

A Cross-Sectional Study of Preference for
Music Using Recorded Acoustic Timbre
Versus
Music Using Sound Sampled Timbre

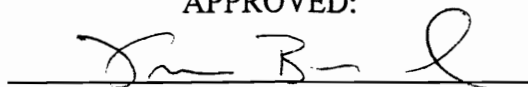
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(ABSTRACT)

The purpose of this study was to determine if a preference exists for recorded acoustic music or music using sound sampled timbre, and if that preference is influenced by age or gender. Participants were divided into two groups, 10 to 15 year olds (n=97), and 50-91 year olds (n=99). Each participant listened to a CD which presented 17 pairs of excerpts from classical music. Each pair contained both a recorded acoustic and sound sampled example of the following timbres: trumpet, flute, trombone, oboe, and tuba. A survey form was used to record the participants' preferences.

Results indicated that preference exists for both music using recorded acoustic timbre and music using sound sampled timbre, with youths preferring recorded acoustic and adults preferring sound sampled. A 2x2 factorial design disclosed that there was a significant difference between the age groups. Gender demonstrated no significant effect nor was there significant interaction between age and gender.

Conclusions pointed to the influence of music heard in the public school environment. With increased availability and exposure to sound sampling, consumption of music using this timbre will increase. Music educators need to recognize that the presentation of timbre used in the classroom may reinforce preferences for acoustic music.

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Introduction

Advances in technology have given birth to a generation of listeners who have had extensive exposure to synthesized and sound sampled timbres. Since the middle 1970's, virtually all popular and commercial music has utilized one or both of these methods of sound generation. Thus it seems logical that today's listener has developed preferences for music with timbres produced in this manner. According to Walker (1990), "musical preferences are established through belief systems which are resultant from experiences reflectant of the culture" (p. 4). This view is also put forth by LeBlanc (1982) whose interactive theory of music preference points to the interaction of the musical stimulus and the listener's cultural environment. It has been demonstrated that properties of the musical stimulus do affect preference. Grice (1994), Holton (1990), and Price (1995-96) report preferences for synthesized or sound sampled timbres. Other researchers report preferences for acoustic timbres and preferences for one instrumental timbre over others (Gordon, 1986; Cutietta & Foustalieraki, 1990; & Weaver, 1987). If Walker and LeBlanc's theories are correct, these reported preferences may reflect environmental influence.

The purpose of this study was to determine if a preference exists for recorded acoustic music or music using sound sampled timbres, and if that preference is influenced by age or gender. Previous research (Chang, 1995) found that preference existed for sound sampled timbre and that this preference was strongly influenced by age. If preference does exist for music performed with sound sampled timbre over music performed with recorded acoustic timbre, the implications for future music education curricula and the performance of classical art music will be significant.

Definitions

Timbre. Timbre has been referred to as the quality of a sound that identifies it uniquely. Obviously, timbre perceptually evokes different meanings for each listener.

Such words as bright, dull, edgy, thick, crass, rich, lurid, and dark have been used to describe timbre. One example of timbre is "the difference of a violin and an oboe when they are playing the same pitch, for the same duration, at the same loudness" (Krumhansl & Iverson, p. 739). Hodges (1980) describes timbre "as the characteristic quality of sound which distinguishes one instrument or voice from another" (p. 54).

Preference. Preference for music has been extensively researched. In 1986, Price developed a glossary of terms to clarify terms associated with affective response. In his glossary, preference is defined as "an act of choosing, esteeming, or giving advantage to one thing over another. Propensity toward something" (p 153). Preference may be demonstrated in two ways: behaviorally or verbally. Behavioral preference may be defined as the differential response for one stimulus as opposed to another. Demonstrated choice through non-verbal actions, such as concert attendance, recording purchase, or choosing to listen to specific music. Behavioral preference may also be called operant preference. Of relevance to the current study is the definition of verbal preference for music, presented as "a choice; liking of something over something else. Demonstrated choice through verbal actions (spoken or written), based upon many musical and sociological factors, including musical contour, degree of symmetry, order, closeness to optimal level of complexity, societal pressures, and degree of enjoyment. Developed through training and familiarity" (Price, 1986, p. 155).

Sound sampling. Sound sampling is a process where acoustic sounds are digitized (or -sampled-) and broken down into discreet intervals of data to be processed or stored by a computer, synth/sampler, or other digital audio device. The stored data is referred to as a samplefile. These sounds can be called up again and again to present music or sound effects. Analog recording more closely follows real acoustic sound, since it is continuous, while sampling (although it gives more flexibility and better long-term storage and

repeated playback) is not as accurate to the acoustic sound since it is broken up into discreet, digital intervals. See appendix A for a comparison of analog versus sound sampled waveforms.

Musical Instrument Digital Interface (MIDI). Refers to a set of instructions in the form of digital (binary) data, which must be interpreted by a sound-generating, or modifying device such as a synthesizer. MIDI contains instructions controlling how and when devices, such as synthesizers, produce sound. MIDI enables synthesizers, computers, rhythm machines, sequencers, and other signal-processing devices to be interconnected through an interface. The interface is based on industry standards, agreed to by manufacturers of MIDI hardware and software.

Sequencer. A sequencer is a device that stores messages, maintains time relationships among the messages, and transmits the messages when they are called for from devices connected to it. According to Alten (1994), the sequencer is the brain of the MIDI studio.

Review of Related Literature

The purpose of this study was to determine if a preference exists for recorded acoustic music or music using sound sampled timbres, and if that preference is influenced by age or gender. Related studies pertain to the following areas: the construction and establishment of music preference; timbre discrimination abilities; and timbre preference. The following review of related literature examines these fields of study.

Preference

Wapnick (1976) provides an in-depth overview of research on attitude and preference for music. He cites eighty-two studies conducted from 1924 through 1976. His report emphasizes three main topics: 1) methods of attitudinal measurement, 2) variables (musical, situational, and subject) related to attitude formation and change, and 3) desirability of manipulated attitudinal change in the classroom.

Various scales and methods have been constructed to measure preferences and attitudes. Wapnick asserts that most measurement designs fall into two categories: traditional scales and behavioral preference. Traditional scales include questionnaires, viable scales, paired comparisons, multiple-choice scales, equal-interval scales, spatial scales, semantic differentials, ranked preferences, and visual presentations or photographs. The most commonly used scale is the equal-interval scale where respondents rank their responses along a number of points on a line or dimension of the scale. Seashore and Hevener (1933) were the first to recommend its use for music. Behavioral preference or operant preference attempts to assess preference through observing behavior or actions of the participants. Although some disagreement exists as to whether preferences, attitudes, and behavior are closely related, Edwards and Edwards (1971) suggest that only under "unusual psychological pressure" do attitudes and

behavior not correlate. Wapnick cautions however, that the superiority of behavioral preference measures over traditional attitudinal measures has not yet been established.

The formation of preferences and attitudes toward music has been shown to be somewhat dependent on the following variables: musical, situational, and subject. Those musical variables shown to influence preferences for music are repetition, redundancy of melodic material, teaching method, and familiarity developed through repetitive listening (Mull, 1957; Getz, 1966; Bradley, 1972; McMullen, 1974).

Situational variables pertain to environmental influences. Environmental influences found easier to measure are repetitive listening, musical training, expectation effects, effects of teaching method, and students preexisting attitudes toward musical activities in the classroom, as well as their music teacher. All of which have been shown to exert some influence on the development of preference (Wiebe, 1940; Marill & Mull, 1942; Evans, 1965; Getz, 1966, Duerksen, 1972, Bartlett, 1973; Abeles, 1975; Kuhn, 1975, Radocy, 1975). Certain situational variables have proven to be more difficult to manipulate and measure. These are peer and community influences, socioeconomic status and attitudes towards music, and the effects of musical training on preference (Rubin-Rabson, 1940; Burmeister, 1955; Johnstone & Katz, 1957; Williams, 1972). Contrasting results exist among these studies.

