EXPLORING MUSIC PREFERENCE:

AN EMPIRICAL STUDY OF A LEXICON FOR TIMBRE

By

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ABSTRACT

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This thesis studies the relationship of two communicative phenomena, music and words that common people use to describe music preference. An experimental design was used to test whether the lexical set of words that describe music preference vary with timbral variations. Using the music performance telecommunication standard called MIDI, timbre was varied while other performance attributes were controlled. Using one-way analysis of variance, significant differences were found between test timbre descriptions using the words: Exciting, Fun, Intense, Melodic, and Relaxing, although only Intense and Melodic showed significant difference across the combined variance of all 4 conditions. Using a traditional lexical set of words that describe style of music, significant differences across timbre conditions were found using the words Rock and Jazz. The results demonstrate the viability and utility of using precise instrumentation, experimentally controlled testing, and listeners own vernacular to guage music preference as a function of music message components.

Dedicated to that human sensation

and communication

that accompanies hearing

some new music

which you like upon first listening

and

continue to like for a lifetime

Acknowledgements

The lineage of any human is relevant to the present and for this reason let me thank my father, Frederick Ferdinand Faes Jr. for his musical inspiration he has been throughout my life. As a junior high school band director during the day and professional musician during the night, he showed me what a sensation music can be to the human spirit. With the lessons received at a young age, discipline was also learned. When the recordings of his school's bands were brought home for me to practice with, I truly learned about time-shifting with recording technology. In a pragmatic sense, my father told me in the early years of playing drums, that the important thing in drumming a beat is not to worry about how fancy you can get but rather how steady your time is, and most important "just don't stop." It must be his Swiss desire for time consistency. In addition, I have shared the stage with my father and have grown very used to top quality musicianship and saxophone playing in general. His fascination with history, discovery and exploration has also had great influence.

On the other side of the genetic coin are the influences of happiness, adaptability, sensitivity, and an incessant desire to further analyze, understand and link human behavior to physical explanation. Helen Sullivan Faes is all this linked together from combining a French farmer and Irish businessman. Protect thyself from useless influence, and watch your "tone of voice" are her favorite axioms. Adhering to this has allowed me to always find brilliance in the influence from my immediate group of significant others. In conjunction with this goes a sense of humor that knows no boundaries. When the chips

were low, mother can always explain the good side of it. Her constant desire to practice and study health care nurtured not only a mind for scientific inquiry but also a warrant to perform in the interest of human welfare. In addition to her practiced skills her motherly qualities raised an entire family no less and even though as strange and all-american as any other family, contained a feeling a coherance to a social cause, usually as individuals, but usually towards the same cause. These siblings get a mention. Kathy was the reference from ahead in life, what life could be like, and how the woman's role had changed. From the first sounds of the Meet the Beatles album to the recent cassette correspondance of Pat Methaney, Kathy has been a stable reference point. Even when her global position changes, it seems to draw me toward her for a brief visit and maybe do something as important as buying a synthesizer that can be used to test timbre. Kathy is a discoverer, and has always made me welcome from wherever she was discovering. Fred is the light-hearted one that has regulary reminded me to "don't worry about a thing," it will be alright. While Kathy was listening to the Doors and contemplating serious issues, Fred was listening to "Wild Thing" or dancing up a storm to James Brown. Dr. Fred has also been an academic influence by helping discuss career goals and conveying fields of interest that he had opportunity to study. One was anthropology which still to this author is of great importance to human inquiry. John, is the adjacent note in life that has been in touch with me for as long as I can remember. Had him and I not been adjacent, we might understand each other better but we make up for that by being constantly activity oriented when together, having good times in the widest variety of settings including the outdoors, on the bandstand, or just getting

together for a hockey game. He is the adjacent one on the bandstand that helps me hold the beat together in a music from the times of swing, latin, or dixieland. We are a rhythm section in music and in life. Never playing the same riff, but never too different either. Recently I thank him for his valuable insight on writing and the importance of doing each draft from start to finish, no stopping. My family was my first laboratory and all helped testing.

Robert E. Rockwell was a fire chief and gunsmith by trade and his leadership skills and manual artistry were unsurpassed. Whether it be discussing a welding torch, rifle or deer antler rub, he always demonstrated grace while handling observation. He believed that there is always a solution, and you'll eventually find it. If you don't have the part, make it and he regularly taught respect and experience in the outdoors, for he believed the adaptive skill helps one for life. When you are stuck, and can't possibly get out, laugh about it for a little while and then wait and think about how to get out. Eventually you'll get out. Be careful and then be careful again, and always value double checking. With his practiced rules from the trades of emergency, danger and explosives the lessons learned were always of a safe, adventurous, journey through mechanics, history, geography, and exploration.

Academic influences have been great, but of course there are too many to discuss here. There are significant points in life where you take a great turn in personal growth. In this light, first let me thank the Catholic nun, Sister James who encouraged this author in first grade to go ahead and perform the Beatles <u>Twist and Shout</u> during "show and tell." Although the mime of the song, the cardboard drums and the plywood guitar probably didn't resemble the Beatles, it did allow for a young child to

experiment with music, and see what the reactions of the other students were to this, at the time, whirlwind of talent called the Beatles.

James Walter Dinkelacker, Ph.D. is an unbelievable occurence of a friend, teacher, fellow musician, scientist, and futurist that any human could have the opportunity to meet once in life. If in the course of any project one becomes overwhelmed with the number of "stones still left unturned," talk to Jamie. He will quickly demonstrate first that half of the stones still unturned are irrevelent to your analysis and don't need turning, and the rest can be raised partially to obtain the data needed without expending energy to entirely turn them over. Jamie has been my mentor in scientific research, exemplifying that social science can be as scientific as the physical sciences, as long as you know your goals, measurement and analyses. Of course the write-up of your results is also an important step in science and for this reason Jamie regularly reminded me that these writing skills would only be acquired in graduate school, which he'd state is required by any individual desiring excellence and innovation. In many ways Jamie has been the reflective force, or maybe more accurately human amplifier, reverb unit, delay, stereo chorus, or any other "idea processing" of many interactions that molded the ideas in this work. If you need a different view, Jamie regularly has one to offer while at the same time if you just want support and amplification of a clear idea, he will do that also. As often goes with such a mind of inquiry, a healthy future view has always been there with a happy outcome for humanity. Space is the place, solar energy stations in orbit, commercialize space and shut down outdated dangerous means of generating energy. We have witnessed the U.S. swing to the right in the United States, the Olympic boycotts, right on thru to

the recent arms limitations agreements and Soviet withdrawl from Afghanistan. Together as humans, united in force. May all other humans on spaceship Earth have the opportunity to interact with such another special being.

Jeffrey "Prog" Marriott is a brilliant computerist, historian and comrade in global debate and contemplation. Since meeting Jeff and working side by side in the data processing environment we have discovered how two people of drastically different orientations and disciplines can augment and balance each other. He is the epitome of logic and insight, and always seems to ask that right question which steers one's mind to the critical issues. His companionship in outdoor excursions has always been a valued break from the mundane schedule and workflow of graduate school. Prog knows no limits in his ability, because he will always acknowledge and pursue the "otherwise." He practices counter attitudinal advocacy like no other, such that if you don't talk about something, it won't exist and if you discuss a plan you'll soon see it happen. I thank Jeff for his consistency.

Brenda Marie Rugenski is a recently found friend with whom I shared many long ago experiences from our Detroit pasts. Because of our similar symbol sets, and her incredible ability to focus all energy on others in any interaction she's involved in, quite often she focused that energy on this author, to believe in himself and let no one interfere with the absolute requirement of self-determination. In addition, the need to quickly get to the heart of the matter, and not dispose oneself to auxiliary distractions was at the forefront of messages from Brenda Marie. Brenda is a valuable partner in mind and spirit. Our ability to discuss major decision points in this graduate program and thesis when we

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My committee members have helped me finish graduate school and in many ways that is all that counts. Dr. Thomas Muth is an absolute joy to interact with, in either specifying legal interpretations, referencing discovery or running with creativity. His constant enthusiasm for one's own ideas made the whole project fun to do and sparked the desire for the next one. The various points at which we met were succinct in time with a status report of progress and a plan for the future. Progress was regularly made under his guidance and questioning. Gary Reid was my overall influence in audio production here at M.S.U. and is very good at what he does in production and teaching. His ability to entertain while teaching makes the ideas flow into the mind without much effort, while his wealth of production ideas always offer just one more approach to offer as a solution in the studio session. Whatever you want to do is "cool" and once you were done it sounds "pretty hip," were the encouraging words anyone needs to keep pursuing their production dreams, and Gary was always there to offer such encouragement and insight. Two other faculty members deserve mention. Dr. Larry Redd has been an inspiration since the seeds of these ideas were planted 10 years ago

especially when he helped me plant the first "music inquiry crop" back then. Upon returning to graduate school he has readily made himself available to me for fine tuning my music industry and research ideas and I am very grateful to him for that. Dr. Carrie Heeter has been a reference point at many times for experimental design, analysis and innovation. Carrie has that artistic ability to bring out the best in you through sound logic and unlimited horizons. Carrie is the driving force behind maintaining a technology environment for the aspiring communication scientist, and as a result you can get familiarized with just about any computer technology through Carrie.

There are a whole host of other people that I would love to discuss in great length, but I will acknowledge them by name and two words that describe prominent charactiristics which I associate with them and have influenced me as I finish this step in life. These wonderful humans are:

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Rock On' and Jazz, tgf

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Introduction. Timbre is part of musical messages that describes how different musical sounds are distinct (Harder, 1975). Whether it be a bass drum beat, a bright trumpet sound or a simple sine wave, the timbre can be described. This description can be provided linguistically and by mathematical formulations. Code systems are used to discriminate different timbre. Producers may use the word brightness, engineers may talk about decibels and musicians of richness. Listeners describe their preferred music with a shared vocabulary or lexicon which for the music researcher is a vital symbol set for communication with producers and listeners. Timbre is a lexicon of music producers and performers, however the common music listener does not use such formal lexical terms for music. Instead the average listener will use a set of words shared with peers to describe music one "likes." In describing music and accompanying socialized responses, this code system is very valuable. The lexicon of music preference is a measurable phenomenon. As music changes so does preference. Timbral changes often accompany changes in technology, since the creation of new types sounds can be the direct result of new technology. With the introduction of new digital production and telecommunication technologies, new timbres are invented everyday. Timbre is changing. This thesis studies whether timbre is related to musical preference. The focus is to measure the relationship between a **music production variable: timbre**; and, a **music listeners' variable: the lexicon for music preference**. If a relationship exists between timbral structure and listeners' preference then utility is provided for those whose goal is to produce, select or perform music. With such an analytical tool, gatekeepers of music messages could then

formulate production and programming decisions based on a music parameter: timbre.

Music Communication. Music is an old form of communication. In some sense it was the first form of communication that could travel over long distances, or "telecommunication." The sounds of drums and horns have been used for centuries to summons the members of language communities (Fishman, 1972), using recognizable signals, distinct from other communities. From the Greek lyre, to the Japanese koto and the American Indian drums, different peoples create different sounding timbre. Music has effects on listeners' physical and social behavior, resulting in ritualistic behavior such as dance and singing. In addition to these physical behaviors, social behavior such as talking and expressive reactions among listeners, is commonplace. A simple music communication model may include a message, media transmission, listeners, and feedback. This process can be depicted as:

Model for Music Communication
Figure 1

Music is defined as the science or art of ordering tones or sounds in succession, combination, and temporal relationships to produce a composition having unity and continuity (Webster, 1985). Four properties are vital components of music: 1) pitch, 2) intensity, 3) timbre, and 4) duration (Harder, 1975). Different cultures differ in their definitions of tone or what combinations of tone are meaningful

and how unity and continuity is obtained, however universally music is controlled sound over time, in all cultures (Merriam, 1964). Music of many styles is communicated in many forms and technology. Technology is available for the performing musician and the recording engineer alike to help produce the music. Such tools as studio electronics and synthesizers aid in the creation of the message, where transducer technologies such as microphones, recording heads and speakers allow conversion of analog signals of one form to another, while magnetic recording and compact disc media are used to record messages. Listeners hear music broadcast on radio and television plus hear music stored in the various playback formats such as compact and vinyl discs, or magnetic tape. At this point any meaning received is described in feedback.

A goal of mediated music communication is to match the reproduction quality of recorded message to the original message. Much music communication and telecommunication technology has been developed to retain as much of the original message as possible through the progression of media, transducer and transmission technologies, i.e microphones, magnetic tape, radio, television and speakers. This reproduction quality goal is related to a fundamental communication goal. That is to transmit messages which convey meaning to listeners. Feedback is used to identify communicated meaning which can then be used to formulate messages in future interactions. Music preference is one type of music listener feedback, and it has been traditionally reported in the form of "charts"(1) which are trade magazine rating systems of which there numerous attempts. There have been intermittent cases of

music research such as street testing and interviews used, but thus far have not become popular in industry. Quite recently music research has been adopted by radio program directors. As economic factors play a more significant role in an industry with increasing supply of music and consumer music duplication with decreasing purchase demand, the need for more formalized music feedback becomes apparent. Refining the above model the production and media technologies now discussed can be inserted as follows:

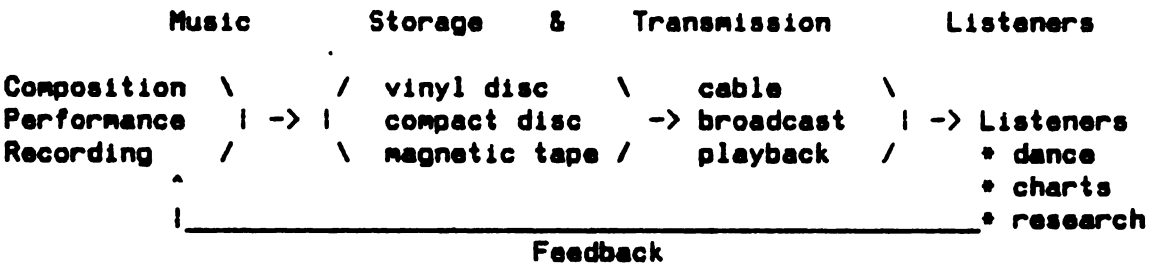


Figure 2 Expanded Model for Music Communication

Music Code Systems. Western civilization standards of "music science" were derived by Pythagoras in the identification of the harmonic overtone series about 550 BC (Finney, 1935). This established fundamental harmonic relationships of music in Western civilization that later were further described with counter-point and chordal harmony systems (McHose, 1947). Code systems standardized the succession and combination of tone in a unifying and continuous function. These code systems also enabled a process of communicating with the composer's idea, by reading music notation. Since the notational advance music of Bach's system of harmony, music code systems have remained the same, while timbre has been modified and the "electronic epoch" has dictated an electronic path of development for music reproduction, storage and

transmission and with synthesized creation of music. Broadcast transmission via the radio spectrum is now a prominant part of the commercial music industry and music cultures in general. The code systems have evolved over the centuries, effecting communication with composer, through many timbre and electronic devices to be passed onto listeners.

The code systems for listeners in assessing the impact of music, can be physical behavior and/or verbal lexicon. The code system for feedback is primarily the code systems of the listeners, however in specialized test settings, the coding scheme can adhere to more formal measures available from survey techniques, and/or laboratory measuring devices such as a spectrometer or listening questionnaires. There are code systems used for each step of the music communication process. In this thesis, two code systems will be measured to see if there is a relationship between them: 1) a production parameter timbre, and 2) the listeners' verbal lexicon. These can be viewed as two communicative phenomena of the message and the feedback. To measure this relationship, some recent digital coding of music performance has added further scientific controls.

Currently, digital coding of music performance information for communication between composer and performer plus between performers enjoys continuing development. This coding has directly impacted the timbre of music we hear. Group music performance communication traditionally is a point to multipoint system, from composer to orchestra members via notated music sheets while other messages about performance dynamics and tempo changes are sent visually directly from

the conductor. In the late 1800's small combos became common, and an improvisational group communication process became described as "jass", now referred to as jazz. Here a communication process between performers was recognized (Merriam, 1964), including not only code systems in the music itself but also haptics, facial gestures, and body language. Recently music communication has been advanced with new digital coding schemes, with a telecommunication standard called MIDI (Moog, 1982) which performs digital interperformer communication. This impacts musical timbre by enabling many previously thought separate timbre to be combined in time and space, into one timbre. In addition, a microcomputer based MIDI interface can automate(2) music performance which aside from reducing the need for human performers, music performance messages encoded digitally reduce noise, and expand flexibility through enhanced editing capabilities. Code systems describing music become more precise in time. This has particularly effected musical control of timbre as music instruments become constructed of digital circuits and the codes systems of performance and recording converge into one integrated code system.

Lexicon for Feedback. The lexicon of music preference is a valuable code system for feedback between the listener and music sender. It identifies the meaning decoded by the listeners. Verbal labels used by individual listeners to describe the impact of music can be similar with others who are members of the same population. It is these verbal labels which are shared with others that makeup the lexicon of music. A Preference meaning or rating can be derived from inquiries of "music

they like," and then the lexicon becomes a lexicon for music preference. In the music communication process, the sender of the music is attuned to and receives listener feedback. Traditionally live audiences responses could dictate to the composer their next compostion, and the performer what to play next. Dance is also an means for feedback for audience, as is singing. Feedback has taken form in the "call-in request lines" of broadcast radio music and more recently music preference research has been operationalized for commercial music and radio program decision making.

Music listeners hear music and describe it with the available lexicon. Music preference research usually classifies music by songs, artists and styles of music. Feedback on these can be obtained, however listeners are able to identify further domains of what they hear in music. They will describe the music with a mixture of colors, textures, flavors and moods (Toole, 1981) plus some reactions and music parameters. When asked to describe the "music one likes," these responses shared with others can reveal a whole host of other music parameters such as happy, loud, beat, exciting and fun. Scaling music preference represented by these words can yield a higher level of precision than style, artist or song title by describing the sound contained in the music, as well as some moods and indicators of activity.

