A STUDY OF THE INTER-RELATIONSHIP OF COLOR FORM AND MUSIC

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THIS BOOK CONTAINS SEVERAL DOCUMENTS THAT ARE OF POOR QUALITY DUE TO BEING A PHOTOCOPY OF A PHOTO.

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CHAPTER I

INTRODUCTION

Color music, the inter-relationship of color (light) and music (sound), has been a recurring theme throughout history. Artists, designers, and musicians have shared an intuitive feeling that there should be a correlation between color and music. Studies of color music go back as far as the early 1700s when Louis Bertrand Castel (1688-1757), a Jesuit priest who worked in math, philosophy, and aesthetics, attempted to design a color organ. This instrument was designed to defracture light through prisms and used tapes for sound. Castel was followed by D.D. Jameson of England, who devised an instrument with glass globes filled with color fluids which were illuminated by artificial light when activated by a keyboard. Bainbridge Bishop (1877) designed a screen that blended colors as an organ was played, using artificial as well as daylight sources. E.G. Lird (1900) translated songs into color diagrams and Mary Hallock Greenwalt (1926), a pianist, won a gold medal for her color organ which projected a light scale coordinated with the music scale. Tom Douglas Jones has spent most of his life experimenting with visual form and color in relation to music.[1] In the summer of 1980, Michael Trencher, a professor at Pratt Institute, conducted a seminar on music and architectural form, but did not consider any direct relationship between color and music.

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[1]Jones, Tom Douglas. The Art of Light and Color (New York: Van Nostrand Reinhold Company, 1972).

STATEMENT OF THE PROBLEM

Although the relationship of color and music has been suggested throughout history, there is no evidence or research which supports this hypothesis. In surveying Kansas State music students[2] to determine if there is a relationship between hue* and the diatonic scale*, no direct relation was identified. Furthermore, Professor Paul Earl, technician and musician, who teaches in Science and Visual Studies at Massachussetts Institute of Technology, has found no scientific correlation between color and sound.

*Hue -- The name of a color.

*Diatonic Scale -- The eight tones of a standard major of minor scale.

Throughout research and discussions with designers and physicists, it has been indicated that the difficulty of correlating color and music lies in the physical differences between light and sound. Because of the absence of a scientific explanation for the apparent relationship, the correlation must be one based upon human perceptions occurring when the concepts of sound and light are merged. Some validity surrounds the concept of a relationship based on perception or intuitive feelings. Some of these feelings may be explained by individuals experiencing photoisms, colored patterns seen while listening to music with one's eyes closed.

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[2] I personally conducted this survey in the Fall Semester 1979 to see if music students subjectively perceived a relationship between a spectrum of color chips and the rates of a diatonic scale.

PURPOSE OF THE STUDY

To confirm that a subjective relationship* exists between the qualities* of "the color of music,"* and the qualities of color and its formal composition*, sounds will be illustrated through color variation in two and three-dimensional forms and their inter-relationship* were examined based on human responses.*

*Relationship -- The condition or fact of being related.

*Qualities -- A characteristic or attribute of something; property; a feature; a natural characteristic of something.

*The Color of Music -- The overall perceived quality of sound in a composition made up of the "tone colors" or "timbre" of each instrument.

*Formal Composition -- The design, structure, or pattern of a work of art.

*Inter-relationship -- To place into mutual relationship.

*Human Responses -- A subjective feeling to the visual and audio media.

An environment, one-fourth the scale of a future project, was designed and built. Participants circulated through the environment, viewing visual forms and design elements* while listening to a music composition. The model was designed to test concepts and schemes as well as to serve aesthetic* purposes. The participants were asked to respond to the visual and environmental design elements, defining their relationship to the sounds of the music composition. The design elements included qualities of color, such as color gradation*; hue, value and intensity*; contrast*; the dimensional

qualities of the form and patterns* such as concentric*, cubistic*, diagonal or zig zag* and vertical* forms and patterns, and their texture*.

*Elements -- Parts which make up a whole.

*Aesthetic -- Sensitivity to the beautiful.

*Color Gradation -- A series forming successive stages.

*Hue, Value, and Intensity -- Three-dimensions of color.

Hue -- The name of a color.

Value -- The dark to light of a hue or neutral.

Intensity -- The brilliance of a hue.

*Contrast -- Diversity of parts.

*Dimensional -- One of four coordinates determining a position in space and time.

*Patterns -- Features characterized by repeated individual traits.

*Concentric -- Circular qualities.

*Cubistic -- Vertical and horizontal directional movement which intersects to create a square form.

*Zig Zag -- Unit forms of the same step which are arranged in a zig zag pattern.

*Vertical -- An upward dimension created by a straight line or the height of mass.

*Texture -- Surface characteristics of a shape which appeal to the sense of touch.

REVIEW OF THE LITERATURE

The review of the literature was used as a framework to design the environmental space containing sound and various color compositions in two and three-dimensional forms. Before the space was designed, background research was outlined in the areas of:

(1) Light

(2) Sound

(3) Color

(4) Music

Light

Light waves travel through space at a constant speed of 186,282 miles per second. The waves are three-dimensional, vibrate at right angles to each other and are transmitted by small pockets of energy called photons which contain no particles.

Within the logarithmic scale of electromagnetic radiation which ranges from the atom nucleus at 10^{15} to the Milky Way at 10^{21}, the visible light rays fall between ultraviolet rays at 10^{8} and infrared rays at 10^{6}.[3] The visible light spectrum, which can be perceived, is measured in nanometers which extend from 380 to 760.[4] There are no even wavelength intervals between each hue in this spectrum of light.

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[3]Gerritsen, Frans, Theory and Practice of Color (New York: Van Nostrand Reinhold Company, Inc., 1975).

[4]Nuckolls, James L., Interior Lighting for Environmental Design (New York: John Wiley and Sons, Inc., 1976).

Sound

Sound waves are two-dimensional and travel at the speed of 770 miles per hour, varying in wave formation according to the source.[5] Sound waves cannot travel in voids, as light can, but are transmitted through atmosphere, water, and solid materials. They vary in speed according to the specific physical factors of the transmitting medium.

When measuring the sound of music, the spectrum begins at 16 frequencies and extends to 16,000 frequencies; it is broken into octave bands. An octave is the frequency range of a diatonic scale which has an even ratio between each note and each octave dimension.[6] If one compares the visible color spectrum of light energy to the spectrum of perceived sound, visible light would be equal to less than one octave of sound.[7] To perceive music and color as inter-related, sound and light must reach the ear and the eye simultaneously.

Color

Once light rays reach the eye, they pass through the lens to the back interior of the eye where the rods and cones are located. Rods are the narrow cells that end in the eye and register the luminosity, light and dark, determined by more or less light energy.

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[5]Backus, John, The Acoustical Foundation of Music (New York: W.W. Norton and Company, Inc., 1977).

[6]Ibid.

[7]Postile, Dennis, Fabrics of the University (New York: Crown Publishing, Inc., 1976).

Cones are less sensitive to luminosity than rods. Cones perceive the light's wavelength of the energy which determines the hue of the color. Once the energy and wavelength are perceived and processed in the eye, they travel through nerve impulses to the brain and perception occurs.[8]

Because of environmental factors, color perception is not always purely perceived. Daylight, incandescent, flourescent, and other light sources strike matter and are reflected, absorbed or refracted before light rays reach the eye. When light enters the atmosphere or a space with matter and this breaking down process occurs, the hue, intensity and value of a color is altered.

Light sources, as mentioned before, affect perception as do the time of day, neighboring colors, the size of colors, and colors seen before or during viewing. Joseph Albers discusses the relevance of color in his book Interaction of Color.[9] He places a constant hue on a variety of backgrounds and illustrates the change of the hue, intensity, value and size of a color value.

There are three types of color the eye can perceive:

1. Subtractive Color is the mixing of pigment (paints) to create other colors. The primary colors are red, yellow and blue. New colors are created as the primary colors are mixed: red and yellow make orange; blue and yellow make green; red and blue make violet. The mixed colors

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[8]Gerritsen, Frans, 1975.

[9]Albers, Joseph, Interaction of Color (New Haven: Yale University, 1963).

are always darker than either of the two mixed.

2. Additive Color is the mixing of light. Color is created by subtracting certain light rays. All three primary lights -- green, red, and blue -- create white light. Green and red combine to form yellow; red and blue make pink; green and blue make turquoise color. The final color after mixing is always lighter than the two colors used in the blend.

3. Parative Color is a unity in the perception of numerous small colors adjacent to each other. The total intensity equals the total value; colors are not singled out. The concept of parative color has been practiced for years in mosaics and woven materials. If one closely observes a fabric, one may see many threads of different hues, which at a distance, are perceived to be one intensity or value.[10]

Contemporary uses of parative color are demonstrated in printing and in television. Printers produce images such as photographs by using four color dot patterns or half tones. These patterns are created by the use of black and the primary colors found in additive color which are red, yellow and blue. Television reproduces images by the use of dot patterns which are composed of primary subtractive colors: red, green, blue, and sometimes the neutral color black. It may be more realistic to say that most perceived colors are parative.