Results from research examining subject variables have found no relationship between intelligence of respondent and music preference (Rubin - Rabson, 1940; Keston & Pinto, 1955; Getz, 1966). An assessment of personality traits revealed that people with similar attributes had similar music preferences (Hedden, 1973). Musical aptitude also has been shown to be somewhat related to musical preference (Fay & Middleton, 1941; Getz, 1966). Of particular interest to the current study were the variables of gender and age, and their influence on preference for music. Wapnick's overview illustrates

the contrasting results found by studies related to gender and age (Fay & Middleton, 1941; Farnsworth, 1949; Fisher, 1951; Music Journal, 1951-52; Keston & Pinto, 1955; Rogers, 1956; Baumann, 1960; Hornyak, 1966; Bradley, 1969). He summarizes the research that examines the independent variables of gender and age on the dependent variable music preference as inconclusive. Hence, theories of preference for music influenced by gender and age are difficult to construct.

Lastly, Wapnick draws attention to the controversial topic of the influence of the music educator over the attitudes, and ultimately the values of his/her students. Should music literature taught in the classroom reflect the students' interests or what the teacher deems as worthy? He cites Madsen's belief that the development of an effective teaching method is more important than what is chosen to be taught (Madsen, 1973). In conclusion, Wapnick asserts that music teachers must present unfamiliar musical stimulation. It is only when the students have gained familiarity with the music, he argues, is the opportunity created for the music to become meaningful .

LeBlanc's model (1982) of the interactive theory of preference provides a foundation for the current study. LeBlanc summarizes his theory as follows: "Music preference decisions are based upon the interaction of input information and the characteristics of the listener, with input information consisting of the musical stimulus and the listener's cultural environment" (p. 29). The model represents a hierarchy. Music or input information enters for processing by the listener, and moves steadily upward, receiving influence from the music stimulus and the listener's cultural environment. Movement on the hierarchy, however, may be two-directional (up or down) indicating the interaction of variables. Of crucial interest to the current study is the role of the physical properties of the stimulus (specifically timbre) in the development and establishment of music preference. LeBlanc states that "the physical properties, complexity, and referential

meaning of the music stimulus, as well as the quality of the performance through which it is heard, influence the music preference decision" (p. 31). He posits that listeners' with or without musical training have the ability to distinguish pleasing or displeasing physical properties of music (which timbre is a component). The entry level of LeBlanc's model is divided into two sections: one representing stimulus input and the other representing the influence of the listener's cultural environment. The current study acknowledges the influence of the cultural environment (as postulated by Walker, 1990) but investigated the influence of timbre on music preference. Research pertaining to timbre preference will be reviewed later.

As illustrated in Wapnick's (1976) overview, the listener's gender may influence music preference, although to what extent has not yet been convincingly established. The effect of age or maturation is even more difficult to measure. LeBlanc's (1982) theory illustrates how age interacts with the cultural environment in developing preference. LeBlanc postulates that at different ages, a listener will be more or less susceptible to influences in their environment. Young children tend to respect the opinions of influential or authoritative persons, thus expressing preferences intended to please these people. Peer pressure and the media exert strong influence over the preferences of adolescents. Adults tend to explicate preferences for themselves, that is, judgments not influenced by outside or environmental factors. Physical changes resultant from maturation (such as hearing loss) may influence the entrance of the musical stimulus which in turn, may influence the development of music preference. LeBlanc's interaction theory of music preference provides critical insight into the structure and development of music preference.

Daniels (1994) summarized the findings of studies which examined the musical preferences of preschool-aged children. The relationship between music preference and

four factors pertaining to repetition, music discrimination skills, active involvement with music, and social reinforcement were explored. Repetition and social reinforcement appear to exert the most influence on pre-school childrens' music preferences (Perry & Perry, 1986). Greer, Dorow, and Randall (1974) did not find a significant increase in free operant listening as a result of learned simple discrimination skills. Sims (1986) found that both high teacher affect and active-listening activities positively influenced childrens' attentiveness whereas Callihan and Cummings (1985) found that active participation and teacher affect enhanced operant preferences for music.

Based on prior research, Daniels (1994) stresses the need to expose preschoolers to various styles of music to develop an overall appreciation for music. Preschools, according to Daniels, should develop music curriculums that include music that the children are less likely to have experienced. She also advocates the use of musical activities to enhance the music preference of children. Of specific interest to the current study was the observation that preferences are formed early in life (Greer, Dorow, & Randall, 1974; Geringer, 1977; LeBlanc, 1979; and Peery & Peery, 1986).

The area of repetition is also of interest to the current study. Repetition develops familiarity and research has illustrated that familiarity exerts great influence on the development of music preference. It may also be argued that repetition could be viewed as a part of the listener's cultural environment. The Aesthetics Research Group at Leicester University, headed by Hargreaves (1984) developed an inverted U-theory, which represents the effect of repetition and familiarity on preference. The theory declares "that completely unfamiliar objects tend to be disliked; with increasing familiarity, liking rises to a peak, and subsequently declines" (p. 134). The theory was applied to an investigation of musical prejudices. Relevant to the current study was the observation that people may not like a style of music, but they may still recognize and respect the

genre for its high quality. All participants in Hargreaves' experiment scored classical music significantly higher for quality, but not for liking, than the popular pieces. This alludes to the ability for people to "fragment" different aspects of their attitudes. This directly applies to the current study's selection of classical music to present the different timbres. Arguably, the classical idiom may be the most recognizable and/or respected music by the participants. Larson's (1971) research tends to support the Inverted U-theory. He explored the effect of musical and extramusical information in the development of the music preferences of elementary music students. Basically, results concluded that too much repetition produced a dislike for the music.

The influence of repetition, in regards to music preference was also examined by Bradley (1971). Bradley constructed a research design to determine if repeated listening experiences to contemporary art music would significantly alter the expressed musical preferences of seventh grade students. Once again, his results supported prior research that exhibits the powerful influence of familiarity through repetition to positively develop music preference.

Tempo has also been shown to exert a major influence on music preference. LeBlanc and McCrary (1983) investigated the effect of tempo on the music preference of fifth-and sixth-grade students. Twenty-four traditional jazz-style musical examples representing slow, moderately slow, moderately fast, and fast tempi were recorded and presented to listeners. Participants convincingly exhibited preferences for fast tempi, supporting earlier research where tempo was an independent variable combined with other musical elements in determining music preference. Using LeBlanc's categories of tempo, the current study employs musical selections which are moderately slow to moderately fast. All tempi are between the metronome markings of quarter note = 88 to

112 beats per minute. According to the results of LeBlanc and McCrary, these tempi should not distract (positively or negatively) the listeners attention from timbre.

In later research, LeBlanc, Coleman, McCrary, Sherrill, and Malin (1988) conducted research as a part of a continuing series designed to construct and establish a formal theory on the development of individual music listening preferences. Again, tempo was the central focus, however, participants ages served as an additional independent variable. Nine hundred twenty-six students, enrolled in grades 3 through fourth year of college, heard the same tape as used in the earlier experiment (1983). Respondents indicated which musical example they most preferred according to tempo. Important to the current study is that all participants showed a statistically significant preference for fast tempi. The faster the tempo, the more they preferred the example. These results support the use of moderate tempi in the current study, so attention will not be distracted by a strong approval or disapproval of tempo for the musical selection.