By systematically varying a music parameter such as timbre, and measuring the lexicon of music preference, a relationship of message structural parameters and lexical feedback parameters is studied. By testing this relationship with systematic variation of timbral music

content, the actual social referential definition of these different timbre can be studied. In this way using a more precise set of preference measures, the lexical set of music preference becomes a scale for comparing different songs, of any artist, style, or timbre. It would be feasible then to examine if jazz listeners in Los Angeles find bell timbres "exciting" while to the New York jazz enthusiast defines "exciting" with a brass timbre. This exemplifies a case where timbral preference would vary with geography.

Music Technology. The progression of audio telecommunication technology has enabled new forms of music content in both production and performance. The late nineteenth century was met with the introduction of an array of audio production technologies. Alexander Grahm Bell originally labelled his invention the "harmonic telegraph," which was meant to act as a device for the hearing impaired, for transmission of phonetic verbal audio signals. It was only after realizing commercial viability of telephone that the "harmonic telegraph" invention halted. The audio frequency spectrum was established as an electronic medium for human communication. At the same time were other ventures into assessing what listeners actually did hear in music, and in physical sounds or tones. With microphones and wireless transmission (Fessendon) music became a broadcasted phenomenon in 1906 (Head & Sterling, 1987; Hybels & Ulloth, 1978). Since then broadcast technology for audio has produced microphones, magnetic tape, multi-track recording, and amplification. The evolution of audio technology has not only established audio frequency spectrum electronically as a means for human communication, but has also enabled new forms of music and music

performance to evolve. Amplification enabled such mass communication phenomenon as the outdoor concert festival. The digital coding capability on magnetic tape eliminates noise. The digital coding of performance information has enabled music timbres to be created and transferred in various telecommunication media, around the world. Since the late nineteenth, telecommunication technologies have almost always had on an impact on music.

As technology advances, so have the available musical instruments. Melding and molding of new metals led to bells of brass, while with inventions of levers we received pianos and saxaphones, and as discussed already telecommunication has had a regular impact on music in the last century. During the electronic revolution transducers technologies that have effected timbre include distortion, wah-wah, and reverb along with and through the added response of the dynamic moving coil and studio condenser microphones, increasing reproduction quality. Not only could voice be carried over longer distances, but could also create sounds such as "crooning" (Frith, 1986) that were not quite characteristic of unamplified long distance vocal sounds (Russell,1986). By 1964 voltage controlled oscillators led to our first electronic synthesizers (Moog, 1982). With the development of musical synthesis, the idea of making the sound attributes independent of the physical structure of the performance instrument now became evident. Up until this time the timbre of music had frequently been associated with the acoustical properties of instruments. Now multiple timbres can be produced by one instrument. With the influx of digital integrated circuits, it is not uncommon to find a sythesizer containing 128 sounds

built-in to the machine, with more sounds available via memory cartridges, digital cassette tape, or floppy diskette.

Timbre: Digital Control. The formation of a standard for digital musical instrument telecommunication is available via a protocal called MIDI, a mnemonic for musical instrument digital interface. This interface communicates performance information between MIDI compatible equipment, such as computers and other synthesizers. Now, computer communication has become commonplace and "countless thousands of music producers have embraced its capabilities" in recording studios as control centers for music performance (Moog, 1986). Digital control of performance allows a music that can be easily produced with much less cost of music production. Today it is possible to record a sequence of your composition on microprocessor based computer system utilizing no microphone transmission of signal to tape. Eliminating a microphone from the recording process has been common for some time, known as the "direct injection method" (Runstein, 1986), but now tape is being eliminated. The advantage of this is a reduced noise floor and elimination of transient microphone responses and studio noises. One new characteristic of the "MIDI recording" is that the information being recorded is digital instructions of performance and not an analog of the music. Therefore, requiring one to travel with instruments and computer to the studio to playback the performance instructions. Once there however, they can produce a master that never travelled through the air and has virtually little noise introduced into the signal. This digital recording is only one outgrowth of the MIDI revolution (Baird, 1986),

Table 1 : Music Technology Evolution: The Past 100 Years

Year	Technology	Impacts
1876	Harmonic Telegraph	Audio Spectrum
1906	Radio (Fessendon)	Music Broadcasts
1948	Television	More Radio Availability
1960	Multitrack Tape Recording	Program Diversity
1965	Electronic Music Synthesis	New Sounds
1970	Cassette Tape	Profits Decrease
		Copyrights and Ownership
		Sales Drop
1980	Music Television	New Medium of Music Promo
	Digital Synthesis	Natural Sounds
	Digital Tape	Less Noise
1982	MIDI	Music Performance Code
		Timbre Communication
		Studio Computing

another is timbre.

MIDI telecommunicates timbre in various forms. Through the ability of simultaneous musical instrument control, extensive mixtures and combinations of the timbres are enabled. In the MIDI specification, a communication chip is on-board any MIDI compatible synthesizer machine. This chip enables the communication of musical information between two or more machines, simply with the insertion of a MIDI cable between successive machines. A microcomputer at the heart of a MIDI system is becoming a valuable musical performance network, allowing timbres that are so extensive in numbers, mixing and matching with each other via a musical telecommunication standard (MIDI), all separate from any magnetic recording tape. It is possible to transfer timbre between synthesizers of the same manufacturer, and this alone has impacted the timbre we hear. One can purchase tapes and memory catridges of new timbre or timbre can be immediately transferred between some instruments via a MIDI cable demonstrating that the telecommunication of timbre.

The music industry is feeling MIDI's effect, and the listeners are hearing its effect on timbre.

From a scientific control standpoint, the level of performance control with MIDI has specific research implications. The cost of producing test music can be cheaper to compose, record, and systematically vary. With MIDI control a researcher can vary a variety of performance parameters, systematically whether it be timbre, tempo, melody, or mode. The scientific control of various timbre is obtained through MIDI's ability to work simply between two or more synthesizers making possible simultaneous performance and therefore control. The live musician performance is less controllable than a machine performance, and therefore there is reason for attention to to be given to MIDI as a music research instrument. MIDI can provide controlled performance of different timbre.

Timbre Design. One major outgrowth of early electronics was and still is the ability to appeal to large groups of people using amplification. At this time a discrete set of musical instruments could be used electronically. These usually included guitar, bass guitar, organ and later electronic piano. Later harpsicord and clavinet were often included as alternative timbres that could be switched on electric pianos and organs. The number of instruments available was limited, but the impact of electronic timbres became prevalent with the addition of each new instrument.

A major area of development in the decade of the 1970's was extensive sound processing and sound synthesis. Sound processing of

"wah-wah", distortion, flanging, phase-shifting were all brought within control of musicians, each modifying the wave form of sound. In addition new in-line studio gear such as delays, exciters, gated reverb, and limiters became utilized. All of these processed the signal of the soundwave and always modify the timbre. When sound synthesis became available, it was quickly used as a primary instrument in new styles(new wave) and for complimentary filler sounds such as strings in other styles(disco). By the 1980's, timbres available in synthesized form increased enormously. In addition digital coding enabled timbres to be programmed, stored, retrieved, editted or written to tape storage for input to other synthesizers of the same manufacturer.

Today the range of available sounds increases with the addition of each new synthesizer but also due to a transformation of musicians into regular telecommunicators. They not only can receive new timbre via telecommunication media, but create new timbre through "real-time layer" (Anderton, 1986) of two timbre into one, control multiple timbre simultaneously and exchange timbre via electronic messaging systems. On these messaging systems are timbre libraries. Resembling the computer software industry, the music sound design industry has adopted computer based electronic bulletion board systems for methods of disseminating and exchange of musical information from timbre to machine performance to musician teleconferencing. In the transfer of information there are many new timbres transferred from one side of the country, to the other, simply via telephone exchanges. Music performance and timbre is becoming programmable, and musicians are becoming software engineers in the process. Through the whole available

range of telecommunication and sound design technologies, timbre is a music parameter under great change. All this new timbre has meaning since people apparently like what they hear in new timbres.

Music Programing. Some music is preferred by listeners more than other music. Listeners like some music at certain times more than other times. The identification of audience segments is important for a programmer (Oinkelacker, 1982) so they can program to their target market segment. The task of programing music for any potential media demands the ability to play preferred music of certain market segments at the right time. Within these constraints, the broadcast radio music programmer assembles playlists made of new releases and established songs that are believed to be preferred by the target market. This "believed preference" can be formulated from a variety of sources including past record sales, chart performance, survey and music testing research.

The recording industry traditionally uses chart performance as a measure of music preference (Hesbacher, 1978). Chart performance has been referred to as an indicator of music preferences of the populace for over thirty years. There are flaws in this logic. Being an indicator of preference made up of three sources of information: radio station playlist, juke box playlists, and record sales, the record rating system peculiarly mixes cause and effect in calculating aggregate music preference (Cable, 1977). Playlists do not represent actual sound exposure and the sales outlets sampled are often unrepresentative of all sales outlets (Hesbacher, Downing, Berger, 1978). Record, tape and compact disc sales are also flawed as indicators of music preference

since many people like what they hear on radio but may never buy it to hear, however when offered an opportunity to record a friends copy, they gladly do so. This ownership and preference go undetected by sales estimates. The impact of consumer cassette tape equipment has helped change the accuracy of sales as indicator of preference. The recording industry has traditionally used a flawed indicator for music preference. The music preference consumer research efforts likewise have inherent limitations.

Commercial music testing is done in two ways: 1) Hook research, a call-out method of testing commercially released music samples over the phone, has been popular for the last ten years with radio stations; and 2) Auditorium testing, testing released music in an auditorium setting with incentive driven subjects there for hours at a time. "Hook" research claims to study those components(choruses, melodies, riffs) that catch the attention of the listening public, however this is done in the context of currently released music. These elements are called hooks due to their ability to capture and hold the interest of listeners. The hook is usually repeated several times within a song (Lull, 1987). "Hook-research" can determine whether a released song is "liked" by a certain audience. Other preference parameters are measured such as familiarity, and airplay evaluations as in "I hear it too much", "I would like to hear it more." This has value for the radio programmer in deciding what particular selection from the recording industry will be played but it does not give a programmer music content preference indices that can be applied to all music, but rather to only the songs played. In addition it does not always supply to the

programmer the music preference "taste culture" indicators of their own station audience (Fox, Wince, 1975). Since the programmer must make the link between their station and the audience (Hennion, Meadel, 1986), and this link can depend on music preference for certain "meaning" triggered by a word, a phrase, a chord, a riff, or (even) a combination of sounds (Harmon, 1972), a warrant for studying whether music preference indicators in the actual music content exist. Hook research more aptly measures ratings of newly released music, while "oldies" released music research uses another popular method of commercial music research, auditorium testing.

Auditorium testing is the other popular method of music research used in any regularity, and in spite of its advantages, it still has major economic drawbacks. Auditorium testing is very expensive. It allows more complete portions of the music samples, and for a much broader frequency band at playback, compared to the telephone used in hook research. The music programmer using research has an idea of listeners' preferences that the programer without research does not. Market research of this nature better equips the music programer for program decision-making. There are currently financial constraints to performing listening tests, due to the number of individual songs that must be measured. Music production parameters such as tempo, key, and timbre are unstudied by the commercial arms of the music industry. The only research available for music program formulation is either very expensive or logically flawed or both. With some of the new capabilities provided by refined measurement scaling, experimental devices in music performance (MIDI), and expanding timbral textures the

message can become varied for scientific experimentation, with exceptional control. The level of analysis of the message can then increase it precision over traditonal methods.

Music components have not been used for classifying test music, thereby requiring the testing of each song title. Music preference ratings and research efforts have used "song title" as their independent variable, and have classified songs by artist and by style. These nominal level classification measures are difficult to code and therefore are not in much research. When they are used, its risky due to high variability in coding such a complex phenomenon. Subsequently, the "song title" is usually the independent variable measure. Research efforts using the song title as the independent measure have inherent cost imbalances when the number of songs selected for a weeks period of programming could number in the thousands for many music gatekeepers (radio, recording, production). The resultant cost of measuring an adequate sample of music becomes enormous. If the lexicon of music preference could be found to relate with specific, tested musical structure parameters then artists selections could be more reliably classified, without having to test every song to be measured.

Performance of test music for research has always posed a challenge for the performer at controlling performance sufficiently enough to play all performance variables identical while varying the experimental variables. Subsequently the breadth of research available concerning the systematic variation of musical message parameters within a song, has not been as prevelent as the measurement of simple tones, complex tones, different songs, intervals, chords and modes. This is simply

because the systematic variation of musical performance is very difficult, without introducing unsystematic variation due to the influence of the human performer during each "supposed identical" performance. MIDI technology now enables control of that systematic variation. When combined with a lexicon for music preference used to describe music people "like," a new classification scheme becomes available linking together music production, and listener feedback. This would therefore enable a musical message to be rated in preference for musical structures. To do this it could be quite helpful to remove one significant factor in preference, familiarity.

Using released music for listening tests, has certain drawbacks. Music preference can change in time and as music becomes more familiar. To assess the impact of music's structure on preference one very significant factor of preference is familiarity, and if not removed then past exposure frequency could become a large basis for variance in past studies of music preference. Current music research techniques are developed for purposes of obtaining an audience for radio, and not necessarily the music itself. Although these are both related, radio sells the audience to advertisers and thereby wants to study how an audience can be identified, accessed and maintained. Familiarity is important to audiences. The music listener preference independent of social setting and occurence (exposure) would be preference for the structure of the music itself. When measuring listeners' reactions to songs they have already heard, a whole range of other variables become introduced into the music preference equation, including familiarity, social peer group evaluation, and simple associative memory phenomena.

The current commercial research has proven valuable but certain questions cannot be answered with the amount of information supplied from this research (Anthony, 1987). An improvement of "music research" rather than radio audience music research is to systematically vary the independent variable while measuring the lexicon of music preference.

Musical messages are created, produced and programmed across limited channels and times. The music listener hears this music and responds via feedback mechnisms. One type of feedback is the music preference ratings such as charts, which in spite of being massive institutions dedicated to music preference assessment, the actual scientific research efforts have been limited in breadth, methods, rigor, and scope for purposes of producing music research. The level of research studying audio phenomena is not in proportion to video phenomena (Atkin, 1983), with a general absence of pop music studies in academic research (Goodwin, 1986). This makes the task of the music programmer especially difficult, since many decisions must be made with very little research. Besides the programmer, though is a whole other host of music gatekeepers that also could benefit from refined music research. Besides always having a natural imbalance between messages (supply) and outlets (channels), music in its technological evolution has become more varied and more easily created and produced. One music production parameter undergoing substantial change right now is timbre, and it is the goal of this thesis to pursue the exploration of a relationship between a message parameter timbre and a lexical feedback known as music preference. Many music communication parameters such as sender, message, medium, and listener(receiver) have been researched, primarily

within other disciplines such as engineering, music, psychology, and sociology. Within this decade two volumes of key communication journals, and volume of a sociology journal have dedicated entire volumes to audio and musical phenomena. These are:

* Communication Research, Summer 1985,
* Journal of Communication, Winter 1982,
* Media Culture and Society 1986

The music related industries are in their dawn of music preference research. Research agendas in the communication related academic fields are just beginning to study music. In an increasingly competitive industry, music research is a necessary requirement for rational business practice, yet the commercially available research lags behind television research of exposure, effects, and preference. What is available is very expensive and in many ways does not measure the fundemental music preference referent, the music structure. The same technologies involved in creating more varied musical messages make possible new avenues for music research. Both creation and control is possible on one music structure parameter: timbre. At the same time trends in social research have resulted in more powerful lexical measures. With such research available music production and programing decisions can refer to scientific relationships concerning the most universal communication (Lull, 1982), to which listeners' ears do not close.

This thesis studies two communicative phenomena: 1) Music and 2) Words (lexicon) that describe music. The technology available make possible experimental controls to test this relationship. With such controls in music research the ability to abstract findings to other

music becomes at least theoretically logical, thereby impacting the research community. This community would benefit from added precision and refinement of the music preference research process.

Chapter Two

Literature Review

The music communication process described earlier borrows from Shannon and Weaver's The Mathematical Theory of Communication (1949). The sender and message classification have been combined, and then articulated to represent the production of musical signals and symbols. Using this perspective, research in this topic area focuses on the message, media, receivers (listeners), and feedback. The message component for analysis in this work is the timbre of music, the media although not an active element in the focus of this work is necessary to review for an adequate understanding of music preference. The receivers or listeners have a variety of characteristics that in this review will relate with the message and media, however the primary element of listeners for this work is the lexicon of music preference, the feedback measure of musical timbre being tested.

The western musical message structure has been systematized through code systems. The social system of music science has for centuries made many assumptions about the meaning contained in music structure, and regularly made recommendations to composers on how to get the "desired effect." As a result there is an enormous amount of social learning that has occurred based on these cultural traditions. With the onset of electronic audio in the late nineteenth century, a conceptual merger between music science and physical acoustics occurred. Research concerning what the listener heard became the focus. "What is sound?" was the question and the focus became the message. The twentieth century obsession with analyzing humans as individuals, led to the

receiver as the point of interest by studying "How does the perception of an auditory stimulus compare to the structure of the stimulus?". This era led to the works concerning frequency response and pitch (Stevens, 1935; Stevens, Volkmann, and Newman, 1937) and equal loudness contours (Fletcher, Steinberg, 1924; Fletcher, Munson, 1933). There is also scattered throughout music education research, an interest in musicians, a message sender, in how their reception charateristics differ from non-musicians. Quite recently the communication and sociological fields have gained interest in popular music, coinciding with the introduction of broadcast radio channels, low cost playback equipment, and youth markets in the popular music recording industry. Out of this grew a strong recorded music-radio industry (Hesbacher, 1978). The goal here is to review those studies relevent to the stages of music communication under study in this thesis. These are: timbre(message), music preference(feedback), and the lexicon of music preference(code system), and the listeners.

Music Messages. Music messages are made up of combinations of multiple dimensions. Music is social, requiring rules for conduct, specifying means of ordering and systematizing its constituents (Cross, 1985). Musical messages are composed using varying degrees of rules and conventions for organizing basic constituents or components. Sets of components are labelled differently, depending on the social systems using the components. Each social system has different expectations and goals, and subsequently has need for ways of packeting music into information about the structure of music. To review research on music

messages and the receiver one must analyze the components common across social systems. Timbre is common across many social systems. The study of timbre is undertaken by physicists, acousticians, audio engineers, music educators, socialogists and communication researchers.