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[10]Gerritsen, Frans, 1975.

Music

Music (sound) must reach the ear for perception to occur. The ear is divided into three parts, the outer, middle and inner ear. Sound waves from the atmosphere enter the ear and pass down the auditory canal to the tympanic membrane, exerting pressure on the ear drum, causing it to vibrate. The vibrations are passed through the ossicular canal to the oval window to the cochlea, where the sound is transmitted through nerve impulses where perception takes place. The relevance of sound depends not only on the physiological and perceptual processes of the ear and nervous system, but also on environmental conditions.

The medium through which sound travels can alter the tone before it reaches the ear. Material and its arrangement in a space can reflect, absorb, or diffuse music (sound) before it is heard. When tones, psychic pitch variations, are played, a music composition is created in a space. Many variables in music acoustics are discussed by authors David Ehresman and David Wessel in abstracts from the Centre Georges Pompidou. One question asked in their abstracts on Musical Acoustics is:

> "Must one agree with Eddington that a science with more than seven variables is an art, and conclude that musical acoustics are either irrelevant or unscientific?"[11]

At the same time, they feel there are some specific research subjects which are relevant to music acoustics. The different tones which can be heard can be classified as types of sound.

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[11]Risset, Jean-Claude, Report Ircam, Music Acoustics (Paris: Centre Georges Pompidou, 1977).

There are several types of tone that can be perceived:

1. Pure Tone or "Simple Tone" is tone held at a single frequency which is seldom achieved without a tuning fork.

2. Complex Tones, sometimes referred to as overtones, are individual tones created by a steady tone instrument and which have a complicated vibration pattern.

3. Subjective Tones are tones that are not actually present in the sound but are perceived. These tones are created by two or more tones and are sometimes referred to as "different tones."[12]

4. Tone Color or Timbre is the quality created by the physical makeup of an instrument, its pitch, and the musician's ability to play the instrument. The tone color, or timbre, of the overall perceived music composition is referred to as the color of the music. Most of the tones we perceive are tone colors.

When color (light rays) and music (sound waves) enter the eye and the ear, they travel through nerve impulses to the brain and perception occurs between color and music, whether consciously or otherwise.

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[12]Backus, John, 1977.

OBJECTIVES OF THE STUDY

The objective of this study was to explore qualities of color,* form, and their inter-relationship to the "color of music" and various visual and environmental forms. Human responses were used to determine these perceived relationships. Many designers, artists and musicians insist that a link exists between music and color; some of them have depended on the sciences for correlations. However, most designers and design methodologists contend that the act of designing, in itself, is not and never will be a scientific activity. While studying the relationship between color and music, no physical explanations were discovered. Scientific, or otherwise, in this study, the existence of a perceived experiential relationship, rather than a physical correlation, between the defined variables was attempted to be determined.

*Color -- The interaction of light rays and surfaces which create a visual perception when interacting with the cones and rods inside the eye.

The methods for this study focused on the following concepts:

1. The music composition was broken into isolated time spans and visual forms were executed based on the qualities of these isolated musical sounds.

2. The visual forms were placed in a space and the music composition was played at intervals while the form was viewed.

3. A questionnaire was administered to selected viewers, who by training are more sensitive to the concepts of this study,

to determine whether they perceived any correlation between the color composition in two and three-dimensional form and the quality of music. The conclusions were derived from their emotional responses to the various visual and audio stimuli within the environment, which was placed in a space relatively free from other visual and auditory interferences.

A selected group of persons, including predominately designers and some physicists and musicians, were asked to listen to the music, to view the environment and respond to the questionnaire. Data from the questionnaire has served as a framework for drawing conclusions about the relationship between color, form and music and other obvious trends of the viewers. The questionnaire consisted of two parts; the first querried whether there was a relationship between the overall color forms and sound, and the second asked which design elements viewers believed to relate closest to sound, i.e., qualities of color, texture, patterns, and dimensional forms.

Through the collection of data from the questionnaire, the inter-relationships between the visual environmental forms and sound, was identified whether they be contrasting*, complementary*, intangible*, or unrelated.

*Contrast -- To set in opposition, to show or emphasize differences.

*Complement -- Something which complements, makes up a whole; either of two similar parts that make up a whole or mutually complement each other.

*Intangible -- Incapable of being perceived, precisely defined or identified exclusively; an asset which cannot be perceived

by the senses.

This model is a pilot study, whose model is one-fourth the size of the total research project which will be undertaken at a future date. The purpose of the pilot study was to test the concept and the scheme. Upon completion of the pilot study, a full-scale environment based on the results and conclusions derived from this project will be refined and constructed. The environment will be designed so viewers can circulate among and through the visual forms as they listen to and experience the sounds from which these forms were designed.

CHAPTER II

METHODOLOGY

To determine if a relationship exists between two and three-dimensional form and the quality of musical sound, a model was designed one-fourth the scale of a future project.* The visual forms used in this study, as well as the space in which the form was displayed, were designed and chosen to interpret isolated segments of music from an ambient music composition. By studying human responses to the environment, it can be determined if the various sounds match the visual forms and if specific elements in the forms relate to specific sounds.

*The two-dimensional seriograph studies were executed full-scale since the one-fourth scale would have been too small.

PRELIMINARY STUDY

The developmental stages of this study were based on findings from a preliminary study in 1979 conducted with a small group of design students. The study dealt with a similar concept: the relationship between color and music.

During execution of the visual forms, a style change occurred, brought about by time, the study of acoustics, and the principles of music. Initially the visual studies were created in hard edge forms. In later stages of form execution, an Impressionistic* orientation was used.

*Impressionistic -- Small strokes or dots which create a visual field by visual fusion.

Various musical styles were also utilized, ranging from classical, to jazz, to ambient tones.

The forms were presented in a linear display with minimal visual disturbance in an environment while ambient music was playing. Analysis of responses revealed that the design students immediately recognized which visual form in the environment matched the sound played. Conclusively, the variations in the visual forms were much too pronounced. It could not be concluded from the preliminary study that the same outcomes would result if viewers were asked to match very similar sounds and visual forms in a more controlled environment.

PILOT STUDY

The concept of this pilot study was developed before the preliminary study was executed. The preliminary study helped develop a stronger basis for the pilot study. The responses the small group of designers had toward the visual media helped confirm the direction of the visual forms in the pilot study.

Music Used in the Pilot Study

The ambient music composition, "An Index of Metals," by Fripp and Eno was used in this study. This music is based on such a minimal concept that a music score doesn't exist, according to Fripp and Eno's agent, E.G. Records located in New York and London.

This composition was chosen for three reasons:

1. It seemed that it would be easy to visualize forms and color of such a simple harmonic structure.

2. As the word "ambient" indicates, the music has an encompassing quality that creates a unified feeling in an environment. Such a feeling is hypnotic, and could draw the viewer's attention away from the outside world and toward the environment.

3. This decision also was based on a subjective feeling.

Environment for the Pilot Study

After isolating several ambient sounds from the music score, gesture drawings of forms were executed from the qualities of the individual sounds while simultaneously working circulation flow diagrams and sequential views out in a given space. This helped to determine where each form would be placed in the environment. This process also helped to establish control of circulation and to establish a good relationship between the viewers who would be experiencing the environment.

The two-dimensional studies were based on the same continuous sound, however approximately 25 variations of the seriographs were run. In all, six were displayed which illustrated different concepts of color, contrast, and patterns. There were three examples of high contrast and three of low contrast. These seriographs were selected as examples of parative value and color to be used in the environment.

The three-dimensional forms were designed according to two different concepts. The first forms were designed while listening to the ambient sounds the participants were to interpret, and then were placed into the environment. For the second concept, the forms were refined from the memory of the music. Some of the design decisions were based on environmental factors independent of the sound. Intense

colors which were not heard in the sound were used to create certain types of eye movement and to control the circulation of viewers through the environment. Some forms were left neutral (i.e., gray colors) because the quality of the music had a neutral quality in its tone color. The harmonic structure and frequency variations in the music composition had little color. It was hard to distinguish between some of the sounds which were isolated and concluded that it would take a fresh eye and ear on the part of the viewers to make the distinction. Although some objectivity was lost toward the environment during execution, an awareness of most other sounds were beginning to be imagined in the three-dimensional forms.

Describing the Viewing Space

It became crucial to maintain a quality of space for conducting the test that was compatible with the model and visual forms. Such an available space, which lent itself to sound, was the heliodon. This space has an excellent lighting system and the acoustics were perfect for the ambient sounds. Because of its dome shape, the sounds which originated at the base of the dome were not broken up as they traveled around the surfaces.

The importance of controlling environmental factors in a viewing space was reinforced while studying Louise Nevelson's environments in the Whitney Museum of Art. Nevelson's three environments create an over-powering feeling as the viewer moves through one to the other. This impact was created by the placement of forms in space, the lighting, sound and other environmental factors. This experience reinforced the strategies used in the pilot study, such as the need to unify the

environmental elements in space for aesthetic appeal to the emotions of viewers.

