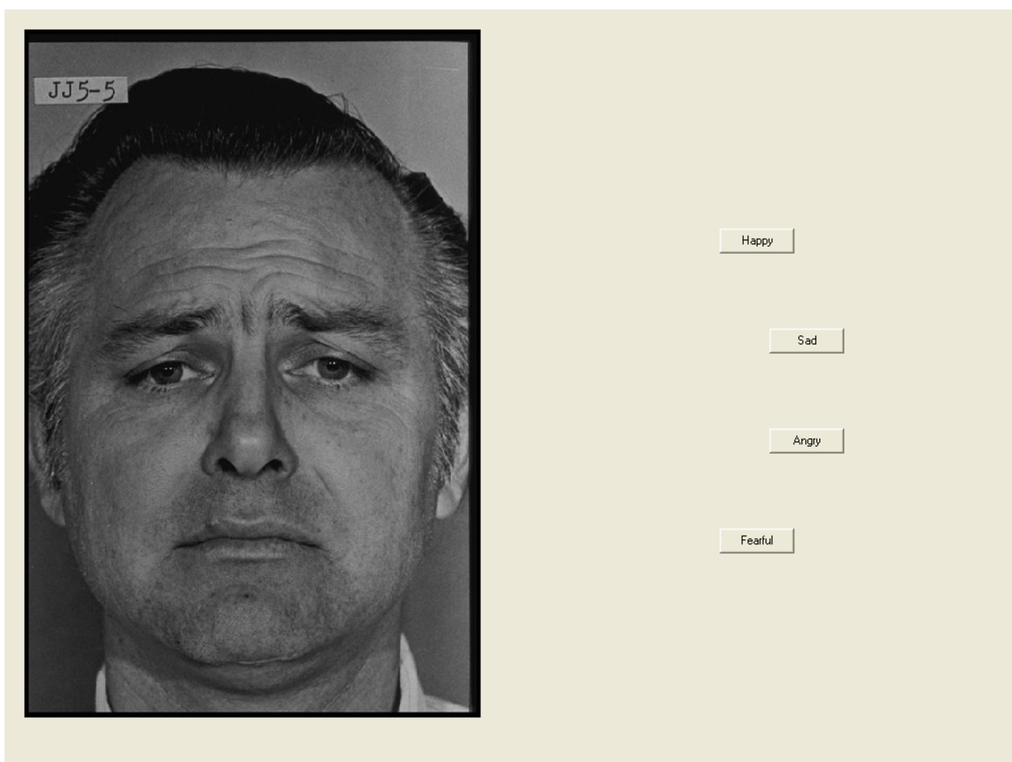

Happy
Sad
Angry
Fearful

Figure 3. Computer screen display before the presentation of the stimulus (top) and at the completion of the stimulus (bottom) in the facial expression task.


Ready


JJ5-5
Happy
Sad
Angry
Fearful

also presented with 16 English sentences, conveying each of the four emotions. Participants were instructed to click on the button that best described the tone of each sentence. Each participant was also reminded that the words of the sentences were not important (sentences were neutrally worded), but that he or she should listen for the tone present in each. Headphones were used during the entire task to minimize outside distractions.

The third task consisted of tonal sentences (see materials), and participants were instructed to think of the stimuli as “sentences with the words taken out” to ease understanding. Participants were asked to choose the emotion that best corresponded to each tonal sentence. Headphones were also used in this task to minimize distractions.

After all testing, participants were debriefed. Emotional comprehension match participants and individuals with Williams syndrome were read the debriefing form (see Appendix E) while chronological age match participants read the debriefing form individually. Participants were given an opportunity to ask questions and were given contact information to allow for questions after the completion of the study.

RESULTS

All individual data were coded in order to provide mean accuracy and mean reaction time scores for each of the four emotions (happy, sad, angry and fearful). Each participant had eight possible scores for each task: accuracy scores specific to each of the four emotions and reaction time scores for each correctly identified emotion. Ten percent of reaction time scores were removed from the facial expression data and 21.14 percent of reaction time scores were removed from the English sentence data because they corresponded with inaccurately identified emotions. Mean accuracy scores and reaction times for each task are provided in Figures 4-18.

An outlier analysis was performed on all reaction time scores for each of the five groups, eliminating any numbers that were two standard deviations above the mean for the task and group. In the facial expression task, 4.17 percent of the reaction time data was removed due to the outlier analysis. In the English sentence task, 3.31 percent of the reaction data was removed due to the outlier analysis.

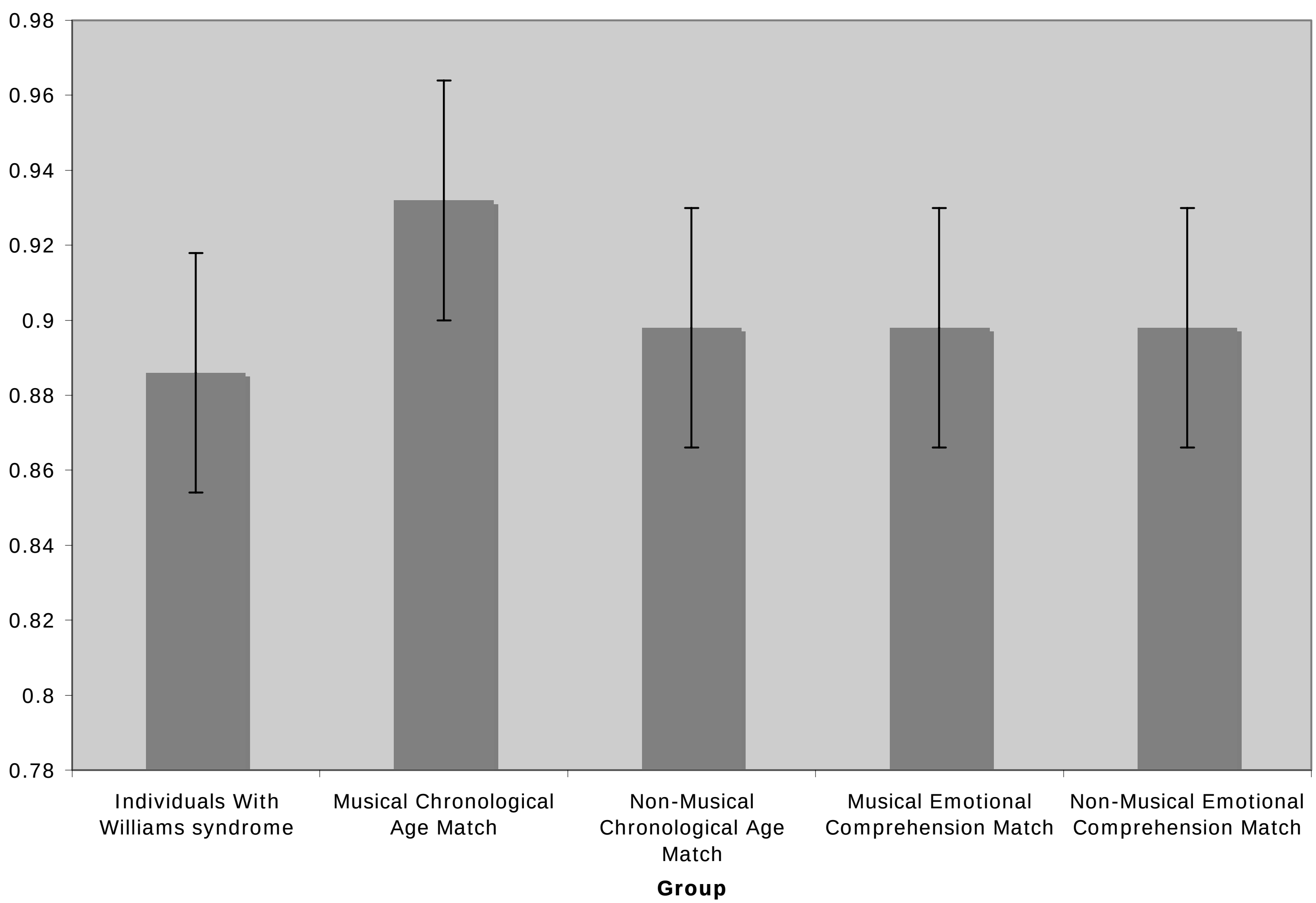
Mean reaction times for a particular emotion and group were also calculated and when necessary, replaced a missing mean reaction time data point. A missing data point would occur when a participant inaccurately identified all four examples of a particular emotion on one of the tasks and therefore all the reaction time data for that particular emotion was discarded. The replacement means for a missing data point were based on its specific emotion and group. In the facial expression data, 1.36 percent of mean reaction times were replaced and 5.91 mean reaction times were replaced in the English sentence data.

Emotion response patterns were analyzed separately for each task (facial expression, English sentence, or tonal sentence) with a 5 (group) x 4 (emotion) x 6 (order) mixed-design ANOVA with group (musical individuals with Williams syndrome, musical chronological age match group, non-musical chronological age match group, musical emotional comprehension match group, and non-musical emotional comprehension group) and stimulus order (EFT, ETF, FET, FTE, TEF, TFE) as between-subjects variables and emotion (Happy, Sad, Angry, and Fearful) as the within-subjects variable. For each analysis stimulus order was taken out if it was not found to be significant, and the data were analyzed with a 5 (group) x 4 (emotion) mixed-design ANOVA with emotion as the within-subjects variable and group as the between-subjects variable. Stimulus order was not found to be significant in any task's accuracy or reaction time analysis and therefore was not a variable in any of the final analyses.

Facial Expression Task

Mean Accuracy Analysis. No significant differences were found for the group variable, $F(4, 50) = .29$, $MSE = .05$, $p > .05$. See Figure 4 for the means associated with this analysis.

Figure 4. Mean accuracy scores for group in the facial expression task. Vertical lines represent standard error for means.


0.98
0.96
0.94
0.92
0.9
0.88
0.86
0.84
0.82
0.8
0.78
Individuals With Williams syndrome
Musical Chronological Age Match
Non-Musical Chronological Age Match
Musical Emotional Comprehension Match
Non-Musical Emotional Comprehension Match
Group

As predicted, accuracy scores varied for the different emotions, $F(3, 150) = 10.51$, $MSE = .03$, $p < .01$. Post-hoc analyses indicated that happiness ($M = .99$) was significantly better than all other emotions (all *p*s < .01), and sadness ($M = .91$) and fear (M = .90) were significantly better than anger (M = .81), all *p*s < .05. However, there was no significant difference between sadness and fear (all *p*s > .05). See Figure 5.

There was also a significant interaction between emotion and group, $F(12, 150) = 1.94$, $MSE = .03$, $p < .05$. Post-hoc analyses indicated that there were no significant differences of emotion within the group of individuals with Williams syndrome or the musical emotional comprehension group (all *p*s > .05). However, a significant difference was found in the musical chronological age match group ($p < .01$), with anger (M = .77) displaying significantly worse accuracy levels than happiness (M = 1.00), sadness (M = .98), and fear (M = .98), (all *p*s < .05). A significant difference was also found in the non-musical chronological age match group ($p < .01$) with anger significantly worse (M = .73) than fear (M = .96) or happiness (M = 1.00) and happiness significantly better than sadness (M = .91) (all *p*s < .05). Lastly, a significant difference was found in the non-musical emotional comprehension group ($p < .01$), with happiness significantly more accurate (M = 1.00) than fear (M = .84) and anger (M = .78), and sadness (M = .955) significantly more accurate than anger (all *p*s < .05). See Figure 6 for all means associated with this analysis.

Figure 5. Mean accuracy scores for emotion in the facial expression task. Vertical lines represent standard error for means.