It was stated earlier that music is "the science or art of ordering tones or sounds in succession, in combination, and in temporal relationships to produce a composition having unity or continuity." Music then is tone over time, in serial and parallel configurations (Harder, 1975) having unity and continuity. Defining "unity", as "a combination or ordering of parts in a literary or artisitic production that constitutes a whole or promotes an undivided total effect." Defining continuity as "an uninterrupted connection, succession, or union", the definition of music is tone over time in combinations that are identified in succession and harmony as belonging together, by a certain social system. The review will now turn attention to the one fundemental component of music, and timbre; tone. The discussion will then review research of the tonal characteristic of timbre both as a physical structure and a received structure of musical messages.

Tone. Music is patterning of tones. Helmholtz, in the late nineteenth century, pioneered a work to identify the relationship between the, at the time, separate fields of physical acoustics and music science. Across these two fields Helmholtz identified three distinguishing characteristics of tone;

1) force,
2) pitch,
3) quality

(Helmholtz,1862)

In this case, force is measured by amplitude of a sound-wave, pitch by the frequency of the sound wave, and quality by multiple dimensions: spectral content, temporal dynamics, and auxilary noises. Helmholtz explained spectral content is made up of various individual simple tones, known as a fundamental and one or more partial tones, known as upper partial tones. Others refer to these upper partials as overtones (Lundin, 1953). The entire set of tones including the fundemental tone, can be referred to as the harmonic series. Temporal change in the onset of tone is known as the envelope, made up of an attack, internal dynamics, and decay elements (Runstein, 1986). The attack is the beginning portion of the sound wave, internal dynamics are temporal changes in intensity of the individiual partial tones, and decay is how the sound ceases. For example, trumpets have a fast attack and are known to emphasize the upper partials at high levels of intensity, and a decay quickly (Beauchamp, 1975). The third component is auxilary noises. With the strumming of a guitar, the bowing of a cello, or the "slapping" of a bass string, noises are introduced at the attack, decay, and everywhere in between on some instruments. These are separated out due to uniqueness in combinations of partial tones over drastic changes in intensity.

These are the three components making up what Helmholtz called the quality of the sound where Helmholtz directly linked quality to timbre but chose not to use the word timbre due the generalizability of his findings to tone theory rather than music. Helmholtz was one of the earliest scientists to make note of the actual formulation of complex waveforms, in which quality, exemplified by timbre, was one of three

main components of organized tone. Helmholtz in his initial sentence discussing the definition of "quality" says: "When we hear notes of the same force and same pitch sounded successively on a piano-forte, a violin, clarinet, oboe, trumpet, or by the human voice, the character is the musical tone of each of these instruments, not withstanding the identity of force, is so different that by means of it we recognize with the greatest ease which of these instruments were used." (Helmholtz, 1862).

Seashore in 1939 expanded the definition of tonal quality by saying it was made of two fundemental aspects, namely, (1) Timbre, which is the simultaneous presence or fusion of numerous simple tones at a given point in time, and (2) Sonance, the successive presence of changing timbre, pitch, and intensity. Here we can see that tonal quality is again referenced to as a major component of timbre. The concept of timbre was again linked to quality, and has been traditionally present since the early days of music and aesthetic research.

Timbre. Mursell (1937) says "probably the most fundemental and universal source of interest in listening to music is the tonal content itself organized in terms of its volume and timbre." He states:

> that when enjoyment arises out of nothing but the shifting volumes and qualities of the tonal content there will be no definite awareness of musical shapes or design. It is a characteristic evoking a low level of response which on one hand hardly is a basis for musicality, but on the other hand is the ultimate foundation of all music (Mursell, 1937).

"The subtleties of timbral discrimination are, to some degree, the very essence of musical interest" (Naumann, Wagoner, 1985), yet timbre has often been the miscellaneous category for describing the receivers'

physical attributes of sound, "gathering into one bundle whatever was left over after pitch, loudness, and duration had been accounted for" (Dowling and Harwood, 1986). This is partially the result of the research technology that was available in the past. It could only systematically vary pitch, loudness, and duration.

Timbre, has also been paralleled to the organization of speech, containing steady-state vowel sounds, onset-transient-consonant tones, and noise bursts. In audiology and psyco-acoustics, lingual organization of vocal timbre is made up of 1) spectral composition of tone in its constituent simple tones, 2) the onset of a. complex tone called the attack-decay envelope, and b. partial tones at certain levels of intensity, and 3) accompanying noises traditionally associated with the method of generating sound. Here we can see similarities in findings of musical and vocal timbre. Timbre is identifiable and has been discriminated into different timbre.

Efforts in assessing what listeners hear, particularly in timbre have been performed. Multidimensional scaling has done with a set of 16 instrument tones (Gordon & Grey, 1978; Grey, 1977) applying multi-dimensional scaling to a set of 16 instrument tones that included both transient and steady-state portions, found three prominant dimensions:

1) spectral energy distribution in steady state
2) onset and offset patterns of the spectral components
3) noisiness of attack

Miller and Carterette (1975) varied frequency of the fundemental tone in the harmonic series, shape of spectrum envelope, and attack-decay functions, and they found that the strongest dimension was fundamental frequency, the second dimension separated envelopes into

piano-like spectrum envelopes from all others, and the third dimension separated sounds with strong attacks from those with what was called trapezoidal onsets and offsets. Trapezoidal refers to a smooth attack and decay of the entire waveform. In a similar effort, varying number of harmonics (upper partial tones), attack envelope, and relative pattern of onset times of different harmonics, Miller and Carterette's results showed that listeners' first dimension separated clusters having three, five and seven harmonics, a second dimension separating the five harmonic tones from the other two types, and a third dimension of overall attack envelope ordering: piano, brass, and smooth. Their conclusions were that spectral content and attack functions are the primary determinants of timbre. Grey in 1978 showed that when synthesized tones are present in a musical context, certain aspects of musical tones can be treated as more or less irrelevent in the determination of timbre, especially subtle fluctuations of parameters during steady-state. Chowning (1973) and other engineers have found similar results in the invention process of "real sounding" electronic synthesizers, using various methods of sound generation. However at the same time, certain determinants of timbre are required to emulate "real" acoustically produced timbre. Results such as these leads one to believe that to research timbre and its effect on music preference, the definition of timbre can be limited to those attributes in different sounds that are a function of spectral composition, and on-set/off-set (attack/decay) of the sound wave.

To analyze music let the fundemental definition be that music is composed of tone over time. Further tone has been decomposed to reveal

a major component, timbre, that is mainly discriminated by two dimensions, 1) Spectral composition, and 2) Time-based on-set/off-set or attack/decay. Instruments are discriminated by listeners according to the way in which they combine these two dimensions. The importance of these research efforts show that timbre has been identified structurally in the context of music listening, contributing to the overall auditory stream recognized and differentiated by listeners.

When applied to the instruments that form sounds of different timbre, each instrument can be defined in terms of its component spectral make-up, and its attack-decay envelope. The classical families of acoustical instruments of strings, brass, percussion, and woodwinds, are differentiated by their unique combination of these two timbral components, but there are some exceptions to adherence to this makeup in some family members. For this reason the classification of timbre is best kept with actual auditory data emitted from the instrument, and not the classical method for categorization by family, and simple spectrum differences.

Musical timbre is recognized in various forms of ordering. Traditional forms of ordering the sound waves of tone accompanied their method of tone creation, however now with synthesized timbre the creation of tone is electronically based, and perceptual validity of synthesized timbre has been reliably demonstrated (Risset, 1983). The research question posed in this work is "can timbre effect independently a lexicon used for music prefernce." We will now address the "unity and continuity" part of our definiition of music, namely what do listeners label and prefer in music, thereby denoting this unity and

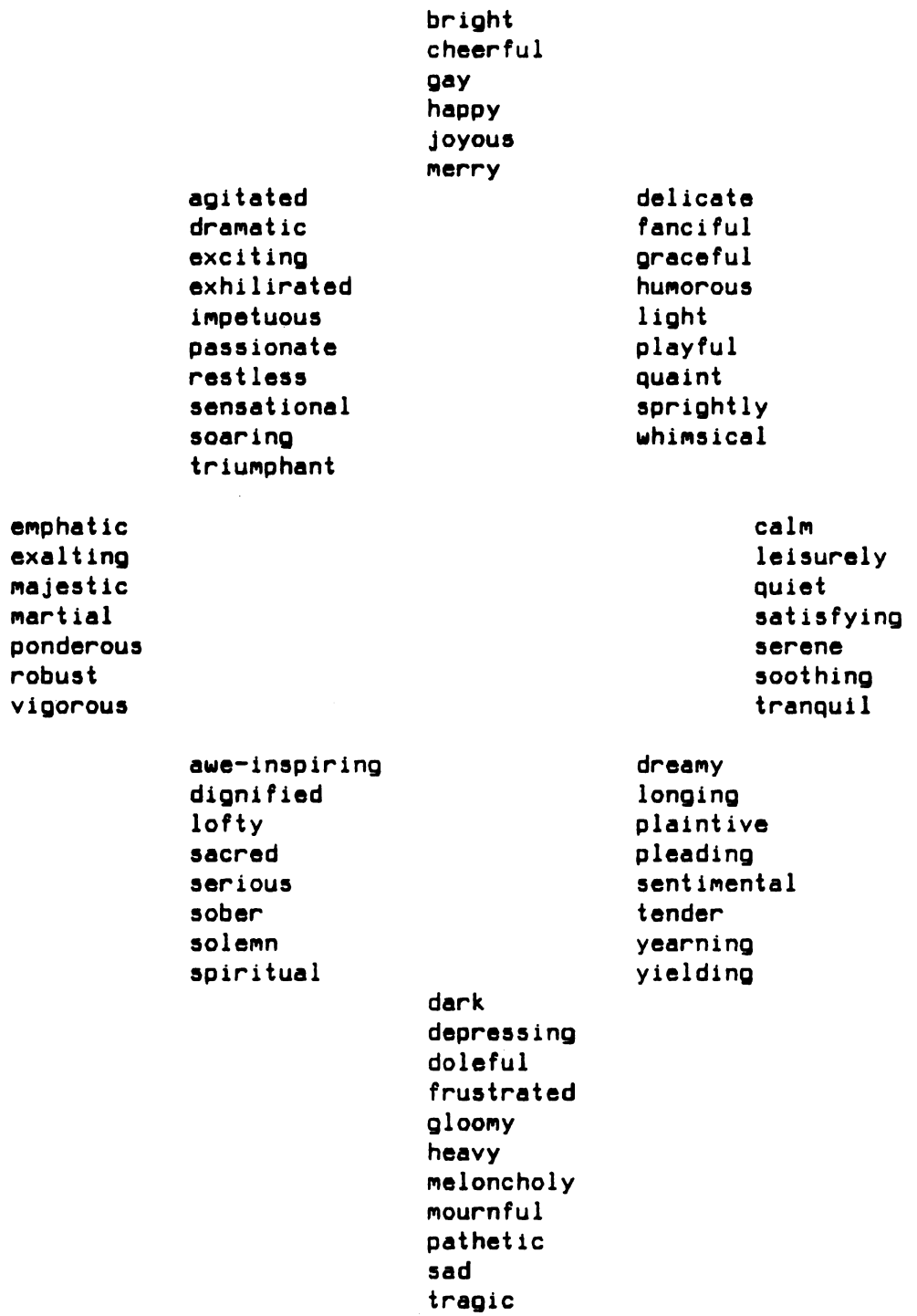
continuity.

Lexicon of Music. Music is a social phenomena which comes in various forms. At the initial level of a musical lexicon, we have a judgement of preference, with binary attributes, 1) Yes; the sound is music, or 2) No; the sound is NOT music. To aid cultures and sub-cultures in communicating about music they often acknowledge a conceptual level of "musical style" or "musical genre." Labels for western civilization styles have numbered many over the years, such as Classical, Rhythm&Blues, Funk, Soul, Rock, Rock&Roll, Pop, Jazz, Folk, Bluegrass, Latin, New Wave, Punk Rock, and New Music (Baumann, 1964; Fox & Wince, 1975; Fink, Robinson & Dowden, 1985). These are used to label different styles. Within each style of music, a certain set of musical timbres are created and combined. With these combinations, music of each style is sought out by avid listeners, and avoided by others. Style of music is a nominal level categorization of musical messages, that has been utilized quite widely by listeners, researchers and industry alike. The criteria for being a listener of one style over another is that one "likes" this style of music. The style label carries meaning to humans but the meaning can be limited. This is demonstrated when an avid classical attends a classical concert but walks away from the show slightly discontented by what they heard. The classification of style is limited in its identification of preferred music content.

The lexicon of music preference is actually the listeners' calibration of information or meaning they decode from the music. To an avid "pop" listener, improvisation may indicate jazz, while to others,

use of strings may mean "classical." To further communicate about musical meaning, a lexicon with further descriptors than "style" is required. Early efforts at using verbal descriptors for musical

Figure 3 - Hevner Adjective Checklist



analysis began with Hevner (Hevner, 1935), who attempted to ascertain a relationship between moods and music by using an adjective list constructed of 67 words, arranged in eight clusters. Revised a number of times to increase the consistency between adjectives within clusters, results using this list have problems due the lack of using descriptors familiar to the listener respondent (Meyer, 1956). However as a paramont study in the area Hevners efforts have been drawn upon again and again. Figure 3 lists the Hevner Adjective Checklist.

In the spirit of what Aristotle called ellicited mood (Tame, 1984), the emotional or mood meaning of music has been of great academic interest. The actual claim of this meaning or informaton being actually emotional, or charaterizing mood qualities specific to music itself is debated. Meyer (1956) states that much of mood derived from music is the result of associative mechanisms linking the sound with past sentiments. Rather than eliciting natural emotional reactions, music depicts conventionalized modes of behavior called "designative emotional behavior." In addition Meyer claimed that the communication of moods and sentiments tends to become standardized, such that certain "musical devices become formulas which indicate a culturally codified mood or sentiment" (Meyer, 1956) This culturally codified mood, is encoded in tones with grammer of "acceptable usage". This can change in time and does, leading to scenarios where "what was not allowed some time ago may now be viewed as acceptable" (Farnsworth, 1969).

The semantic concepts of "connotation" and "denotation" organize different types of meaning found in music. Connotative meaning can be equated with the idea of associative meaning, while denotative meaning

of music is that created within the structure of the music itself (Nielzen & Cesarac, 1983). Meyer's used the term "embodied" to refer to what we have presented here as denotative meaning.

Mean ratings of large groups can (also) serve as a qualitative description of music (Nielzen and Cesarac, 1983). Osgood's semantic differential has been used (Gray and Wheeler, 1967; Crozier, 1974), for measuring meaning. In a study done by Nielzen & Cesarac, three main factors were found when scaling mood:

Factor 1: Tension-Relaxation,
Factor 2: Gaiety-Gloom
Factor 3: Attraction-Repulsion

This study was meant to find dimensions in the emotional experience of music, i.e. the designative-connotative meaning in music. In a similar effort to assess the connotative meaning (McMullen, 1982), more than connotative is acknowledged when he mentions descriptions of the music being heard. He states that:

> When many individuals, if not most, describe their response(s) to music, words such as relaxing, sad, or majestic are a common part of their vocabulary. These words often are the only means some individuals possess to communicate to others either how they feel personally or to describe the music being heard.

McMullen points out how the denotative meaning can be described by the sensuous or physical attributes of the stimulus, and the formal which refers to the relationships between the physical objects or the perceptions of these relationships. In the development of a list of verbal descriptors for measuring the connotative words used for describing music, it is noted that "connotative words do not have the same meaning for all humanity", and "we do not know for certain if the word happy for one person refers to the same internal experience for

another individual." Therefore, verbal descriptors of denotative and connotative meaning are proposed and used but it has been proposed that these may vary across individuals and populations, and the connotative labels of music affect can be classified by two main dimensions: activation and evaluation. This is similar to the results of the Osgood, Suci and Tannenbaum research of 1957. Their three primary dimensions were: evaluation, potency and activity.

Maher and Berlyne (1981) used rating scales classified in three main groups: an evaluative judgement group, collative or information properties of the stimulus, and reports of internal states. In this study a list of paired descriptors were found to be related to the difference in tones(intervals) used in musical stimuli. Hair (1981) found the usage of the words: loud, soft, fast, slow, high and low, in a design comparing childrens' with adults verbal identification of musical meaning. Nierman (1985) found that students ratings of music were sometimes too low on several items simply because students were not familiar with the musical vernacular descriptors for such concepts. In this case, it was stated that some denotative meaning of music is not simply described by the average individual, while "on the other hand, items involving components of loudness and timbre were very easily perceived by most students regardless of the vernacular used." The limitation of listeners' labelling processes of musical meaning may actually be limited, yet be informative about what listeners are not limited in identifying.

Meaning in music both connotative and denotative has been mesaured using an appropriate lexicon for each area. Because of the inherent

difference between verbal language and music, particulary in aggregate's lack of musical vocabulary, the boundaries between connotation and denotation become blurred. The connotative meaning includes associative moods, while denotative meaning concerns the musical ordering of tone. A limited number of words describing these different domains of meaning, common across respondents in the aggregate, are quite often the only means one possesses at describing the meaning, or information decoded from music. These descriptions do vary by population and age where some denotative descriptions are easier for some musical parameters than others. Musical timbral structure is an identifiable denotative dimension, that may be related to its verbal denotative and some connotative lexical counterparts.

The measurement of preference components may be a function of physical components, so that verbal connotative and denotative items are the result of physical structure or connotative designative moods associated. To address this one must investigate how the physical makeup of the message is related to the verbal lexicon. Music style can correspond with timbral elements, however as styles evolve subsequent message-lexicon relations change. It has been shown there are methods for analyzing timbral elements, and musical meaning via a lexicon for music. Music preference is a special case of meaning. It supposedly predicts exposure patterns to music, as well as other social affiliation and status codes. In the same light music preference is the same construct at work when one ordering of sound is identified as noise while another is music. In this case preference is descriptive of the music structure, at the fundamental distinction between music and noise.