The Questionnaire

The first section of the questionnaire was constructed to determine if the viewers perceived a relationship between the total environment and the sounds. The second part attempted to determine if the viewers could establish a direct relationship between each individual form and the sounds. Where relationships existed, frequencies of viewers' most common responses are charted on Figures (see Appendix A). The next phase of the questionnaire was constructed to test which qualities of color, pattern and form were more directly related to the ambient sounds. The last phase consisted of personal data collected to determine if the ratings were the same among men and women. Although these last results would not provide information directly relevant to this study, this data could be the basis for a future project.

The Viewers

The viewers included mostly design students and design faculty. A random sampling of physicists and musicians from the university faculty also were chosen to participate in the study. Because the physicists and musicians comprised only 16 percent of the group isolated conclusions couldn't be drawn based on their responses. It was believed that the data could provide insight on which to base future design concepts. Also, the physicist who participated in the study had provided objectivity concerning the concept in preparing for the study. Forty-five percent of the viewers were women and 55 percent were men.

CHAPTER III

RESULTS AND CONCLUSIONS

RESULTS OF QUESTIONNAIRE

The Relationship between Environmental Forms and the Quality of Sound

The questionnaire provided most of the data used to determine whether the viewers perceived a subjective relationship between the qualities of color and its forms, and the qualities of ambient sounds.

The purpose of the first inquiry on the questionnaire was to determine if viewers, when listening to the entire composition, perceived a high, medium, low, or no relationship between the quality of the sound and the quality of the environment. They could also indicate if they were not sure a relationship existed. Figure A, Appendix I, shows that 60 percent of the female and 63 percent of the male viewers perceived a high relationship between the sounds and the environment; 20 percent of the females and 15 percent of the males perceived a medium relationship; and 20 percent of the females and 23 percent of the males perceived a low relationship. All viewers perceived some dimension of a relationship between the environment and sound. The responses "no relationship at all" and "not sure" were not checked by any viewer.

Figure A also indicates that the female and male perceptions of the overall environment were very similar. There was a greater percentage of similar responses between female and male viewers in this section than in any other section of the questionnaire.

Question two of the questionnaire asked viewers to match the forms with the isolated, ambient sounds which were played sequentially. The eight different sounds were played more than once to give the viewer a chance to listen to the sound as they reviewed each form. These responses had less consistency between female and male viewers than any other section of the questionnaire. The viewers claimed the sound qualities were so similar to each other that they perceived a relationship between the sounds and multiple forms at the same time.

Figure B illustrates sound one and its relationship to different visual forms. The results indicate that 33 percent of the women responded that visual form E (plate 13) had the most direct relationship to this sound. The female viewers also indicated that visual forms A and G provided the highest perceived relationship to sound one. The mens' responses were more fragmented; 20 percent indicated that visual form E (plate 13) had the highest relationship to sound and 15 percent perceived visual form F (plate 14) and visual form G (plate 15) to have the highest relationship. Female and male viewers provided differing responses on all but visual form G: 16 percent of the women and 15 percent of the men rated this form as having a relationship to sound one.

The Relationship of the Design Elements to the Quality of Sound

In Part II of the questionnaire, viewers rated the degree to which the less spatial design elements of each visual form related to qualities of sound. While each sound played several times, viewers rated each design element on a scale from neutral, 0 to 10, with zero meaning no relationship and 10 signifying the greatest perceived relationship. During data

tabulation these ratings were divided into three categories. Seven to 10 constitutes the upper category, a more definite relationship; the mid-category is from 3 to 6, a moderate relation; and the lower division includes neutral (n) and 0-2 ratings, almost no relationship between design elements and the quality of sound. The viewers' most highly rated design elements were divided into one of these three categories and the percentage of the total group's ratings in each category were calculated and are displayed in Figures 10-18.

Figure 10 illustrates the design elements of Visual Form B (plate 10) and their relationship to the quality of the sound as perceived by the viewers. One-hundred percent of the women perceived the design elements of value, dimensional shapes, and texture/surfaces to have the greatest relationship to the quality of sound. In rating Visual Form B, 100 percent of the men rated patterns and forms in the design elements to have the most direct relationship to the quality of sound. Eighty-five percent of the women rated hue, intensity of hue and patterns, and forms within the upper category. Eighty percent of the men rated intensity of hue in the upper category and 85 percent of both groups rated intensity of hue in the upper category. The design elements on Vertical Patterns were rated by 83 percent of the women and 16 percent of the men as being in the upper categories. This rating is the greatest disparity between male and female responses.

Design elements rated in the mid-third category of Visual Form B was color contrast which received the highest rating by women (28 percent). Sixty-seven percent of the men rated diagonal/zig zag patterns in the mid range and 57 percent rated concentric form in the

mid-range.

The lowest rated design element in Visual Form B was the concentric shape; 100 percent of the women and 15 percent of the men rated this quality in the lowest category. Twenty-two percent of the women and 42 percent of the men rated the vertical pattern in the lower-third category.

In analyzing the viewers' perceptions of a relationship it may be concluded that viewers' ratings within the high and low categories were consistently high or low on all figures, while the mid-categories were consistently at the low end of this third category, with the exception of one or two design elements. This indicates that the design elements utilized in this study provided either a high relationship or little or no relationship to the sounds used.

CONCLUSIONS

Ratings of the Three-Dimensional Forms

Of all the categories, intensity of hue and value, patterns and forms, dimensional shapes, and texture and surfaces were rated as having the highest relationship to sound. Concentric and cubistic design elements were rated by the greatest percentage of women and men as having the least relationship to sound.

Concentric shapes may have been rated low because few forms in the model had a concentric shape. However, this low rating also could be attributed to the fact that some viewers did not completely understand the concept of concentricity. Another reason concentricity may have been rated so low is that "time," a dimension of music, is usually perceived as a horizontal quality, and frequency is usually

perceived as a vertical quality. Concentricity is a more complex visualization and are not readily perceived by viewers. Some individuals could perceive concentricity to a more complex harmonic structure in frequency over a continuous tone with a rapid decrease in frequency and some timbre change. However, listening to sound with such a minimal concept, as used in this study, gave such small variations in harmonic structure that viewers may have thought concentricity was much too complex a concept.

Cubistic patterns were also rated as having little relationship to the sound which was played. This may have been because other design elements were more dominant over any of the cubistic qualities. Most of the forms which contained a cubistic form had other dominant design elements in them. Also, the sound did not lend itself to a choppy or broken form; it was very continuous and seldom broken.

The viewers seemed to relate to the three-dimensional forms better than to the two-dimensional forms. One reason for this may be that sound is directional, and sound has qualities common to three-dimensional form; it travels in space as it is generated from its source and diminishes in time and space.

It has been discussed that width relates to time, and height to frequency. A third dimension of sound is pitch. Pitch is subjective, dealing with timbre, frequency, time and the decibel level. This dimension is more real in three-dimensional than in the two-dimensional (seriograph prints) series. The seriographs have an illusion of depth created by the layers of inks and the control of intensities and contrast.

Ratings of Dimensional Forms

The two-dimensional seriograph visual forms which were most often rated as having a relationship to the quality of the sound, very low in color intensity and have a neutral quality.

Seriograph F (plate 14) was rated as having the greatest relationship among the two-dimensional studies. Women rated this print higher a greater percentage of the time than men. This print has a series of very subtle color underlays and dark neutral value overlays which diminish most any visible color. Seriograph F also sets up a strong and dominant vertical pattern of lines.

Seriograph E (plate 13) was given a high rating a greater percentage of time by women viewers, and given a mid-range rating by men most of the time. This print is also very subtle in color and has an upper value of metallic overlay. There is a subtle diagonal pattern which gives an illusion of depth.

The three-dimensional Visual Form G (plate 7) was rated highest the greatest percentage of times by the women and men than any other forms. This massive maze of mutual rods are not only the tallest but also the largest in the environment. It also has a very diagonal quality to it which is created by the different heights in rods. As light hits the different surfaces of Visual Form G, casting shadows on other areas, an illusion of different values is created. This also creates a dynamic illusion of depth to match Visual Form G's physical height and mass. Visual Form G is also one of the most abstract three-dimensional forms used in the environment.

Visual Form H (plate 6) received a high rating; men rated it higher than women. This linear rod formation has a more rhythmic quality, has the same surface quality, but not the same dimensional depth as Visual Form G. It has a width that is much more dominant than most other forms which probably resulted in its high rating. However, its neutral metallic surface seems to complement the neutral ambient sound.

Visual Form I (plate 6) was also rated highly by women and men. This seems unusual since the form is concentric and full of intense colors. The colors were layered in the natural spectrum on different planes to create movement between the smaller divisions, which were made by concentric patterns and larger divisions. One reason this form was rated highly could be because the quality of some of the sounds were concentric.

Visual Form J (plate 5) is also concentric and very similar to, but smaller than the design in Visual Form I. This may have been given a low rating by all viewers because of its small scale and because it was situated below eye level.

It was predicted that Visual Form K would be rated as having a very high relationship to sound by all viewers. In fact, men gave it a high rating and women rated it much lower. This form is concentric in quality, with two complementary colors on each side of the planes. The most outstanding quality is the progression of planes which gives it direction in space. One reason it may not have been rated as having a high relationship to sound by women is that the scale is so small and it is positioned below eye level in the environment.