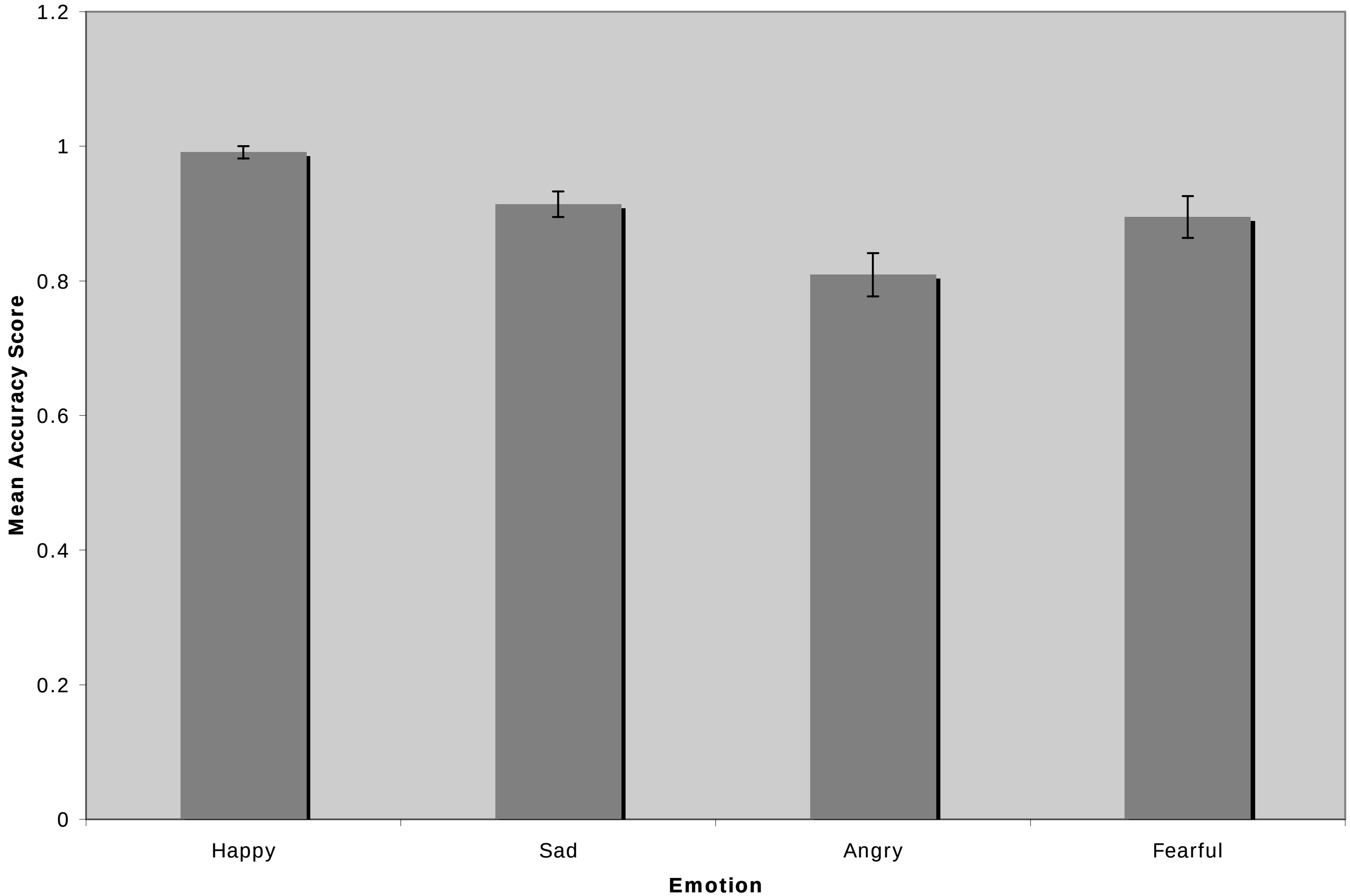
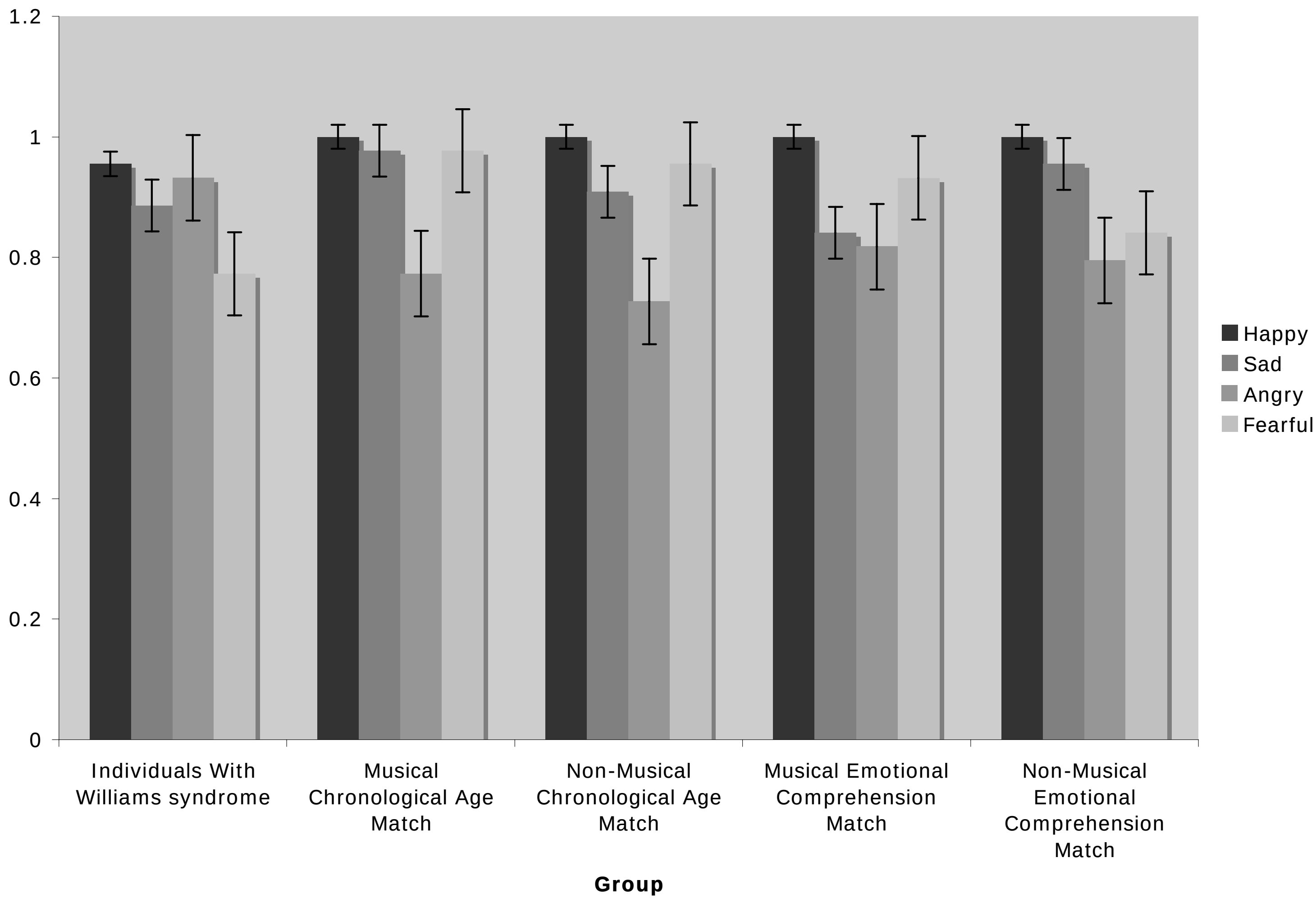

1.2
1
0.8
0.6
0.4
0.2
0
Mean Accuracy Score
Happy
Sad
Angry
Fearful
Emotion

Figure 6. Mean accuracy scores for group by emotion interaction in the facial expression task. Vertical lines represent standard error for means.


1.2
1
0.8
0.6
0.4
0.2
0
Individuals With Williams syndrome
Musical Chronological Age Match
Non-Musical Chronological Age Match
Musical Emotional Comprehension Match
Non-Musical Emotional Comprehension Match
Group
Happy
Sad
Angry
Fearful

In summary, the analyses showed a significant main effect of emotion, as well as a significant interaction between the two variables. It was not surprising to find no significant differences between the emotional comprehension match groups and the group of individuals with Williams syndrome because the three groups were matched on accuracy for this task. It was surprising, however, to find that the emotional comprehension match groups performed as well as the chronological age match groups. Perhaps even more interesting is that the individuals with Williams syndrome performed as well as the chronological age match groups. The emotional comprehension analyses showed significant differences that were somewhat consistent with predictions (happiness resulting in higher accuracy levels than all other emotions and sadness more accurate than anger). Fear performed better than expected, displaying higher accuracy levels than anger.

The significant interaction between emotion and group was also surprising, and it is difficult to explain why there was no difference of emotion in the musical emotional comprehension match group and the group of individuals with Williams syndrome, but differences in accuracy levels were found in the musical and non-musical chronological age match groups and the non-musical emotional comprehension match group. It is noted, however, that the musical emotional comprehension match group only showed a significantly worse identification of anger, while the two non-musical groups found more complex differences. This may indicate that individuals with musical training are able to interpret the four different emotions more equally than the non-musical groups, who seem to have a greater range of accuracy levels across the four emotions.

Mean Reaction Time Analysis. All reaction times were measured in seconds. There was a significant main effect for group, $F(4, 50) = 13.84$, $MSE = 8.08$, $p < .01$. Post-hoc analyses indicated that the musical chronological age match group ($M = 1.80$) and the non-musical chronological age match group (M = 2.00) were significantly faster than the musical emotional age match group (M = 4.67), the non-musical emotional age match group (M = 5.02), and the group of individuals with Williams syndrome (M = 4.71), all *p*s < .01. There were no significant differences between the musical and non-musical emotional match groups or the group of individuals with Williams syndrome. See Figure 7 for all means associated with this analysis.

A significant main effect was also found for emotion, $F(3, 150) = 5.36$, $MSE = 1.29$, $p < .01$. Happiness (M = 3.19) was significantly faster than all other emotions (all *p*s < .01). Sadness (M = 3.53) was also significantly faster than anger (M = 3.89), ($p < .05$). There was no significant difference between fear (M = 3.96) and sadness or anger ($p > .05$). See Figure 8 for the means associated with this analysis. There was no significant interaction between emotion and group, $F(12, 150) = 1.14$, MSE = 1.29, $p > .05$ (see Figure 9).

The findings in this task's mean reaction times for group were not entirely consistent with predictions. As predicted, the chronological age match groups performed significantly faster than all other groups, however, the non-musical

Figure 7. Mean reaction time for group in the facial expression task. Vertical lines represent standard error for means.

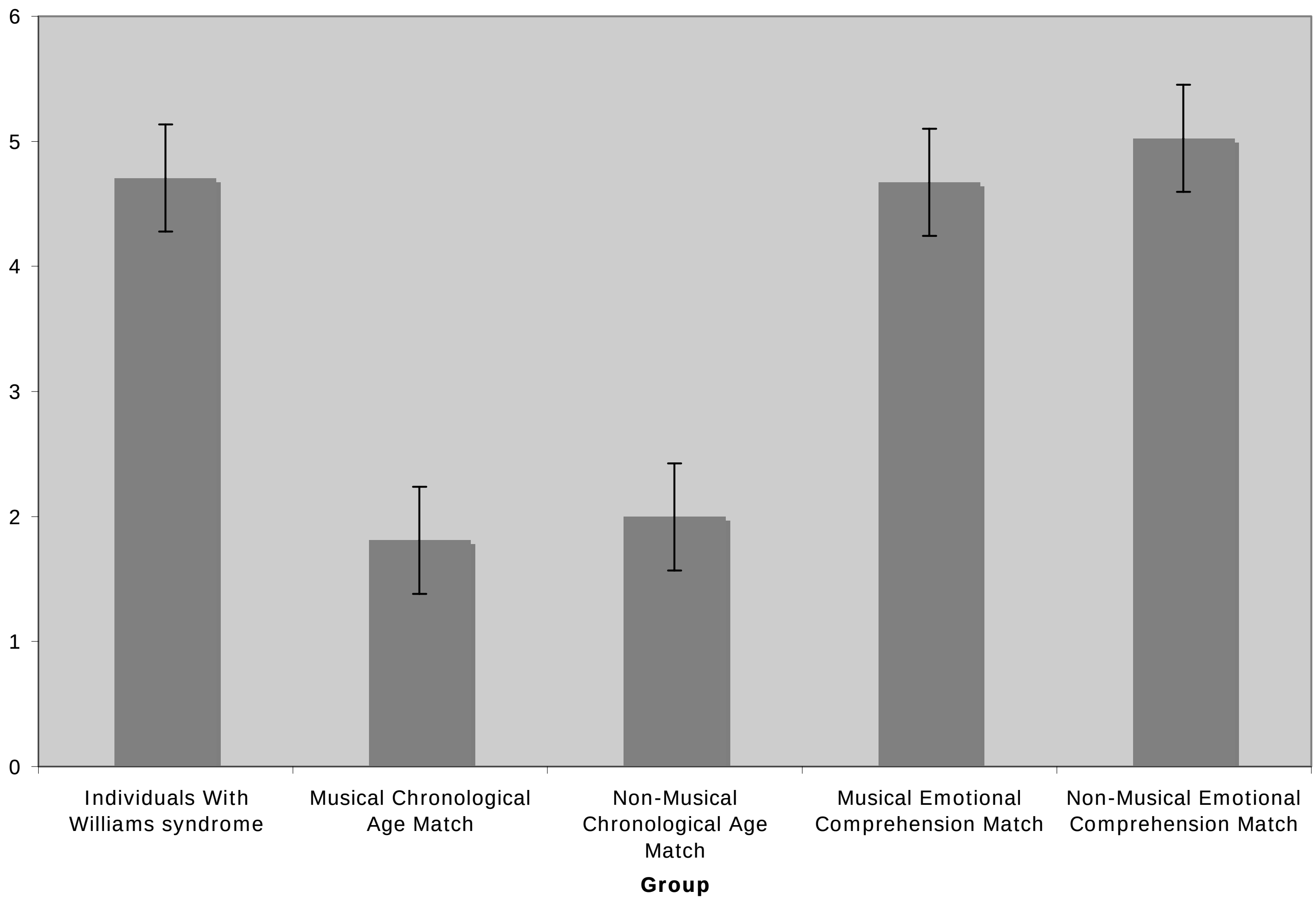

6
5
4
3
2
1
0
Individuals With Williams syndrome
Musical Chronological Age Match
Non-Musical Chronological Age Match
Musical Emotional Comprehension Match
Non-Musical Emotional Comprehension Match
Group

Figure 8. Mean reaction time for emotion in the facial expression task. Vertical lines represent standard error for means.