Music preference can be a binary measure on one dimension, or ratio level on numerous verbal dimensions. Aggregate listeners can hear the difference. It is here where a lexicon for music preference becomes valuable as an identifier of music structure. At the same time addition, preference has certain social redemption, status and group membership value, such that a lexicon for preference could hold certain social relations

Presently in a world with virtually unlimited timbre when just 20 years ago the distinct types of timbre in music could be counted on one's fingers, one must wonder if the use of new timbre incringe on the boundaries between styles such that the meaning in music is more finely discriminated, beyond style. Another view is that people could always hear timbre but could not describe it. If it did not vary much then perhaps there was no need to further describe it. Regardless, timbre is an active component of music structure and perception. How the common listeners describe music may hold the tools necessary to identify timbre and timbral differences. In many ways these are often the only lexical terms available to the average listener. The focus of this work addresses whether timbre exists in the reception of music as witnessed in listeners' feedback using a lexical measure of music preference. This is of great interest to the music communication researcher, producer, and programmer by studying the relationship between a highly variable music parameter (timbre) and a lexical set of music preference items.

Music Preference. Music preference is the set of behaviors and perceptions involved in identifying music one likes, and listens. Music which people like is indeed music to which they will listen. One study (Fink, Robinson, and Dowden, 1985) found that attitudinal structures for music they liked and behavioral structures for the music they would attend at live performance, yield the same multi-dimensional structure of the types of music for the aggregate audience. Two primary dimensions were identified as, 1) Formality-Complexity, and 2) Ecological-Geographic were found. These findings, based on a large sample size (N=17,254), in a United States national survey, identify one very fundamental finding of music preference attitudes and exposure behavior. The two are congruent.

Models for the music preference communication process have found that music preference is related to three main factors: 1) message, 2) social system within which the music is active, and 3) the receiver. Wapnick (1976) describes three categories of variables related to formation of attitudes of preferences for music: 1) musical, 2) situational, and 3) subject. LeBlanc (1980) describes the sources of variation in musical taste to be the music, environment and the listener. It is noteworthy that for purposes of this work that both these models identify the physical properties of the music as a single and unique component in the determination of music preference.

In a refinement of these models for purposes of communication research, we will collapse two of the main components of music preference from these two models: the individual (subject,listener) with the group (situational, environment). This yields a simpler model of two components: message and listeners. It has been noted both in social

research (Soloman, 1985) and music preference (Taylor, 1985; Burton, 1985), that research across studies often lacks continuity, and within studies lacks comprehensive designs. As Taylor states:

> the design of experiments often leads to a body of disjointed research literature that is difficult for the music practitioner to use.

In the mass media fields music practictioners include composers, musicians, producers, and programmers. In a related field, anthropology, cultural inquiry often begins with a wholistic approach to analysis, then followed by quantitative analysis. This is implemented for reasons of limiting bias in initial assessment of not only the parts within a system but also the system itself. Music, a very complex social phenomenon, can be viewed as a "social organism" (Durkeim, 1834), and this wholistic cultural analysis technique bears merit. A frequently utilized dictum in anthropology is "Occam's Razor", which the states the "simplest of competing theories be preferred to the complex," or that "explanations of unknown phenomenon be sought in terms of known quantities"(Webster, 1985). LeBlanc has attempted to state a complex model for music preference and then operationalize a systematic attempt to sort out and examine those variables that impinge on the listener's domain. This has led to focus on generic styles of music preferences (1979), effects of style (1981), tempo (1981, 1983), performing medium (1981, 1983), vocal vibrato and vocalist's sex (1986). General preference was for popular music styles, faster tempos, instrumental mediums, low amounts of vocal virbato, and male vocal timbres. LeBlanc has done much to contribute to a comprehensive approach for the research of musical preference, and these studies found that instrumental mediums

and male vocalists both are examples of timbre as an active part of music preference formulation.

Other efforts to discern items of relevence to music preference have been done, but to summarize them is beyond the scope of this work. The thrust of this work is to focus on a relationship of timbral message attributes and a listeners' lexicon for music preference. It is with this focus that we continue the final steps of our literature review. This section will summarize those attempts at studying how musical preference varies with musical message structure, particulary timbre, and how transmission and listeners effect this process. Although tranmission is not formally part of the research focus here, it is a relevant variable in the spirit of exploration and in the control of directly pertinent research variables; music and listener feedback.

As mentioned previously, LeBlanc found a significant difference in preference for different performing mediums. In his definition, medium was operationalized as vocal or instrumental. Viewing the voice as a unique timbre of its own, the performing medium varied was actually a dual category measure of timbre: 1) instrumental and 2) instrumental plus vocal. The results demonstrated a higher level of preference for instrumental timbres. LeBlanc (1979) showed in a study of fifth graders that their favorite music genres (style) of music were, in order of popularity: pop, rock, ragtime, Dixieland, march, and country-western. Christenson, DeBenditttis and Lindlof (1985) summarize in Children's Use of the Audio Media (1983) that children use the words "sound" and "beat" in determining their preference. Chistenson and Lindlof report that six to thirteen year olds were more likely to cite "the sound" or

"the beat", than the lyrics as reasons for what they liked about music.

Boyle, et al. (Boyle, Hosterman, Ramsey, 1981), studying factors influencing pop music preferences of young people, found that between respondents of grades 5, 7, 9, 11, and college, that "grade 11 subjects rated instruments as significantly more important factor than did subjects in grades 5, 7, and 9." Males rated instruments and peer influence as more important than females. Factors related to popular music that separated age groups such as peer influence and dancebility diminished in effect from the lower three grades to the upper two. The factor of hearing it on the radio was significantly more important to grades 7 and 9 than to the upper grade levels (11 and college). In summary, Boyle et al. conclude that "the study confirmed that both sociocultural and structural factors were viewed by young people as important in influencing their preferences for tunes, although structural reasons were generally viewed as more important than sociocultural." Boyle, et al discuss the importance of using a "low theory" made up of verbalizations which are the only symbols available to respondents, in describing their music listening preference. He states that much attention in studying this domain is needed.

Baumann (1964) found in his epoch work, that younger teenagers prefer popular selections as compared to other styles. As age increased there was increased preference for other styles, especially classical items, although the classification of music styles beside classical needed clearer definition. Baumann found significant differences in preferences of high and low socio-economic groups for some kinds of music, where across all popular music recordings high SES listeners

liked the category more, while seven of the twenty musical selections, were rated as "liked most" by more low SES listeners. The level of formal training in studying certain instruments varied by SES, and was attributed to the opportunities provided by the higher incomes. The most popular instrument studied within each SES group was piano, while the next most popular instrument in low SES was the guitar and for high SES, it was the trumpet. Geography played a role as a factor in popular music style preference where eastern (U.S.) teenagers favored it significantly more, and western teen-agers had a greater liking for classical. This was previous to the major shift of much of the popular music recording industry to southern California, which may have eventually increased western preference for popular styles.

Topic Synthesis. Popular music preference research identifies two main sources of variation, the message and the listening social group, although one other major source of variation resides in industry. Though some researchers will separate the individual from the group in modelling musical preference, for sake of simplicity in modelling socially derived preference, the listener and the social situation or environment will be combined. This refinement is warranted in the mass communication research environment, for two reasons. First, there are notes about the already scattered nature of social and music research and 2)the social nature of music preference. This refinement may allow for consolidation of former scattered variables into a more cohesive whole. Prominent message variables are: instrumentation, style, tempo, vibrato, radio play, and familiarity. These factors do engage with certain sub-groupings of all listeners described by: age, formality, geography, sex,

socioeconomic status, and peer approval. This is the set of factors that can be relevent to our two stage breakdown of preference.

Transmission factors, however, are not the focus for this work. This thesis simply measure the relationship of the music message with the feedback mechanism most natural to the music listener, the lexicon of music preference. The message parameter under investigation is timbre and it will be varied systematically, and measured with the lexicon of music preference to discover if this lexical set varies systematically. The investigation of the variables involved though will continue with review of other stages in the music communication process prior to music preference lexical feedback: media transmission and listeners reception.

Mass Mediated Music. Some of the earliest forms of mass communication over great distances were music (Carrington, 1949). The beats of drums notified early man of activity for purposes of defense, work, or celebration rituals (Merriam, 1964). The introduction of telephone made the audio spectrum an electronically transmittable phenomenon. Radio made possible transmission of music, as a type of programming using both recorded and live performances. With the introduction of commercial television in 1948 (Hesbacher, 1978; Charron,Sandler, 1983; Rothenbuhler, 1987), much broadcast and advertising emphasis transferred to the television, making radio an alternative, rather than primary medium. A working arrangement developed between the recording industry and radio. Additionaly, radio had less access control exerted over it by others in the household, particularly the heads of household (Lull, 1985). This occurred as a result of the independence of access listeners: anywhere

and anytime. As a result uncontrolled adolescent exposure became prominent and popular.

Radio established a relationship with recording producers and a listening audience. The records played on the radio reached an adolescent audience that became a major audience segment by 1957, when the percentage of popular music oriented Top-40 radio formats were on the upswing (Denisoff, 1973). The producers of recorded music "had replaced the music publishers as the dominant institutions of the music industry. Control of sheet music was replaced by control of radio and recorded copies, a change of access control from one medium to another (Laing, 1986). In order to get attention on the national musical soundscape, music has to succeed in penetrating the repertoire of existing record companies and of radio broadcasting, or to create its own apparatus of production and distribution (Regev, 1986). The performance of music on radio became primarily a recorded message, mostly due to the reduction in programming cost that could be realized(Hesbacher, 1978). Christensen et al. (1985) found that children listen to radio primarily for music. The major portion of the total radio listening audience became adolescents.

As the recording industry members have varied in numbers, increases in industry concentration have led to decreasing diversity of programming types (Peterson, Berger, 1975; Rothenbuler and Dimmick, 1982). However, Rothebuhler and Dimmick stated that "song type may succeed market concentration as the primary predictor of change in popular sound recordings" (Anderson, Hesbacker, Etzkorn, Denisoff, 1980). The classification scheme used for "song type" has three indicators: 1)vocal style, 2)instrumentation, and 3)song structure. The recording industry

admits relatively few pieces of music to its channels, then mass produces and aggressively markets those few (Chaffee,1985). Music marketing is composed of promotion and radio play, commonly referred to as "plugging" (Cable, 1977). In the marketing process of the recording industry, as in many industries, little effort is dedicated to assessing consumer (listener) preference, frequently adopting an explanation for musi preference as "People don't know what they like ? They like what they know" (Denisoff, 1973). Artists' music is selected, produced and promoted. The primary promotion medium is radio. Radio promotion is repeated exposures of the new releases, and has even led to a format entirely dependent for programming from newly recorded popular music, Top 40, which is now often identified as Contemporary Hits Radio (CHR). Eventually some music becomes preferred after intense promotion, or in time as the music reaches listeners via other radio formats. The number of music compositions "tested" by its listening audience is limited, and exposed in a repetitive manner. As has been stated the extent of diversity of music programming can vary with both song type and industry concentration where song type is classified using indicators of vocal style, instrumentation, and rhythmic structure, and where industry concentration is measured with accepted concentration ratios.

Repetition of music has been shown to be effective in the development of "liking" (Hargreaves, 1984; Seashore, 1938; Lundin, 1967; Meyer, 1956) and familiarity(Russell, 1986). Popularity and "pleasantness-unpleasantness" of repeated music trends have been discussed by Lundin. These trends exhibit an inverted-U function. "Popular music tends to reach the maximum of pleasantness at an early repetition, whereas

classical selections reach their affective height with later performances" (Lundin, 1967). Hargreaves studied how this repetition was related to message complexity and familiarity, which are inter-related. As familiarity increases, though objective complexity stays the same, subjective complexity decreases. It is hypothesized that there is some optimum level of subjective complexity which is reached over time, as familiarity increases, and from which preference evolves. Verveer, Barry, and Bousfield (1933) in an early effort distinguished between continuous repetition and repetition at intervals, and found both to have a positive effect on ratings of "pleasantness" on a 20-point scale. Hargreaves (1984) recently has found that repetition at intervals is more significant than continuous repetition, with an interaction effect between these two types of repetition. The results were interpreted as further support for the inverted-U theory. Repetition thus plays a factor in music preference.

The working relationships between radio and records enable a mechanism for repitition of popular music selections, via broadcast radio. This effects preference for that music, due to the interaction of familiarity and liking. The ability to access their audience through available mass media technology; radio, makes possible a peculiar metamorphosis of recorded music and broadcast radio. This is such that it integrally intertwines these two industries to the point that recording industry concentration ratios are related to radio programming diversity (Peterson et al. 1975, Rothenbuhler and Dimmick, 1982). The findings indicate though that song type may still serve as a better predictor of programming diversity, and one component of song type is instrumentation.

Radio serves as a medium upon which other new technologies get superimposed making a web of technology for highly repeated, limited number of musical selections. With a virtually guaranteed audience in the early days of the relationship between radio and records, technology was devoted to the reproduction technology.

Reproduction technology has its impact on timbre. The microphone, enabled new methods of vocal delivery that was associated with certain emotional qualites that could not be obtained with musical instruments or live acoustic performances (Frith, 1986; Russel, 1986). With the introduction of recorded music, listeners were allowed to listen to their own copies as much or as little as they wanted. This technology effects the exposure rates of radio broadcast music. Radio besides repeatedly exposing listeners to a limited set of songs, enables a regular medium for newly recorded music. Magnetic tape enables new types of music messages by making the recording studio a production tool for multi-track tape reproduction. This enables the musician to simultaneously perform various tapes tracks for a comprehensive unified result. The use of tape also enables types of tape editing, splicing, and musical sounds in general. Recorded music has exhibited its influence on timbre. By reversing sections of tape the envelope and spectral contents of sound can be reversed in time. This effect was high during the psychodelic age of rock&roll in the late sixties, when the Beatles, Jimi Hendrix, and Spirit all used such effects to influence the timbres in their music. In addition each year new effects have been introduced, starting a progression from wah-wah, distortion, and sustain to stereo chorus, flanger, and now a whole range of digital controls such as delay and

reverb. Some of these effects are a static conversion, while others allow for analog control with a foot pedal that work as accelerator pedals in an automobile. Each of these "effects" modifies timbre.

Telecommunication technology is integrally tied to the development of music, particularly timbre. It effects message content through instrumentation, recording, and microphoning technologies, while the message exposure is modified through playback recording, and broadcast technology. Exposure is now influenced by instruments with a variety of "preset" rhythms, and "one key" playing capability. More people are able to play music now. Mediated music has an inherent dynamic to modify itself into continuously innovative musical forms, and these are quite often tied to the potentials enabled from rising technologies. As has been pointed out this is not even peculiar to electronic music. The rise of the small combo after the invention of the saxophone, led to a completely new style of music, jazz, whose fundemental goal is to modify itself. These new technologies introduce new timbres into music, from which old styles are made into new styles, and old styles remain marked by their timbral elements. In conjunction with this though are listeners that react and respond to mediated music for a variety of reasons including behavioral access and effects, structural content, and peer approval. One group of listeners that is especially attentive to newly released recorded music and subsequently radio programing are the youth of the world. Music carries meaning for youth in a variety of ways. These meanings will continue to change as they progress through life. The meanings are carried in simple repeated messages that literally get hammered, into the inner workings of social youth (Lull, 1987). This

fundamental human relationship of music and age is our next and last area of focus.

Youth Culture. Radios, compared to television, are more available to people, due to lower cost, and simpler technology. Popular music is referred to as the "voice of the youth" (Chaffee, 1985), which is uncontrolled by parents especially since music can be taken outside the realm of the household, made portable in cars and in one's hand, as in the "transistor radio" craze of the 1960's or the "ghetto blaster" craze of the 1980's (Christenson, Debendittis,1985). When cassette tapes became popular, the control listeners had over their music programming became even greater by making their own choice, their own copies at their own time (Frith,1986). In addition, popular music tends to have less rigid social norms of lyric content, and of visual displays during performances. Out of these norms and actions, sub-cultures become associated with each (Lull,1987). Here is a socializing force. Peer approval is another active social mechanism (Hanser,1974; Alpert,1982) in making musical judgments and judgements of popular music preference. Preference for music perpetuates music communication, and preference is a social phenomenon. Preference is a topic commmunicated between listeners sometimes with language, and sometimes without. An assignment of symbols, though, demonstrates an extent of probability of "shared meaning". That which is "real" is something not only which has been symbolized, but also shared and agreed upon with others. Only through sharing our observations and agreeing on them does an observation become "real" (Einstien,1952). To ascertain relationships requires meaning to transmit from respondent to researcher, using a shared symbol set. Using

this the social scientist more closely measures social phenomenon. Once given the shared symbol set, and an identifiable phenomenon, the scientist is ready to measure conditions, whether they be controlled or naturalistic. To do this requires measurement instrumentation.

Measuring Music Preference. In identifying music preference, "most experimental studies present a music stimulus and then call upon them to respond to that stimulus in some way." (LeBlanc, 1984) Some operationalize the preference as "liking" (LeBlanc, 1982), while others discuss it as a behavioral act of "choosing, esteeming, or giving advantage to one thing over another." (Kuhn,1981) Others have operationalized preference as the amount of "pleasingness" (Seashore, 1938; Russell, 1986) however Russell found that "pleasingness", does not particularly predict the music one prefers. Other measures are behavior observation techniques that derive the preference from frequency of occurence such as overt selection via experimentation equipment. There is much use of measures of how much do you like a certain musical stimulus, or ratings on a continuum of like-dislike. In both cases they have used measurement scales with ranges of 1-5, 1-7, up to 1-20.

In another vein of music preference research, certain factors believed to be relevent are rated using an ordinal scale of "like least", "like", and "like most" (Baumann, 1964). From this type of scale again, the researcher is able to identify relative ordering weights of these factors. As has been the problem with such scaling data of "believed to be relevent" dimensions, the ratings may be made on factors that are actually irrelevent. To avoid this, the communication fields influence

social research to develop a "shared symbol set" with respondents, prior to measurement instrument design. In this way the dimensions yielded, contain a relevancy at the on-set of testing in the research process. This derives from the fact that the factors being measured are shared between researcher and respondent. After assessing this symbol set, it then is a logical step that each member of the evoked set of descriptors can be scaled to yield measures. In addition more finely calibrated scales are a natural outgrowth of a dimension already measured as relevent, and questions of "Is this relevent?" can be further advanced to "How much of this is relevent?". The question now is "Is a scale of 1-to-7 adequate for respondents to discriminate their responses on these relevant dimensions?".