The remaining two-dimensional Seriograph Visual Forms were rated in the low to upper mid-range. Seriograph A (plate 11) was rated in the upper mid-range. It was given a higher rating more often among men than women. This print has high contrast and intense lines running vertically and horizontally which creates a cubistic pattern.

Seriograph B (plate 10) was rated in the mid-range by women and men. This print has a high contrast and intensity, and horizontal elements in it. The existence of the horizontal element is most likely the reason it was rated this high.

Seriographs C and D (plate 12) were rated in the low range by all viewers. Visual Form C has a high contrast and an intensely busy zig zag pattern in it. This pattern is much too busy for the quality of the sound. Visual Form D has low contrast with low-intensity diagonal shapes. This print lacks the illusion of depth which is probably the reason it was rated in a low category.

Visual Form M (plate 8), the base of the environment, was given a low rating. It is a cubistic grid and a smooth progression of intense colors. The viewer most likely had problems visualizing a form that served as the floor of the environment as a design element.

The primarily spatial design elements which seemed to stand out above all others were the dimensional qualities of height, width and depth, whether two or three-dimensional. Other elements which seemed to be related most often to the sound had massiveness in scale and the surface qualities of forms. The Visual Forms with neutral and low intensity colors more often were rated higher because the music was so neutral in quality. Three-dimensional forms seem to be more

dominant because they give form to the color. Surface quality was one of the most highly rated elements in the questionnaire.

The viewers consistently had problems matching the sounds to any of the Visual Forms because there was very little contrast in the quality of the sound. Some viewers asked if there were any differences in some of the presented sounds. If one wanted to explore this concept further, it would be to their advantage to choose a different musical composition; one with a much more dynamic tone color and harmonious structure to it. This could offer a broader and more contrasting tone quality that would be easier for the viewers to visualize and interpret.

The viewers perceived a definite relationship between the qualities of the entire composition of sound and the quality of the overall environment. A high relationship was perceived between a majority of the design elements and the quality of the isolated sounds. It appears to be unanimous among women and men that there is a relationship between the qualities of the sound used in this environment and the design elements.

AREAS FOR FUTURE STUDY

This thesis investigates the emotional responses of viewers to visual forms which interpret the quality of isolated sounds. Because the results and conclusions of this pilot study were based on a model one-fourth its intended scale, one area for future study could be to examine the changes in viewers' responses to scale changes in the visual forms, which are based on the qualities of sound. Viewers' ratings could change because of the new relationship of the human body to the enlarge scale of the forms. With the scale change, viewers could move within the environment and observe each form more independently of the other forms.

Another study could explore the inter-relationship of a tone, or chord, and media transition in forms. The visual interpretation of the tone could begin with static two-dimensional compositions, and proceed into two and three-dimensional active compositions such as kinetic form and animation films. The final forms would be executed by the human body (choreography), which responds to the chord played. The relationship could be measured by viewers responses, with attention to trends and patterns based on cultural differences.

One area of study which has been explored extensively, but which could be further examined, is the relationship of the diatonic music scale to the spectrum of color. One specific and related research topic would be to focus on the inter-relationship of the timbre of a tone and a color diagram which deals not only with hue, but value and intensity.

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APPENDIX A

QUESTIONNAIRE

You are being asked here today to view visual and environmental forms and to fill out a questionnaire. As you enter the space sound will be playing and the visual forms will be placed in certain areas. At this time I would like for you to spend the first several minutes walking around, sitting or relaxing as you become familiar with the space, sound and visual studies.

A music composition will be played in its entirety, please listen. Later on fragments of the same composition will be played and you will be asked to answer certain questions.

When a white object is placed in the container near the central form please begin the questionnaire which starts on the next page.

PART I

I. Do you perceive any subjective overall relation[1] between the quality[2] of the sounds you have heard and the visual forms being viewed?

Definite relations _____
Moderate relations _____
Fractional parts/others are vague _____
Not sure _____
No relations _____

II. A series of sequential sounds (fragments from the same music composition) will be played as you view the individual forms. There is a number assigned to each sound fragment and a letter is placed beside each form.

III. As the sounds are being played match the qualities of the forms to the qualities of the sounds. Place the letter or letters which represent the form or forms next to the number which represents the sound. You may wish to listen to the sequence of the sounds once before beginning the questionnaire to become more familiar with their qualities. The sequence of sounds will be played twice.

Once you match a letter with a number please do not change it.

Sounds	Forms/Letters which seem to match
I	
II	
III	
IV	
V	
VI	
VII	
VIII	

IV. The attached sheets have a number in the upper left hand corner that represents the sounds which you have heard. Place the letter or letters of the form next to the number of the sound that you have matched to it.

V. As the sounds are replayed answer the questions, as best you can, on the attached sheets.

(1) relation - a logical or natural association between two or more things; relevance to one another

(2) quality - a characteristic or attribute of something; property; a feature; a natural character of something

PART II

Sound ___I___ Visual Form or Forms (Your letter from Page 1_____)

On the list below rate to what degree each of the design elements from the chosen form/forms relate to the qualities of the sound. Rate these elements from 0 to 10, zero meaning no relation, ten meaning the most definite relations. If you feel neutral place an N in the blank space.

I. How does the color or color gradation in general relate to the qualities of the sound?_____

How does hue (specific color or colors) relate to the qualities of the sound?_____

How does the intensity (brilliance of color) relate to the qualities of the sound? _____

How does value (dark to light of the neutrals or color) relate to the qualities of the sound? Light _____
Mid range _____
Dark _____

How does the contrast of hues or values relate to the qualities of the sound? _____

II. How do the patterns or forms in general relate to the qualities of the sound? _____

How do the concentric forms relate to the qualities of the sound? _____

How does the cubistic patterns relate to the qualities of the sound? _____

How do the diagonal or zig-zag patterns relate to the qualities of the sound? _____

How do the vertical patterns relate to the qualities of the sound? _____

How do the dimensional shapes relate to the qualities of the sound? Length _____
Width _____
Depth _____

III. How do the textures or surfaces perceived in general relate to the qualities of sound?

PART II

Sound ___II___ Visual Form or Forms (Your letter from Page 1_____)

On the list below rate to what degree each of the design elements from the chosen form/forms relate to the qualities of the sound. Rate these elements from 0 to 10, zero meaning no relation, ten meaning the most definite relations. If you feel neutral place an N in the blank space.

I. How does the color or color gradation in general relate to the qualities of the sound?_____

How does hue (specific color or colors) relate to the qualities of the sound?_____

How does the intensity (brilliance of color) relate to the qualities of the sound? _____

How does value (dark to light of the neutrals or color) relate to the qualities of the sound? Light _____
Mid range _____
Dark _____

How does the contrast of hues or values relate to the qualities of the sound? _____

II. How do the patterns or forms in general relate to the qualities of the sound? _____

How do the concentric forms relate to the qualities of the sound? _____

How does the cubistic patterns relate to the qualities of the sound? _____

How do the diagonal or zig-zag patterns relate to the qualities of the sound? _____

How do the vertical patterns relate to the qualities of the sound? _____

How do the dimensional shapes relate to the qualities of the sound? Length _____
Width _____
Depth _____

III. How do the textures or surfaces perceived in general relate to the qualities of sound?

PART II

Sound ___III___ Visual Form or Forms (Your letter from Page 1_____)

On the list below rate to what degree each of the design elements from the chosen form/forms relate to the qualities of the sound. Rate these elements from 0 to 10, zero meaning no relation, ten meaning the most definite relations. If you feel neutral place an N in the blank space.

I. How does the color or color gradation in general relate to the qualities of the sound?_____

How does hue (specific color or colors) relate to the qualities of the sound?_____

How does the intensity (brilliance of color) relate to the qualities of the sound? _____

How does value (dark to light of the neutrals or color) relate to the qualities of the sound? Light _____
Mid range _____
Dark _____

How does the contrast of hues or values relate to the qualities of the sound? _____

II. How do the patterns or forms in general relate to the qualities of the sound? _____

How do the concentric forms relate to the qualities of the sound? _____

How does the cubistic patterns relate to the qualities of the sound? _____

How do the diagonal or zig-zag patterns relate to the qualities of the sound? _____

How do the vertical patterns relate to the qualities of the sound? _____

How do the dimensional shapes relate to the qualities of the sound? Length _____
Width _____
Depth _____

III. How do the textures or surfaces perceived in general relate to the qualities of sound?

PART II

Sound IV Visual Form or Forms (Your letter from Page 1 _____)

On the list below rate to what degree each of the design elements from the chosen form/forms relate to the qualities of the sound. Rate these elements from 0 to 10, zero meaning no relation, ten meaning the most definite relations. If you feel neutral place an N in the blank space.