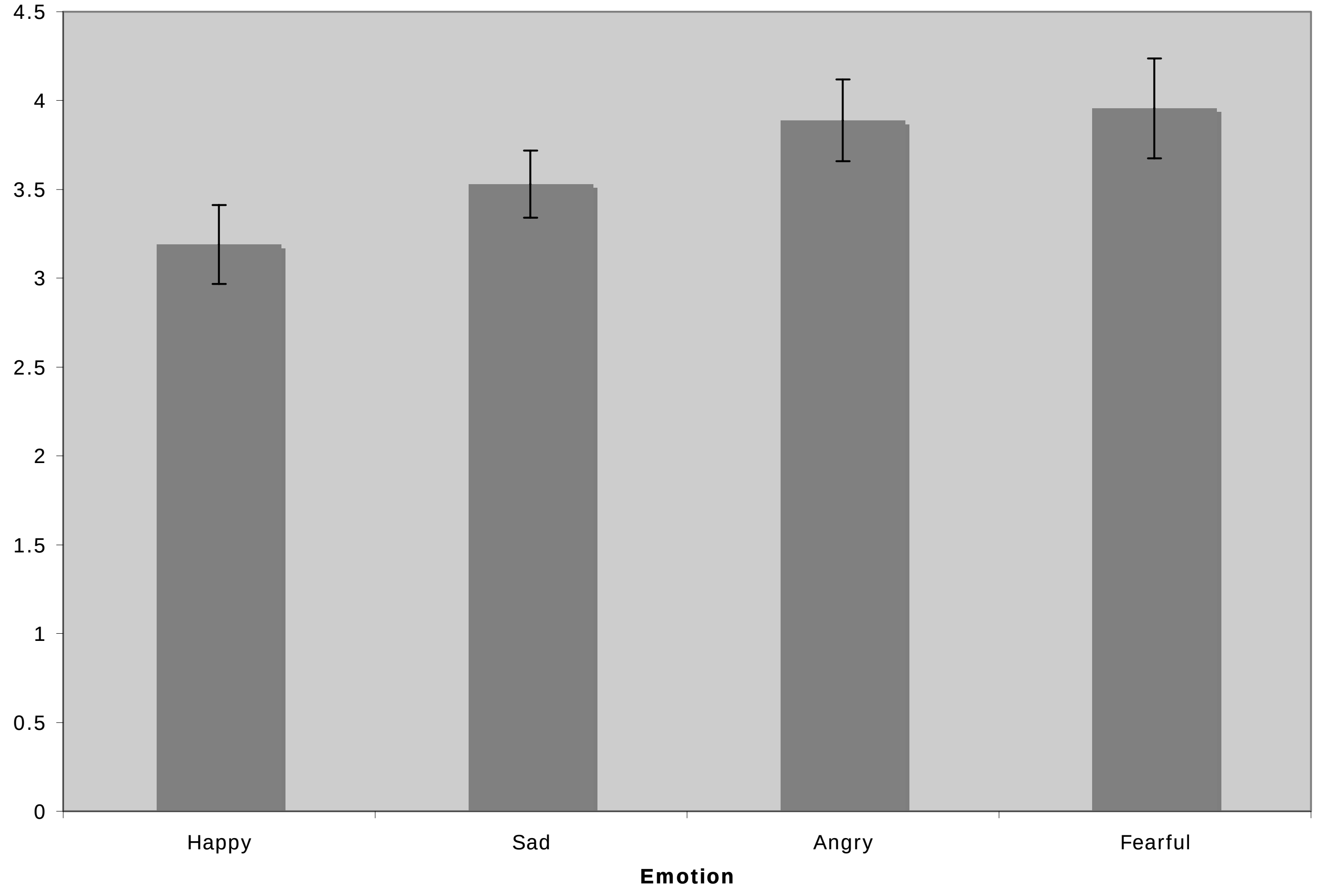
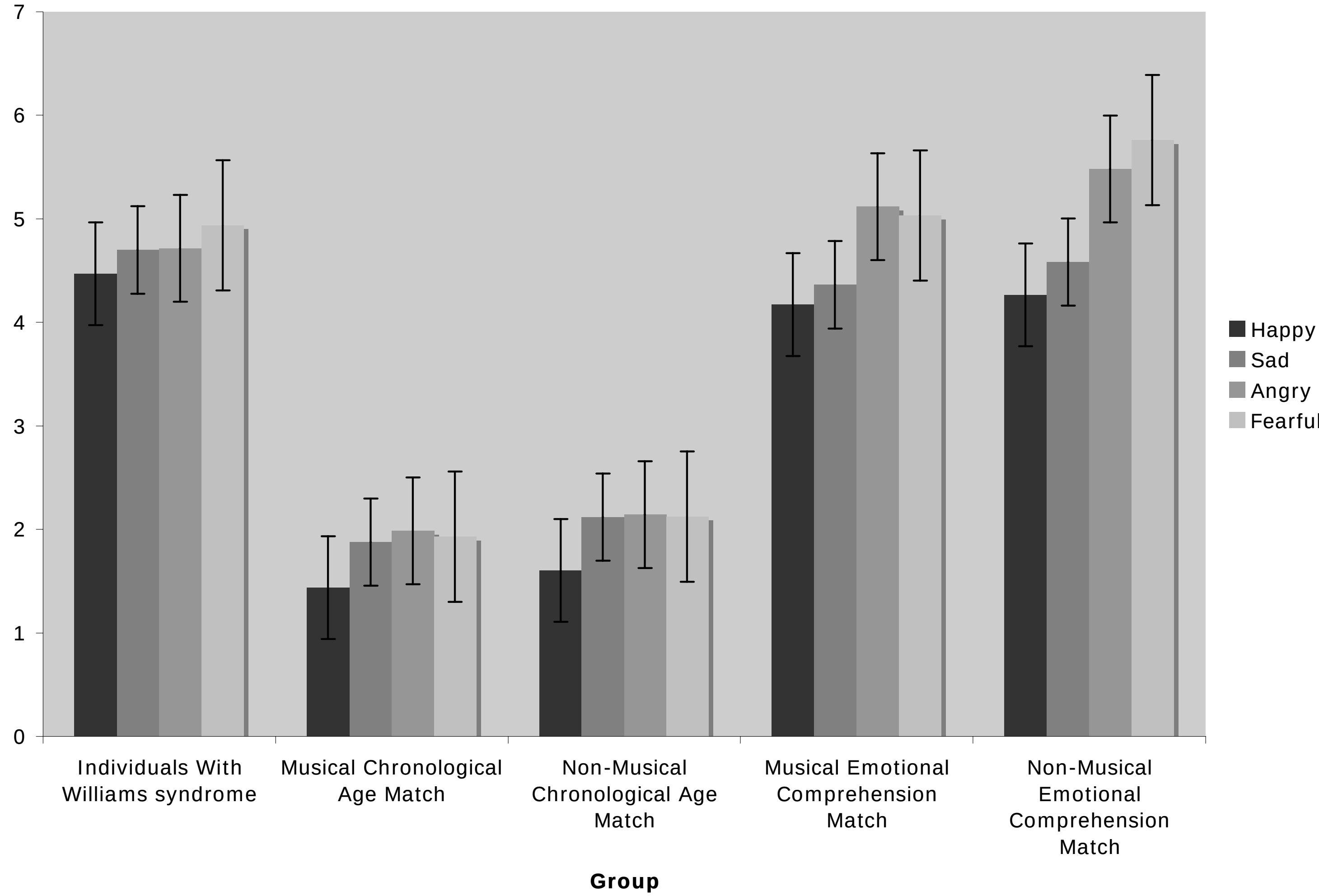

4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Happy
Sad
Angry
Fearful
Emotion

Figure 9. Mean reaction time for group by emotion interaction in the facial expression task. Vertical lines represent standard error for means.



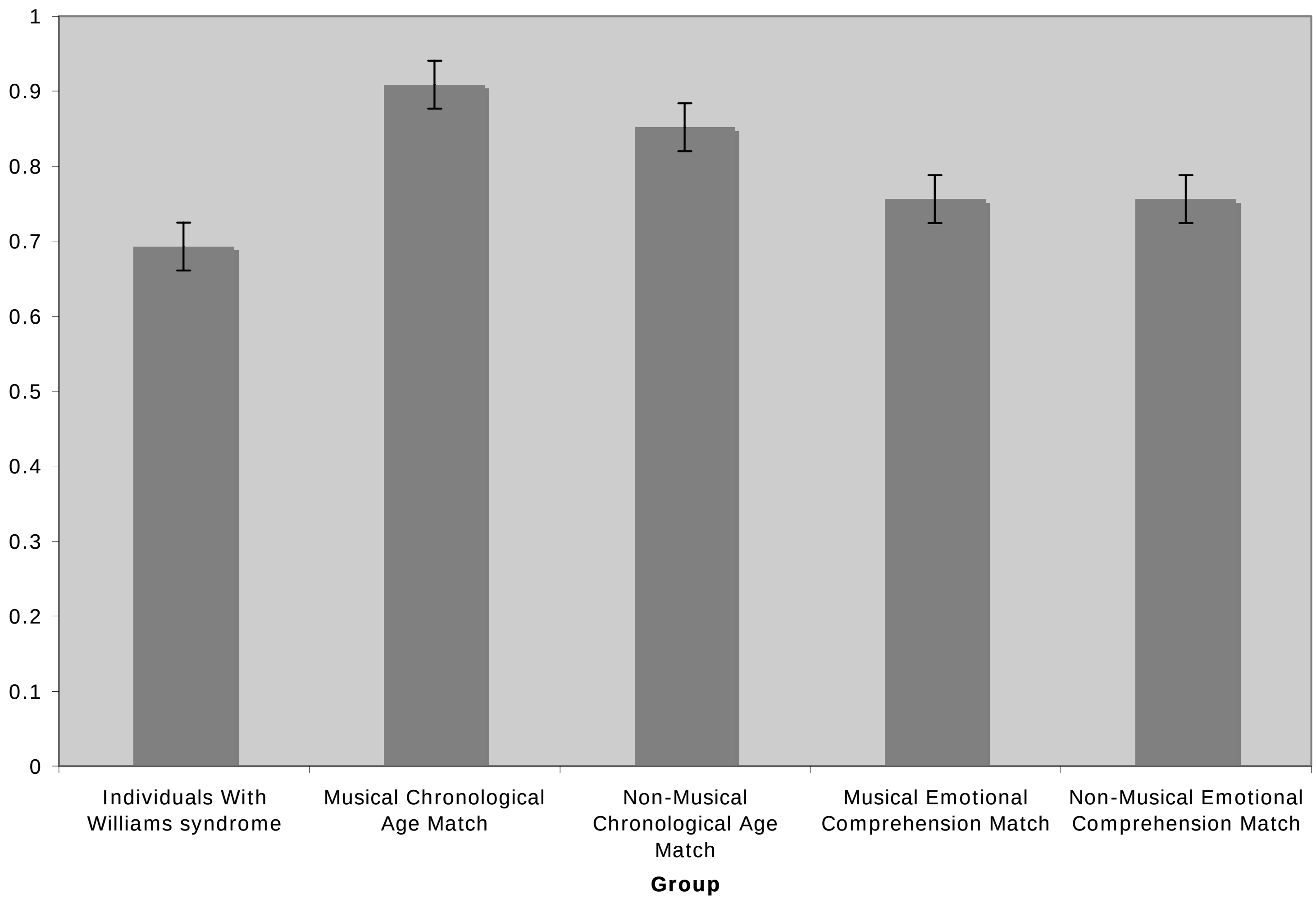
7
6
5
4
3
2
1
0
Individuals With Williams syndrome
Musical Chronological Age Match
Non-Musical Chronological Age Match
Musical Emotional Comprehension Match
Non-Musical Emotional Comprehension Match
Group
Happy
Sad
Angry
Fearful

chronological age match group performed equally as well. There was also no significant difference between the emotional comprehension match groups and the individuals with Williams syndrome, which may be because this task only tested emotional comprehension. I expected to find a significant difference between the musical and non-musical groups in the English and tonal sentence tasks because of the introduction of prosody, the musical aspect of speech. The emotion data was again consistent with hypotheses, with happiness once again being identified more quickly than all other emotions and sadness being identified more quickly than anger.

English Sentence Task

Mean Accuracy Analysis. The English sentence analyses also showed a significant effect of group, $F(4, 50) = 7.48$, $MSE = .04$, $p < .01$. As indicated by post-hoc analyses, the musical chronological age match group (M = .91) and non-musical chronological age match group (M = .85) performed significantly better than the group of individuals with Williams syndrome (M = .69), as well as the musical emotional match group (M= .76) and the non-musical emotional match groups (M = .76), all *p*s < .05. There was no significant difference between the group of individuals with Williams syndrome and the musical and non-musical emotional comprehension groups or between the two emotional comprehension groups (all *p*s > .05). There was also no significant difference between the musical and non-musical chronological age match groups. See Figure 10 for all means associated with this analysis.

Figure 10. Means accuracy scores for group in the English sentence task. Vertical lines represent standard error for means.



1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Individuals With Williams syndrome
Musical Chronological Age Match
Non-Musical Chronological Age Match
Musical Emotional Comprehension Match
Non-Musical Emotional Comprehension Match
Group

A significant main effect of emotion was found across accuracy scores, $F(3, 150) = 68.89$, $MSE = .04$, $p < .01$. Similar to the facial expression task, happiness was significantly better ($M = .98$) than all other emotions (all ps < .01). Sadness ($M = .88$) was significantly better than fear ($M = .47$), $p < .01$. Fear was also significantly worse than anger ($M = .85$), $p < .01$. There was no significant difference between anger and sadness (p > .05). See Figure 11 for all means associated with this analysis. There was no significant interaction between emotion and group, $F(12, 150) = 1.32$, $MSE = .04$, p > .05 (see Figure 12).

To review, I found a significant main effect of group and a significant main effect of emotion. In the group data, it was surprising that both the musical and non-musical chronological age match groups outperformed all other groups. I expected the musical groups, particularly the group with Williams syndrome, to perform better on this task than the non-musical groups. It is interesting that the group of individuals with Williams syndrome showed lower accuracy scores than the non-musical chronological age match group and equal accuracy scores to the non-musical emotional comprehension match group. The main effect of emotion followed predictions, with happiness and sadness providing the highest accuracy scores.

Mean Reaction Time Analysis. A significant main effect was found for group in the analyses of the mean reaction times, $F(4, 50) = 11.94$, $MSE = 1.56$, $p < .01$. The musical chronological age match ($M = .95$) and non-musical chronological age match (M = 1.05) groups were found to perform significantly

Figure 11. Mean accuracy scores for emotion in the English sentence task.

Vertical lines represent standard error for means.