In other preference research, LeBlanc (1979) sought to identify the most preferred generic music style of fifth grade students. In addition, he strove to identify the critical competitors of the most preferred style. Two hundred seventy-eight children listened to a short listening test which was developed as a measurement of preference for different generic styles of music. Cultural environment variables and the personal qualities of the respondents were explored. Data suggested that fifth graders could discriminate timbres, novel timbres, and mechanical sounds. Overall data exposed easy-listening pop as the most preferred style of music. Although rock was second, ragtime, Dixieland, band-march, country and western/bluegrass and randomly generated electronic stimuli earned preference scores statistically comparable to rock. This finding draws attention to the need for music educators to not prejudge or assume what the music preferences are of their students.

Wapnick and Rosenquist (1991) have explored a relatively new area of research in music preference. Their study investigated preferences of undergraduate music majors for sequenced versus performed piano music. Forty participants were asked to rate performances in five dimensions: quality of recording, tone quality of piano, technical merit, artistic merit, and overall impression. The researchers were interested if sequenced music examples could adequately emulate the technical and artistic levels of expert performers. The listening examples were composed of excerpts from four different performances of four solo piano pieces, of which one was sequenced. The results indicate that experienced pianists who do not have the pianistic abilities of recording artists may be able to create sequenced versions of piano music that are of equal technical and artistic merit. The current study incorporates sequenced excerpts designed to emulate actual performances to investigate the influence of timbre on preference for music.

Investigating reactions of musically trained (n=34) and untrained (n=69) individuals to various digital synthesizer and sampled acoustical sounds, Price (1995-96) found that musicians' tended to have a negative bias towards synthesizer timbres. Using a 10 point semantic differential scale, participants rated six performances of three pieces, one synthesized and one sampled per selection, for music quality, recording quality, tone quality, technical merit, artistic merit, overall impression, interest, pleasantness, complexity, and familiarity. Overall findings revealed that musicians' tended to rate everything lower for the synthesized selections, with the exception of familiarity. Interestingly, two surprising results occurred: 1) though both performances for each example were identical, musicians rated even the quality of music higher for the sampled timbre; and 2) no significant difference existed between the perceived complexity of musicians and nonmusicians, contrasting earlier research by Hargreaves (1986). Price posits that no radical or progressive idea, such as the use of synthesizers and samplers in

music, has ever been initially well-received and that further research may provide a foundation from which informed judgments may be formulated.

Indirectly related to the current study, is research probing the establishment of children's preference for instruments, of which timbre is an independent variable. Byo (1991) sought to determine the impact of biased instrument demonstrations in modifying students' unfavorable responses to specific band instruments. The influence of sexual stereotyping was also examined. Results correlating pretest/ posttest data demonstrated a significant change in students' stated instrument preferences. Byo asserted the need for music teachers to be aware of children's biases when constructing presentations of instruments to offset or dissuade those biases.

Geringer (1977) studied operant behavior preferences versus verbal preferences for musical instruments in children ages 3-5. He also sought to determine the existence of consistent patterns of preference for specific musical instruments among musically naive children. Although novelty may have influenced children's preferences, consistent patterns of initial instrument preference were demonstrated. Verbal statements of preference corresponded to operant playing behavior for only 16 of the 40 children. This reveals that spoken preferences may not represent "true" preferences.

Timbre Discrimination

A review of the literature reveals significant interest in timbre during the 1970's. Perhaps this was due to the rapid advancements in computer technology. Computers gave scientists interested in the structural and perceptual properties of music timbre, the ability to determine the perceptual closeness of acoustic timbre with synthesized timbre, opening the way for sound sampled technology (Risset and Wessel, 1982). Many of these studies investigated the acoustical or scientific structural properties of timbre (Plomp, 1970; Wedin & Goude, 1972; Wessel, 1973; Grey, 1975; Chowning, 1977;

Schottstaedt, 1977; Gordon & Grey, 1978; Risset, 1978; Terhardt, 1978; LeBrun, 1979). For the purpose of this study, timbre discrimination and perception research will be examined.

Kersey (1966) was one of the first music educators to explore the effect of an exploratory instrumental program on the aural perception of timbre. Kersey theorized "that exposure to an exploratory program of instrumental music instruction would have a desirable effect on the musical development of children by improving their aural perception of timbre" (p. 303). Two hundred twenty-five fourth grade students were selected to participate. The experimental group had received exploratory instrumental instruction in grade three and continued that instruction in grade four. The exploratory instrumental instruction was instituted for one-half school year on the following four instruments: clarinet, trumpet, violin, and percussion. The control group did not receive the exploratory experience. Both the experimental and control groups were administered a Test of Aural Perception of Instrumental Timbre.

Kersey's Test of Aural Perception of Instrumental Timbre presented forty examples, each five seconds in length, on Bb concert pitch performed by one of the following instruments: flute, clarinet, saxophone, trumpet, trombone, tuba, violin, or cello. Results indicated that students who participated in the experimental group scored significantly higher on the test than did students in the control group. The exploratory program improved students' ability to identify the timbres of the eight instruments. Kersey concluded that students who received instrumental music instruction are better able to perceive timbres than students' who do not receive instruction.

Research conducted by Johnston (1994) however, disputes Kersey's findings. The purpose of Johnston's study was to investigate the ability of trained musicians and musically untrained college students to discriminate music instrument timbre as a function

of duration. Timbre discrimination as a function of duration, musical ensemble participation, and the relative discrimination abilities of vocalists and instrumentalists were examined. A same-different response was constructed in which 120 timbre pairs were randomized and counterbalanced. The trumpet, clarinet, and violin timbres comprised the pairs in 2 blocks for data collection. To replicate an actual musical listening experience, complete, complex timbres were recorded digitally and presented in a sequence of changing pitches.

Conclusions were that the threshold for timbre discrimination as a function of duration is at or below twenty milliseconds. Of interest to the present study is Johnston's findings regarding the abilities of trained musicians and musically untrained college students. Johnston found that trained musicians tended to discriminate timbre better than musically untrained college students, however, this difference was not found to be significant. Johnston summarized his findings in stating that musicians could not discriminate significantly better than those subjects who had not participated in musical ensembles.

Grey and Moorer (1977) "measured the ability of trained musicians to discriminate between an original tone and resynthesized tone and data- reduced forms of the original tone" (p. 454). In their study, the original tone was a digitized wave form of a recorded instrument tone. Participants were asked to discriminate which tone of the four notes per trial was in any way different than the others. Results suggested that the listeners responded to the magnitudes of the physical simplifications of the tones in their discrimination. That is, as the data reductions were made to the original tone, the listeners could more easily distinguish the different tone in each group.

In a later study, Grey (1978) compared timbre discrimination in isolated tonal contexts to discrimination in musical patterns . The discrimination between two synthetic versions of each of the three instrument timbres were examined in the following contexts: isolated

tones, single-voice melodic patterns, and multivoice musical patterns. The examples were computer analyzed notes played on three instruments: clarinet, trumpet, and bassoon. Results of the study were inconsistent from instrument to instrument. The clarinet and trumpet examples were more difficult to discriminate as more voices were added. The bassoon was more easily discriminated in the single-voice context . Additionally, all of the examples of the bassoon were better discriminated than either clarinet or trumpet . This phenomenon may suggest that timbre discrimination involves more than one factor or dimension. Grey concluded that the musical context seems to extend and amplify spectral differences between tones, while isolated contexts may make slight timbre differences more apparent .