I. How does the color or color gradation in general relate to the qualities of the sound? _____

How does hue (specific color or colors) relate to the qualities of the sound? _____

How does the intensity (brilliance of color) relate to the qualities of the sound? _____

How does value (dark to light of the neutrals or color) relate to the qualities of the sound? Light _____
Mid range _____
Dark _____

How does the contrast of hues or values relate to the qualities of the sound? _____

II. How do the patterns or forms in general relate to the qualities of the sound? _____

How do the concentric forms relate to the qualities of the sound? _____

How does the cubistic patterns relate to the qualities of the sound? _____

How do the diagonal or zig-zag patterns relate to the qualities of the sound? _____

How do the vertical patterns relate to the qualities of the sound? _____

How do the dimensional shapes relate to the qualities of the sound? Length _____
Width _____
Depth _____

III. How do the textures or surfaces perceived in general relate to the qualities of sound?

PART II

Sound ____V____ Visual Form or Forms (Your letter from Page 1_____)

On the list below rate to what degree each of the design elements from the chosen form/forms relate to the qualities of the sound. Rate these elements from 0 to 10, zero meaning no relation, ten meaning the most definite relations. If you feel neutral place an N in the blank space.

I. How does the color or color gradation in general relate to the qualities of the sound?_____

How does hue (specific color or colors) relate to the qualities of the sound?_____

How does the intensity (brilliance of color) relate to the qualities of the sound? _____

How does value (dark to light of the neutrals or color) relate to the qualities of the sound? Light _____
Mid range _____
Dark _____

How does the contrast of hues or values relate to the qualities of the sound? _____

II. How do the patterns or forms in general relate to the qualities of the sound? _____

How do the concentric forms relate to the qualities of the sound? _____

How does the cubistic patterns relate to the qualities of the sound? _____

How do the diagonal or zig-zag patterns relate to the qualities of the sound? _____

How do the vertical patterns relate to the qualities of the sound? _____

How do the dimensional shapes relate to the qualities of the sound? Length _____
Width _____
Depth _____

III. How do the textures or surfaces perceived in general relate to the qualities of sound?

PART II

Sound ___VI___ Visual Form or Forms (Your letter from Page 1_____)

On the list below rate to what degree each of the design elements from the chosen form/forms relate to the qualities of the sound. Rate these elements from 0 to 10, zero meaning no relation, ten meaning the most definite relations. If you feel neutral place an N in the blank space.

I. How does the color or color gradation in general relate to the qualities of the sound?_____

How does hue (specific color or colors) relate to the qualities of the sound?_____

How does the intensity (brilliance of color) relate to the qualities of the sound? _____

How does value (dark to light of the neutrals or color) relate to the qualities of the sound? Light _____
Mid range _____
Dark _____

How does the contrast of hues or values relate to the qualities of the sound? _____

II. How do the patterns or forms in general relate to the qualities of the sound? _____

How do the concentric forms relate to the qualities of the sound? _____

How does the cubistic patterns relate to the qualities of the sound? _____

How do the diagonal or zig-zag patterns relate to the qualities of the sound? _____

How do the vertical patterns relate to the qualities of the sound? _____

How do the dimensional shapes relate to the qualities of the sound? Length _____
Width _____
Depth _____

III. How do the textures or surfaces perceived in general relate to the qualities of sound?

PART II

Sound ___VII___ Visual Form or Forms (Your letter from Page 1_____)

On the list below rate to what degree each of the design elements from the chosen form/forms relate to the qualities of the sound. Rate these elements from 0 to 10, zero meaning no relation, ten meaning the most definite relations. If you feel neutral place an N in the blank space.

I. How does the color or color gradation in general relate to the qualities of the sound?_____

How does hue (specific color or colors) relate to the qualities of the sound?_____

How does the intensity (brilliance of color) relate to the qualities of the sound? _____

How does value (dark to light of the neutrals or color) relate to the qualities of the sound? Light _____
Mid range _____
Dark _____

How does the contrast of hues or values relate to the qualities of the sound? _____

II. How do the patterns or forms in general relate to the qualities of the sound? _____

How do the concentric forms relate to the qualities of the sound? _____

How does the cubistic patterns relate to the qualities of the sound? _____

How do the diagonal or zig-zag patterns relate to the qualities of the sound? _____

How do the vertical patterns relate to the qualities of the sound? _____

How do the dimensional shapes relate to the qualities of the sound? Length _____
Width _____
Depth _____

III. How do the textures or surfaces perceived in general relate to the qualities of sound?

PART II

Sound VIII Visual Form or Forms (Your letter from Page 1 _____)

On the list below rate to what degree each of the design elements from the chosen form/forms relate to the qualities of the sound. Rate these elements from 0 to 10, zero meaning no relation, ten meaning the most definite relations. If you feel neutral place an N in the blank space.

I. How does the color or color gradation in general relate to the qualities of the sound? _____

How does hue (specific color or colors) relate to the qualities of the sound? _____

How does the intensity (brilliance of color) relate to the qualities of the sound? _____

How does value (dark to light of the neutrals or color) relate to the qualities of the sound? Light _____
Mid range _____
Dark _____

How does the contrast of hues or values relate to the qualities of the sound? _____

II. How do the patterns or forms in general relate to the qualities of the sound? _____

How do the concentric forms relate to the qualities of the sound? _____

How does the cubistic patterns relate to the qualities of the sound? _____

How do the diagonal or zig-zag patterns relate to the qualities of the sound? _____

How do the vertical patterns relate to the qualities of the sound? _____

How do the dimensional shapes relate to the qualities of the sound? Length _____
Width _____
Depth _____

III. How do the textures or surfaces perceived in general relate to the qualities of sound?

PART III

Please fill out the information below

Age ___(18 or under) ___ 18-25 ___ 26-35 ___ 36-45 ___ 46-55 ___ 56 or over ___

Sex Female _____ Male _____

Occupation _____

Specialization _____

Geographic location you have lived most of your life _____

Population of town or city you have lived in most of your life _____

How long have you been in Manhattan, Kansas _____

List three special interests you have.

_____

_____

_____

Any comments concerning the feelings you have toward the visual form will be appreciated.

KSU
KANSAS STATE UNIVERSITY

Pre-Design Professions Department

College of Architecture and Design
Seaton Hall
Manhattan, Kansas 66506
913-532-6846

Dear

Thank you for accepting the invitation to view visual forms, listen to sounds, and fill out a questionnaire.

I will meet you and the other participants at the Information Desk in the K-State Student Union on February 24th. We will then walk to the heliodon, which is in the basement of Seaton Hall, to view the forms and hear the sound as you fill out the questionnaire.