Scaling relevant verbal dimensions has been done successively using nominal categories, ordinal, interval and ratio levels. The semantic-differential and Likert scales are popular in social science. Many concepts relating to domains as diverse as message exposure, uses and gratifications, attitudes and opinions, and product purchase patterns have been scaled. A continual shortcoming of ordinal and interval level data is its inability to yield measures which discriminates sub-groups by "How much." At a basic level, this problem stems from the exclusion of a real zero point, in spite of the simple logical deduction that if a scaled item is "not applicable" then it does not exist as a variable relevant to the inquiry. The definition of zero is "the arithmetic symbol of 0 denoting the "absence of all magnitude or quantity" (Webster,1985). This is the case for a verbal concept which is "not applicable." One of the things in measurement is the assignment of

symbols to some phenomenon. The exclusion of a zero point symbol from a measurement scale automatically includes all factors in any solution. By including a zero point in a scale, then the lowest rating on such a scale enables that item to drop out of the equation and thereby allow a simpler, more accurate solution with less variables. Research is scientific, and parsimony, or simplicity is to be opted over complexity in formulating scientific explanation (Popper, 1959). The application of the symbol zero is further warranted in the arena of music preference research, since the message itself is a demonstrated, physically quantifiable phenomenon.

In the works of S.S. Stevens (1935) the development of 0 to 10 scale proved quite useful in early studies of psycoacoustics. Auditory phenomena are quantifiable as a ratio-level measure. Though measures used by Stevens were primarily with regard to pitch-detection on "how much is heard," the application of this measurement scale to an evoked set of music preference descriptors is logical since these are listeners' own music descriptors and these are being used to define music, a physically quantifiable phenomenon. As music preference is found to be described by message structure, mood, and social behavior, all of these phenomena have been measured using ratio-level scales, yielding useful data of "how much" each concept applies. From such ratio-level measures other questions can be addressed through analytical techniques of how the set of concepts exist as a set. It has been shown that timbre is related to music structure and music preference, and preference is a function of music structure, media transmission and social group. The logic of this work is to measure how music preference varies with timbre

using a lexicon of music preference.

Timbre is multi-dimensional, and the words used to describe music preference can cover multiple lexical domains. Though respondents do not have the capability to describe formally the relations between the different physical components of varying timbres, they do have a generally agreed upon ability to discriminate timbre. They know when the timbre has changed, and have come to define certain styles of music by certain timbre. People prefer some timbre over others. Timbre allows for a certain quality of music. Timbre physically is a multidimensional multi-variate phenomenon, and certain magnitudes can be ascribed to different timbres in each dimension. Timbre is multidimensional, and likewise the aggregate description of musical preference is multi-variate. For a comprehensive solution to their relationship, it is logical to measure how this set of lexical music preference concepts varies with different timbre. If a difference is found, then further analyses could be warranted. A difference in the relationship between music preference descriptors and music timbral elements, across different timbral variations, can begin to provide insight into this traditionally salient music component and quite recently a telecommunicated musical phenomenon.

Chapter Three

Methods

Introduction. The measurement of a music preference lexicon as a function of timbre requires the specification of our independent variable, musical timbre, and the dependent variable which is a lexicon for music preference. The independent variable physically describes the music message using a production component, timbre. The dependent variable in this study is the lexicon of musical preference, a lingual component. To examine a tradition, a style lexicon will be used, which is still often one's first description of music preference. This can be a valuable indicator of a listener's popular music sub-culture preference. In addition at the heart of this study is the use a lexicon of music preference, which is found in raw form to be unique from style for most listeners in the aggregate, identifying a different conceptual understanding of music. By applying ratio level measures to this lexicon of music preference, and using a physically describable timbre in a controlled music setting it is possible to explore if there is a relationship of preference with timbre.

Timbre. Timbre will be differentiated by selecting experimental conditions that differ in both of the two primary dimensions (Gordon and Grey, 1978; Moorer, 1975; Charbonneau, 1981):

- Spectral Composition
- Attack Functions

The spectral composition is described by its harmonic composition of how many harmonics and which ones it has from the theoretical harmonic series. The attack function has been found to order into three relevent

types: fast piano-like attacks, brass like attacks (which is a bit slower), and smooth or trapezoidal attack-decay. In exploring whether there is a difference between timbres, the two main dimensions spectral composition and attack-decay will be combined in such a way as to present different timbre. There are three categories of traditional methods for generating sound: 1) percussive, 2) string, and 3) wind (Hall, 1980). An example of each has been selected: 1) bells, 2) strings, 3) brass. Each of these differ from each other in both spectral composition, and attack decay functions, as Table 2 indicates. Figure 4 shows the reader a three-dimensional plot (trumpet) of volume by frequency by time, to supply a graphic representation of both spectral content and attack functions, and how they interrelate over time.

Table 2 - Components of Bells, Brass, and Strings

Timbre	Spectrum	Attack
Bells	3 harmonics	Very Fast
Brass	7-11 harmonics	Fast
Strings	5-8 harmonics	Smooth

Dowling & Harwood (1986)

Although some multi-dimensional research of timbre perception points to piano as a distinct type of timbre in spectral envelope, we will translate this finding into using bells instead which still have the same type of attach/decay however the spectral content is a bit simpler to synthesize. The validity of this timbral difference is retained since bells are a unique sounding timbre with a quick attack, and exponential decay. Bells are also a familiar timbre that has been especially popular with the onset of synthesized and layered (telecommunicated) timbre. Thus the substitution of bells for piano simply changes our harmonic

with the onset of synthesized and layered (telecommunicated) timbre. Thus the substitution of bells for piano simply changes our harmonic composition while keeping a relatively "piano-like" attack, and also presenting a highly relevent timbre in the context of popular music. Our operationalization of all timbres is synthesized timbre, on a digital synthesizer using a frequency modulation technique for synthesis.

Preference Lexicon. A lexicon for preference is that set of words used by the aggregate for describing their preference of certain phenomena or lingual domain, be it adjective, noun, or verb. Our domain is music preference and as we have already seen the lexicon used most often by listeners, researchers and industry is that set of words used to describe

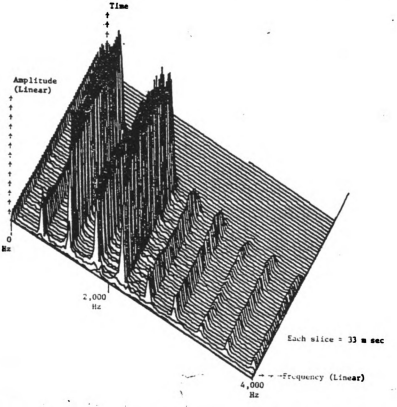


Figure 4 - Three Dimensional Plot of Trumpet Timbre

(Figgs, 1981)

genre or style. In addition music preference tends to have various sub-styles or sub-cultures active within it at any one time. This set of words is important in initially describing one's music preference. In addition a different set of words can be obtained by asking listeners "What words do you use to describe the music you like?", which yields a set of words that further describes music communication. Words such as beat, loud, fast, relaxing and exciting, are characteristic of this domain of describing the music they "like." These descriptors often indicate a level of "meaning", in both denotative-embodied and connotative-designative ways. To assess the actual preference for any music selection it is important to determine if indeed "description of the meaning of preference" for a particular song is the same as "liking" that song. Therefore it seems important in this exploratory effort to measure both. In addition both "liking" and "pleasant" have been used to describe preference and both these will be used.

The style and preference lexicon have been collected from the population under study by asking them "What kind of music do you like?", and "What words do you use to describe the music you like?", respectively. A quick sort was done and the resultant lists represent lexicons of style and preference respectively. By selecting those descriptors that occurred at least twice, the following lists identify the following music styles and lexicon of preference:

Style	blues, classical, country, folk, funk, jazz, new age, new wave, pop, punk, soft-rock, rock
Meaning	beat, dance, exciting, fast, fun, happy, intense, loud, melodic, relaxing, slow, upbeat

Although "pleasing" was only identified by one of our intercepted

respondents, it is included here since it has been a popular measure in the past for measuring preference.

Music Preference. Music preference has been frequently measured with simple descriptive statistics of style preference, and how these interact with listener variables. The listeners' variables of interest to music preference are: 1) Age, 2) Socio-Economic Status, 3) Peer group, 4) Media Usage, 5) Familiarity, and 6) Dancing frequency. Although findings of sexual differences, have not conclusively been found across studies, some studies have indicated differences by sex at certain stages, such as the change of 11 years to 13 years old. We will include sex this for purposes of validation. In addition as another social indicator the type of housing (on-campus, off-campus) is included as measure of potential differences, a variable that has special significance in this year preceeding the arrival of an FM radio station on campus.

Exposure of the music message is a strong determinant of preference, when exposure is repeated. As was discussed in Chapter Two, repetition and familiarity are integrally interelated over time. As repitition continues, familiarity goes up and in certain cases, preference goes up, although in certain cases when a message is "too complex" familiarity will go up but preference will not. In this light, the test music to be used is "simple-uncomplex" music, made of an 8 beat hook. Popular music frequently takes the form of music accompanied by lyrics. Lyrics were not included in the test music because this experiment is designed to measure music timbre and not limited to popular "song." The test music was made of harmonically "simple-uncomplex" structured music portion of a

typical "pop song," without the sung part of the music.

The model for the operationalization closely conforms with that found in Anderson, Hesbacher, Etzkorn, and Denisoff (1980). The "pop song" is a simply defined combination of musical parts, particularly having a beat, chordal progression, and a melody. Quite often vocal timbres are used for the melody. The combinations of these variables contribute to "song type" of which there are two recognized type of songs in any style of popular music: ballads and upbeat. "Tempo basically distinguishes ballad and upbeat songs; other critical determinants of song type are: song structure, vocal style, interpretation, rhythm, instrumentation and arrangement." (Anderson, Hesbacker, Etzkorn, Denisoff, 1980). A song type category scheme referred to by the recording industry includes instrumentation, song structure, and vocal style. Since previous research (LeBlanc, 1981, 1983) shows a preference for instrumental music over combined instrumental/vocal music, and it can be stated with confidently that by testing instrumental music, the musical form of preference is being explored is simpler, vocal timbres were not included in this study. A popular song was produced that matches the style "pop upbeat", containing "rhythm and blues" components active in the "hook" bass line, accented by the corresponding rhythmic and melodic chordal "hook" phrase. This "pop upbeat" song structure, is composed of a simple ABAB pattern, with only two predominant harmonic chords used in each of the A and B patterns, thereby keeping harmonic variation to a minimum (Krumhansl, 1985).

Ratio Scales. As has been mentioned earlier, if there is a difference between the preference lexicon of popular music preference for different

timbre, this difference may not be identified with traditional levels of measurement. The exclusion of a real zero point often includes more variables in a solution then may be the case if variables have been quantified as "not existent" or zero (0). In conjunction the independent variable of timbre is a physically describable music attribute, that although cannot be measured unidimensionally, does vary in magnitude in each of its two prominant perceptual dimensions.

Since the primary timbral dimensions, 1) spectrum frequencies, and 2) attack-onset have been quantified and measured using ratio-scales, their use is proposed for use here. To measure a phenomenon, such as the relationship between sound and words, the words also can be treated as ratio-level phenomenon. As has been previously discussed, assignment of number range of 0 to 10 has been done to sound and words using a direct magnitude estimation scale. The need for ratio-level measures lies in the crux of our research problem, of whether people discriminate timbre using a set of words. Such precise word usage may only be found with ratio precision. In exploring such a relationship, the measurement tools must be able to discriminate such a relationship, if any exists. The level of precision afforded with such precise levels can always be modified in the future if our precison "overshoots" our phenomenon. In this exploratory effort, measurement will include an absolute zero-point, and a scale up to 10 continuing in the tradition of listening tests (S.S.Stevens, 1935, Toole, 1982). The multivariate nature of timbre is acknowledged, and used.

A lexicon for music preference carries meaning of music, and meaning at times "does not exist." In a music-word relationship this can be due

to a mismatch between the set of sounds presented and the set of words used describe the sounds. If meaning does exist the combinations of words of this set used to describe any type of timbre in music, can be more accurately analyzed with available numerical analysis techniques. The lack of ratio measures being used somewhat derives out of the available analysis technology available. Twenty years ago the level of a computational technology was not what is available to them now in this "micro-millenium" (Evans, 1979). Ratio-level scales were used for measuring the lexicon of popular music preference. If this varies with timbre, the instrumentation for music preference has been numerically set up to "match the concept(music preference) to a good numerical scale." (Miller, Nicholsen, 1976) and reflect the physical nature of the timbral stimulus. Therefore we can represent numerically the degree of preference and obtain further meaning of this preference by measuring not only "What's relevent?" but for those concepts that are relevent, we can determine "How much."

Analysis. Given measures of listeners' ratings of a preference lexicon, the nature of the relationship with timbre in the test music was analyzed with three analytical techniques. The measure of difference between independent conditions was done using an ANOVA, for each descriptor across all conditions. To further refine our understanding of any differences, contrasts were calculated for each descriptor, across all paired conditions. To measure the set "as a set" other analysis techniques were used.

As a validity check the lexicon of music preference ratings of general

musical preference were checked against the ratings of the timbre conditions, to check for colinearity. The dimensional nature of the lexicon for preference was analyzed using a factor analysis, which can identify how the set of words, in particular combinations, explain variance in the ratings measured. Factor analysis analyzes "the degree to which clusters of intercorrelated variables may represent fewer underlying, more basic, hypothetical variables." (Williams, 1979). This acts in this study as a check of dimensional validity with general findings in semantics, and can also identify inter-relationships between members of the music preference lexicon.

As a comparison with traditional methods, a rank order of the lexicon for general music preference was measured along with the ratio level measures. The two will be charted to check if the ordinal relationships among lexical members is retained in the results using ratio measures. Another comparison with traditional measures was the scaling of style for each timbre condition, to see how this set of descriptors can discriminate timbre, compared to the lexicon for music preference. For each style lexicon, an analysis of variance was calculated.

The numerical nature of the independent variable, timbre, could have been translated into ratio-level measures which could then enable regression analysis. This is outside the scope of this work, but if findings warrant futher investigation, the analysis could yield those coefficients of pertinent descriptors used in discriminating timbre, thus formulating a equation for music preference as a function of timbre. Since the nature of our independent variable is bi-dimensional the regression equations could be fit to each dimension of timbre. Since

the nature of this study is not one of prediction, this is the reason for not including regression analysis in this thesis. The analysis of other "listener" variables will be cross tabulated with our primary dependent preference variables to check if there are any relationships, in an effort to validate our findings against findings from other scientific efforts. These cross tabulations will calculate chi-square ratios of observed over expected occurences.

There were four (4) analysis techniques used determine if any differences in the music lexicon for preference, as individual variables and also a set of descriptors, across timbral conditions. T-tests, correlation afforded us univariate analytical tools, while the set of words were analyzed as a set using the multi-variate tecchnique of factor analysis. Besides analyzing the data for determination of support or unsupport of the research hypothesis, other analyses were run to allow for comparison of findings with traditional techniques. Lastly some traditional demographic crossbreaks were performed.

All statistical tests were calculated with a level of significance of $p = .05$. This was selected for two reasons. First, this level of significance although representing a "wrong guess" 5% of the time, is currently used as convention in the social sciences. Second, since the nature of this thesis is exploratory, the purpose is to discover relations, and therefore in early discovery certain relations that may not hold to linear solutions, must be retained for further replication at higher levels of significance in the future.

The Research Question. This thesis investigates whether any relationship is found between musical timbre and a lexicon of music preference.

The central research question under examination is:

> **Do people discriminate between music with different timbre using a lexicon of music preference?**

To refine this question we state:

> **Is there is a relationship between the preference lexicon and timbre of music ?**

The Research Hypothesis. Defining the research hypothesis with an exploratory focus, simply tests whether there is a difference in usage of the music preference lexicon across timbral conditions.

Hypothesis I: There is a difference in the lexicon that describes different timbre.

$$p \neq p \neq p \neq p$$

Null Hypothesis: There is no difference in the lexicon that describes different timbre.

$$p = p = p = p$$

This hyphothesis was tested first by seeing if there is any significant difference across all conditions, and then further analysis tested the nature of any differences found. This is the extent of our exploratory research question and hypothesis.

Test Timbre and Music. The timbres used in the research tested three types of different timbre. To vary timbre at least 2 different timbre conditions are needed, however to be sure that timbre is what is being varied then 3 timbre conditions are selected. Due to the exploratory nature of this effort, for the sake of parsimony other conditions are not desired. This research uses three timbres: bells, brass, strings. The timbres used were factory pre-sets from three instruments commercially available from the same manufacturer: a Yamaha DX-27, DX-100, and FB-01 FM digital synthesizer. The sounds were labelled as "Brass 2" on DX-100, "Lo Strings 2" on the FB-01, and "Glocken" on the DX-27. A pre-test of these three test timbre was performed to validate the differences in these three timbre. The pre-test respondents were asked "How different?" the timbres were from each other. Differences were a scaled on 0 to 10 scale. The bells and brass, and bells and strings were always different, but the strings and brass closely resembled each other. To correct for this in the actual test sessions the equalization in the high-end (10-15Khz) was boosted during the mixdown of the brass melody track, a technique used by Wapnick (1980) for varying timbral spectrum. In this way the brightness characteristics of the brass (Beauchamp, 1982) was accentuated. The synthesis technique used is a frequency modulation technique using 4 sets of oscillators, known as operators. The synthesizers are all members of the Yamaha 4-operator based synthesizer family. The sound synthesizers used to generate the different test conditions are identical.

The test song is made up of a 16 measure, 4/4, two-chord, key of G major heavy bass line funk verse segment, and an 18 measure, two chord,

key of 6 minor, latin-feel part (pop music's chorus). This music is designed to be upbeat enough to sufficiently arouse the test listeners attention. This is accomplished by using simple harmonic structures built over two chords, fairly upbeat (less than 100 beats per minute) tempos, prominent bass pattern, and solid drum beat.