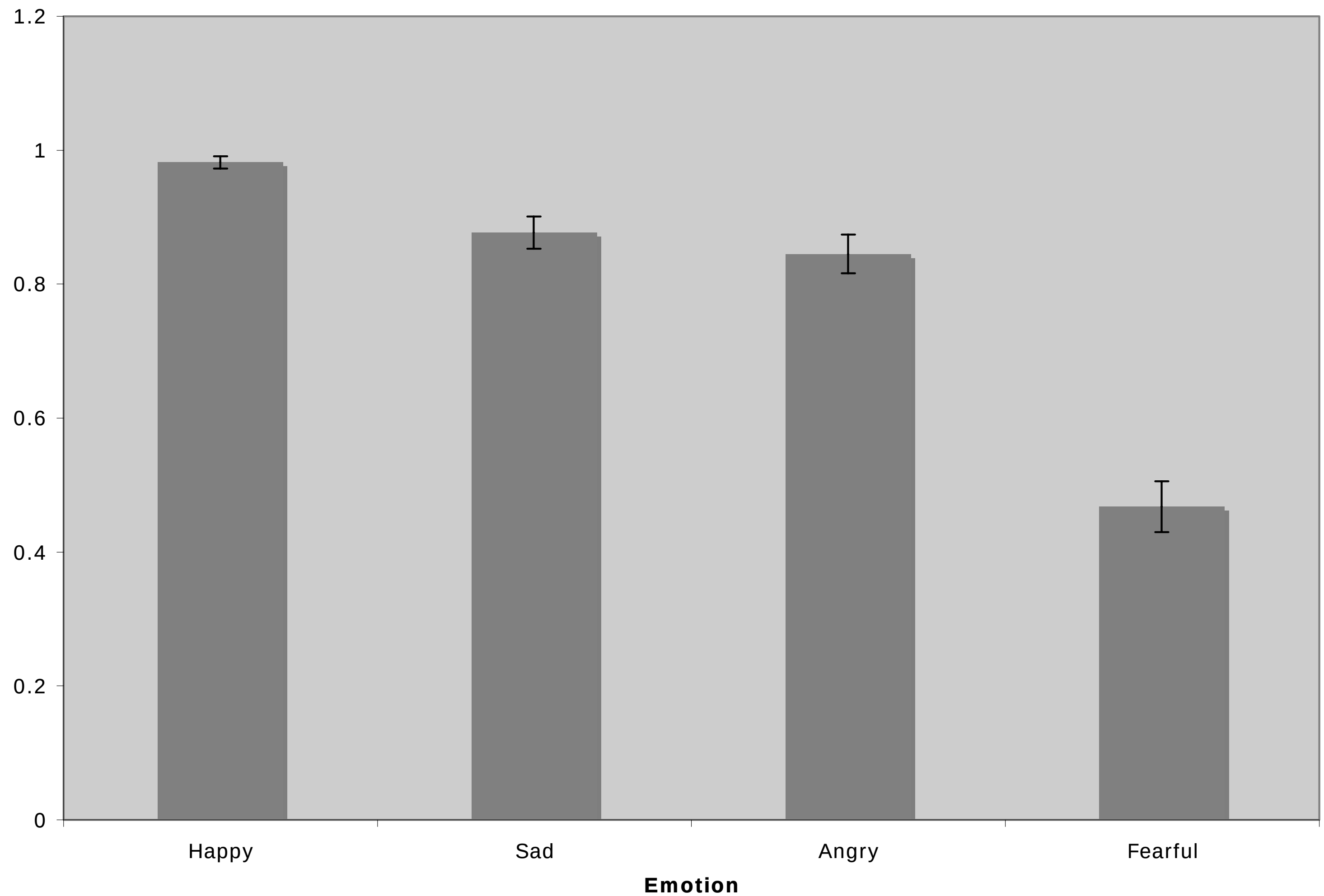
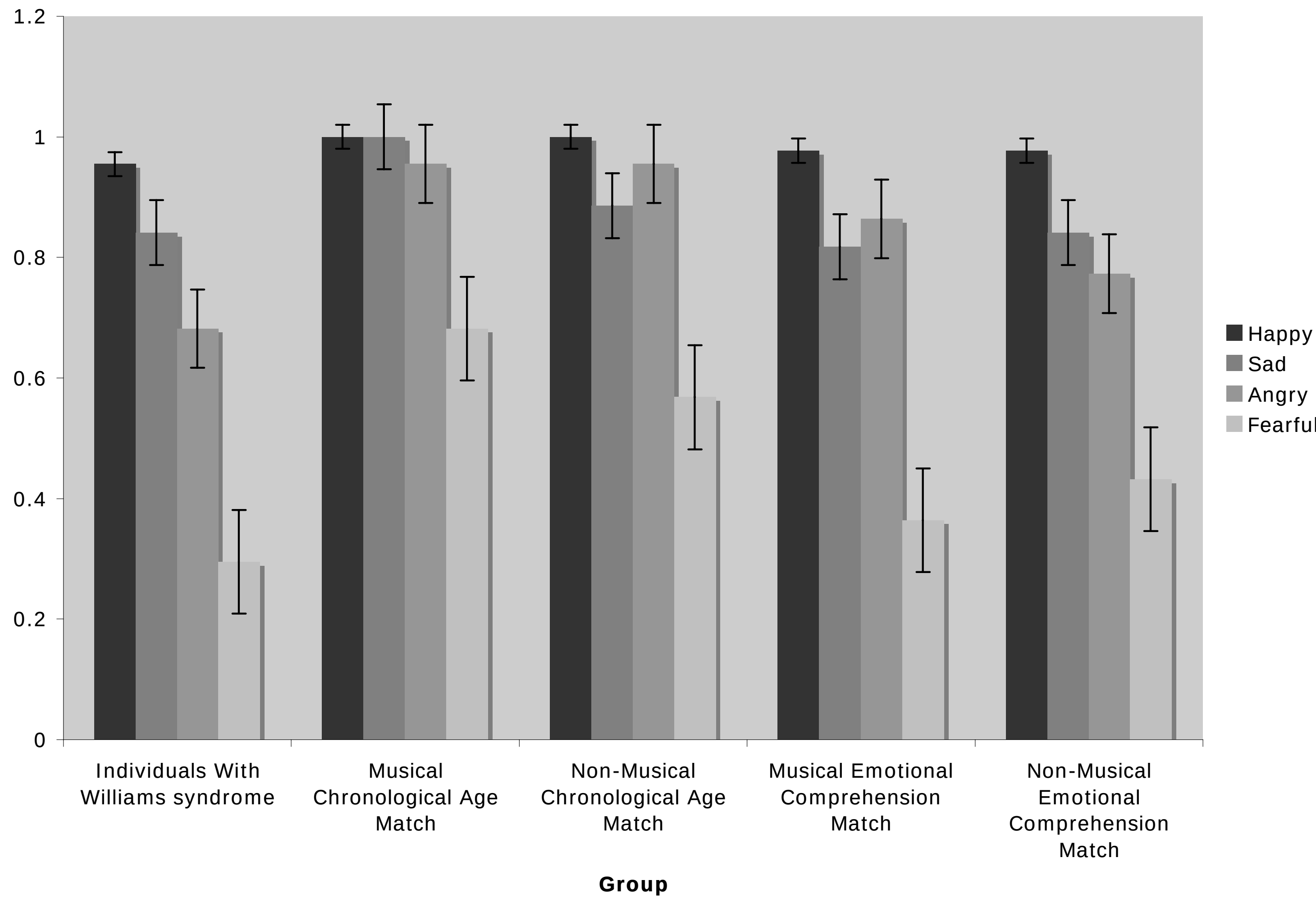

1.2
1
0.8
0.6
0.4
0.2
0
Happy
Sad
Angry
Fearful
Emotion

Figure 12. Mean accuracy scores for group by emotion interaction in the English sentence task. Vertical lines represent standard error for means.



1.2
1
0.8
0.6
0.4
0.2
0
Happy
Sad
Angry
Fearful
Individuals With Williams syndrome
Musical Chronological Age Match
Non-Musical Chronological Age Match
Musical Emotional Comprehension Match
Non-Musical Emotional Comprehension Match
Group

faster than the group of individuals with Williams syndrome (*M* = 1.95), the musical emotional comprehension match group (M = 2.19) and the non-musical emotional comprehension match group (*M* = 2.33), all *p*s < .05. See Figure 13 for all means associated with this analysis.

A significant main effect of emotion was also found, $F(3.\ 150) = 2.11$, $MSE = .30$, $p < .01$. Post-hoc analyses indicated that happiness (M = 1.51), sadness (M = 1.66), and anger (M = 1.65) were significantly faster than fear (M = 1.97), all *p*s < .05. No other emotions were significantly different from one another. See Figure 14 for all means associated with this analysis. There was no significant interaction found between emotion and group, $F(12, 150) = .76$, $MSE = .30$, $p > .05$. See Figure 15 for all means associated with this analysis.

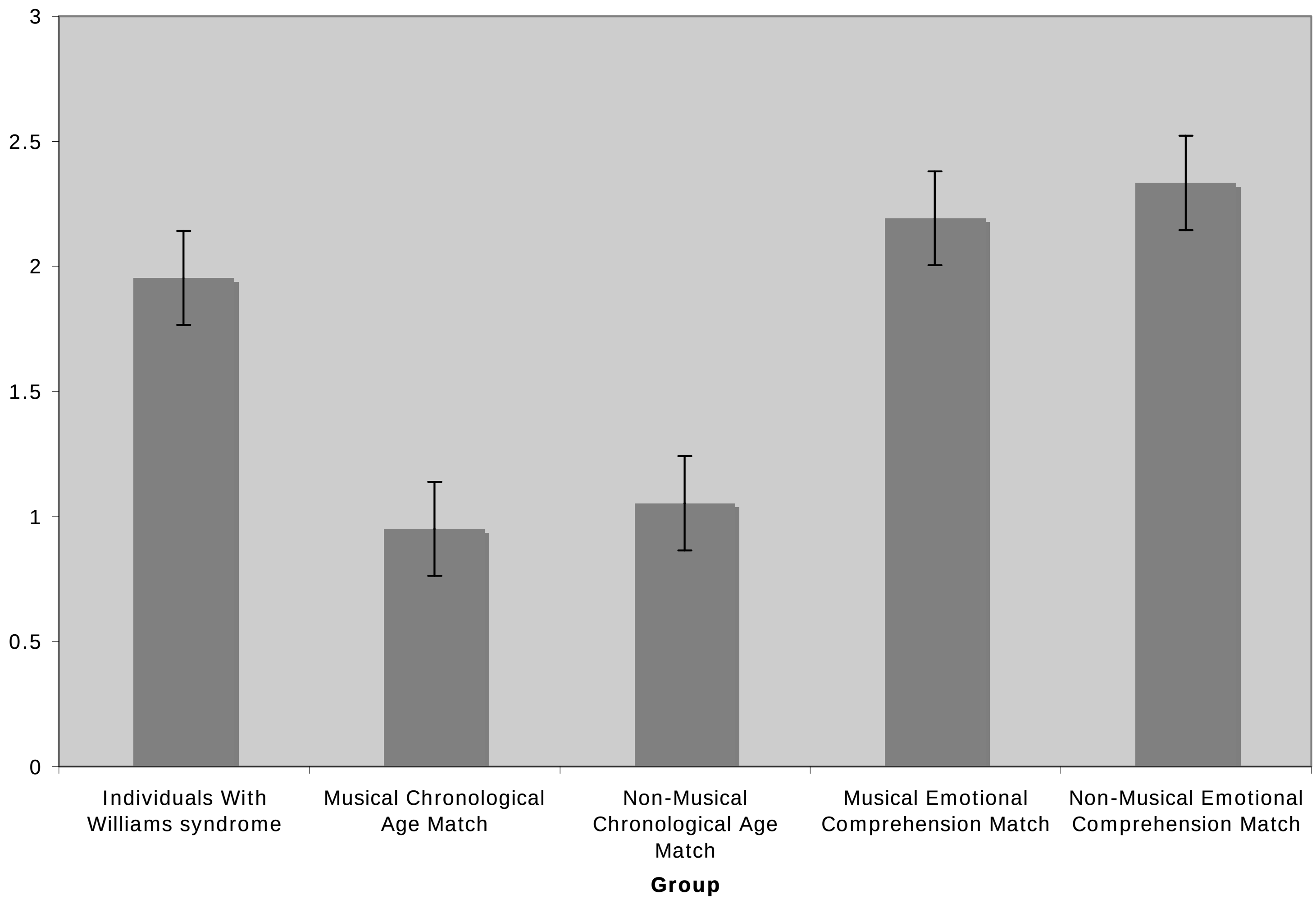
The group means were not consistent with predictions, and no effect of music was found to be significant in this task. This group finding was surprising because of its inconsistency with hypotheses and past research. However, consistent with the emotion hypotheses, fear performed significantly worse than other emotions, and happiness displayed the fastest mean reaction time.

Tonal Sentence Task

Mean Accuracy Analysis. There was no significant main effect found for group in this task, $F(4, 50) = .83$, $MSE = .05$, $p > .05$ (see Figure 16).

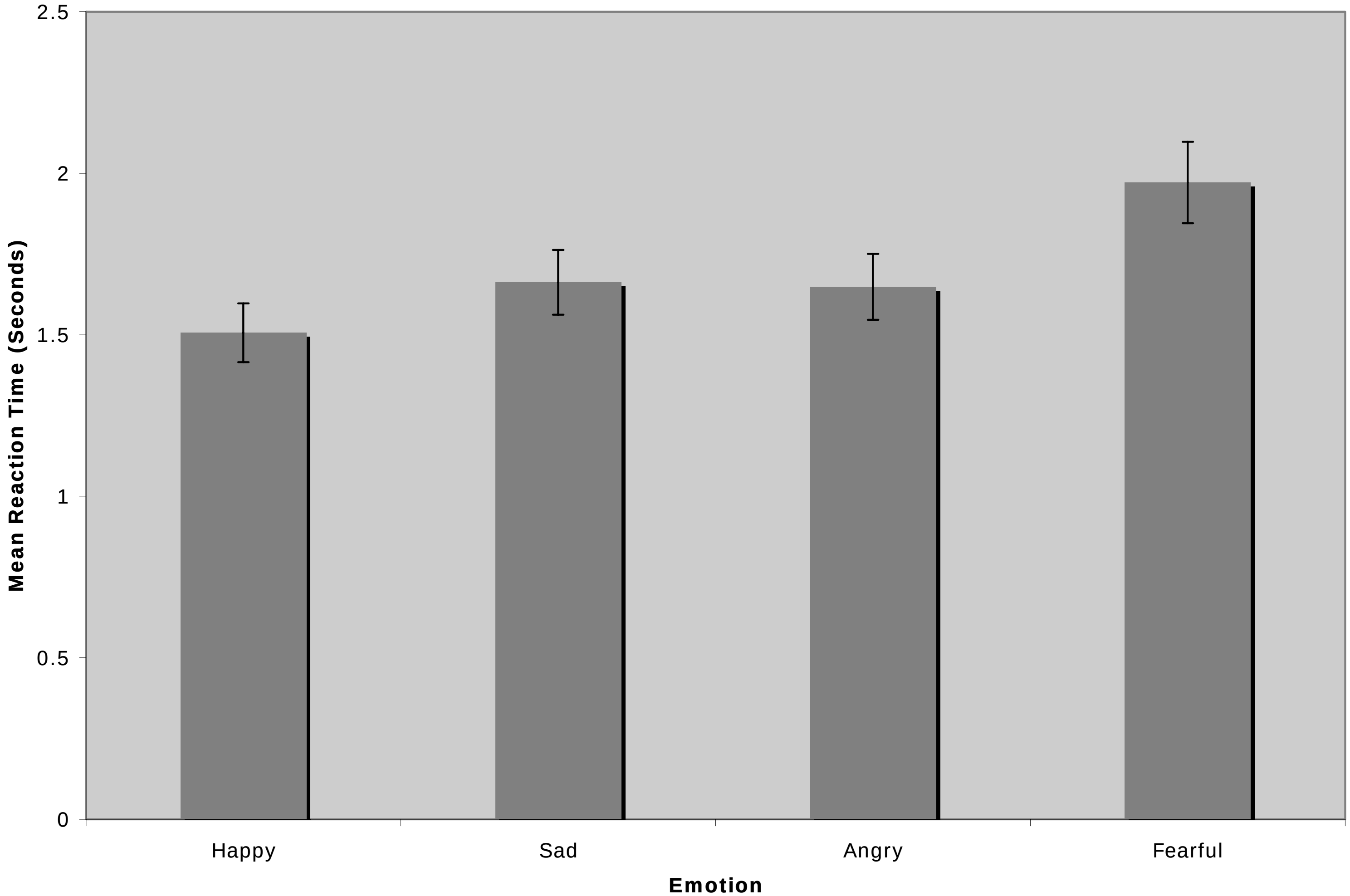
A significant main effect of emotion was found in this task, $F(3, 150) = 20.81$, $MSE = .06$, $p < .01$. Happiness (M = .50) and sadness (M = .47) were most

Figure 13. Mean reaction time for group in the English sentence task. Vertical lines represent standard error for means.



3
2.5
2
1.5
1
0.5
0
Individuals With Williams syndrome
Musical Chronological Age Match
Non-Musical Chronological Age Match
Musical Emotional Comprehension Match
Non-Musical Emotional Comprehension Match
Group

Figure 14. Mean reaction time for emotion in the English sentence task. Vertical lines represent standard error for means.



2.5
2
1.5
1
0.5
0
Mean Reaction Time (Seconds)
Happy
Sad
Angry
Fearful
Emotion

Figure 15. Mean reaction time for group by emotion interaction in the English sentence task. Vertical lines represent standard error for means.