Bernier and Stafford (1972) utilized Seashore's Test of Timbre Discrimination (1940) to examine the relationship of musical instrument preference to timbre discrimination skills. They hypothesized "that individuals who can easily detect differences in the timbre of a tone would be more likely to appreciate musical instruments with more complex sound waves, and that the degree of this tendency would be directly proportional to the length of time one has played the instrument" (p. 283). That is, a participant's musical instrument timbre preference is directly related to the instrument they chose to play.

Eight hundred and seventy-six respondents, categorized as adolescents and young adults from both sexes, listened to one hundred pairs of tones presented on two 78 rpm records. A questionnaire was completed to ascertain what instrument each person played and length of study spent on each instrument. Three hundred thirty participants indicated no musical instrument playing experience. Bernier and Stafford correlated the mean scores for each musical grouping with the wave complexity of the instruments which was determined by professional judgment. Results revealed that participants whose

instrument was solo voice earned the highest average timbre discrimination scores, while non-musicians displayed the lowest timbre discrimination scores.

Crowder (1989) investigated mental imagery as it pertains to the perception of timbre. Acknowledging that earlier research conducted by Segal and Fusella (1970) had found that mental imagery reduced sensitivity in auditory conditions, Crowder cited later research by Farah and Smith (1983) which reported that "imaginal tones raised sensitivity for tones of the same frequency" (p. 472). In experiment one participants were asked to respond to two successive tones, describing them as same or different. Experiment two used the same paradigm except the first tone was always a sine wave and then the participants were asked to form an image of what an assigned instrument would have sounded like playing that pitch. "A match between this imagined timbre of the first tone and the timbre of the second tone produced faster reaction time to identical pitches than a mismatch" (p. 472). "Humans, Crowder speculates, are utterly incapable of reproducing physically any but the grossest dynamic or spectral features of timbres" (p.478). Hence, sensory imagery, he concludes, improves participants ability to perceive timbre.

Pitt and Crowder (1992) "explored imagery for musical timbre further by investigating which acoustic attributes of a timbre are represented in its mental image" (p.728). According to Dowling and Harwood (1986) spectral properties and dynamic properties are the two primary components which contribute to the perception of timbre. Pitt and Crowder designed four experiments, each with two parts, which examined if spectral properties and dynamic properties are represented in the image of musical timbre. The paradigm required participants to distinguish two tones as same or different and the timbres of the two tones as same or different. Experiment one examined imagery of a single, real instrument. Experiments two and three used "synthetic stimuli" because spectral and dynamic properties could be more controlled, and experiment four

investigated if loudness is stored in auditory image. Results demonstrated that the image of timbre is based more on spectral properties than dynamic properties. Loudness is not associated with timbre, but probably encoded in another part of memory. Further research was called for which would be more "sensitive to the time varying properties of timbre" (p. 737).

Krumhansl and Iverson (1992) examined perceptual interactions between musical pitch and timbre. Of interest to the present study is that the results of Krumhansl and Iverson proclaim that "the musical function of timbre may be subject to perceptual limitations" (p. 739). Through three experiments they found that timbre variation did not alter pitch perception. Rather, "timbre perception was weak and was found only when pitch was constant" (p. 739). Krumhansl and Iverson postulate that perceptual interactions exist between pitch and timbre and that they are not perceived independently. "Pitch and timbre interact in perception" (p.749).

Cianfone (1986) examined the timbre discrimination skills of preschoolers, second graders, and sixth graders. The purpose of the study was to determine the relationship between age, sex, pitch level, and timbre discrimination. In addition, he examined the effects of prepuberty and puberty on timbre discrimination abilities of sixth grade females. Results found significant differences in timbre discrimination abilities due to age. No significant differences existed among prepubertal females and females in puberty at the sixth grade level. Sex exhibited no influences on timbre discrimination abilities.

Grice (1994) studied the effect of various timbres on the aural perception of young children. She examined relationships between timbre type, familiarity, and preference, as well as the influences of timbres used by the music teacher, and the home backgrounds, gender, and socioeconomic status of the students. Four hundred and sixty -nine first grade students were administered an aural melodic discrimination test. The test was divided into

thirds, according to the timbre used for the melodies. These timbres were a synthesized timbre, a vocal timbre, and a piano timbre. Additionally, all students were administered an aural familiarity test and two aural preference tests that incorporated timbres used in the study. Questionnaires were distributed to and completed by music teachers and parents concerning which timbres were used in the classroom and descriptions of home environment. Results yielded that familiarity with timbre did make a significant difference in aural discrimination skills. Aural discrimination test scores were found to be dependent upon timbre preference. Students who exhibited high preference for synthesized timbre earned significantly higher test scores.

Timbre Preference

Another component of examination in the Grice study was student preference for timbre. This introduces a subject crucial to the current study, timbre preference. Grice found that students most preferred the synthesized timbre over the vocal and piano timbre. Grice goes on to encourage the use of synthesized timbre in music education. Her research directly supports the data of Holton (1990) which also calls for the integration of synthesized timbre into the music education curriculum.

Holton designed a study to determine if children preferred acoustical or synthesized timbre and if playing an instrument had a significant effect on this preference. The Test of Acoustic and Synthesized Timbre Preference (TAST) was constructed by the researcher and consisted of two parts: (1) musical examples and (2) demographic information. The TAST employed two types of synthesized timbre. One that was to represent the acoustical instruments and one that was purely electronic in nature. Instruments taught in beginning band and orchestra were selected for the acoustical examples. These instruments were the following: violin, cello, flute, clarinet, trumpet, and trombone. Four hundred and seventy-nine students from the third, fifth, and seventh grades were surveyed. The

influences of gender, experience playing an instrument, grade, and school were explored to determine if they had a significant effect on children's timbre preferences.

Results indicated that playing an instrument did have a significant effect on timbre preference. Students who played instruments preferred the acoustical timbre, while non-playing students preferred synthesized timbre. Overall, boys preferred synthesized timbre more than girls. In contrast, girls preferred acoustical timbre more than boys. All three schools preferred synthesized timbre more than acoustic timbre, however, the mean for synthesized timbre in one school was considerably higher than the other means for the remaining two schools. The difference in preference for acoustical and synthesized timbre for each grade was significant. As students progress from third grade to seventh grade their preference for synthesized timbre decreased, perhaps due to involvement in instrumental music programs. On the basis of his findings, Holton proposes that children may prefer to play synthesizers more than acoustic instruments. As stated earlier, he consequently calls for the implementation of synthesizers in school music programs.

The problem of attrition in instrumental music classes prompted Edwin Gordon to develop a systematic examination of timbre preferences. Gordon (1984) developed, researched, and published the Instrument Timbre Preference Test (ITPT). "The purpose of the ITPT is to act as an objective aid to the teacher and parent in helping a student choose an appropriate woodwind or brass instrument to learn to play in beginning band music" (Gordon, 1991; p.33). "The ITPT is a group test composed of seven different synthesized timbres of the same short melody which are performed on a Moog Opus 3 Synthesizer" (Gordon, 1986; p.9). The synthesized timbres are as follows: first timbre-flute, second timbre-clarinet, third timbre-saxophone/French horn, fourth timbre-oboe/English horn/bassoon, fifth timbre- trumpet/cornet, sixth timbre-trombone/baritone/French horn, and the seventh timbre-tuba/sousaphone. A melody

possessing a range of an eleventh, was the musical example so as to produce a broad spectrum of each timbre. Five reasons were given for the use of a synthesizer produced timbres. One reason is that Gordon believes it is impossible for musicians to perform a given melody on different instruments with the same musical expression. Due to the restrictions of the attention spans of participants, the synthesizer was selected to produce the tones because all the different stylistic timbres could not be included on the test. In addition, a synthesizer could represent more than one instrument timbre that would allow students a choice of instruments to play for a given timbre, also reducing the time of the test. Lastly, the synthesized timbres would not be associated with outside or psychological reasons which might influence preference for that instrument. In 1986, Gordon published results of a two year study of the predictive validity of the ITPT and the Music Aptitude Profile (MAP). Earlier research (Gordon, 1965) established that the music aptitude of a student predicts success in beginning instrumental music with approximately 56 percent accuracy. The structure of his next study investigated the results of the MAP combined with the ITPT to predict success in beginning instrumental music instruction. The major purpose of the MAP is "to act as an objective aid in the evaluation of students' basic musical aptitude so that the teacher can better provide for individual needs and abilities" (Gordon, 1965). Results of the two year study showed that "72 percent of the variance for students' success in beginning instrumental music is a result of a combination of their music aptitude and an environment which allows a student to play an instrument for which they have a timbre preference" (p. 16). Later research conducted by Gordon (1991) supported "the practical validity of the ITPT, particularly in terms of longitudinal prediction" (p. 48).