The Recording Session. This song was performed using a pre-written and taped rhythm track using a Yamaha DX-27 and RX-17 Digital Rhythm Programmer. This rhythm track uses a drum, bass, and chording (using the same timbre of the bass line), to generate the rhythm, tempo, and general harmonic structure of the song, including a "hook" in the rhythm of the bass with chording. Using this track as input to one track on an Otari MX-5050, 4 track tape recorder, the other three tracks were filled with simultaneous performance of our three MIDI-compatible synthesizers. The outputs from the synthesizers were routed through a patch bay as input modules on a Soundcraft 12-Channel Mixing Board, which then re-routed the signals to the recording machine. All machines were calibrated using 100 hz, 1000 hz, and 10,000 Hz reference tones.

MIDI Control: Experimental Performance. Synthesizers were configured by chaining MIDI control information from the master keyboard DX-27 to the DX-100 and on thru to the FB-01. With this MIDI control of music information, simulataneous control of each synthesizer enabled identical performance dynamics in all three experimental conditions. The experimental conditions had a simple five-note melody with one note occuring on the down-beat of each measure, except the occurence of two notes in the last four beats of section A, or verse portion of the song.

The melody was played so it was always triggered throughout the first sixteen beats, or section A. The melody in section B of the song was played using six notes, in alternating succession of sets of three notes, against 8 beats, and two chords; B flat minor 9 and a G minor. In this way the song was constructed to maintain as little variance as possible in other musical structures, yet attain enough variance to match a popular song.

From the 4-track version of the test song, identical mixdowns of the rhythm track with each timbre condition wer made to an Otari 2-track stereo machine. The specifications for the 2-track mix was a 60/40 on setting of the two panaromic potentiometers (pan-pots). Another way to look at it is that the rhythm track and melody track had their pan-pots set at 60 and 120 degrees respectivley within a 180 degree reference meter for the two. This attempts to eliminate any particular interaction between timbre and stereo separation.

Listening Tests. The population under study are members of the Michigan State University undergraduate student population. Particularly, the students selected for testing were members of introductory undergraduate communication and telecommunication classes. They signed up for one of four groups of listeners, one control condition and three experimental conditions: bells, brass, and strings. The listeners in each group heard a 45 second cut of two complete verses and choruses, with a fade out at the end of the second chorus. This way a simple-uncomplex "pop hook" music test is exposed to the listeners, conducting a test of a portion of a repeated piece of music, resembling the design of a familiar type of music, "pop song."

The listeners were asked to self-report their response to the test music. Before any listening tests, subjects were were asked to respond to two questions. What words do you use to describe music ? What words do you use to describe the music you like ? These are asked in an effort to check the calibration of the instrument used for the next set of questions. One practice question was asked, to familiarize the respondents with the measurement scales that were used. The practice question asked the respondents to rate the lexicon of preference for the song "Jingle Bells." It was thought that this culturally familiar song is familiar enough to most people to serve as a good practice song, even from memory.

During the test session the listeners were asked to record their rating of the music on the ratio-scalings of the preference lexicon and style, at any time during the listening session. The respondents were able to fill out scales in any order they found convenient. This allowed for immediate recording of the detection of any of the attributes. At the end of each listening session, respondents were asked to report their media use, music listening and purchase patterns, along with other demographics including age, income level, education level, ethnicity and sex. College relevent variables such as fraternity/ sorority membership college class (year in school), housing type were also included to gauge any music preference indicators against the socially relevent items. The listening enviroment was the same for each condition, a classroom capable of holding about 35 people. There was a total of 120 people sampled with 30 in each group.

Self Report Instrument. The self-report instrument is designed to measure relationship of timbre and music preference lexicon. In addition it is meant to assess certain listener attributes by known factors in the music preference phenomenon. Subsequently the instrument first asks a set of music descriptors as a validity check of how well does our earlier identified lexicon fit this population. Then the ratings of the lexicon are assessed using a scale from 0 to 10. A measure of "how much" preference is taken by measuring how much one "likes" and how much one finds this song "pleasing."

A rank order of preference for musical style and preference descriptors is done as a validity check against our ratio-measures to see if the same relations exist. Media use has been checked in general, with special attention to radio, recorded, and other music listening exposure, Radio use is measured in hours, recorded music in number of purchases in a year, with percentage of all purchases made for each type of recorded music. The other music listening exposure questions are measures of yes/no to ownership of certain audio components, and attendance at live music events. In addition a measure of familiarity is taken by asking various questions of "if you have heard music like this, where?". Lastly the measures of age as years, socio-economic status as "Do you have a job?", "Is it part-time or full-time?", and "How much is your income?" are asked. Music behavioral yes/no measures used of dance, singing, and playing (Do you play any musical instruments ?).

Chapter 4

Results, Discussion and Conclusions

Results. The set of respondents from the undergraduate classes were made up of 47.5% females, and 52.5% males, average age was 21.2 years and with an average income approximately halfway between the income categories of 2 and 3, which interpolates to an average income of $4500. The sample was predominantly Caucasion, where 88% of the sample identified themselves as white. Those employed made up 65% of the sample. The year in school was represented by 22.7% freshman, 26.1% sophmore, 39.5% junior, and 10.9% senior. The percentage of the sample living on-campus was 60%, and off-campus 39.2%.

Table 3
Sample Demographics (N=120)

Demographic	Frequencies			
Age	Mean: 20.2 years			
Employment: 65%	Part-time: 64.2%		Full-time: .8	
Income	$1000-$3000: 43.8%		$3000-$6000: 35.0	
Gender	Females: 47.5%		Males: 52.5	
Hometown	Rural: 26.1%		Urban: 12.6	
	Suburban: 61.3			
Housing	Student House: 15.1%		Greek: 3.4	
	Residence Hall: 60.5		Family House: 2.5	
	Apartment: 16.8		Other: 1.7	
Race	American Indian: 0%		Asian: 2.5	
	Black: 8.3		Caucasion: 88.3	
	Hispanic: 2.5			
Year in School	Freshman: 22.7%		Sophmore: 26.1	
	Junior: 39.5		Senior: 10.9	
	Graduate: .8			

The basic use of music through various broadcast media is represented by an average radio listening of 3.4 hours, with a mode of 2 hours. Music purchasing exposure is represented by an average number of 14.7 separate purchases in a year, ranging from 0 stated by one person, to 65 albums in a year by another.

Table 4
Sample Music Exposure Profile (N=120)

Demographic	Frequencies			
Radio Listening:	3.4 hours per day			
Music Purchases: (avg. % bought)	Albums: 19	45's: 6		
	Compact Disc: 12	Cassette: 56		
	Live Concert: 6	Other: 1		
Number of Purchases:	14.7 purchases a year			
Hi-Fidelity Media Ownership:				
	Cassette: 98.3%	Compact Disc: 20.8	Turntable: 82.5	
	Radio: 98.3	Stereo TV: 27.1		

Lexicon of Preference. The lexicon of music preference, originally derived from the sample population, was scaled both for the test music, as a preference description rating, and also the music liked in general, which will be referred to later as general preference rating. These measures serve to test the research hypothesis and validate the findings, and structure timbre-lexicon findings in relation to the general use of this lexicon for general music preference. General preference ratings are shown in table 5, and show that the lexical descriptor with the highest mean is "beat" at 8.6, with the lowest mean rating being "slow" at 5.3. The standard deviations for the descriptors ranged from 1.4

(beat) to 2.8 (slow). The measures range primarily in the upper half of the scale, although "slow", "loud", "relax", "intense", and "melody" had at least 20% of its responses falling within the lower half of the 0 to 10 scale. Such precision would not have been available from a 1 to 5 point scale.

Table 5
Mean Rating of Lexicon for General Preference

Lexical Term	Mean
Beat	8.6
Exciting	8.2
Upbeat	7.7
Fun	7.7
Dance	7.3
Fast	7.0
Happy	6.7
Relaxing	6.5
Intense	6.2
Melody	6.4
Loud	6.0
Slow	5.3

In using the ratio level scale, a parallel use of rank order scales was done as a check of the ratio scales reliability. Table 6 shows how

Table 6
Comparison of Rank Order and Ratio Scales

Lexical Term	Rank Order	Ratio Scale	
Beat	3.9 (1)	8.6 (10)	
Exciting	4.6 (3)	8.2 (10)	
Upbeat	4.8 (4)	7.7 (10)	
Fun	5.1 (4)	7.7 (10)	
Dance	5.8 (1)	7.3 (10)	
Happy	6.8 (7)	6.7 (5)	
Relaxing	7.0 (10)	6.5 (5)	
Fast	7.1 (8)	7.0 (8)	*
Intense	8.0 (11)	6.2 (5)	
Melody	8.1 (12)	6.4 (8)	
Loud	8.3 (12)	6.0 (5)	
Slow	8.4 (10)	5.3 (5)	

* (only case of scale ordering difference)

the two scaling techniques compare. In all cases except one do the ordering of preference descriptors match, and the difference occurs in the descriptor "fast," where the numerical difference is approximately 1/20th the scales magnitude (.5/10) which is still more precise than difference between scale points on a rank order scale of 1 to 12 where the difference between scale points here is 1/12. What this means is the ratio scale has reflected the traditional rank order measure. In addition the divergence from the rank order findings continues to hold value identifying relations between the lexical set and timbre that may not adhere to linear modelling but perhaps other modelling such as curvilinear. Though sophisticated non-linear modelling techniques were outside the scope of this thesis, it is well documented in the literature of how perception is often found to be in a logorithmic or exponential relationship with physical referents. With a ratio level measure, such curvilinear relations can be studied in the future. In addition the assignment of numbers to concepts by social groups, can often yield numerical relations that are exaggerated due to certain individual's use of extreme scores. With the ratio level data, a logorithmic transformation is made possible. All the information from the rank order technique has been retained while increasing the precision of measurement discriminations between lexical measures.

The lexical measures of musical preference were checked on their interelatedness with a Pearson Product moment correlation. The rule selected for noting correlation coefficients is greater than 0.40 strength at the p = .05 level of significance. The most pronounced relationships existed between slow and relaxing (0.65), beat and exciting

(0.48), exciting and fun (0.47), fun and happy (0.46), fun and dance (0.43), upbeat and dance (0.43), and happy and dance (0.43).

The general musical preference raw data was numerically transformed using a natural logorithm for the goal of reducing impact of extreme scores on the mean and subsequent group mean differences. Using the transformed data, a factor analysis was run on the lexicon of general music preference. The factor analysis was run with a criterion minimum eigenvalue of 1.0 and used a varimax method of rotation. The results yielded a four factor solution, accounting for a total of 66% of the variance, with each the four factors accounting for the following percentage of variance: (1) 27.7, (2) 17.2, (3) 12.5, (4) 8.5. Table 7 summarizes these factorial groupings, including listing the preference descriptors that loaded at least 0.50 on the rotated factor loadings. Factor one has high loadings in dance, exciting, fun, fast, happy, and upbeat. Factor two includes slow, relaxing, and melodic. Factor three includes loud, intense, and melodic, and factor 4 includes

Table 7
Factor Analysis Summary

Factor	% of Variance Explained	Lexical Loading
1	27.7	dance, fun, fast, exciting, upbeat, happy
2	17.2	slow, relaxing, melodic
3	12.5	intense, melodic, loud
4	8.5	beat, loud

beat and loud. The underlying dimensional structure yields factors which might be described by unbeat & exciting, relaxing & slow, intense & melodic, and beat & loud.

Hypothesis Testing. The lexical measures of the test music timbral variants were analyzed individually with a one way analysis of variance across all paired and non-paired combinations of timbral groups. The most prominant findings concern the brass timbre with control and other timbre. Brass timbre is described as less "Intense" than the bells, and the strings. Brass is less "Relaxing" than the strings and the bells/strings combined means. Brass is less "Exciting" than the control, and brass is less "Melodic" than the strings, and finally brass is less "Fun" than the control. The control was also more fun than the combined means of all timbral groups. The finding for the "Melodic" descriptor between brass and strings was not isolated to these timbres. Strings were found to be more melodic from the combined means of the other two timbre (brass/bells), plus from each of the timbres brass, and bells. These results are summarized in Tables 8 and 9. The use of the greater than (">") and the less than ("<") signs correspond with the

Table 8
Lexical Differences of Timbre by Timbre Combinations

	Control	Brass	Bells	Strings
Control		> Fun (All 3 timbre combined)		
Brass			< Intense (combined) < Relaxing (combined)	
Bells				
Strings		> Melodic (combined)		

level of the timbre on the vertical axis of the tables. An example is that the control timbre is greater in fun than the brass.

Table 8 shows that the control varied in "fun" from all 3 the timbral experimental conditions, brass varied in "intensity" and "relaxing" from bells and strings combinations, and strings varied in "melodic" from the brass and bells combination. Table 9 shows similar results except the finding of brass being less exciting than the control condition, and brass was less "fun" than the control. Table 9 also

Table 9
Lexical Differences of Timbre by Timbre

	Control	Brass	Bells	Strings
Control				
Brass	< Exciting < Fun		< Intense < Relaxing	< Intense < Melodic
Bells				< Melodic
Strings				

shows that the only finding of difference between bells and another timbre, is with strings, in its lessor level of "melodic."

Null Hypothesis: There is no difference in the lexicon that describes different timbre.

The results from the above analyses demonstrate support for rejection of the null hypothesis. The measures of some members of this lexical set of music preference descriptors, varied between timbres. The descriptors that varied are "intense", "melodic", "exciting", "relaxing", and "fun." Descriptors that remained relatively stable across timbral variations were "loud", "fast", "happy", and "dance." These serve as

indicators of control of the apparatus (music) in loudness (loud) and tempo (fast). Likewise the danceability was apparently uneffected by timbre as was the level of happy. The stable measures were also indicative of the scales capability for consistent measurement, compared to varied measures found. Table 10 lists lexical mean ratings by timbre.

Table 10
Preference Lexicon Means By Timbre

Preference	Control	Brass	Bells	Strings
Beat	8.9	8.3	8.5	8.5
Slow	.9	1.1	1.1	1.7
Upbeat	7.8	8.0	7.3	8.2
Relax	3.2	2.6	3.6	4.3 *
Excite	7.1	5.8	6.4	6.8 *
Loud	6.3	6.3	6.9	5.9
Fun	7.4	6.1	6.9	6.4 *
Intense	4.8	2.9	4.9	5.0 *
Fast	7.8	7.1	7.3	7.0
Happy	6.6	6.7	7.2	6.0
Dance	7.5	7.2	6.4	7.3
Melody	3.4	3.4	3.4	5.0 *

* represents significance at p = .05

It is worthwhile to point out that the findings of differences in peoples' descriptions of timbre variations are verified in other measures. First, the finding of "intense" and "melodic", the variates whose significant differences were found across the combined variance of all timbre groups, also are described together by factor 3 found in the factor analysis. Second, the relationship between use of descriptors for general preference and test music identification, was checked for colinearity in these two measures of the preference lexicon. There were not any findings that were indicative of such a trend. The preference ratings assigned to the test music were different from the general preference numerical assignments such that the differences across timbre

were not also reflected in general music preference ratings. For example, the brass group did not necessarily dislike "less intense" music, but they did like slower music. Across timbres, brass was found to be less intense while intensity did not characterize the general preference of the brass group of listeners, in niether a positive or negative trend. In the same light, the strings group liked more upbeat, fast, dance music and this may account for the strings being described as more relaxing than the brass. The brass condition was found to be less exciting than the control, while the brass group liked slower music, and the control group liked less loud; intense; relaxing; melodic and more dance music. The strings were described as more melodic, and the strings group liked more upbeat, dance and fast music than the others. This shows that the application of this word set to the test music, was different than its application to describing ones' general musical preference. There was no apparent signs of a linear relationship between the general preference lexicon and use of this lexicon for timbre preference. The instrument was sensitive to the independent measure.

Like and Pleasing. The fundamental descriptors for musical preference in levels of "like" and "pleasing," were scaled across timbral conditions. The findings are that people significantly liked the control more than all the timbral conditions combined, and more than the brass and bells separately, but not more than the strings. The strings are "liked" more than the brass. The "pleasing" ratings of the control condition were significantly higher than the brass, but not more than the bells or the strings. The strings were more pleasing than the combined means of the

brass and bells. So here we see that two traditional measures, often used interchangably, yield different groups of variance among timbre groups. Apparently the "like" concept identified the bells group as less likable, but not less pleasing, and strings were more pleasing than the combination brass/bells, while strings were "liked" more than only the brass. The ratings descriptors of "like" and "pleasing" varied between some timbral conditions, however they varied differently from each other.

The relationship between the "like" and "pleasing" descriptors and the lexicon for music preference was analyzed by calculating Pearson Product Moment correlations between them. Again using the rule of any correlation greater than 0.40 at the significance level of p=.05, as notable, the following relationships are worth noting. "Like" is correlated with "exciting", "upbeat", "fun", and "relaxing". "Pleasing" is correlated with "relaxing", "exciting", and "upbeat." The only difference between "like" and "pleasing" here is that fun does not show up as correlated with "pleasing", and the strongest relationship with "like" is "exciting" while with "pleasing" it is "relaxing," although this difference is not significant.

Style Lexicon: Findings. The measures of the set of music styles presented to the listeners after hearing the test music were analyzed using a one way analysis of variance for each of the styles across all the timbral groups. The strings are described significantly more as "rock" than brass, bells, and the brass/bells combined means. The brass was significantly less "rock" than the combined means of "strings/bells." The other style variation across timbre is that brass is less "jazz" than

control, bells, strings and all combinations of the timbral conditions.

Table 11
Group Means of Music Style By Timbral Group

Style	Control	Brass	Bells	Strings	
Rock	2.7	1.8	2.5	4.0	*
Blues	1.9	1.3	1.5	2.1	
Jazz	6.3	3.1	5.8	6.4	*
Soft-Rock	3.4	2.9	2.7	3.6	
New Wave	3.7	3.9	3.4	3.8	
Folk	.3	.1	.2	.5	
Pop	5.2	4.9	4.7	5.1	
New Age	3.7	4.2	4.6	4.5	
Country	.1	.3	.2	.6	
Punk	1.5	1.6	1.4	2.7	
Funk	5.3	5.9	4.4	5.0	
Classical	1.0	.6	1.2	1.0	

* significant at p = .05

To check how the style lexicon varied with the lexicon for musical preference, a Pearson Product Moment Correlation was run between the two lexical sets. Three significant (0.05) correlations were found, with a strength of at least 0.30. One is pop with dance (0.46), jazz with exciting (0.39), and folk and slow (0.30).