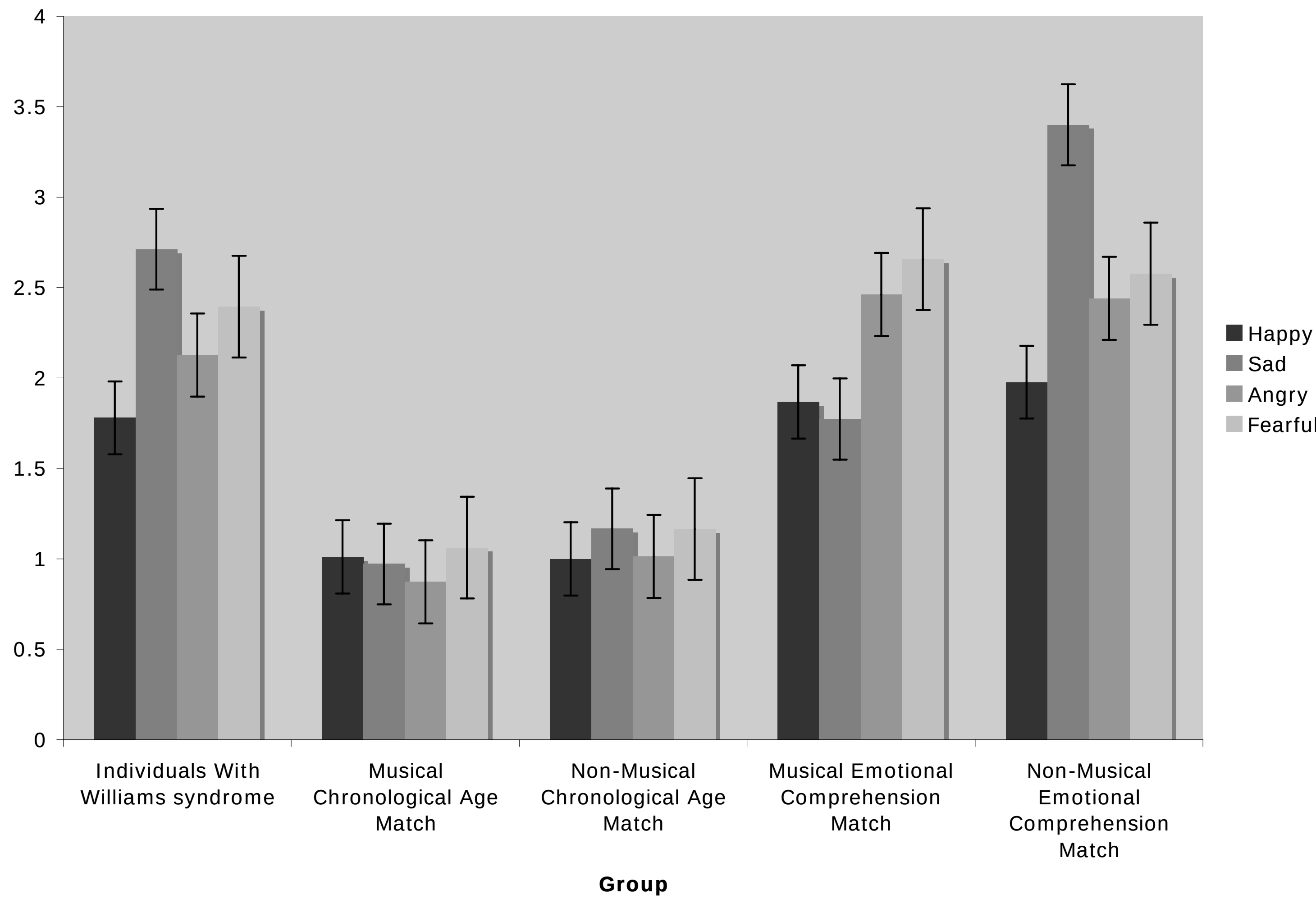
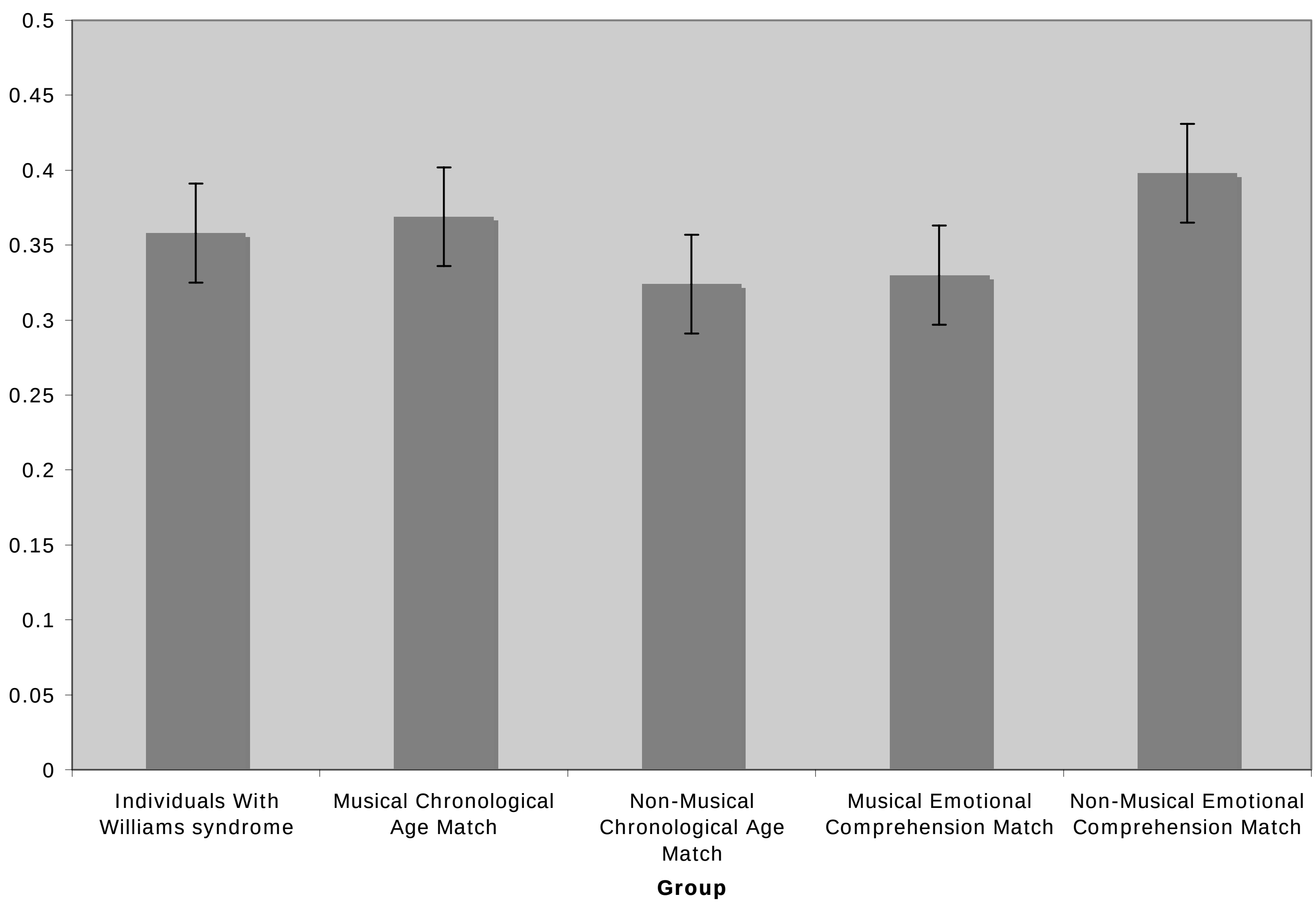

4
3.5
3
2.5
2
1.5
1
0.5
0
Individuals With Williams syndrome
Musical Chronological Age Match
Non-Musical Chronological Age Match
Musical Emotional Comprehension Match
Non-Musical Emotional Comprehension Match
Group
Happy
Sad
Angry
Fearful

Figure 16. Means accuracy scores for group in the tonal sentence task. Vertical lines represent standard error for means.


0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Individuals With Williams syndrome
Musical Chronological Age Match
Non-Musical Chronological Age Match
Musical Emotional Comprehension Match
Non-Musical Emotional Comprehension Match
Group

accurate in this task and were significantly better than anger (*M* = .21) and fear (*M* = .25), (all *p*s < .01). See Figure 17 for all means associated with this analysis. There was no significant main effect for the interaction between emotion and group, *F*(12, 150) = 1.03, *MSE* = .06, *p* > .05 (see Figure 18).

It was surprising that there was no effect for group in this task, as the task seems to be the most musically based of all three tasks. However, this finding may be due to the low accuracy levels across all groups resulting from the higher difficulty and unfamiliarity of this task in contrast to the facial expression or English sentence tasks. Emotion results were consistent with results in the facial expression and English sentence tasks (as well as consistent with predictions), with happiness and sadness performing the best overall.

No analysis of reaction time was run for this task because the accuracy levels of the tonal sentence task were very low and therefore many data points for reaction time were missing.

Figure 17. Mean accuracy scores for emotion in the tonal sentence task. Vertical lines represent standard error for means.

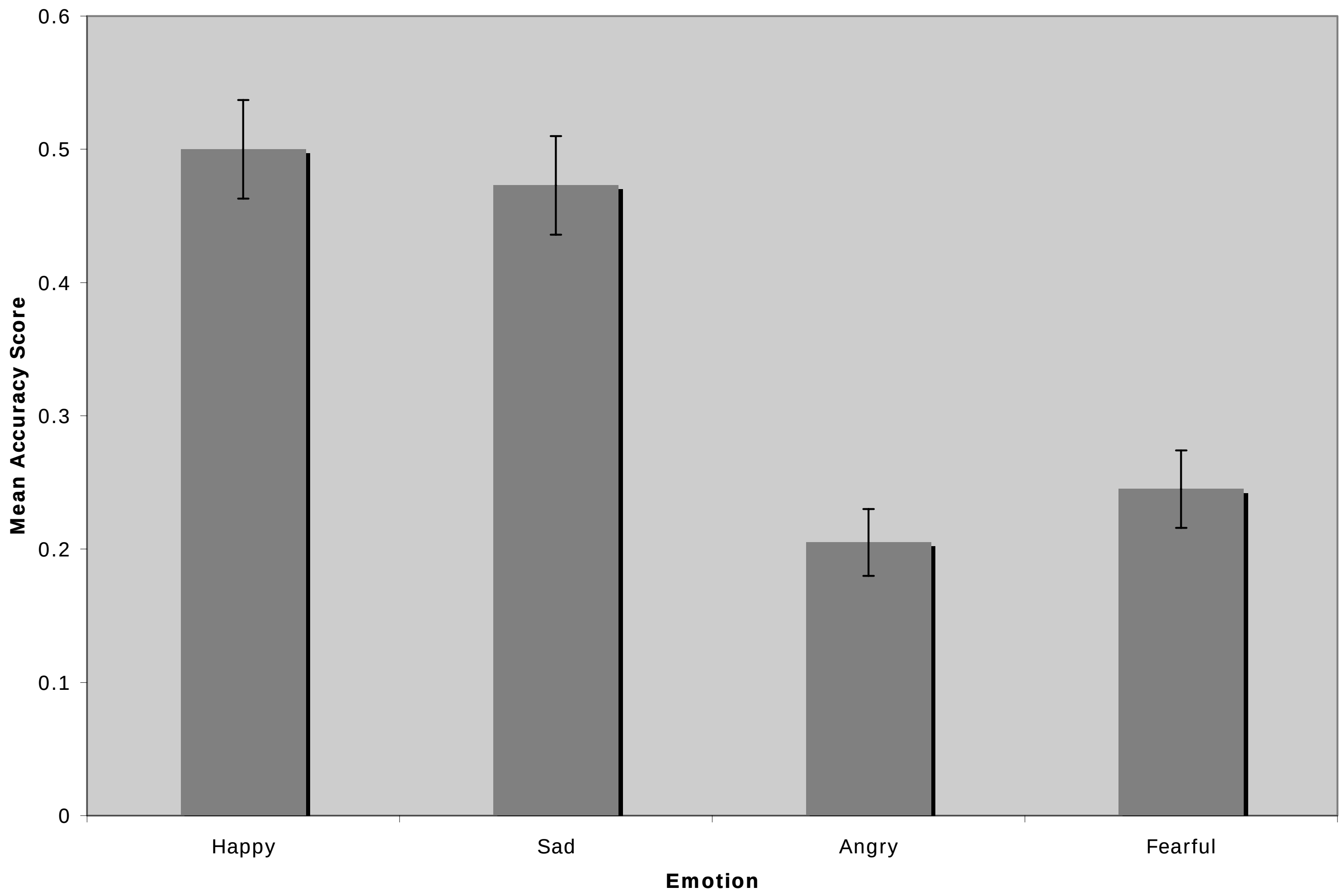
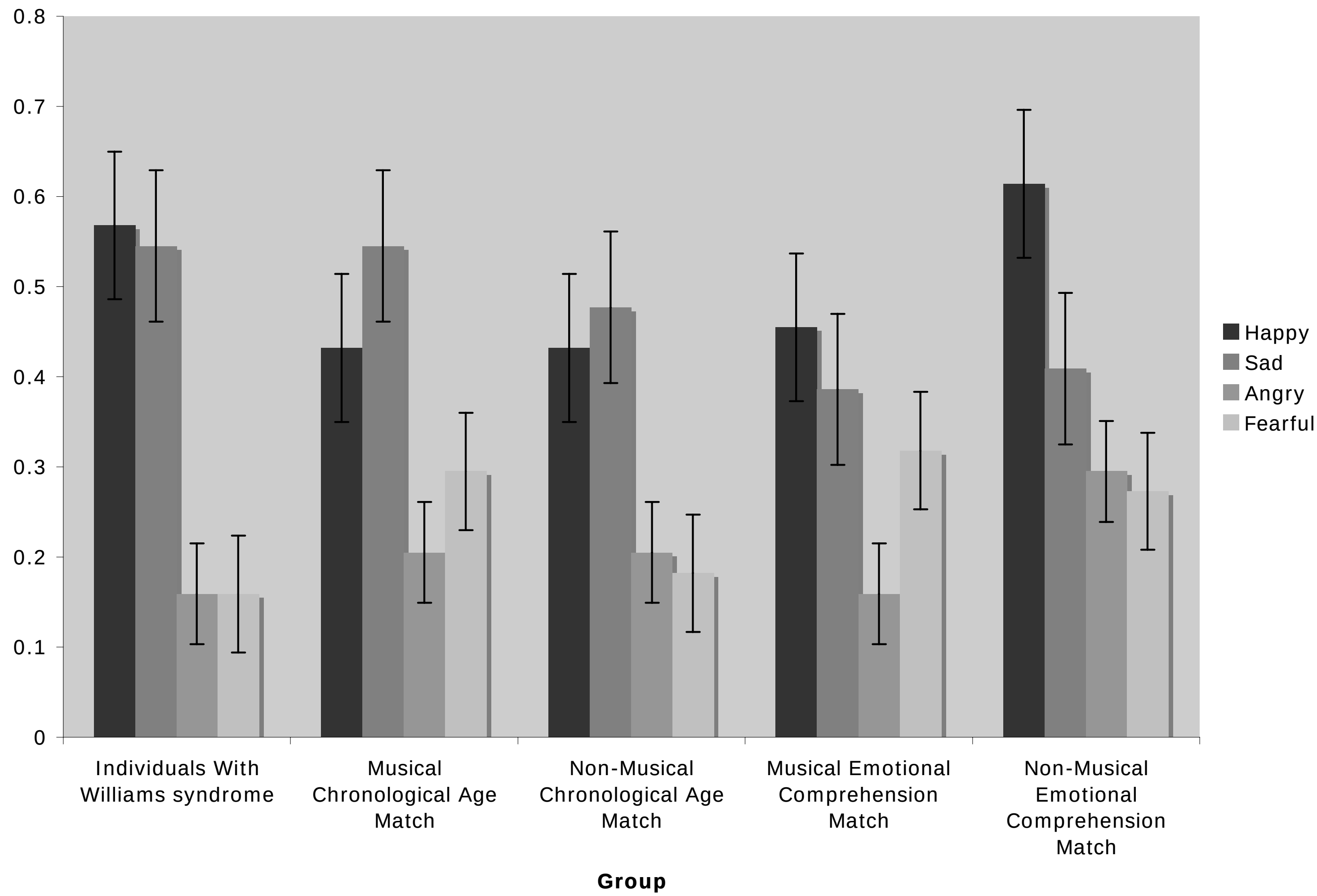

0.6
0.5
0.4
0.3
0.2
0.1
0
Mean Accuracy Score
Happy
Sad
Angry
Fearful
Emotion

Figure 18. Mean accuracy scores for group by emotion interaction in the tonal sentence task. Vertical lines represent standard error for means.