Weaver (1987) tested three hundred-eleven students in grades four, five, and six to investigate the relationship between preference for "natural" and "synthesized" timbre.

Weaver constructed a Timbre Preference Measure (TPM) incorporating nine band instruments demonstrating one melody performed by professional musicians. To demonstrate the synthesized timbre, Weaver incorporated Gordon's ITPT examples. The same melody was presented by both the ITPT and the TPM. The elementary students were administered the TPM by the researcher and approximately one week later were administered the ITPT. Weaver's study examined the interrelationships of preference for specific natural timbre and specific synthesized timbre and found that significant preference for timbre existed only in extreme ranges for both natural and synthesized tones. She did not ask respondents to indicate a preference for one timbre (synthesized or acoustic) over the other, rather her study looked for relationships within each timbre group and if there was a correlation for preference between the timbre groups.

In 1988, Schmidt and Lewis performed a validation study of Gordon's ITPT. Citing Weaver's results, Schmidt and Lewis found that there existed a remarkable lack of commonality between the ITPT timbres and the music instrument timbres they were intended to represent. Overall results of their study did lend support to the hypothesis "that timbre preference may be an important factor in instrumental music" (p.153). Schmidt and Lewis, however, found inadequate reliability and criterion-related validity for certain timbres in the ITPT. Prompting them to suggest that the ITPT should be re-developed before it serves as a measurement of timbre preference and predictor of future instrumental music success.

Cutieta and Foustalieraki (1990) surveyed fourth grade students in the United States and Greece for timbre preferences for select band instruments versus non-band instruments. They also attempted to determine the effect of cultural differences on instrumental preferences. Two hundred and thirty fourth graders from the United States and 198 fourth graders from Greece listened to a tape of 18 pairs of musical examples

(constructed so only the timbre was different) and were asked to indicate which of the two they preferred. Clarinet, trumpet, and bassoon were selected to represent the band instruments and guitar, piano, and violin were selected to represent the non-band instruments. American students tended to prefer the trumpet and clarinet timbres. However, many American students selected the violin and guitar. The Greek students strongly preferred the non-band instrument timbres over the band instrument timbres. There was a sizable proportion from both cultures that preferred timbres of instruments which were not represented in the local school programs, which supports the theories of Walker (1990) and LeBlanc (1982), which postulates that the listener's cultural environment develops their preferences. School is apart of the listener's environment, but this study suggests that the strongest influences may be outside of the school.

Of unique interest to the current study is Darrow's (1991) examination of the timbre preferences of hearing impaired children. Twenty-one children from grades 2-4 at a state school for the deaf participated in this study. All of the children suffered from severe or profound hearing loss. Each student listened to Gordon's ITPT and indicated on an answer sheet which of the two timbres they most preferred. Results yielded a group preference for the clarinet and saxophone/French horn timbres. Surprisingly, the flute was the least preferred. Individual timbre preference demonstrated the clarinet as the most preferred timbre. Some students, however, did not indicate a strong preference or dislike for any timbre. Data from this study supports previous studies which showed that preferences are more apparent in older children and that preferences may have a cultural bias. Cultural environment may explain the lack of preference among some of the hearing impaired children, who have had little contact or exposure to music stimulation .

In a study that focused on the relationship between personality type and timbre preference, Stewart (1992) found that all personality types (which were determined by

the Myers-Briggs Type Indicator) had similar timbre preferences. The largest difference of timbre preference existed between introverts and extroverts. Results revealed that introverts preferred the flute-like timbre and extroverts preferred the trumpet-like timbre. This study also surveyed people over the age of 50. Of particular interest to the current study is Stewart's finding that few sex- or age- related timbre preferences existed.

May (1995) attempted to determine the stability of timbre preference of students in the sixth grade through the tenth grade. Once again, Gordon's ITPT was used to measure the students' timbre preferences. "All sixth grade students enrolled in a single school district took the ITPT" (p.1). Four years later, the same students were re-administered the ITPT. Results reflected that timbre preference for two thirds of the students had changed from their original timbre preference. In contrast to previous studies, data determined by information obtained from a questionnaire suggested that gender, band instruction, and musical home environment did not appear to make any significant difference in influencing the stability of timbre preference.

Chang (1995) found that age influenced preference for sound sample timbres over recorded acoustic timbres. The older the respondent the more they tended to prefer the sound sampled timbres of flute, oboe, trombone, and tuba. In her study, she also found that gender significantly influenced a preference for the trumpet timbres.

Conclusions

Previous research by LeBlanc (1982) has demonstrated that music preference may be developed from the interaction of the listener's stable characteristics with the musical stimuli and the listener's cultural environment. Wapnick's (1976) overview of research revealed that the effects of age and sex on music preference has not been convincingly determined. Results from numerous studies have asserted that children have the ability to discriminate and recognize timbre and that this ability may improve with age (Kersey,

1966; Gordon, 1984; Cianfone, 1986; Weaver, 1987; Cutietta & Foustalieraki, 1990; Holton, 1990; Grice, 1994; May, 1995). Research has also revealed that students prefer synthesized timbre over acoustic timbre (Holton, 1990; Grice, 1994). In contrast, Chang (1995) found that older people preferred sound sampled timbre.

The current study attempted to determine if a preference for music (recorded acoustic or sound sampled) exists and if that preference is influenced by age or gender. The timbre discrimination abilities of fifth, sixth, seventh, and eighth graders were surveyed in the present study. Based on prior research, their ability to detect timbre should not be of question. Adults, ages 50-91 were also surveyed.

The current study employed the use of sound sampled timbre because this technology is used commercially to represent acoustic instruments. The purpose of the current study was to determine if a preference exists for recorded acoustic music or music using sound sampled tones, and if that preference is influenced by age or gender. Results may have ramifications for music education curricula, as well as future music consumption.

Method

Participants

Participants represented a wide spectrum of backgrounds and experiences. The experiment was conducted in eleven sessions in the following environments: one elementary general music class (5th grade), three middle school science classes (grades 6-8), a community center, retirement community, public conference room, and a church all located within a ten-mile area in southwestern Virginia. The participants were sectioned into two groups according to age. Group I included 10-15 year-olds, group II included ages 50-91. Group I (youths) had 97 participants and group II (older adults) consisted of 99 respondents.

Materials

The researcher selected 15 excerpts, four measures in length, from classical music literature to represent recorded acoustic and sound sampled timbres. The selections were chosen for their similarity in rhythmic and melodic content (See Appendix B for titles of selections). Based on the findings of Chang (1995), the flute, oboe, trumpet, trombone, and tuba, were selected to represent the musical examples in the current study. Each instrument individually presented three different melodies. Consideration was given to the range of pitches for each example so that the resulting tessitura would facilitate the production of a pleasing, characteristic tone on each instrument. All selections were performed in the key of F major.