Familiarity: Where. One question asked about whether listeners had heard any music like this before, and if so "where?". The responses were classified according to the following nominal categorization: 1) Records, Tapes, CDs, 2) Radio Music, 3) Radio Ads, 4) Television Programs, 5) Television Ads, 6) Television News, 7) Concerts and 8) Bars. The findings although not statistically testable due to sampling size, do offer insight to the applicability of timbral preference findings. For this reason the following findings are reported if at least 50% of the test condition group respondents selected a particular response. The

control and strings groups found the music they heard to resemble Records, Tapes and CDs. Although just under 50%, the control, bells, and strings were thought to resemble music heard on the radio, as Radio Music. None of the conditions were thought to resemble radio or television advertisement music. One interesting finding is that the brass condition was overwhelmingly thought to resemble television program music, in comparison to other timbre conditions. None of the test groups indicated any similarity in test music with television news, concert or bar music. The findings reported here simply exemplify the applicability of timbral preference findings to particular media channels.

Demographics: Findings. The lexicon of music preference was cross-tabulated with the demographics: age, sex, housing(on/off campus), income. Off campus respondents rated loud and beat higher in the music they like than did on-campus respondents. Of the off-campus respondents, 50% rated beat as a 10, compared to 26% of the on-campus respondents. Although not significant sixty percent (60%) of the females describe that they like (in general) with a 7-10 rating for happy, compared to 44% of the males. The rating of 7-10 for the descriptor dance was reported by 79% of the females compared to 53% percent of the males. Although not significant, there appeared to be higher income preference for more melody and less excite.

Music Behavior. The music behaviors of dance, sing, and play ("If you play music,. . .") were cross-tabulated by the lexicon for general musical preference. One finding along the verification domain is that 77% of the people who dance more than once a week, rate dance highly as a

component of their general musical preference. This compares to 12% of those people who dance once a month. Forty percent (40%) of people who dance once a day, rate upbeat as a 10, compared to 16% of those people who dance once a week. Apparently dancing alot corresponds with liking upbeat music. Dancing more than once a week, corresponds with liking music that is fun, however as shown earlier, fun and upbeat are in a strong positive relationship with each other. Likewise, fast, and happy music is liked by dancers. The dancing music behavior appears to correspond with the first dimension of the preference lexicon factor analysis. One finding related to musicians is that musicians like less slow music, than do non-musicians. There are findings between this lexicon of music preference and music behavior, particularly the behavior of dance, but perhaps even musicianship is related to some words.

Media Programming: Sports Coverage. Exposure to varieties of sporting media coverage was reported by listeners. These yes/no reports were crosstablulated with the lexicon for music preference, and the findings are two in number. First, professional baseball(Detroit Tigers) radio listeners and college hockey (MSU) television viewers like less slow music, than those who do not watch such athletic coverage. Second, college hockey television viewers like loud music more than those who do not watch college hockey events.

Radio Exposure and Buying. Radio listeners who listen to radio 2 to 4 hours a day rate music they like with dance as a 7-to-10 rating. Of this group, those who rate dance as a 10 level of preference, makeup 39.2%, 42.1%, and 35.3% for the two, three, and four hour listeners

respectively. The rounding point appears to be around 3 hours for the point where one finds 50% of the listeners liking music with a dance rating of 7-10. People who listen above or below the 3-4 hour range seem to rate dance lower in their general musical preference.

People who buy 0 to 10 musical purchases rate "dance" the highest, with a decreasing amount of "dance" preferred by members of higher purchasing groups. The members of the 0 to 10 music purchases group have the highest percentage of 7-9 ratings at 77%, where the percentage in the group buying 11 to 20 music purchases is 66%, and of the group who buys 21 and more purchases, 43% rated dance in the 7-10 range.

Discussion. This sample of students used the lexicon for music preference in different amounts to identify the timbral conditions, particularly the descriptors of exciting, fun, intense, relaxing, and melodic. Across all timbral conditions' variance (including or excluding the control) the lexical set that described timbre was made of intense and melodic. It was previously noted that these two descriptors align themselves on factor 3 from the factor analysis, which is another verification of the lexical measurements. Compared to the three factors identified by Nielzen and Cesarac (1981), 1) Tension-Relaxation, 2) Gaiety-Gloom, 3) Attraction-Repulsion, the factors of the music preference space may match if factor 1 (dance, exciting, fun, fast, happy) is viewed as a gaiety-gloom factor, and factor 2 (slow, relaxing, and melodic) and 3 (intense, melodic, and loud) combined as an intense-relaxing factor, with factor 4 (beat, loud) as a attraction-repulsion factor. There is some similarity here but the divergence is holding

information and error and therefore further investigation is warranted to identify each. In comparing these factors to those found by Maher and Berlyne (1981), it might be that the factor 1 found in this study may be an evaluative judgement group, factor 2 and 3 as an internal states group, and factor 4 a collative group describing the designative information. Again there are similarities and divergencies with previous studies. The lexicon of music preference did vary in part when applied to different test timbre, and therefore the research hypothesis is supported by the findings. At the same time there were some other patterns of preference descriptor ratings that are worth discussing.

The findings of the brass being less intense; relaxing; than the glocken and the strings, and less exciting; and fun than the control, plus it was the brass that was liked least by the sample, it would conclude that people did not like the brass version of the song as much as other timbres due to its reduced intensity (not volume), relaxing, excitement, and fun. At the same time there may have been another factor at work, particularly vibrato. The brass timbre used as timbral group 1 from the frequency-modulation synthesizer had been mixed down and finalized when it was realized that a noticable level of vibrato was present in the synthesizer timbre. As LeBlanc (1986) found in a study particularly focused on vibrato, preference was for "minimal levels" of vibrato. The amount of vibrato in the brass timbre must be examined to determine if indeed the amount present was enough to define it as greater than minimal. It was noticable to this researcher.

The finding of strings as significantly more melodic, is an interesting finding. The components of melody that were present were so

minimal in terms of variation and duration, that in combination with the slow attack and virtually zero decay from the way it was performed (with keys depressed always) it may have sounded as if there was no melody. Compared to a timbre such as the bells which had a pre-programmed decay rate, one may think that this bell timbre had more of a melodic type duration, and therefore was more melodic. This was not the case. The spectral content of the strings being a combination of odd numbered harmonics, and a slow attack time, were found to be significantly more melodic than all other timbral conditions, but not more than the control condition. It should be noted here that Wessel (1979) found some interesting relationships between adjacent notes (melody) and timbre space. Though his results showed an effect on adjacent notes when varying "timbral distance," which means timbral variation, there could have been a related phenomenon at work in the finding of strings being more melodic. In the findings here though the timbral distance would be zero between adjacent notes of the single tape track, however all notes taken adjacently could present some variations in timbral distance between adjacent notes. This is an aspect of timbre research for the future, particularly in reference to the lexicon for timbre.

The music preference measures of "like" and "pleasing" were found to vary with timbre. The amount of "like" was higher for the control, compared to the brass and the bells, but not the strings. The amount of "pleasing" was significantly higher for the control than only the brass. Although the order of timbral conditions in terms of highest to lowest was the same for each measure, there were more significant differences found using the word "like," than using the word "pleasing." This may be

due to the fact that like is an active verb while pleasing is a sensual state. Perhaps the pleasing state is more sensitive to other components in the music than timbre, however the liking of the music was apparently sensitive to the timbral variation. The higher preference for the control and strings version could be consistent with the findings of Hargreaves (1984) that the lower the complexity of music, the higher the preference by the general listener. The control is structurally a less complex version of the song since it lacks an entire track of produced music. The strings could be thought of as less complex due to its smooth ascending attack, which limits temporal variation as discussed previously in reference to melody. These two versions of the song, if viewed as less complex could very well explain for their increased "like" and "pleasing" ratings. It can be stated though that listeners liked some timbre conditions more than others, and also found at least one timbre "less pleasing" than other timbres.

The style lexicon revealed differences across timbre, however less of its members were measured as different across timbre as members of the preference lexicon. In comparison, the preference lexicon from which 5 descriptors were used differently across timbre compared to two style descriptors used to identify timbral difference. This also means that less style descriptors varied, particularly only "jazz" and "rock" varied with timbre. The findings of strings having more "rock" than the other two timbre is interesting in that strings do not at first listen sound like a rockin' sound, however it should be noted that the spectral content of the strings closely align with the timbre that so often is credited with making that "rock sound" especially early in rock history,

the electric guitar. While the strings were high in "rock", at the other extreme was the brass, with the bells "rock" ratings falling in between, yet different only from the strings. The style lexicon varied with timbre in 2 of the 12 descriptors used, and besides rock, the variance of "jazz" ratings across timbral conditions was significant.

Brass was significantly less jazz than all other conditions, where the overall mean rating of jazz for this song was 5.4. This could indeed be consistent with what LeBlanc (1986) states as jazz's use of "little vibrato", which if heard by the listeners may have instantly labelled this music as "non-jazz." Presuming this to be true, then a timbre with any more than "little vibrato", may be negatively associated with jazz. The measure of jazz did vary across timbral conditions, and and vibrato may have been work. It is still the case that whatever difference was present, be it due to its reviewed timbre structure (brass), or some other characteristic parameter of the timbre (vibrato), significant differences were found between brass and every other condition: control, bells and strings. Therefore style acted as a usable lexicon for assessing timbral differences, however it did not identify as many differences in timbral conditions as did the lexicon for preference.

The lexicon of music preference used in this research demonstrated its salience to the music preference research domain. It was used to not only rate general musical preferences, but was also used to rate test music, and identify differences in the test music. The differences, corresponding with varying timbre, were significant in 5 of twelve words from this lexical set: exciting, fun, intense, melodic, and relaxing.

The strongest differences occurred in two descriptors that occur in the same factor identified in factor analysis, thereby fortifying these results and allowing for a synthesis of these results with previous related findings. The ratio level measurement scale of 0 to 10, appeared to work well by presenting a scale of the dependent variables, matching their concept to a good numerical scale. In all but one case in assessing general music preference did the lexical measures span 0 to 10, and in all but 4 cases when assessing test music preference.

In terms of standard demographic breakdowns, the finding that females describe the music they like as more dance than males is significant, and in many ways makes since from the perspective of socialization theory where females may traditionally practice such behaviors at an earlier age. An interesting check on this would be to find out if males state that they actually dance any less than females. According to this sample, this comparison was not possible due to sampling limitations. Related to the dance concept is the reports of high "dance" ratings for general music preference, and as stated earlier this served as a good validity check for the dance concept and lexical measures. Other validity checks were that people who dance like more beat, upbeat, fun, happy, fast music. This correspondance with factor 1 from factor analysis serves as further evidence for labelling this factor an activation dimension, rather than an evaluative dimension. With this interpretation there is a convergence of factor 1 and factor 4 into one combined factor.

The strongest findings from identifying where respondents heard music like their test music was brass sounded like television programs, then

control and strings like records, tapes and compact disc music. Though these findings are not statistically significant, they demonstrate how music research of an experimental nature could be classified according to the competing media outlets for music distribution and exposure.

The final point for discussion is the however slight findings of levels of radio listening and music purchases by the music preference lexicon. In this case there were no significant findings however most importantly the utility of the measures in relation to the preference lexicon measures that correspond with radio listening and music purchases was demonstrated. The descriptor dance again was found to correspond with certain levels of radio listening and music purchase behavior, indicating some sort of correspondence between this overt musical behavior and overt music exposure behaviors. Besides music exposure behavior, the media programming breakdowns yielded some interesting examples of how such a lexical breakdown could make possible music programming decisions that would acccompany certain program-types. The findings demonstrate for example that professional baseball radio listeners and not TV viewers, like less slow music, as do college hockey television viewers. Perhaps this could indicate that the high paced music often used under the intros and extros of television baseball coverage, is not particularly relevent to the television baseball fan, while it is to the radio baseball fan. In this case tempo may become a factor for sporting events music. The other finding between programming type and the lexicon of music preference is that college hockey television viewers like more loud music than those who do not watch televised college hockey. This may only substantiate the fact of that

old familiar timbre at hockey games, the organ (although many arenas now use synthesizers) is played blaringly loud because the crowd likes it. Perhaps loud music accompanies aggressive behavior. An application of this to televised hockey production would be using louder music beds for intros and extros for hockey coverage which would appeal to the listening and viewing audience, in addition to acting according to that old axiom of advertising: to gain attention. There may be a whole avenue for research available for hockey music, particulary with regard to timbre. An article in Sports Illustrated (Kirshenbaum, 1984) deserves mention here. The article briefly alluded to the impact of an organist's selection of "Eye of the Tiger" (ROCKY III theme song) on the continued flaring tempers and eventual ejection of two players from a one game. Likewise another organist's selection of "You Always Hurt the One You Love" was credited in another game when the music started after a fight broke out. The fight quickly petered out after the onset of the music. These examples demonstrate that others think about the impact of this music. A question in the context of this thesis concerns whether the timbre used in the two different games, varied at all from each other. This area is wide open for development and investigation.

The lexicon of music preference used to measure music preference and test timbral conditions worked and revealed differences. The differences found between conditions in reference to exciting, fun, intense, melodic, and relaxing demonstrated support for rejection of the null hypothesis which stated there is no difference in the way people use the lexicon across different timbres. The use of style as a lexical indicator of timbral difference was less applicable, however it did have applications

at identifying timbre variation. It must be pointed out that when there was a relationship between a style descriptor and timbre, it was a strong relationship, while the other style ratings were found to be clearly non-applicable, almost as if style acted as a step function in identifying timbral differences. The lexicon of music preference used here demonstrated a useful technique for assessing musical preference different from style, and in some ways more precise, since more descriptors were applicable to more of the conditions, while at the same time more descriptors varied across the test and control conditions. At the same time this is an exploratory study, and all findings are expected to be subjected to extra scrutiny and replication. The use of traditional preference measures of "like" and "pleasing," showed measures that they were tapping a similar phenomenon although the differences between the two measures particularly in the timbres they varied with warrant further investigation. Examples are whether indeed strings are more pleasing than other timbre, or that control is liked more and is more exciting. At the same time the addition of timbral elements also effects the complexity of the music, which could become a focus for future timbre research. Lastly the use of the lexicon of music preference as a scaling variable in identifying certain demographic, and media programming exposure patterns although not the focus of this work, proved to exemplify the potential utility for identifying music preferences for certain demographic and media program target markets. Along with the demographic findings is the measure of familiarity. Although the test must was not expected to be familiar to the listeners, it did have some level of familiarity in regard to certain classes of

music media and outlets. This approach to classifying test music could help place music of particular timbre in media and programming niches.

The style of the song was originally conceptualized as an upbeat, pop and funk style. This was verified by the ratings of the upbeat lexical measure falling in the upper quarter of the measurement scale, and the style descriptors funk, pop, and jazz all were rated greater than 5 on the 0 to 10 scale.

The control apparatus of MIDI for telecommunication of performance data to all of the timbral conditions during test music production, proved quite useful. The control of the performance was brought down to a digital level of note-on/ note-off, across all timbres to the same second within 32 nanoseconds, which is the recognized delay time of MIDI signals between synthesizer nodes. The delay is probably unoticable to the human ear between the first two or three synthesizers in a chain, however after that the results may begin to be noticed as "delayed", lagging behind or dragging down the tempo. Besides this one drawback of MIDI, it was adequate for the research task at hand, and worked <u>easily</u>.

<u>Recommendations</u>. The use of the lexicon for identifying music preference and particularly timbral preference, in this exploratory study, proved to be quite useful, and productive, although there are some recommendations for future research that can be categorized as:

1) analytical
2) production control
3) musical components
4) sampling scope

The analytical results of differences across timbre were useful although analyses of the data were limited due to the nominal level

categorization of timbre. In the future it would be quite useful to have the independent variable scaled in some ratio measures, such as frequency, intensity, and duration so that more sophisticated analytical techniques could be used to not only identify differences across timbral groups but also identify the trends underlying these differences. Mathematical functions such as Bessel functions, Fast Fourier Transforms (FFT), and other techniques using line-segment approximation functions have been not only used to explain timbre but also to create it in the domain of electrical engineering, particularly timbre synthesis. With actual ratio measures equated in mathematical functions the results could begin to assemble predictive models for music timbral preference. One last analytical recommendation stays with convention which is a call for replication of these findings.

The production of the test music could be controlled in terms of such factors as vibrato that may have been introduced in timbral conditions. One way to identify such extraneous factors before actual test sessions could be done by using a focus group to review the test conditions before going into the field for testing. Through the use of such a focus group, factors as vibrato, loudness, and equalization could be examined. One note of caution about equalization though, particularly with regard to timbre, is that the timbre is effected by equalization, and therefore must be utilized with this in mind particularly for timbre research. This may be less of a factor where other non-pitch related factors are at work such as tempo, or beat. In addition to the use of a focus group for review of the test music prior to testing, another production recommendation is the use of a complete MIDI studio with computer control

of all synthesizers in a star typology network. This configuration first reduces the maximum performance delay to synthesizers of 32 nanoseconds and second the computer control enables a wider array of control parameters not only in performance of the music but also for systematic variation in timbral design, melodic components, rhythm components, and general compositional variations of notes, tempo, loudness (volume) and sustain (which could be viewed as a timbre decay envelope variant). In addition, the whole arena of dynamic variation such as timbre changes can be examined with a extreme amount of control. Using intermediate processing equipment that responds to MIDI control makes other "mixdown" parameters such as stereo pan settings feasible as a research topic, particulary using this digital control. The computer based MIDI studio can serve then as not only an adequate apparatus for control, but also an apparatus for innovative controls. With multiple computer-based MIDI work stations the MIDI research laboratory can create a new age of music research, from behavioral measures, compared to self-report as was used in this study.

The recommendations for musical components is actually to expand the range of music components found in relation with the music preference lexicon. Identifying, as was done in this study, a subset of lexical variates that correspond with a music component (timbre) is a model for other designs. Such designs could investigate those lexical subsets which vary with other musical components such as pitch (tone or octave), tempo (time), note and rest length (duration), and mode (scaling temperment). To expand the applicability of the music preference lexicon into the research of these other music components is recommended for the purpose

of continuing a quest for thorough and comprehensive research designs.