0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Happy
Sad
Angry
Fearful
Individuals With Williams syndrome
Musical Chronological Age Match
Non-Musical Chronological Age Match
Musical Emotional Comprehension Match
Non-Musical Emotional Comprehension Match
Group

DISCUSSION

The present study was based on research by Thompson et al. (2004), which found a positive relationship between musical training and emotional comprehension in prosodic sentences. This research built upon Thompson et al.'s study in order to further understand music and emotion as well as investigate this relationship in individuals with Williams syndrome. The study was designed to examine whether or not musical training was sufficient to overcome the emotional comprehension and theory of mind difficulties that are often exhibited by individuals with Williams syndrome.

It was predicted that musical groups (musical chronological age matches, musical emotional comprehension matches, and individuals with Williams syndrome) would outperform non-musical groups (non-musical chronological age matches and non-musical emotional comprehension matches). It was also predicted that participants would identify happiness and sadness more accurately and faster than anger and fear.

Music and Emotion

In the present study, it was found that musical and non-musical chronological age matches outperformed musical and non-musical emotional comprehension matches and individuals with Williams syndrome. These findings were shown in the mean reaction time data from the facial expression task as well as the mean accuracy and mean reaction time data from the English sentence task. It was surprising that there were no significant differences between the musical and non-musical groups in mean accuracy or reaction time scores. These results indicate that there was no relationship between musical training and emotional comprehension. Therefore, the results in the current study are inconsistent with findings from Thompson et al. (2004).

Though the present study used the same measure of musicality (years of lessons) as in the procedure designed by Thompson et al. (2004), this measure may have been less accurate in the present study due to the relatively homogenous population that participants were drawn from. To replace the current measure of musicality, it would be beneficial to investigate other ways to determine these groups, possibly with a simple test of musicality such as tonal and rhythm repetition and identification tasks. If the original measure were repeated, it would be ideal to find musical participants with more years of musical training than in the present study and non-musical participants with no musical training at all. A semi-longitudinal study, similar to Thompson et al.'s research with children who took yearlong arts lessons as part of the study, might also be helpful to control the specific amount of musical training experienced by each participant.

The group results above also suggest that age or education, rather than musical training, were possibly the influencing factors in accuracy and reaction time scores of the emotional comprehension and chronological age match groups. The group of individuals with Williams syndrome are an exception, however, as they were the same age as the college students and performed at the same level as the children. The low accuracy scores and slower response times that were displayed by the individuals with Williams syndrome indicates that they are not proficient in the area of prosodic emotional comprehension. These results suggest that not only does musical training *not* compensate for mild emotional comprehension difficulties in individuals with Williams syndrome, but that these stimuli belong in Tager-Flusberg and Sullivan (2000)'s area of social-cognitive knowledge because of their complexity. This finding is in contrast to Sullivan, Winner, and Tager-Flusberg's (2003) definition of social-perceptual knowledge, which includes the understanding of prosodic sentences.

Williams syndrome and Prosody

The facial expression task, chosen for its relatively simple set of stimuli, only tested the interpretation of social-perceptual information. As shown in studies by Karmiloff-Smith et al. (1995) and Tager-Flusberg and Sullivan (2000), individuals with Williams syndrome display relatively intact social-perceptual components of theory of mind. This finding is supported in the present study, as individuals with Williams syndrome displayed no significant differences from the chronological age match groups in accuracy levels in the facial expression task, though there was a significant difference in reaction time. These data indicate that individuals with Williams syndrome are proficient at recognizing emotions in facial expression stimuli, but that their processing time is slower than typically developing individuals of the same age.

In the English sentence task, individuals with Williams syndrome showed significantly worse accuracy levels than the musical and non-musical chronological age matches. They also were significantly slower than the chronological age match groups, though there were no significant differences in accuracy levels or reaction times between the individuals with Williams syndrome and either of the emotional comprehension match groups. The difference of findings between the accuracy levels in the facial expression task and the English sentence task indicates that individuals with Williams syndrome may not have as developed prosodic understanding of emotion in speech as in body language and facial expressions. Though the study did not directly compare individuals with Williams syndrome to a control group matched on mental age, it is possible that further research may find that individuals with Williams syndrome are performing at mental age on prosodic tasks. This speculation is based on the similar grade levels of the children tested in the emotional comprehension match groups to the approximate reading levels of the individuals with Williams syndrome.

I argue that individuals with Williams syndrome may not have interpreted the English sentence stimuli as well as the facial expression stimuli because of a difficulty understanding two competing pieces of information. An example from the English sentence stimuli (in the present study) is, “The lamp is on the table.” This sentence, purposefully neutrally worded, holds no emotional value without the prosodic content. Therefore, the prosodic cues in the English sentence stimuli conflict with the neutral emotion conveyed semantically. Though all participants were told to concentrate on the tone of the sentence, not the words, the individuals with Williams syndrome may have had difficulty screening out semantic meaning and were therefore unable to select the correct emotion because of competing cognitive processes. In future studies, it would be interesting to compare these results to the interpretation of prosodic cues that correspond directly to the words in the sentence. For example, for the expression of happiness, one might pick the sentence “It is my birthday today,” or for sadness, “My cat died a week ago.” I predict that individuals with Williams syndrome would be much more accurate in the proposed task because the two pieces of information would be congruent and therefore could be understood simultaneously.

Tager-Flusberg and Sullivan’s (2000) findings regarding theory of mind and Williams syndrome suggest that individuals with Williams syndrome were more adept at tasks testing social-perceptual knowledge (general knowledge and perception of others) in contrast to social-cognitive knowledge (based on false belief tasks). The data gathered in the facial expression task supported Tager-Flusberg and Sullivan’s argument that individuals with Williams syndrome have a relatively intact social-perceptual understanding of emotion, but are not as proficient in these social-perceptual tasks as typically developing individuals. However, according to Sullivan et al. (2003), speech prosody tasks (such as the English sentence task in the present study) appear to be more consistent with social-perceptual knowledge.

Similar to the present studies' findings on the interpretation of English sentences with conflicting prosodic and semantic meaning, Sullivan et al. (2003) found that individuals with Williams syndrome have difficulty understanding jokes and lies. Sullivan et al. (2003) explored this relationship in response to research that found individuals with Williams syndrome to have relatively spared theory of mind abilities (Karmiloff-Smith et al., 1995). However, this study has since been criticized because of its control groups and Sullivan et al. challenged Karmiloff-Smith et al's findings in their more recent study. The researchers presented each participant with four stories, two containing lies and two containing ironic jokes, and were asked to differentiate between the two. The participants were presented with a falsehood (in the context of a story) that the adult knew was untrue, such as "I did a great job cleaning up my room." In the lie scenarios, the child *was not* aware that the adult knew the truth. In the joke scenarios, the child *was* aware that the adult knew the truth and was not trying to be deceptive. Therefore, the only difference between the lies and the jokes was the child's belief about the adult's knowledge (Sullivan et al.).

Sullivan et al. (2003) found that all groups in the study (individuals with Williams syndrome, individuals with Prader-Willi syndrome and individuals with non-specified mental retardation) performed extremely poorly. All three groups mistakenly identified jokes as lies and, according to the researchers, understood the stimuli at a similar level to a typically developing young child (the participants in the study were adolescents). The researchers concluded that individuals with Williams syndrome have very low abilities in the area of social-cognitive knowledge in contrast to their other highly developed language abilities. This finding supports the idea that individuals with Williams syndrome have difficulty interpreting two conflicting sets of information.

Sullivan et al. (2003) classified prosodic sentence tasks in the area of social-perceptual knowledge, along with the interpretation of body language and facial expressions. I argue that the similarities between their jokes and lies stimuli and the English (prosodic) sentence stimuli in the present study place the English sentence stimuli in the social-cognitive area of theory of mind. The processes required to interpret the conflicting semantic and prosodic content of the English sentence stimuli are more complex than Tager-Flusberg and Sullivan's (2000) description of the social-perceptual component. Therefore, I argue that the prosodic sentences in the present study primarily test the social-cognitive area of theory of mind. As mentioned above, this position would be further supported by a study examining individuals' with Williams syndrome understanding of prosodically manipulated sentences that were congruent in prosodic and semantic content. This theory may also benefit from a study examining the abilities of individuals with Williams syndrome to interpret sarcasm, a difficult concept that requires the incorporation of two very distinct pieces of information

Williams syndrome and Musical Training

As the relationship between music and emotion was not supported in other groups, it is difficult to determine how the performance of individuals with

Williams syndrome was influenced by their musical training. In order to specifically investigate how musical training impacts emotional comprehension in individuals with Williams syndrome, future studies may wish to examine a non-musical group of individuals with Williams syndrome as well as a musical group of individuals with Williams syndrome. The non-musical group would provide a clear base for determining the emotional comprehension levels of individuals with Williams syndrome before their exposure to music and would allow us to better interpret the influence of musical training. The sixth group would also provide a more balanced study, as the chronological age match and emotional age match groups each consist of musical and non-musical divisions.

Emotional Comprehension

Participants displayed relatively high accuracy levels in all emotions across both the facial expression task and the English sentence task, ranging from 69% accurate to 100% accurate. As predicted, all participants were almost always faster and more accurate at assessing happiness as compared to anger and fear. Participants were also often more accurate and faster when comparing sadness to anger and fear, but the overall accuracy levels were not quite as high for sadness as those associated with happiness. These findings are consistent with research by Thompson et al. (2004).

Bunt and Pavlicevic (2001) studied the interpretation of emotion in short music therapy excerpts and found that individuals were more apt to recognize happy and sadness than anger and fear. Juslin and Laukka (2003), as discussed previously, found that it was most difficult to express happiness and fear. These studies, however, are not completely congruent with the interpretation of prosodic sentences, as in the present study, because Bunt and Pavlicevic focus on the interpretation of *music* and Juslin and Laukka focus on the *expression* of prosodic sentences. It appears from this research that happiness is easiest to interpret, but most difficult to express.

In the present study, as well as in research by Thompson et al., the high accuracy levels in the recognition of happiness and corresponding low accuracy levels in the other three emotions may be due to the relatively benign laboratory settings, or to the frequency at which happiness and sadness are encountered in speech in contrast to anger and fear. These findings may be a result of the absence of other sources of information that are usually associated with certain emotions. For example, happiness is usually accompanied with only a smile, whereas sadness can show tears, and fear and anger are usually displayed with very strong body language along with prosodic content. The environmental cues associated with fear and anger may also be more easily recognized because these emotions are more often a part of traumatic and volatile situations.

In future research, it would be interesting to investigate the use of different emotions (disgust, surprise, etc.) and the emotional comprehension levels pertaining to these less common emotions. The more complex emotions may show less of a ceiling effect (as found in the accuracy levels of happiness) and therefore have interesting accuracy results across the five groups in the facial expression task. The introduction of new emotions may clarify the true abilities of individuals with Williams syndrome in the realm of social-perceptual and social-cognitive emotional comprehension.

Conclusions

The present study did not support the relationship between musical training and emotional comprehension as found in research by Thompson et al. (2004). Analyses revealed that individuals with Williams syndrome did not perform as well as expected, which has important implications on the overall language abilities of individuals with Williams syndrome. This finding suggests that individuals with Williams syndrome are not as skilled at interpreting emotion in others' prosodic sentences as their high verbal abilities might imply. Their language and conversational skills, a part of the hyper social personality, may only be present in their own speech rather than in the interpretation of others' speech. Individuals with Williams syndrome, well known for their language abilities, exhibit well-developed verbal skills, but may not adequately interpret the entire meaning of others' thoughts and ideas. Further research in this area is necessary to understand the true abilities of individuals with Williams syndrome.

It is evident from the present study that these findings could have important implications for institutions such as the Berkshire Hills Music Academy. If further research can determine that musical training is beneficial for the understanding of emotion in individuals with Williams syndrome, it may be helpful for these individuals to partake in increased amounts of musical training.

Prosodic interpretation is an integral part of social communication and therefore it is valuable to address ways one might increase these abilities. Music, already known for its therapeutic value in many other areas, may also be a strong teaching tool for prosodic interpretation.

The relationship between music, emotion, and prosody is complex, and according to the findings in the present study and research by Thompson et al. (2004), this relationship is still somewhat unclear. The interpretation of emotion in other's body language, facial expressions, and prosodic verbal remarks are integral to social understanding and conversation between others. A prime example of the importance of prosodic understanding is the current dependence on electronic communication such as instant messenger or e-mail. These forms of communication, though quick and easy, often lose meaning through the absence of prosody and can cause misunderstandings. The ability to comprehend the finite implications and emotions conveyed in others' speech is highly valued in society, and must be addressed if deficient in certain populations, such as in individuals with Williams syndrome.