The excerpts were then entered into computer files with the compositional notation software program, Mosaic 1.4 (1994). These files were then saved as standard MIDI files and imported into Performer 5.01 (1994), a sequencing software. Performer 5.01 is a MIDI sequencer designed to provide comprehensive MIDI recording, playback, and editing of files. Participating musicians recorded the acoustic excerpts in a digital multi-

track recording studio. To not distract the listener's attention from timbre, all instrumentalists' were asked to perform the excerpts at approximately 92 beats per minute. No other performance considerations were given. This would allow each instrumentalist to perform their own interpretation of the selection.

The acoustic samples were captured to DAT (digital audio tape) using a Neumann KM-140 cardioid condenser microphone and a Focusrite preamplifier. The recording process also included the use of the Yamaha AD8X Converter, which converted the analog continual wave forms into digital discrete intervals. The digital signal entered the Yamaha Digital Mixing Console 1000. A cassette tape was then made of the digital master to be used by the researcher.

The researcher then matched the MIDI files to the acoustic samples. Careful attention was given to emulate exactness of attacks, dynamics, use of rubato or accelerando, tempo, and *crescendi* and *decrescendi* in the actual performances. A professor of music with expertise in music technology then listened to and critiqued the MIDI files, and concluded that the files closely emulated the actual performances.

The sampled sounds were produced from the E-mu Systems' *Proteus/2* 16-bit Multi-Timbral Digital Sound Module. The sounds are based on actual digital recordings of acoustic instruments. The recording engineer loaded the recordings of the acoustic examples, sampled examples, and recorded instructions (given by the researcher) into the Sonic Solutions Digital Audio Workstation, which is a hard disk editor that is used to edit and assemble digital audio recordings onto the final compact disc (CD). An 18 minute compact disc recordable (CDR) was used to store the final product. It is important to note three characteristics of the recording procedure: 1) the analog audio waveform was converted to digital only once; 2) no equalization or compression was used; and 3) the recording engineer in cooperation with the researcher, matched the apparent loudness

levels of all the excerpts to ensure that apparent loudness would not influence the listener's perception of the timbre of the music. The order of the presentation of recorded acoustic and sound sampled timbres was randomly altered throughout the survey. For all sessions, the Sony CFD-454 CD Radio Cassette-Corder was used to present the research CD. A panel of graduate music education students listened to the research CD and concluded that a distinguishable difference was apparent between the recorded acoustic timbre and the sound sampled timbre.

A survey form was designed to record the preferences of the participants. Seventeen response items were included on the form. Two items were for participant practice and 15 items were selected to record their preference.

Procedure

Prior to each session, instructions were given by the researcher regarding the format of the survey. No indication was given as to what kind of timbre would be presented. Respondents were asked to circle the letter of the example they most preferred. After the survey forms were distributed, the participants listened to the CD, which also contained instructions given by the researcher and the musical selections. Two practice exercises were heard to familiarize participants with the procedure of the survey. Participants then heard 15 pairs of musical selections, each consisting of one recorded acoustic and one sampled sounds. Each of the five instruments performed three selections. After hearing the example they indicated which selection they preferred by circling the appropriate letter on the survey form. Upon completion of the survey, participants promptly handed in their forms.

Results

One hundred ninety-six participants listened to the musical selections and completed the preference survey. Group I (10-15 year olds) had 97 participants and group II consisted of 99 respondents, ages 50-91. The total sample included 79 males and 117 females.

Each of the 15 selections on the survey was treated as a test item, with the sound sampled choices producing a score of 1 and the recorded acoustic choices equating a score of 0. Fifty-eight point seven percent of the respondents preferred a majority (8 or more out of 15; see Table 1) of musical selections using sound sampled timbre. Overall reliability as measured by Cronbach's alpha was .35. A review of the item responses indicated that older adults did not respond as consistently as the younger participants. Of relevance to the current study was the reliability of Gordon's (1984) ITPT. His test contained 42 items and he reported retest reliabilities that ranged from .46 to .89 (Weaver, 1987). Gordon's ITPT is approximately 3 times the number of items found on the current study. If the survey in this study were 3 times as long, its reliability as estimated by the Spearman Brown Prophecy formula would be .62. The researcher, however, chose not to lengthen the survey due to the attention span of participants. Given the results of the Spearman Brown Prophecy calculation (Mehrens & Lehmann, 1980) the survey was deemed reliable for the purposes of this study.

The present study employed a 2x2 factorial design with age, gender, sound sampled timbre, and recorded acoustic timbre as the variables. The results of the analysis of variance to test the effect of age and gender disclosed that there was a significant difference between the two age groups, with older adults preferring a higher percentage of musical selections using sound sampled timbre ($F= 6.854, df=1, p \leq .001$). There was no

Table 1

Total Percentages of Preferences for Musical Selections Using Sound Sampled Timbre

# of selections	Freq.	Percent	Cum. Percent
1	0	0.0	0.0
2	2	1.0	1.0
3	1	.5	1.5
4	9	4.6	6.1
5	13	6.6	12.8
6	24	12.2	25.0
7	32	16.3	41.3
8	32	16.3	57.7
9	27	13.8	71.4
10	26	13.3	84.7
11	16	8.2	92.9
12	10	5.1	98.0
13	3	1.5	99.5
<u>14</u>	<u>1</u>	<u>.5</u>	<u>100.0</u>
Total	196	100.0	100.0

significant difference between males and females nor was there a significant interaction between age and gender.

The total number of selections preferred by the two groups had a polarizing effect, hence, a strong overall preference for musical selections using sound sampled timbre was not exhibited. A closer examination of each of the five instrument timbres demonstrated the effect of age on preference within individual instrument timbres. An analysis of this data follows.

Scoring of each musical instrument (trumpet, flute, trombone, oboe, and tuba) was similar to the scoring of the 15 selections. For the purposes of this study, preference for a specific timbre existed when a participant selected 2 out of 3 or 3 out of 3 selections using that particular timbre for the individual instrument excerpts. The 3 excerpts for an instrument were summed so that a participant who indicated "0" equals no sound sampled timbres selected and a "3" represented all musical selections using sound sampled timbre were chosen for that instrument. A chi-square analysis was conducted investigating the frequencies of preference demonstrated by the age groups for musical selections using sound sampled timbre (see Table 2). For 4 out of the 5 instruments, significance pertaining to preference influenced by age existed (trumpet, flute, trombone, and tuba). All 4 of the instruments yielded significance at $p \leq .05$. Gender did not demonstrate a significant influence for any instrument. An interesting pattern was discovered in the preferences of the age groups for the musical selections.

Of the 97 youths, 29% preferred all recorded acoustical excerpts for trumpet compared to 10% of the 99 older adults. Only 7% of the youths preferred all sound sampled excerpts for trumpet compared to 25.3% of the older adults. When looking at the total number of selections for each instrument (out of the possible 3 examples) for 4 out

Table 2

Significance Levels of Chi-Square Analysis of Individual Instrument for Frequencies of Preference for Musical Selections Using Sound Sampled Timbre By Age Group

Instrument	Chi-Square	DF	Significance
Trumpet	19.18120	3	.00025 *
Flute	10.96974	3	.01 *
Trombone	7.69538	3	.05 *
Oboe	4.924	3	.18
Tuba	8.95135	3	.03 *

* $p \leq .05$

of 5 of the instruments (trumpet, trombone, oboe, and tuba), a higher percentage of youths over older adults, preferred either 0 out of 3 sound sampled selections or 1 out of 3 sound sampled selections. For the same group of instruments, a higher percentage of adults preferred 2 out of 3 or 3 out of 3 sound sampled selections. (Please see Table 3 for the pattern of percentages of preference for each instrument according to age group.)