The scope of this study was limited to college students and is therefore only generalizable to this limited college population. More sophisticated sampling and larger samples would allow for not only results generalizable to a larger population, but also allow for sub-group sizes that would allow statistical analyses of such sub-groups and appropriate criterion variable. An example breakdown would be the preference lexicon by radio listening by age.

Conclusions. In a world with increasing diversity of all forms of communication, the musical forms of communication we encounter are also more varying in time. Timbre is one component of music that has been long recognized for its impact on music. Due to limitations in the ability to control timbre, the level of rigorous scientific timbral control available to the music or media researcher has been limited except in the area of sound synthesis. Here timbre synthesis and timbre perception research have been at the forefront of sound synthesis. Now with the introduction of music telecommunication technology timbre can be varied while performance remains a constant. Such is the scenerio within which this thesis began. Observing an ever increasing amount of timbre in a music environment where industry relies on little research and what it does have available is fairly crude, a technique for scaling listeners' verbal descriptions of the music they like had been proposed. By scaling the actual words (vernacular) that a population uses to describe the music they like, it has been presented that it could serve as a ratio-level measure that indicates not only certain denotative domains but also connotative domains of music meaning and preference. It

acts as a measure of general music preference plus identifies certain variations of test music messages.

Through the identification of how these words are rated and rated across varying timbral elements in music the warrant for this thesis research is that results may be obtained that describe the actual timbral makeup of songs that are preferred, the nature of the preference and how much they are preferred. Differing from some present research by attempting to measure impacts of actual music content, at least as the average listener would describe it, the scope of such research can expand into the arena of predictive music research. This results from varying the music message components and measuring how people use the lexicon of music preference to describe the variations. This is accomplished by using a controlled music apparatus, listeners' own words as feedback, and precise measurement instrumentation. The significant findings of lexical timbral differences warrant further investigation of this research topic. This can not only identify a lexicon for timbre but also a lexicon for other music components or general music preference. Used in conjunction with other music behaviors, exposure or social indicators, the lexicon of timbre preference begins to provide profiles of different music "taste cultures."

The findings of this experimental research demonstrate the usefulness of new technology while also showing that in the course of increased control there are other attributes to which the need for more control becomes evident. In the case of this research, vibrato was suspected as playing a role in the brass timbre findings. It was only through the added controls of timbre performance that another variable control was

recognized as needed. In this inquiry the variable vibrato takes on different meaning in music synthesis since it does not actually reside in the arena of performance as it once had. For example, vibrato in acoustic wind instruments is an expressive breathing technique using pulsing degrees of volume and pitch modulation while now electronically it is a hardware setting for low frequency oscillation. So with the added control yet another distinction between synthesized performance-production and live performance-production is discovered. New controls bring a finer focus to the music preference lab which reveals a need for further controls and replication.

MIDI control helped research the timbre phenomenon while at the same time uncovering findings that warrant replication and further refinement. Significant findings in more than one lexical comparison across timbre, indicate there is reason to believe this research design has merit and will work in the future. The stage is set for not only researchers but for the music and media industry to see and hear that more precise musical preference measures than currently in use are possible and available. These measures not only classify groupings of people, but provide levels of control and measurement that can provide for predictive modelling of musical and listener message design. The musical message is the music structure itself (brass, bells, strings) while the listener message design is the utilization of the lexicon of music preference for not only laboratory research but also for eventually verbally communicating with listeners. Messages could be designed to notify them of music availability using the symbols they use to describe certain musical components such as timbre which could now be purposely included

in "tailor made" music compositions.

With a research tool that identifies not only music that people like but also what part of the music they like, how they like it and how much they like it, the assignment of music preference indices to certain songs and classes of songs becomes feasible. These classes may become known as new styles, sub-styles or just continued to be identified by the style and preference lexicons in use now. Indicators of music behavior (dance) when combined with such lexical preference measures can enable music gatekeepers in settings of such music behavior to select the right "tune" for the preferred behavior be it singing, dancing or exercise. At the same time lexical indicators of music exposure through radio or music purchases can act as a guide for the commercial music sector. Radio can better program to their market segments, and recording companies can select new music for producing on the basis of the "music." For the music communication researcher the relationship of the words with themselves can act as a general indicator of music preference, describing how people think and talk about music communication. This furthers understanding of and better reduces uncertainty in the music preference research communication process while also expanding the theoretical framework for studying music preference. For music cultures and communities it means that the identification of music "they like" can begin to correspond with particular music components such as timbre that have been identified simply by using their own words.

Footnotes

(1) Charts — Charts are the tabulated listings of released music ratings. There are such listings in many popular music industry publications including Billboard, Cashbox, Downbeat, and Rolling Stone.

(2) Automate — Use in reference to automated communications whereby through a combination of techniques and facilities by which intelligence (decisions-making) is conveyed from one point to another without human effort. In these sense of this thesis MIDI, or Musical Instrument Digital Interface, in conjunction with microcomputer control, can automate some music performance.

Bibliography

Alpert, Judith
1982 "The Effect of Disc Jockey, Peer, and Music Teacher Approval of Music on Music Selection and Preference." Journal of Research in Music Education 30,3:173-186

Anderson, Bruce; Hesbacher, Peter; Etzkorn, K. Peter and Denisoff, R. Serge
1980 "Hit Record Trends, 1940-1977." Journal of Communication Spring 1980

Anderton, Craig
1986 "The MIDI Recording Studio," Musician, special ed. , 1, 31-36

Anthony, Dave
1987 "Research Helps, But Never Underestimate Instinct," Billboard, 99, 50:

Baumann, Victor H.
1964 "Teen-Age Music Preferences." Journal of Research in Music Education 75-84

Beauchamp, James W.
1975 "Analysis and Synthesis of Cornet Tones Using Nonlinear Interharmonic Relationships." Journal of the Audio Engineering Society 23,10: 778-794

Beauchamp, James W.
1982 "Synthesis by Spectral Amplitude and "Brightness" Matching of Analyzed Musical Instrument Tones." Journal of the Audio Engineering Society, 30,6: 396-405

Beal, A. Lynne
1985 "The Skill of Recognizing Musical Structures." Memory and Cognition 13, 5: 405-412

Blalock, Hubert M.
1979 Social Statistics, McGraw-Hill Book Company, New York

Bogart, Leo
1956 The Age of Television, Frederick Ungar Publishing Co., New York

Boyle, J. David; Hosterman, Glenn L. and Ramsey, Darhyl S.
1981 "Factors Influencing Pop Music Preferences of Young People." Journal of Research in Music Education 29,1: 47-55

Cable, Michael
1977 The Pop Industry Inside and Out, W.H. Allen, London

Carrington, John F.
1949 Talking Drums of Africa, Carey Kingsgate, London found in The Anthropology of Music, Merriam, 1964

Chaffee, Steven H.
1985 "Popular Music and Communication Research - An Editorial Epilogue." Communication Research 12,3: 413-424

Charbonneau, Gerard R.
1981 "Timbre and the Perceptual Effects of Three Types of Data Reduction," Computer Music Journal, 5,2: 10-19

Chowning, John M.
1973 "The Synthesis of Complex Audio Spectra by Means of Frequency Modulation." Journal of Audio Engineering Society 21,1: 526-534

Christenson, Peter G.; DeBenedittis, Peter and Lindlof, Thomas R.
1985 "Childrens Use of Audio Media." Communication Research 12,3: 327-343

Denisoff, R. Serge
1973 "The Evolution of Pop Music Broadcasting: 1920-1972," Popular Music & Society, 2, 3: 202-225

Dinkelacker, James Walter
1982 "Distinguishing Radio Audience Segments by Format Preferences in the Multichannel Programming Environment: A Multidimensional Approach," Dissertation for Degree of Ph.D., Michigan State University

Dowling, W. Jay and Harwood, Dane L.
1986 "Timbre, Consonance, and Dissonance," chapter in Music Cognition, Orlando, Academic Press, Inc

Durkheim, Emile
1953 Sociology and Philosophy, trans. D.F. Pocock, reprinted with permission of The Free Press, and George Allen & Unwin Ltd., found in a book entitled Emile Durkheim, Thomas Y. Crowell Company, New York

Einstien, Albert
1952 Relativity: The Special and the General Theory, Crown Publishers, New York

Evans, Christopher
1979 The Micro Millenium, Washington Square Press, New York

Farnsworth, Paul R.,
1969 The Social Psychology of Music, The Iowa State University Press, first edition 1958

Figgs, Linda Drake
1978 "Qualitative Differences in Trumpet Tones as Perceived by Listeners and by Acoustical Analysis." Unpublished doctoral dissertation, University of Kansas

Fink, Edward L.; Robinson, John P. and Dowden, Sue
1985 "The Structure of Music Preference and Attendance" Communication Research 12,3: 301-318

Finney, Theodore M.
1935 A History of Music, United States Armed Forces Institute, Harcourt, Brace and Company, Madison

Fishman, Joshua A.
1972 The Sociology of Language, Newberry House Publishers, Rowley, Massuchusetts

Fox, William S.; Wince, Michael H.
1975 "Musical Taste Cultures and Taste Publics," Youth & Society, 7,2: 199-224

Frith, Simon
1986 "Art versus technology: the strange case of popular music." Media, Culture and Society 8: 263-279

1987 "The Industrialization of Popular Music." an article in Popular Music and Communication, 53-77, ed. James Lull, Sage Publications, Newbury Park, California, 1987

Gordon, J and Grey, J.M.
1978 "Perceptual Effects of Spectral Modifications on Orchestral Instrument Tones," Computer Music Journal, 3,2: 45-52

Grey, J. M.
1977 "Multidimensional Perceptual Scaling of Musical Timbre." Journal of the Acoustical Society of America, 61: 1270-1277

Hair, Harriet I.
1981 "Verbal Identification of Music Concepts." Journal of Research in Music Education 29,1: 11-21

Hall, Donald E.
1980 Musical Acoustics: An Introduction, Wadsworth Publishing Company, Belmont, California

Hanser, Suzanne B.
1982 "The Effect of Peer Approval and Disapproval on Improvement of Pitch Matching and Group Behavior." Journal of Research in Music Education 30,4: 221-228

Hargreaves, David J.
1984 "The Effects of Repitition on Liking for Music." Journal of Research in Music Education 32,1: 35-47

Hargreaves David J.; MesserSchmidt, Paul and Rubert, Charlotte
1980 "Musical Preference and Evaluation," Psychology of Music, 8,1: 13-17

Head, Sydney W., Sterling, Christopher H.
1987 BROADCASTING IN AMERICA: A Survey of Electronic Media, fifth ed., Houghton Mifflin Company, Boston, Massachussetts

Helmholtz, Hermann L. F.
1862 On the Sensations of Tone as a Physiological Basis for the Theory of Music, New York, Dover Publications, Inc., translated and rendered conformal to the Fourth German Edition of 1877

Hennion, Antoine and Meadel, Cecile
1986 "Programming music: radio as mediator" Media, Culture and Society 8: 281-303

Hesbacher, Peter
1978 "Sound Exposure in Radio: The Misleading Nature of the Station Playlist", Popular Music and Society, 6, 2: 105-117

Hesbacher, Peter; Downing, Robert; Berger, David G.
1978 "Sound Recording Popularity Charts: A Useful Tool for Music Research II. Some Recommendations for Change" Popular Music and Society, 6,2: 118-131

Howell, Peter; Cross, Ian and West, Robert,
1985 Musical Structure and Cognition, Academic Press, London

Hybels, Saundra and Ulloth, Dana
1978 Broadcasting An Introduction to Radio and Television, D. Van Nostranc Company, New York

Kirshenbaum, Jerry
1984 "Mood Music," Sports Illustrated, 60: 10

Krumhansl, Carol L.
1985 "Perceiving Tonal Structure in Music," American Scientist, 73: 371-378

Laing, Dave
1986 "The music industry and the 'cultural imperialism' thesis." Media, Culture, and Society 8: 331-341

LeBlanc, Albert
1984 "Selecting a Response Mode in Music Preference Research." reprint from Contributions to Music Eduction, 11:1-14

LeBlanc, Albert and Sherrill, Carolyn
1986 "Effect of Vocal Vibrato and Performer's Sex on Children's Music Preference." Journal of Research in Music Education 34,4 222-237

LeBlanc, Albert and Cote, Richard
1983 "Effects of Tempo and Performing Medium on Childrens's Music Preference." Journal of Research in Music Education 31, 1: 57-66

Loy, Gareth
1985 "Musicians Make a Standard: The MIDI Phenomenon," Computer Music Journal, 9, 4: 8-26

Lull, James
1985 "On the Communicative Properties of Music." Communication Research 12,3: 363-372

Lundin, Robert W.,
1953 An Objective Psychology of Music, The Ronald Press Company, New York

Maher, Timothy F. and Berlyne, D. E.
1982 "Verbal and Exploratory Responses to Melodic Musical Intervals," Psychology of Music, 10, 1: 11-25

McHose, Allen Irvine
1947 The Contrapuntal Harmonic Technique of the 18th century, F.S. Crofts & Company, New York

McMullen, Patrick T.
1982 "Connotative Responses to Musical Stimuli: A Theoretical Explanation." Bulletin of the Council for Research in Music Education Summer:45-55

Merriam, Alan P.
1964 The Anthropology of Music, Northwestern University Press

Meyer, Leonard B.,
1956 Emotion and Meaning in Music, The University of Chicago Press, Chicago & London

Miller, J.R. and Carterette, E.C.
1975 "Perceptual Space for Musical Structures." Journal of Acoustical Society of America 58: 711-720

Miller, Gerald and Nicholsen, Henry E.,
1976 Communication Inquiry, Addison-Wesley Publishing Co.

Moog, Bob
1986 "MIDI: Musical Instrument Digital Interface" Journal of the Audio Engineering Society, 34,5: 394-404

Moorer, James A.
1975 "The Synthesis of Complex Audio Spectra by Means of Discrete Summation Formulae." Center for Computer Research in Music and Acoustics, Department of Music, Report No. STAN-M-5

Moorer, James A. and Grey, John
1978 "Lexicon of Analyzed Tones." Computer Music Journal 2, 2: 23-31

Mursell, James L.,
1937 The Psychology of Music, W.W.Norton & Company, 1937, New York

Nielzen, Soren and Cesarec, Zvonimir
1981 "On the Perception of Emotional Meaning in Music" Psychology of Music, 9, 2: 17-29

Nierman, Glenn E.
1985 "The Development of a Test of Verbal Descriptors in Music." Bulletin for Research in Music Education, bulletin 84: 21-33

Petersen, Richard A.; Berger, David G.
1975 "Cycles in Symbol Production: The Case of Popular Music" American Sociological Review, 40: 158-173

Platt, John R. and Racine, Ronald J.
1985 "Effect of frequency, timbre, experience, and feedback on musical tuning skills." Perception and Psychophysics 38,6: 543-553

Popper, Karl
1959 The Logic of Scientific Discovery, Basic Books Inc., New York

Rigg, Melvin Gillison
1939 "What Features of a Musical Phrase Have Emotional Suggestiveness?", A Bulletin of the Oklahoma Agricultural Mechanical College, Social Science Research Council of the Oklahoma A & M College, 36, 13

Risset, Jean-Claude and Wessel, David L.
1982 "Exploration of Timbre by Analysis and Synthesis." The Psychology of Music, ed Diana Deutsch, Academic Press, 26-54

Rothenbuhler, Eric W. and Dimmick, John W.
1982 "Popular Music: Concentration and Diversity in the Industry, 1974-1980." Journal of Communication, 32, 1

Rothenbuhler, Eric W.
1987 "Commercial Radio and Popular Music", in Popular Music and Communication, ed. James Lull, Sage Publications, Newbury Park, California, 1987

Runstein, Robert E. and Huber, David Miles,
1986 Modern Recording Techniques, Howard W. Sams & Co.

Russel, P. A.
1986 "Experimental Aesthetics of Popular Music Recordings: Pleasingness, Familiarity and Chart Performance." Psychology of Music, Society for Research in Psychology of Music and Music Education. 14:33-43

1987 "Effect of Repitition on the Familiarity and Likability of Popular Music Recordings," Psychology of Music, 15, 187-197

Seashore, Carl E.,
1938 The Psychology of Music, McGraw-Hill Book Company, Inc., New York

Simon, Paul
1987 Acceptance Speech for BEST ALBUM of 1986 award, Academy of Recording Artists

Shannon, Claude E., and Weaver, Warren
1949 A Mathematical Theory for Communication, University of Illinois, Urbana, IL

Shepard, John; Virden, Phil; Vulliamy, Graham; Wishart, Trevor
1977 Whose Music?: A Sociology of Music Languages, Latimer New Dimension Limited, London

Shepard, John
1986 "Music Consumption and cultural self-identities: some theoretical and methological refelctions" Media, Culture and Society 8: 305-330

Tame, David
1984 The Secret Power of Music, Turstone Press, London

Taylor, Jack A.
1986 editorial, **Forum**, Journal of Research in Music Education," 34, 4: 221

Toole, Floyd E.
1982 "Listening Tests - Turning Opinion into Fact." Journal of the Audio Engineering Society 30,6: 482-493

Verveer, E.M., Barry, H., Bousfield, W.A.
1933 "Changes in affectivity with repetition." American Journal of Psychology, 45, 130-134

Waldrop, M. Mitchell
1985 "Why do we like music?", Science, 3, 36

Wapnick, Joel and Freeman, Peter
1980 "Effects of Dark-Bright Timbral Variation on the Perception of Flatness and Sharpness" Journal of Research in Music Education, 28, 3: 176-184

Wapnick, Joel
1980 "Pitch, Tempo and Timbral Preferences in Recorded Piano Music." Journal of Research in Music Eduction 28, 1: 43-53

Wessel, David L.
1979 "Timbre Space as a Musical Control Structure," Computer Music Journal, 3,2: 45-52

Winter, James P.
1985 "American Music and Canadian Youth" Communication Research 12,3: 345-352

Woram, John M.
1982 The Recording Studio Handbook ELAR Publishing Company, Inc., Plainview, New York

Wooderson, Dawn C. and Small, Ann R.
1981 "Instrument Association Skills: Children in First and Second Grades" Journal of Research in Music Education 29, 1: 39-46

PLEASE NOTE:

The audio cassette is not included in this material. It is available for consultation at this author's graduate school library.

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