I am looking forward to seeing you Tuesday at

Sincerely yours,

Rebecca Alston

APPENDIX B

FIGURES

Relationship of the Quality of the Music Composition to the Overall Environment

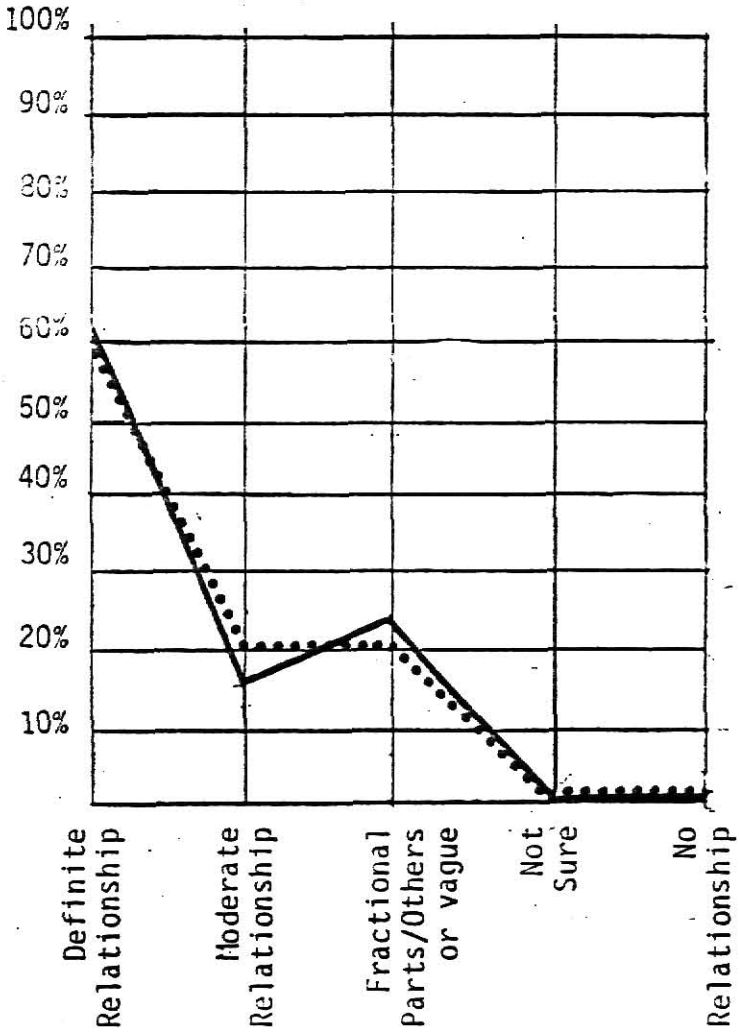


Figure 1

Percentage of Forms Related To A Sound

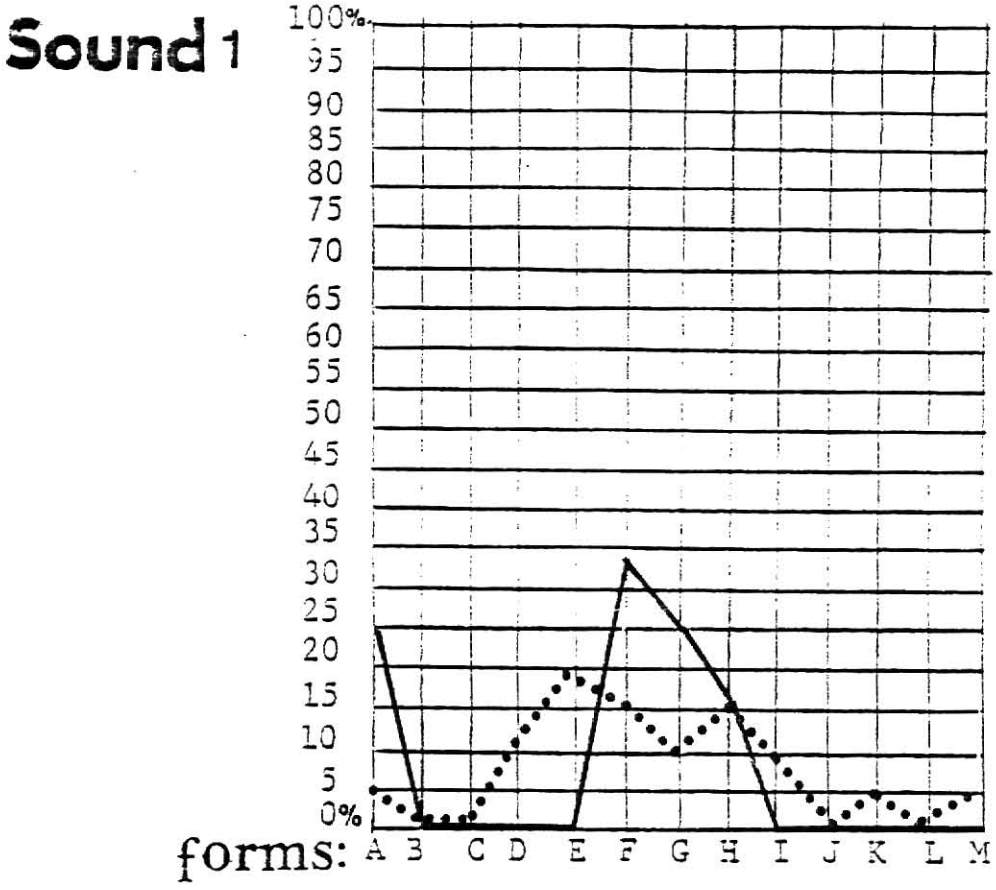


Figure 2