The established pattern did not occur for the flute musical selections. In addition to the trumpet, the pattern for percentage of age groups' preference for sound sampled music was evident for trombone, oboe, and tuba. Even though age was not shown to have a significant effect on preference for music of the different oboe timbres, the pattern for percentages of age groups' preference for excerpts was also demonstrated. Interestingly, 77% of the total participants preferred the tuba selections using the sound sampled timbre. The established pattern of preference for number of selections nevertheless occurred.

Before discussing the results, randomization of the sample needs to be addressed. The sample chosen was selected to closely represent the area population, however, the sample was not chosen randomly, rather practicality was the determinant factor in the selection. Although these participants represent clusters in the community, the majority of the older adults tended to represent a more affluent, better educated segment of the local area.

Table 3

Pattern of Preference for Each Sound Sampled Timbre

Instrument	0	# of selections			Sign.
		1	2	3	
Trumpet					
Youth (%)	28.9	35.1	28.9	7.2	*
Adult (%)	10.1	31.3	33.3	25.3	
Flute					
Youth (%)	21.6	27.8	33.0	17.5	*
Adult (%)	16.2	48.5	46.7	7.1	
Trombone					
Youth (%)	8.2	41.2	42.3	8.2	*
Adult (%)	6.1	25.3	52.5	16.2	
Oboe					
Youth (%)	13.4	46.4	29.9	10.3	
Adult (%)	8.1	36.4	40.4	15.2	
Tuba					
Youth (%)	8.2	19.6	36.1	36.1	*
Adult (%)	.0	18.2	38.4	43.4	

(* = Significance at $p \leq .05$)

Discussion

The purpose of this study was to determine if a preference for music using recorded acoustic timbre or sound sampled timbre exists and if this preference is influenced by age and/or gender. The results suggest that a preference exists for both timbres and that this preference is determined by age. Youths tended to prefer more music selections using recorded acoustic timbre while older adults preferred more music selections using sound sampled timbre. Age significantly influenced the preferences of the respondents for 4 out of 5 instruments (trumpet, flute, trombone, and tuba) represented on this survey. Gender had no effect on the participants' preference, hence, lending support to earlier research conducted by Stewart (1992) and Cianfone (1986).

The findings of this study, however, do not support earlier research, which has suggested that children prefer synthesized timbre over acoustic timbre (Grice, 1994; Holton, 1990). In considering this, it is important to note the difference between synthesized timbre and sound sampled timbre. The most discernible characteristic of synthesized timbre is the readily identifiable electronic quality of the sound. Although a digitally recorded and stored waveform from an actual musical instrument is used as the sound generator for sampled sounds, the processes of multi-sampling and looping produces tones similar to actual instruments, but which possess timbral qualities unique to sampling.

An analysis of the individual instrument selections revealed a higher percentage of youths did not prefer sound sampled excerpts for the trumpet, trombone, oboe, and tuba. Conversely, a higher percentage of older adults preferred musical excerpts using sound sampled timbre for the same instruments. This pattern did not exist for the flute selections. The flutist who recorded the acoustic excerpts used extensively more vibrato than was presented in the patch for the sound sampled excerpt. According to LeBlanc

(1986), children tend not to prefer vibrato. This may explain why the children did not prefer the recorded acoustic flute selections to the same degree that they preferred the other instruments' selections.

This study chose to manipulate timbre, which is designated by LeBlanc (1982) as one of the physical characteristics of the musical stimulus. LeBlanc goes on to say that interaction of the physical characteristics of the musical stimulus with the listener's cultural environment ultimately leads to preference decisions. Based on the results of this study, timbre manipulation does effect preference decisions. However, this preference is strongly influenced by age.

Based on theories by Walker (1990) and LeBlanc (1982), it is logical to postulate that the older adults through experience, have had more exposure to acoustic music. Subsequently, older adults would tend to prefer music using acoustic timbre over music using sound sampled timbre. This preference may have been developed through repetition, familiarity, and expectations drawn from experience. Conversely, it is reasonable to conclude that the youth group would most prefer sound sampled timbre, also resultant from repetition, familiarity, and expectations drawn from experience. These results, however, did not occur in this study. Why did the older adults prefer the sound sampled timbre significantly more than the youth group? The researcher believes that the explanation may be found in the public schools.

Even though the majority of audiences at classical music concerts are categorized as older adults, the older adults who participated in this study may not have actively attended live concerts of acoustic music. That is, attendance at live performances is not a part of their environment. Compare the exposure of older adults to live performances with that of children, ages 10-15. Students attending this particular school system, receive exposure to general music classes, Orff ensembles, as well as choir and band concerts.

The elementary and middle school administrations also sponsor small and large ensemble concerts made up of musicians from local universities and high schools, both instrumental and choral. Acoustic music as presented in the public schools, may be a larger part of the youth group's environment than that of the older adults.

Due to the enrollments of the band and choir in the middle school in this study, several ensemble members could have participated in the survey. Although some research has suggested that musical training has no effect on the development of preference for music, the daily repetition of exposure to live music experienced by the musicians in class, may have developed expectations for music using acoustic timbre. As suggested by Cutietta and Foustalieraki (1992), the presence of the band in the school may have positively affected the preference for music using those timbres.

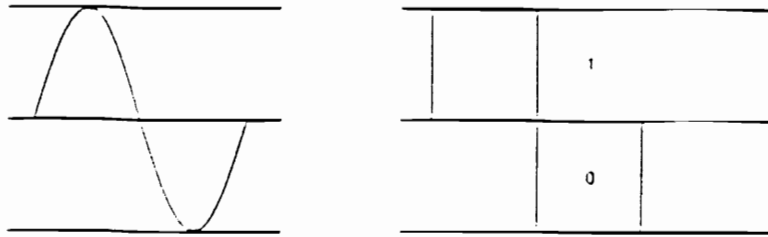
Another possible explanation for the results could be that older adults perceived the sound sampled selections as more perfect, hence a more appropriate or correct choice. Certain musical elements of the sound sampled timbre may have been perceived as more exact. These elements include the preciseness of attacks and releases, and intonation between intervals. Most adults want to appear knowledgeable, thus a preference for sound sampled timbre may have been indicated.

Recommendations for further research include the following: 1) the effect of musical training on the development of preference for music needs to be investigated. The question of measuring musical training for adults should be very specific and accurate. 2) the preference of band and choral students for music using sound sampled timbre needs to be measured to determine the influence of participation in ensembles on preference for music. This research should seek to expose any differences between preferences of band and choral students for music as well; 3) the musical selections presented should be recorded using analog equipment for the acoustic timbre. Analog recording allows for a

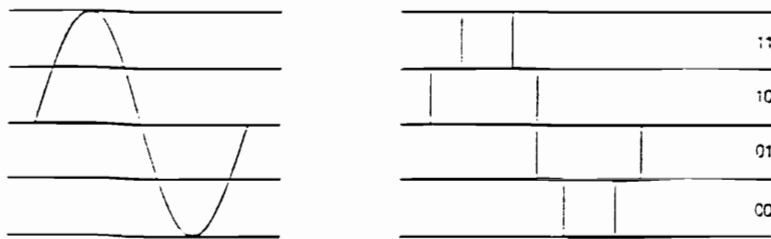
truer representation of the acoustic sounds. Even though analog cassettes undergo slight degradation each time they are played back, due to the relatively limited number of playbacks required in a study, the -closeness- of the analog recording of the acoustic model might prove to be more representative; 4) various musical genres should be studied to assess the influence of timbre on preference for music; and 5) a longitudinal study assessing the interaction of timbre with the listener's musical environment would assist in determining the degree of influence of both variables.