BHMA Guardian Consent Form

Dear Parents of BHMA students,

My name is Kathy Binder, Professor of Psychology and Education at Mount Holyoke College, and I am working with Bonnie Abbey-Warn on her undergraduate thesis. The purpose of this letter is to explain some of the research that we are conducting at Berkshire Hills Music academy and request your permission to recruit your son/daughter for our research project.

Our study focuses on emotional comprehension in disorders such as Williams syndrome. Specifically, we are investigating the relationship between the unique musical gifts that individuals with Williams syndrome posses and how this musicality affects emotional comprehension in speech. We will supplement past research that highlights the relationship between musical training and emotional comprehension by examining this relationship in individuals with Williams syndrome. Williams syndrome's unique cognitive profile, which shows deficits in math and special abilities but strengths in verbal and musical skills will further, examine music's influence on emotional comprehension of speech. We hope that the information collected in this study will further educators understanding of emotional comprehension in individuals with Williams syndrome and that this information will positively influence their teaching methods.

The research will take approximately 30 minutes or less. Participation is completely voluntary, and all the students at BHMA will be informed of their rights to refuse participation or terminate participation at any time. Each student will be given explicit instructions about the tasks before they begin, as well as numerous practice trials to acquaint them with the task.

The present study consists of three short tasks. Students will participate individually with one researcher. After the student's rights have been explained, and the student has read and signed the informed consent, the student will be asked a few questions pertaining to his/her gender, age, and years of musical experience. After completing this short survey, the three tasks will begin.

All three tasks will be randomized so that no student receives the tasks in the same order. One of the tasks will ask the student to view facial expressions on a computer screen and pick the most appropriate emotion that corresponds to the expression on the person's face. Four choices of emotion (happiness, sadness, fear, anger) will be presented on the computer screen and the student will be asked to click the one that he/she believes is correct. The next task will ask the student to listen to short music clips on headphones and once again select the most appropriate emotion from the four choices. The final task will ask the student to repeat the same procedure but to listen to sentences on the headphones and choose his/her response. Each sentence has been manipulated by a raising and lowering of pitch to convey specific emotions though the text remains neutral. At the conclusion of the study, students will be debriefed, and any remaining questions will be answered.

Please know that we will take great care with all the information we receive. Individual names and performance will not be reported. All the information we receive will be kept confidential, as only my student and myself will have access to the information. Of course you may have access to the participant's individual results. Please note that we are not measuring individual performance, and cannot generate a standardized score with these data. Rather, we hope to gain a sense of how this population understands emotion as a whole. For that reason, you may instead wish to request the results of our study upon its conclusion. If you would like that information, we will be more than happy to provide it for you. Finally we would like you to know that these experiments (and all the materials used in the experiments) have been reviewed by

Berkshire Hills Music Academy and Mount Holyoke College's Internal Review Board. This process of ethical review and approval ensures that each task is of minimal risk to the student, and that each student who decides to participate does so voluntarily.

If you have any questions at all about the study, please feel free to contact me. I can be reached at (413) 593-2105, or by email at kbinder@mtholyoke.edu.

Thank you very much for your time and consideration. We look forward to working with the students at the academy.

Sincerely,

Kathy Binder

Kathy Binder
Psychology and Education Department
Mount Holyoke College
50 College St.
South Hadley, MA 01075
(413) 538-2105

Please detach and return bottom portion.

Parent Permission Form

If you choose not to participate or terminate your consent to participate, it will have no effect on any present or future services that may be provided or purchased by the Department of Mental Retardation in the Commonwealth of Massachusetts or provided by vendor/agency with which research is connected.

If you participate you may stop at any time and withdraw your consent. There are no penalties for stopping.

_________ Yes, I give permission for my son/daughter to participate in this research. I understand that participation is strictly voluntary, and that my son/daughter will be informed of this. He/she will also be informed of all the procedures before each task, and will have the right to not participate or discontinue participation at any time.

________ No, I do not give permission for my son/daughter to participate in this research. Please do not include him/her in any of the studies.

Student's name____

Guardian's name____

Parent/guardian signature____Date__________

NES Parent Permission Form

Dear Parent,

My name is Katherine Binder, and I am an Assistant Professor of Psychology & Education at Mount Holyoke College. Currently, my undergraduate student, Bonnie Abbey-Warn, and I are working at your child's school. The purpose of this letter is to explain some of the research that we are currently conducting and request your permission to recruit your son/daughter for our research project.

While the larger focus of our study examines emotional comprehension in disorders such as William's syndrome, we need to compare our results to children at a similar level of emotional comprehension. Therefore, school children will serve as an emotional comprehension match for our participants with Williams syndrome. Williams syndrome is a genetic condition that has a very unique cognitive profile. Individuals with Williams syndrome are typically mild to moderately retarded but often show good language and music skills with low spatial and mathematic abilities. We are investigating the relationship between the unique musical gifts that individuals with Williams syndrome posses and how this musicality affects emotional comprehension in speech. We hope that the comparison between adults with Williams syndrome and children of normal development will provide us with a basis for comparison that will specify how musicality influences emotional comprehension in speech.

The research will take approximately 30 minutes or less. Participation is completely voluntary, and all students will be informed of their rights to refuse participation or terminate participation at any time. Each student will be given explicit instructions about the tasks before they begin, as well as practice trials to acquaint them with the task.

The present study consists of three short tasks. Students will participate individually with one researcher. After the student's rights have been explained, and the student has read and signed the informed consent, the student will be asked a few questions pertaining to his/her gender, age, and years of musical experience. After completing this short survey, the three tasks will begin.

All three tasks will be randomized so that no student receives the tasks in the same order. One of the tasks will ask the student to view facial expressions on a computer screen and pick the most appropriate emotion that corresponds to the expression on the person's face. Four choices of emotion will be presented on the computer screen and the student will be asked to click the one that he/she believes is correct. The next task will ask the student to listen to short music clips on headphones and once again select the most appropriate emotion from the four choices. The final task will ask the student to repeat the same procedure but to listen to sentences on the headphones and choose his/her response. Each sentence has been manipulated with raising and lowering of pitch to convey specific emotions although the text remains neutral. At the conclusion of the study, students will be debriefed, and any remaining questions will be answered.

Please know that we will take great care with all the information we receive. Individual names and performance will not be reported. All the information we receive will be kept confidential, as only my student and myself will have access to the information. Of course, as a parent, you may have access to your child's individual results. Please note that we are not measuring individual performance, and cannot generate a standardized score with these data. Rather, we hope to gain a sense of how this population understands emotion as a whole. For that reason, you may instead wish to request the results of our study upon its conclusion. If you would like that information, we will be more than happy to provide it for you. Finally we would like you to know that these experiments (and all the materials used in the experiments) have been reviewed by BHMA, Mount Holyoke College's Institutional Review Board, and the Department of Mental Retardation. This process of ethical review and approval ensures that each task is of minimal risk to the student, and that each student who decides to participate does so voluntarily.

If you have any questions at all about the study, please feel free to contact me. I can be reached at (413) 538-2105, or by email at kbinder@mtholyoke.edu.

Thank you very much for your time and consideration. We look forward to working with the students at the school.

Sincerely,

Kathy Binder

Kathy Binder
Psychology and Education Department
Mount Holyoke College
50 College St.
South Hadley, MA 01075
(413) 538-2105

Please detach and return bottom portion.

Parent Permission Form

_________ Yes, I give permission for my son/daughter to participate in this research. I understand that participation is strictly voluntary, and that my son/daughter will be informed of this. He/she will also be informed of all the procedures before each task, and will have the right to not participate or discontinue participation at any time.

________ No, I do not give permission for my son/daughter to participate in this research. Please do not include him/her in any of the studies.

Student's name____

Parent/guardian's name____

Parent/guardian signature____Date_______

BHMA Participant Informed Consent Form

Title of Study: “The Relationship Between Musicality and Emotion In Individuals With Williams Syndrome”

I am being asked to participate in a research project by a student who is doing research (the researcher). The experiment is part of Bonnie Abbey-Warn’s thesis project.

If I choose to take part, I will view facial expressions on a computer screen and will listen to music clips and sentences through headphones. My job will be to pick one of four emotions for each picture seen or music clip or sentence heard. I will pick the response that I think is most accurate, and I will try to do it as quickly as I can without losing accuracy. There will be 16 pictures, 16 music clips, and 16 sentences. I will choose my response (happy, sad, angry, fearful) on a computer screen. I will be given practice items to become familiar with the procedure before beginning the tasks. I will be given the opportunity to take a break at any time during the task.

I understand that the researcher will explain all of the procedures to me, and she will answer any questions that I may have.

I understand that the tasks could make me uncomfortable. If I become uncomfortable, I can stop at any time by using words or actions to do so. And, if I stop, no one will ask me to continue at any time. No matter what happens, if I do become uncomfortable staff will be available to me to talk about these feelings or anything else that comes up. The researcher will make sure that staff at BHMA are available to help if I need more help, and the researcher will have me talk to someone else who will provide this help.

I understand that choosing to take part means that I agree to let the researcher know my name and my age. The researcher will not let anyone else know of any of my private or personal information. Any information that the researcher receives will be made part of a final researcher report and may be used in papers submitted for publication or presented at professional conferences, but under no circumstances will my name or other identifying characteristics be included.

I understand that I do not get paid to take part, but if I want, Bonnie will tell me about what I helped her to learn after the project is over.

I understand that I do not have to take part (participate) in the project. If I do choose to take part, I can quit at any time. I understand that my decision to participate or any decision not to participate in any part of the study will have no effect on any present or future services that may be provided or purchased by the Department of Mental Retardation.

If you choose not to participate or terminate your consent to participate, it will have no effect on any present or future services that may be provided or purchased by the Department of Mental Retardation in the Commonwealth of Massachusetts or provided by vendor/agency with which research is connected.

If you participate you may stop at any time and withdraw your consent. There are no penalties for stopping.

___________________________	___________________________	_______________
Signature of Participant	Name of Participant (print)	Date

I attest to the fact that this individual understands and is able to give consent to participate in this study.

___________________________	___________________________	_______________
Signature of Witness	Name of Witness (print)	Date

I have fully explained this project to _______________________________ (participant) and have answered all questions to the best of my ability.

___________________________	___________________________	_______________
Signature of Researcher	Name of Researcher (print)	Date

Contact information:

If you have any questions at all about this research project, you may contact Bonnie Abbey-Warn at any time. She can be reached at (617) 650-2674.

Mount Holyoke College Informed Consent Form

Title of Study: “The Relationship Between Musicality and Emotion In Individuals With Williams syndrome”

Investigator(s): Dr. Kathy Binder and Bonnie Abbey-Warn

Brief description of project and procedures to be followed:

If you choose to participate, you will be asked to complete a short survey (requesting your name, age, and musical training) and then to partake in three short tasks. The experiment in its entirely should take no more than 30 minutes and you will have practice to familiarize yourself with the tasks. You will view facial expressions on a computer screen and will listen to music clips and sentences through headphones. You will be asked to pick one of four emotions (happy sad, angry or fearful) for each picture seen or music clip or sentence heard. You will be asked to pick the response that you think is most accurate and try to do it as quickly as you can without losing accuracy.

This project has been approved by the Institutional Review Board of Mount Holyoke College. The following informed consent is required by Mount Holyoke College for all participants in human subjects research:

A. Your participation is voluntary.

B. You may withdraw your consent and discontinue participation in this study at any time. You will not be penalized in any way if you decide not to participate.

C. The procedures to be followed in the project will be explained to you, and any questions you may have about the aims or methods of the project will be answered.

D. All of the information from this study will be treated as strictly confidential. No names will be associated with the data in any way. If you provide your address in order to receive a report of this research upon its completion, that information will not be used to identify you in the data. The data will be stored in locked offices in Reese Psychology and Education Building and the data will be accessible only to the investigator(s).

E. The results of this study will be made part of a final research report and may be used in papers submitted for publication or presented at professional conferences, but under no circumstances will your name or other identifying characteristics be included.

If you understand the above, and consent to participate in the project, please sign here:

____ (Participant sign here)

____ (Participant print name here)

____ (Date)

If you have any questions about this research, contact Kathy Binder at (413) 593-2105 or kbinder@mtholyoke.edu and Bonnie Abbey-Warn at (617) 650-2674 or beabbeyw@mtholyoke.edu or the Chair of Mount Holyoke College’s Institutional Review Board, Sirkka Kauffman, at (413) 538-2867 or skauffma@mtholyoke.edu.

Debriefing Form

You have participated in an experiment designed to assess the relationship between musicality and emotional comprehension. Our study focuses on emotional comprehension in syndromes such as William's syndrome. Specifically, we are investigating the relationship between the unique musical gifts that individuals with Williams syndrome posses and how this musicality affects emotional comprehension in speech. This study supplements past research that highlights the relationship between musical training and emotional comprehension by examining this relationship in individuals with Williams syndrome. Williams syndrome's unique cognitive profile, which shows difficulties in math and spatial abilities but strengths in verbal and musical skills will further, examine music's influence on emotional comprehension of speech.

You have participated in either an experimental group at Berkshire Hills Music Academy, or a control group matched to individuals with Williams syndrome on emotional comprehension or chronological age. The data collected does not measure achievement or intelligence in any way and will be used to assess the group as a whole, not individual performance. Data collected will be kept confidential and will not be associated with your name. If you have any remaining questions please contact Bonnie Abbey-Warn at (617) 650-2674.

Verbal Questionnaire

1. How old are you?

2. What is your gender?

3. Do you play a musical instrument? (Voice included)

    3b. If yes, which instrument(s)?

4. Have you taken formal lessons for this instrument?

    4b. If yes, for how many years?

5. Have you participated in any musical ensembles?

    5b. If yes, which types?

6. Have you taken music classes?

    6b. If yes, please describe.

7. Please describe any other relevant musical experience you have.

English Sentence Stimuli

Entire set repeated for each of the four emotions—happy, sad, angry, and fearful.