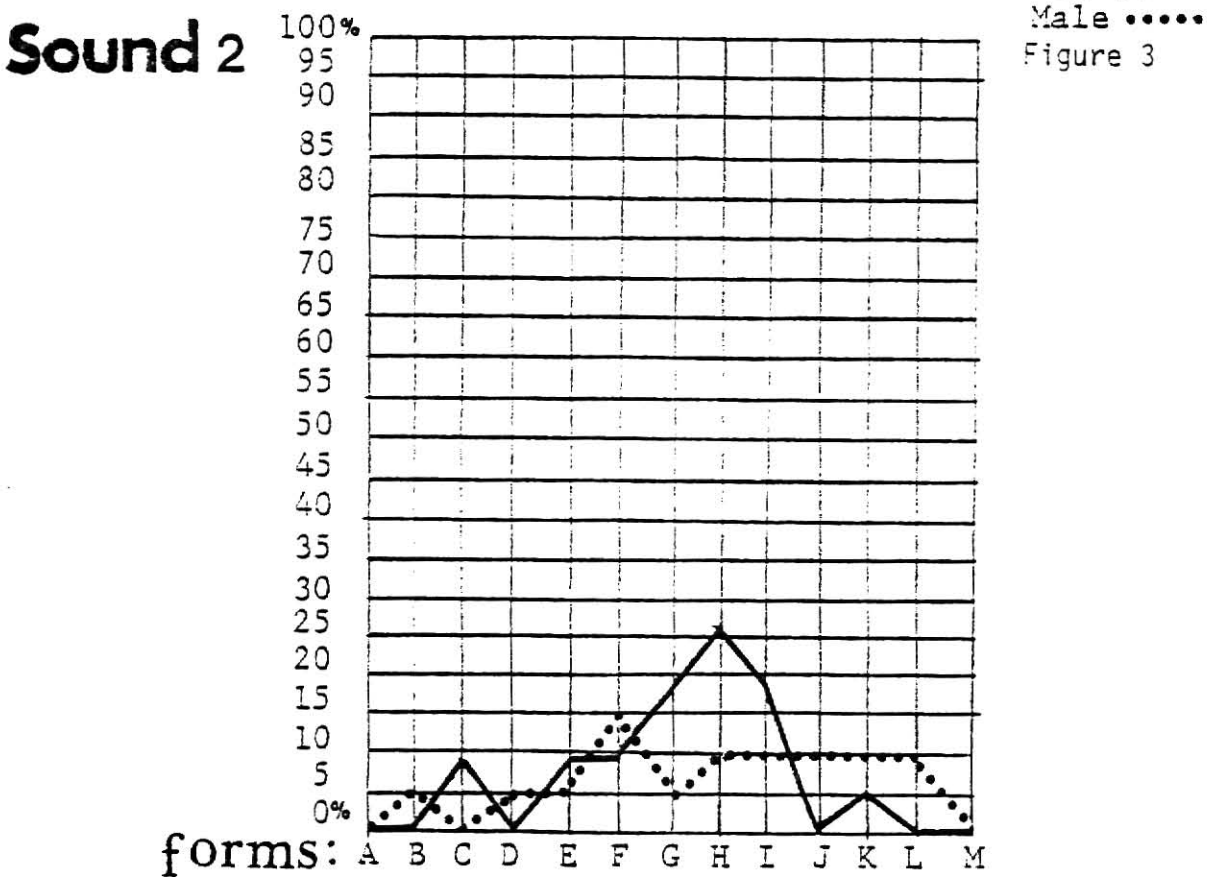


Figure 3

Percentage of Forms Related To A Sound

Sound 3

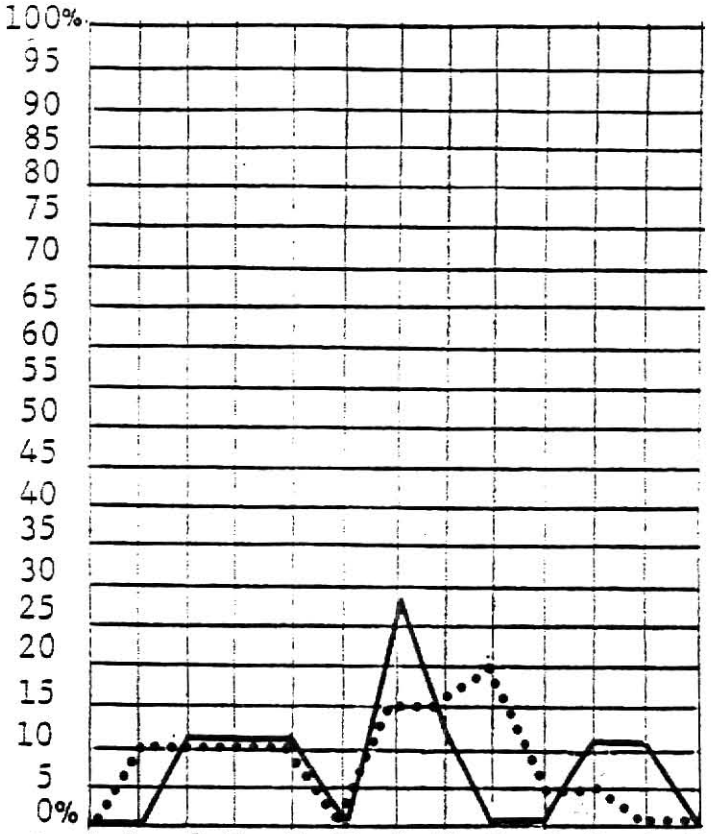


Figure 4

Female ——
Male ·····

Sound 4

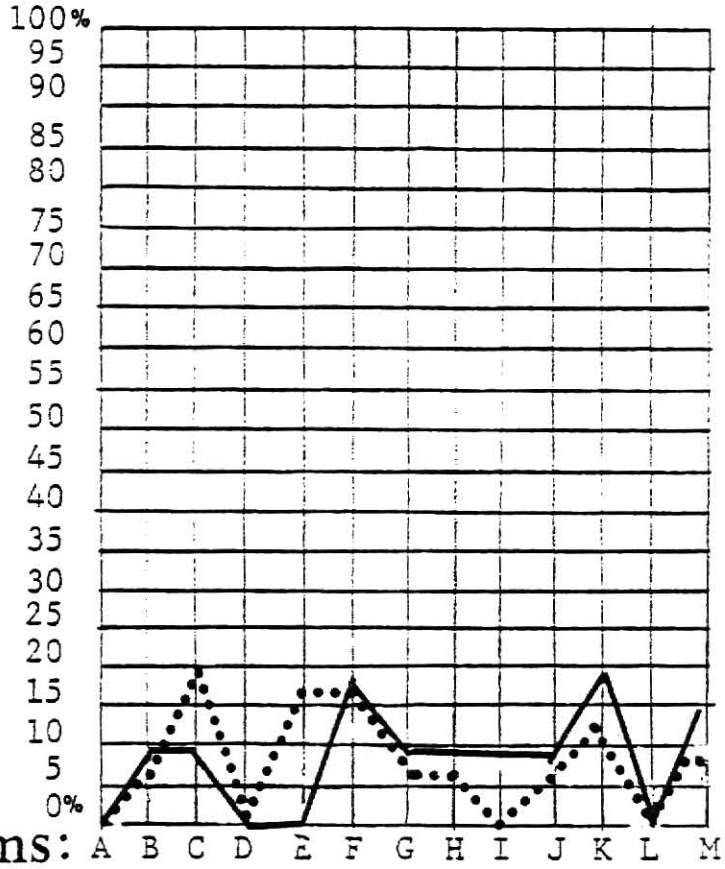


Figure 5

Percentage of Forms Related To A Sound

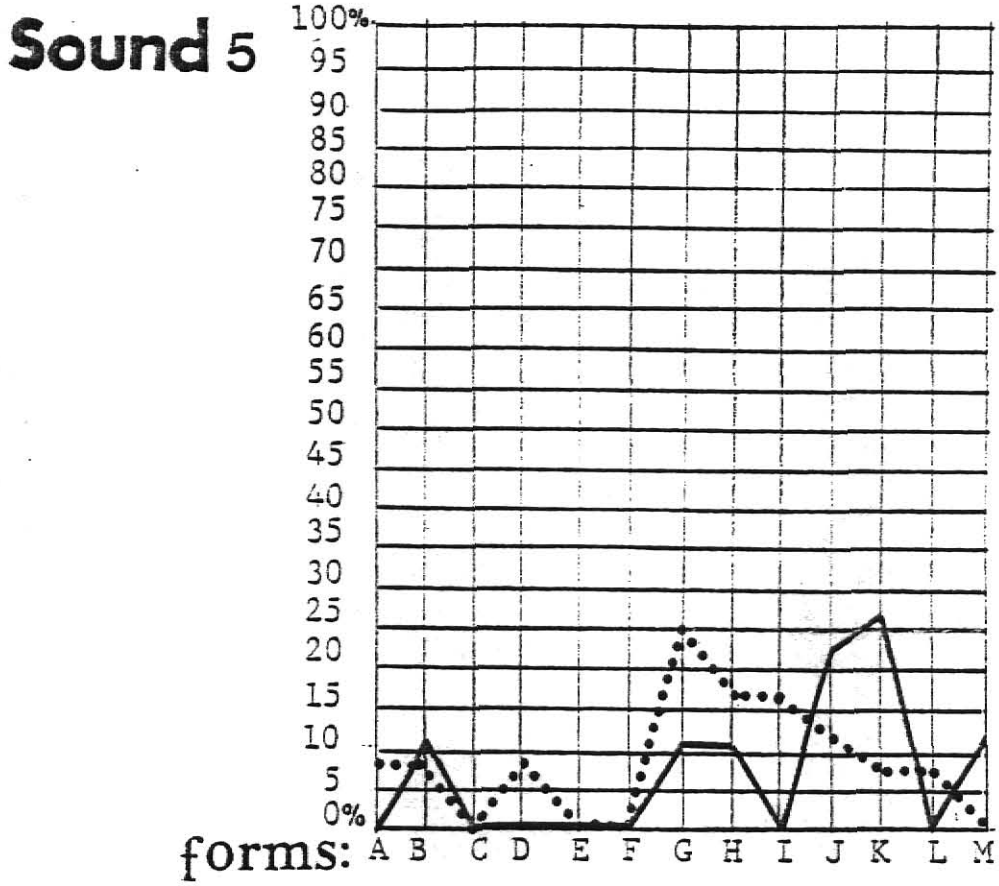
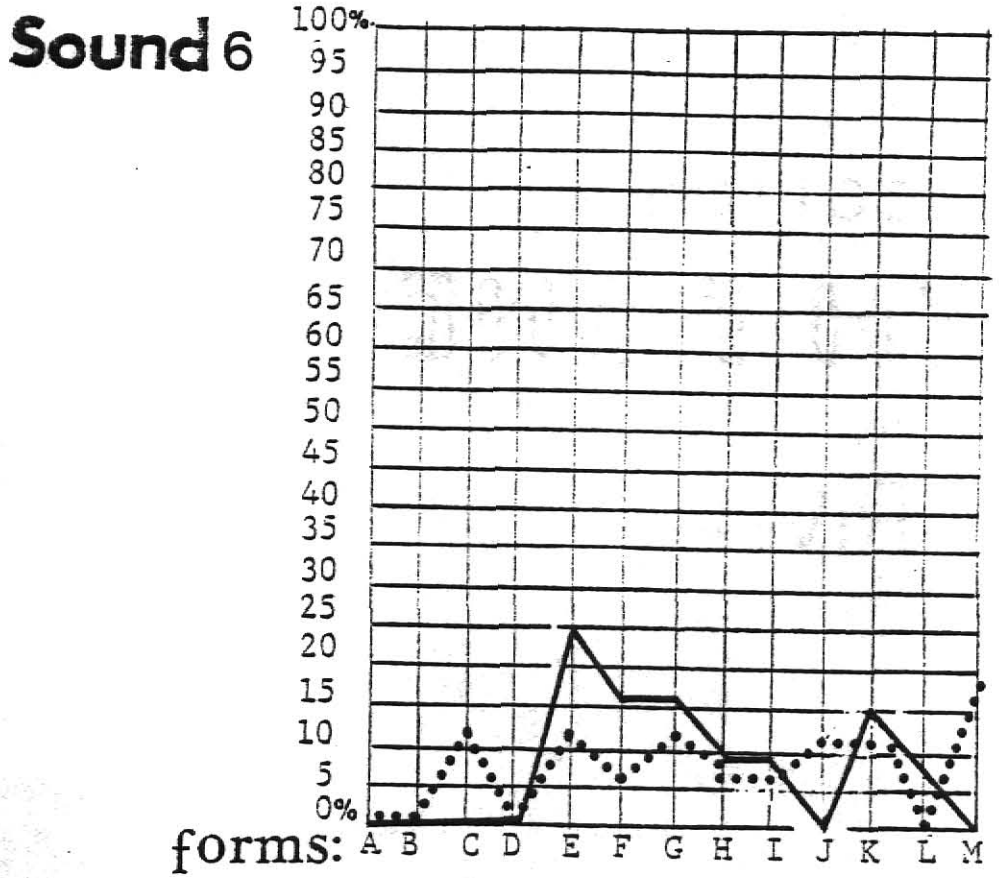