Although sound sampled timbre is similar to recorded acoustic timbre, the results of Chang (1995) and this experiment clearly demonstrate that the differences between the two timbres are discernible and that preference for either timbre is strongly influenced by age. In both studies, youths tended to prefer acoustic timbre while older adults tended to prefer sound sampled timbre. With increased availability and exposure to sound sampling, more and more compact disks will contain this timbre. Consumption of music using sound sampled timbre will inevitably increase. Further research will assist music educators in determining their role in the development of preferences for music using acoustic timbre. It would appear the role of public school music education programs on the development of preference for music has been well established. Music educators need to recognize their importance in the development of preference for music, and that the presentation of timbre used in the classroom may reinforce preferences for acoustic music.

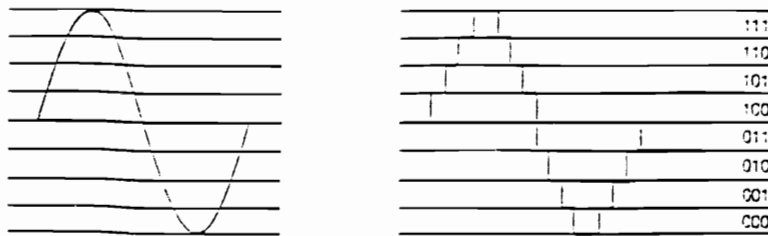
Appendix A-Representation of the Digital Recording Process (Alten, 1994)



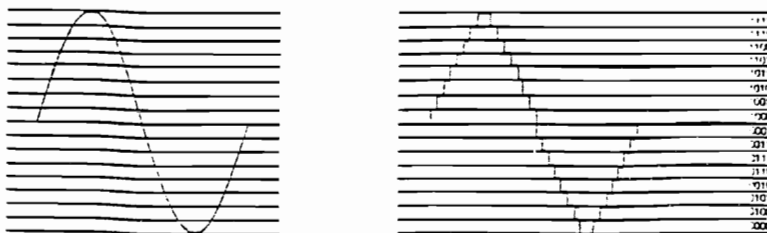
2 quantizing levels—1-bit system



4 quantizing levels—2-bit system



8 quantizing levels—3-bit system



16 quantizing levels—4-bit system

8-4 Coding. As the number of quantizing levels increases, the digital representation of the analog signal becomes more accurate.

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Appendix B- List of Melodic Excerpts
Instrument-Composer-Title

Excerpt #1- Trumpet Haydn, German National Hymn

Excerpt #2- Flute Tchaikovsky, Swan Lake (ballet) Theme

Excerpt #3- Trombone Ippolitov-Ivanov, The Sardar's Procession

Excerpt #4- Oboe Vivaldi, The Four Seasons- Winter: Second Movement

Excerpt #5- Tuba Beethoven, Symphony No. 9 in D Major Fourth Movement Theme,
"Ode to Joy"

Excerpt #6- Flute Saint-Saens, The Swan from Carnival of the Animals

Excerpt #7- Trumpet Handel, Thine Be The Glory from Judas Maccabeus

Excerpt #8- Oboe Elgar, Pomp and Circumstance March No. 1

Excerpt #9- Tuba Tchaikovsky, Marche Slav

Excerpt #10-Trombone Sibelius, Finlandia

Excerpt #11- Oboe Dvorak, Symphony No. 9 "From the New World" Second
Movement Theme

Excerpt #12- Flute Faure, Pavane

Excerpt #13- Tuba Bach, Jesu, Joy of Man's Desiring from Cantata 147

Excerpt #14- Trombone Jennings, Chester

Excerpt #15- Trumpet Brahms, Symphony No. 1 in c minor, Fourth Movement Theme

Excerpts #1-13, 15-16 were selected from The Real Little Classical Fake Book,

Hal Leonard Publishing Corporation, 1992.

Appendix C- Measuring Instrument

Survey form

Age_____

Sex_____

Please listen to the following examples and select the letter of the example you most prefer.

Let's **practice**:

Exercise 1. A B

Exercise 2. A B

Now you are ready to **begin**, please listen to the CD for the selections.

Selection 1. A B

Selection 2. A B

Selection 3. A B

Selection 4. A B

Selection 5. A B

Selection 6. A B

Selection 7. A B

Selection 8. A B

Selection 9. A B

Selection 10. A B

Selection 11. A B

Selection 12. A B

Selection 13. A B

Selection 14. A B

Selection 15. A B

The survey is now finished, thank you for your time and assistance.

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Vita

E. Christina Chang is a native of Christiansburg, Virginia. Her parents are B. C. and Dorothy Goodman. She graduated from Christiansburg High School in 1980. Upon completion of high school, she attended Virginia Tech, majoring in music. She received a B. A. in Music from Virginia Tech in 1985. She has taught instrumental music (band) for nine years in the states of Virginia and North Carolina. Her past positions include the following: Director of Bands, Manassas Park High School, Manassas Park, VA (1985-86); Director of Bands at Radford High School and Dalton Intermediate Schools, Radford, VA (1986-87); Band Director at Coulwood Middle School and Wilson Middle School, Charlotte, NC (1987-88); and Director of Bands at Gibson Middle, Langston Junior High School, and assistant director of the Marching Eagles of George Washington High School, Danville VA (1988-94).

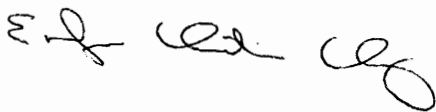
Chris' bands have earned excellent and superior ratings on the middle, junior high, and high school level at state concert festivals and competitions. The last six years of teaching, her bands earned unanimous superior ratings. While at Danville, the Langston Symphonic Band was invited to represent the state of Virginia at the 500th Anniversary Celebration of Columbus' Discovery of America, where they performed in Washington, D. C., on May 4, 1992. She has also served as a marching band adjudicator and concert festival adjudicator at over 30 competitions and festivals held in the states of Virginia, North Carolina, and South Carolina. Chris has made 12 appearances as a guest conductor of middle and high school honors bands in the states of Virginia and North Carolina. In 1994, she received the Langston Teacher of the Year Award for outstanding professionalism, leadership, and achievement.

From 1994-96, Chris has been a graduate assistant with the University Bands of Virginia Tech. She has assisted with the Marching Virginians (1994-96), served as

assistant conductor of the University Wind Ensemble(1994-96), graduate student conductor of Symphony Band (1996), Director of the Hokies Basketball Pep Band (1995), graduate student conductor of the Wind Symphony (1995-96), conducted small ensembles on three recitals/convocations and served as graduate teaching assistant of Music Appreciation. Her pilot study was selected for presentation at the poster session on research at the 1996 Music Educators National Conference Annual Meeting, held in Kansas City, Missouri.

Chris is a member of the collegiate chapter of the Music Educators National Conference at Virginia Tech, and a member of Phi Kappa Phi academic honorary fraternity. She is a past member of Virginia Band and Orchestra Directors' Association, and Music Educators National Conference professional level, and the national honorary band sorority, Tau Beta Sigma.

Chris is married to Fred Chang, who is the band director at Christiansburg High School, and they have a three year-old son, Ross.

A handwritten signature in black ink, appearing to read "Fred Chang". The signature is written in a cursive style with a large initial "F" and a long, sweeping underline.