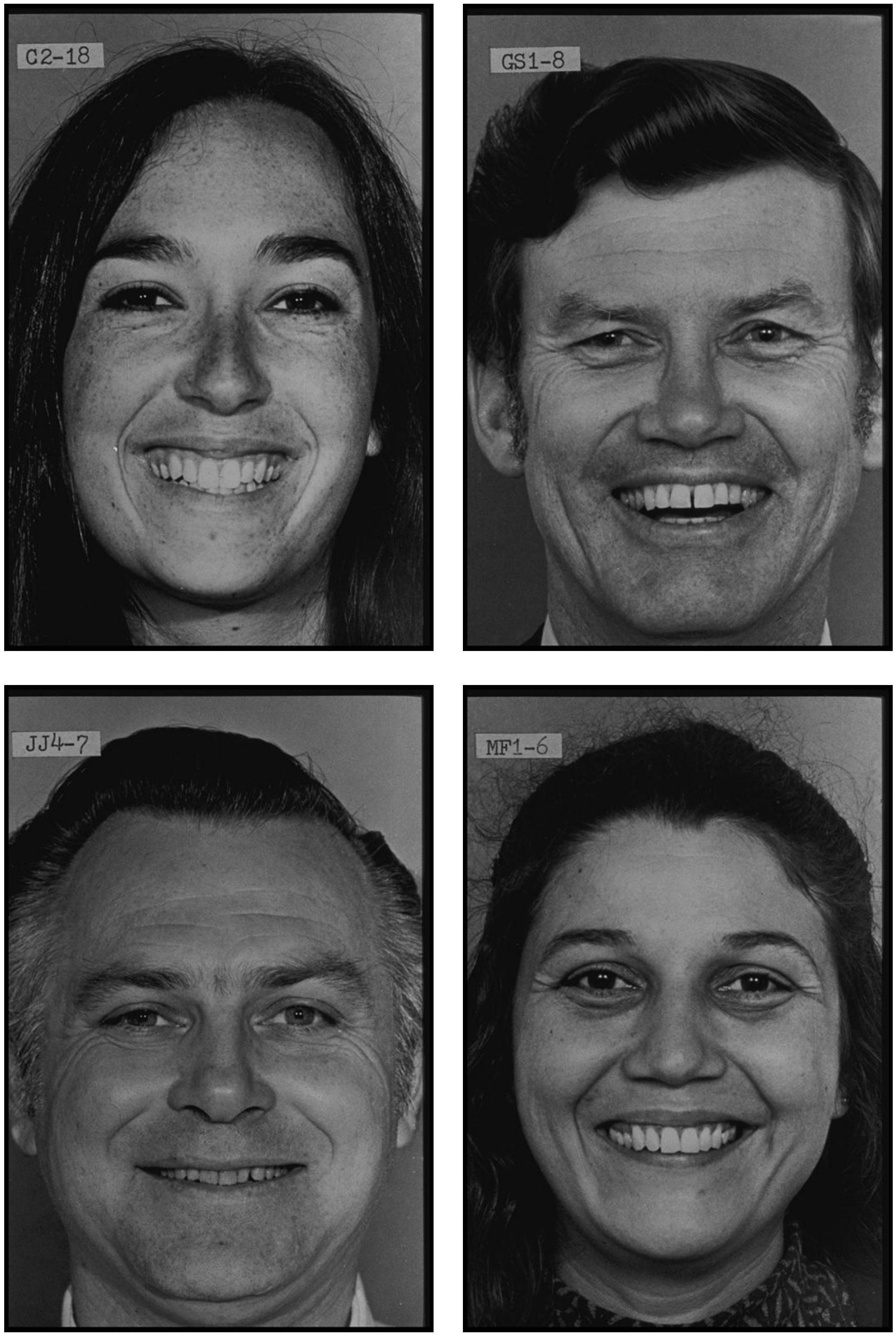
“ The Boy went to the store.”

“ The chairs are made of wood.”

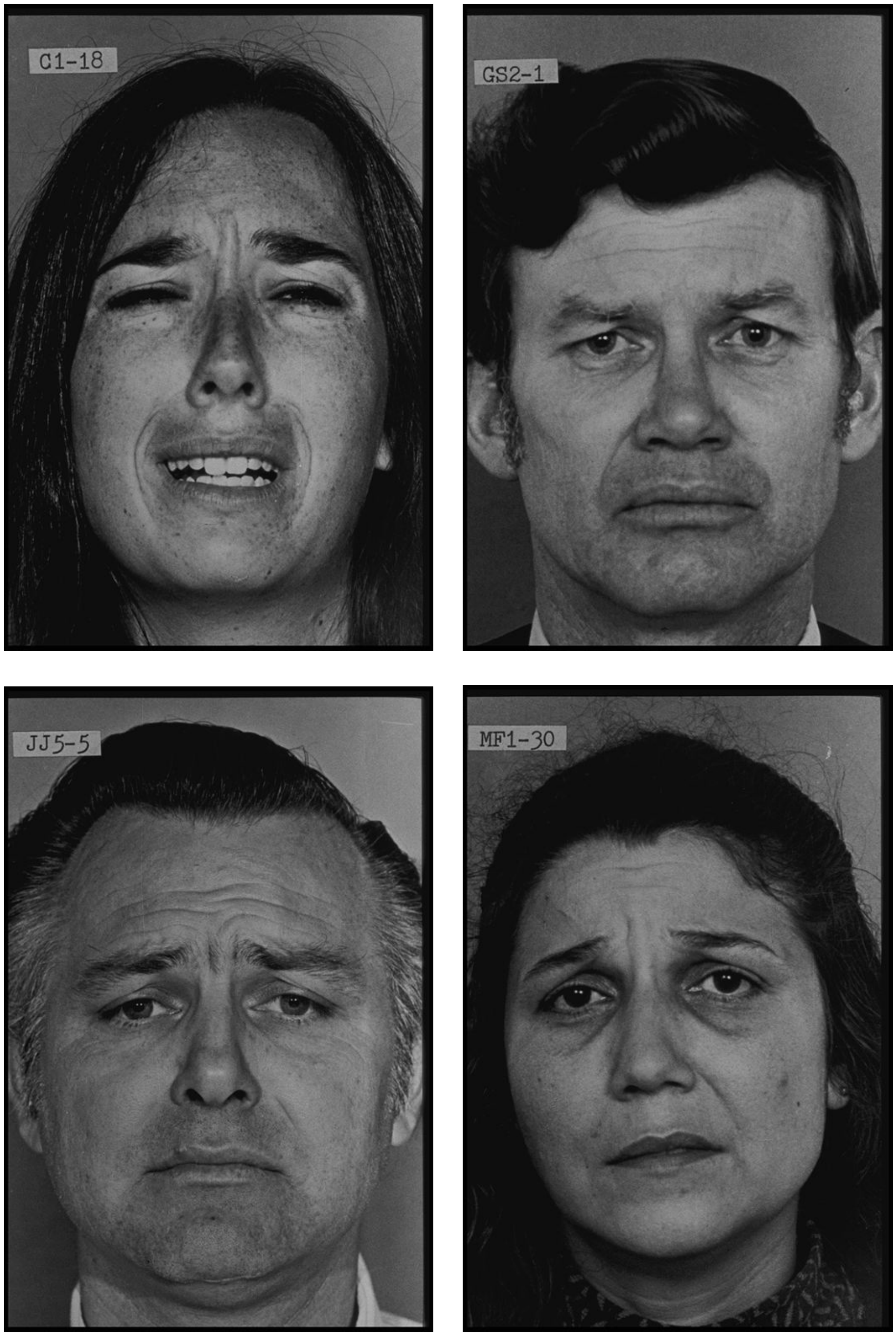
“ The lamp is on the table.”

“ The shoes are in the closet”

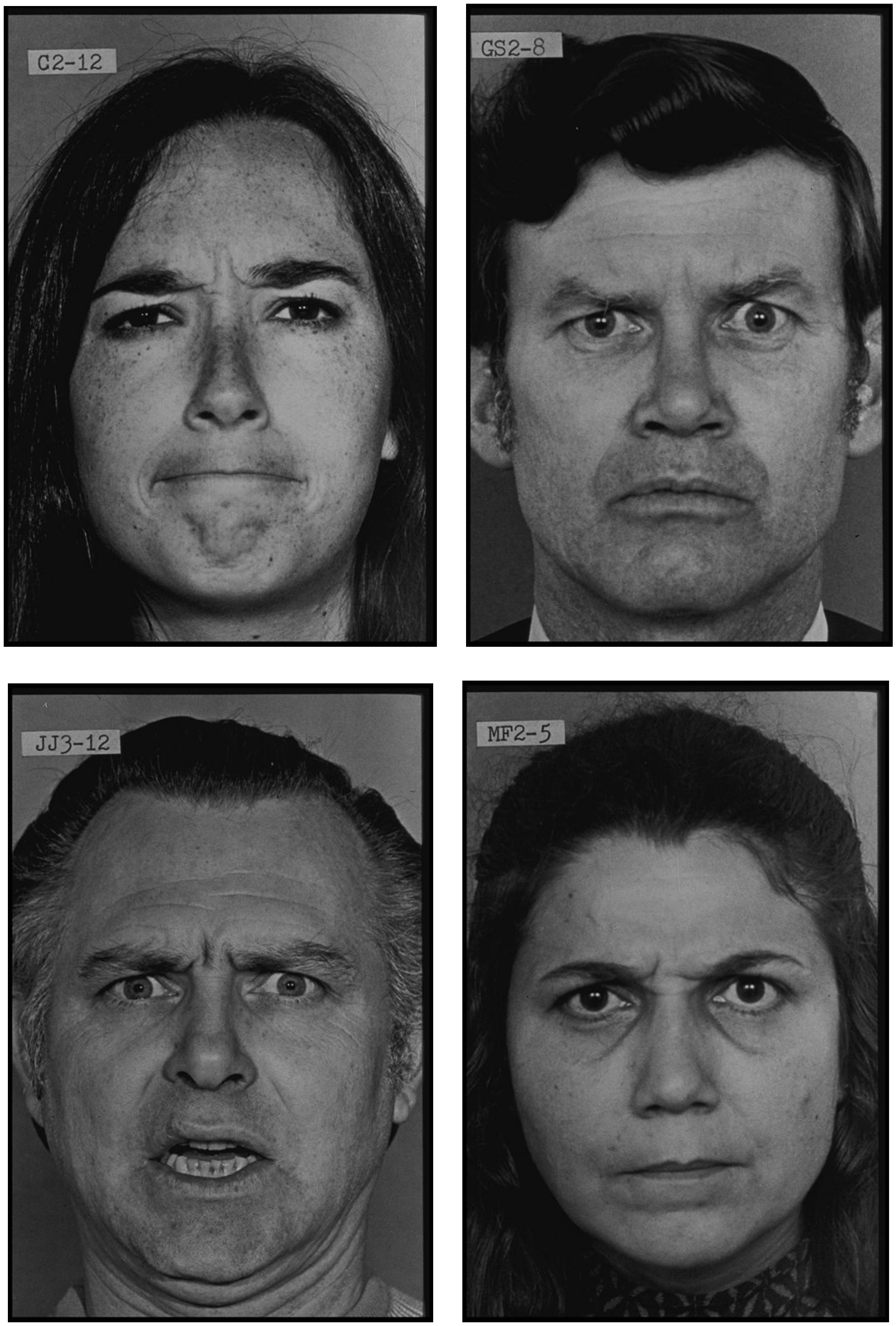
Happy Facial Expression Stimuli (Ekman, 1975)



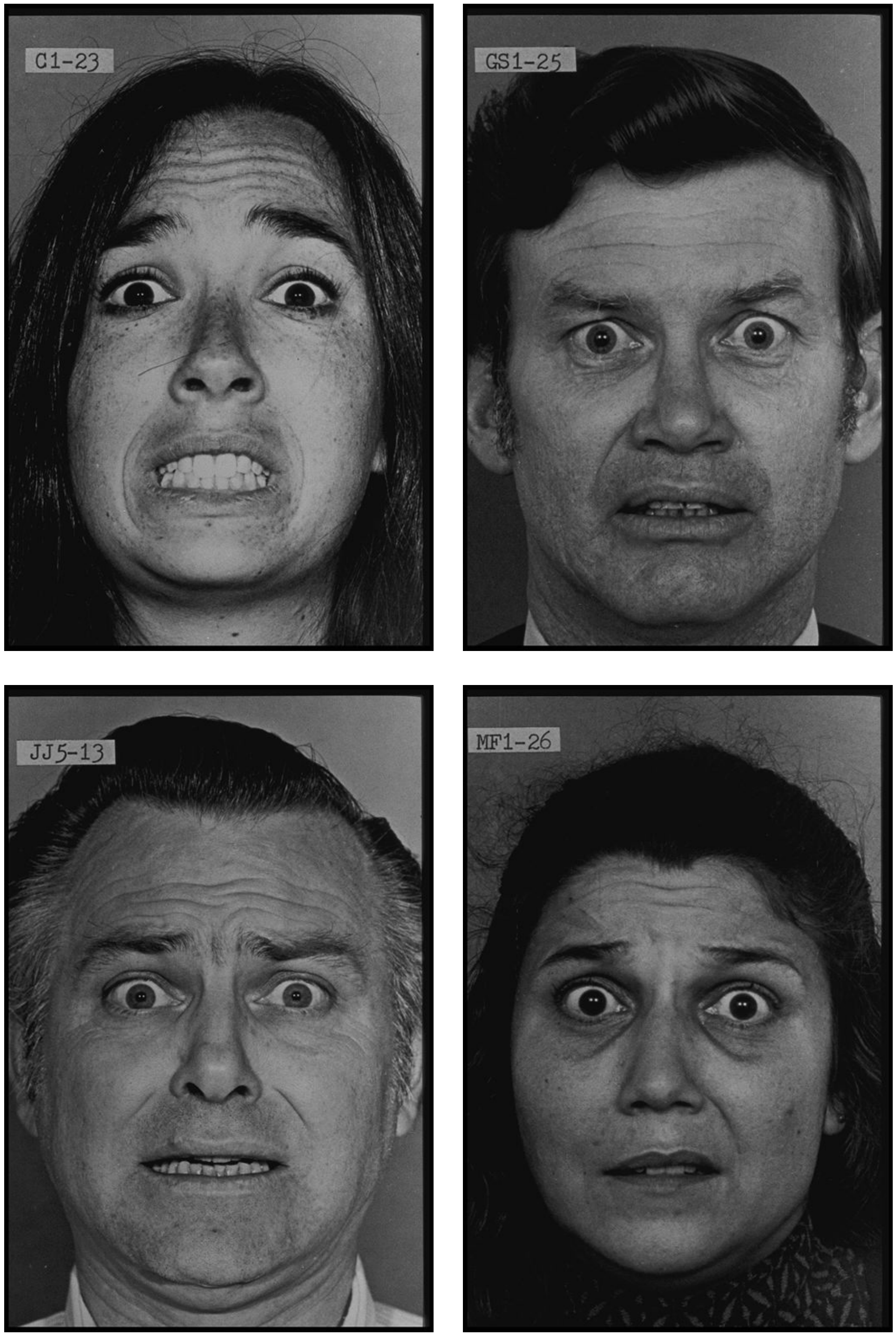
Sad Facial Expression Stimuli (Ekman, 1975)



Angry Facial Expression Stimuli (Ekman, 1975)



Fearful Facial Expression Stimuli (Ekman, 1975)



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