Figure 6



Female
Male

Figure 7

Percentage of Forms Related To A Sound

Sound 7

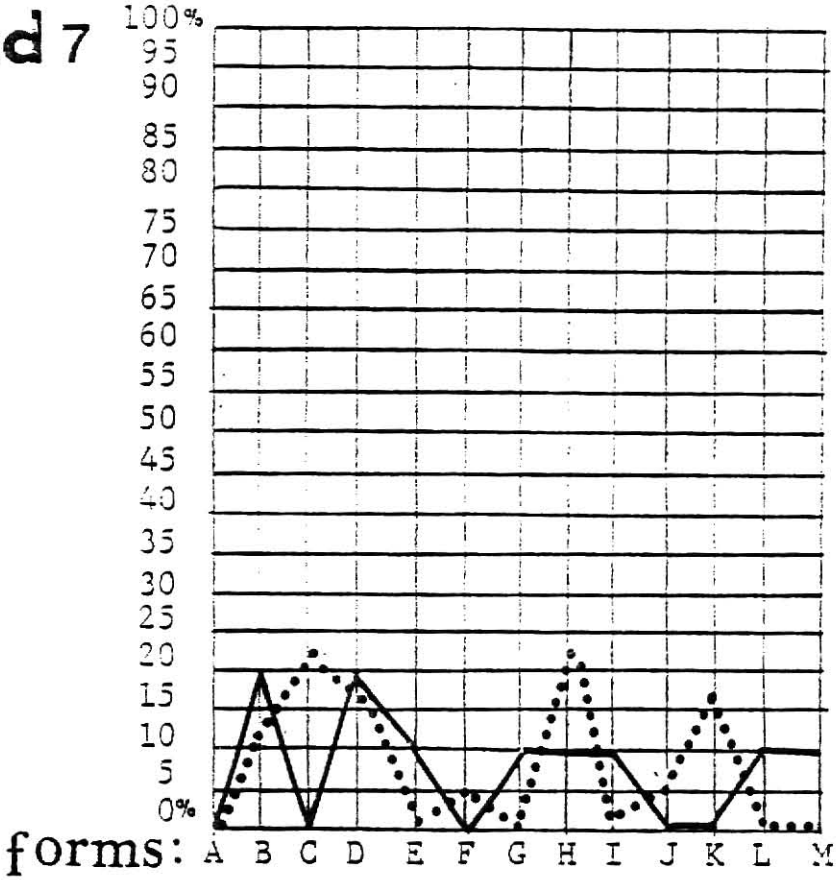


Figure 8

Female ——
Male ·····

Sound 8

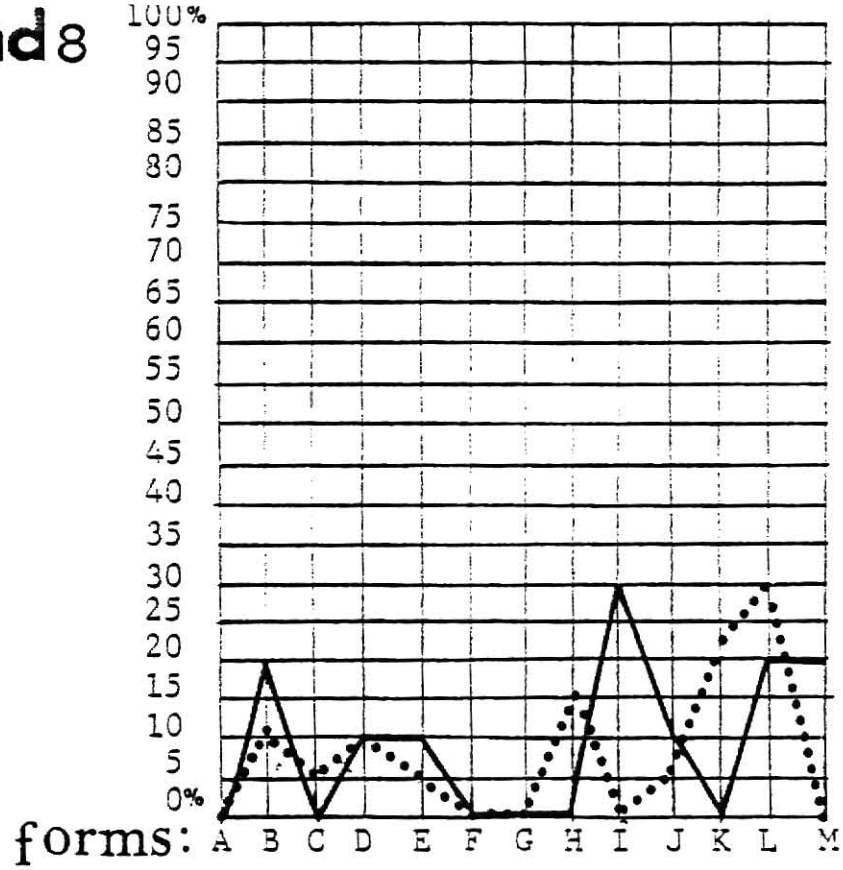


Figure 9

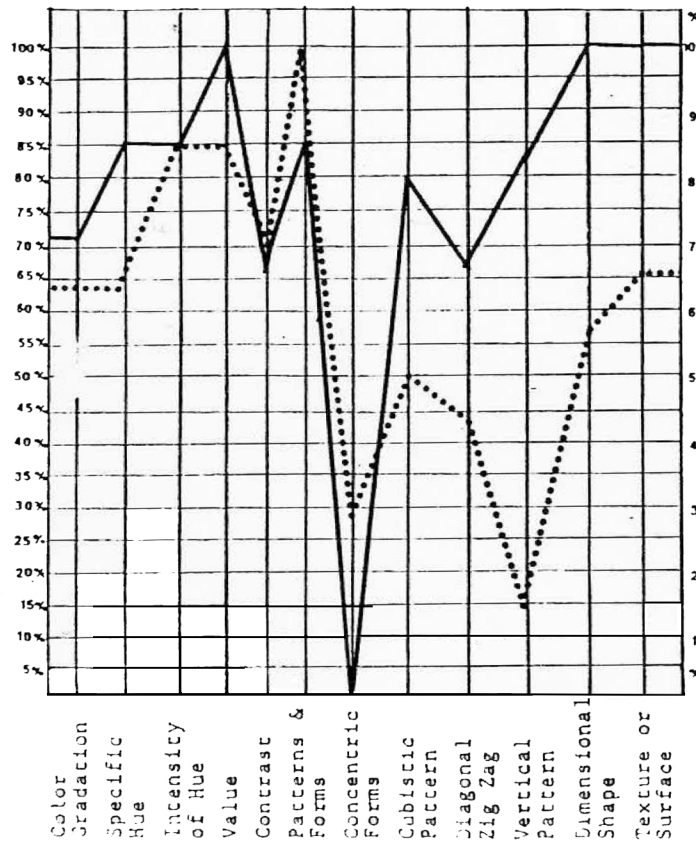
The following figures illustrate the percentage of relationship between each design element and the quality of sound as rated by the viewers. Only those forms which were rated by viewers as having the highest relationship to the sounds are illustrated.

Percentage of Design Elements Related to the Quality of Sound
Figure 10

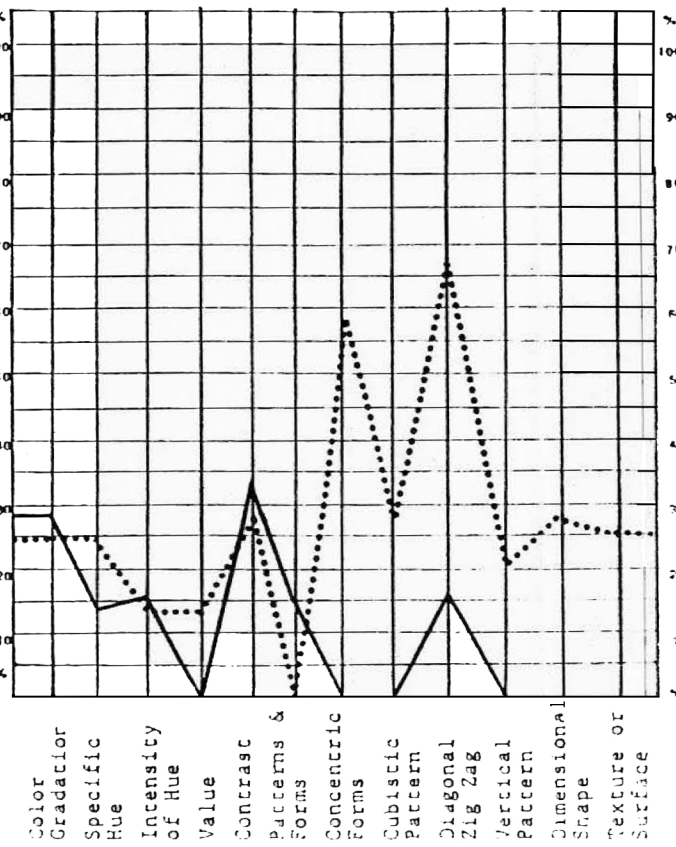
Form B

Rating of the design elements (n, 0 - 10): female —— male .....

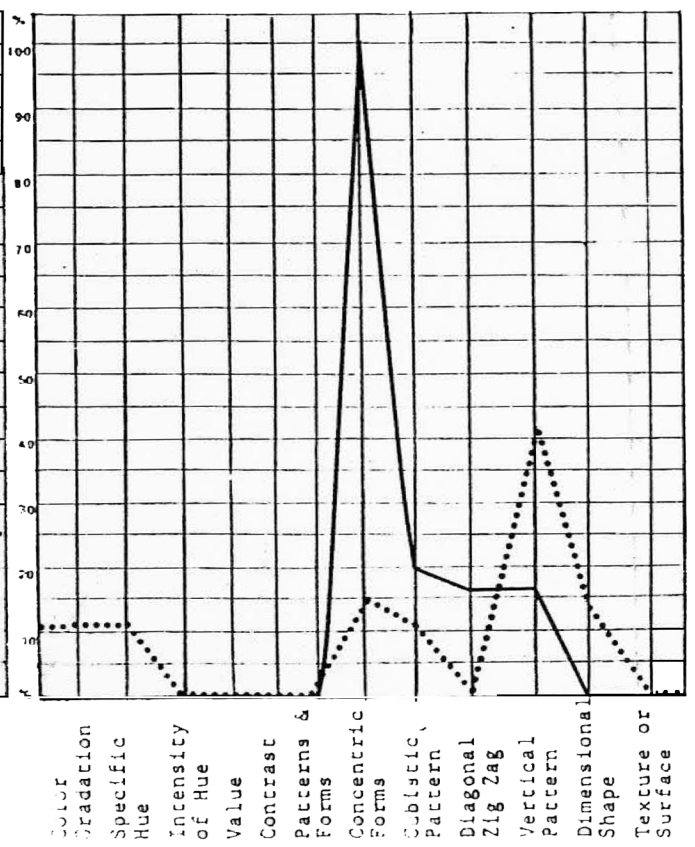
high relationship to music (7 - 10)



mid relationship to music (3 - 6)



low relationship to music (n - 2)

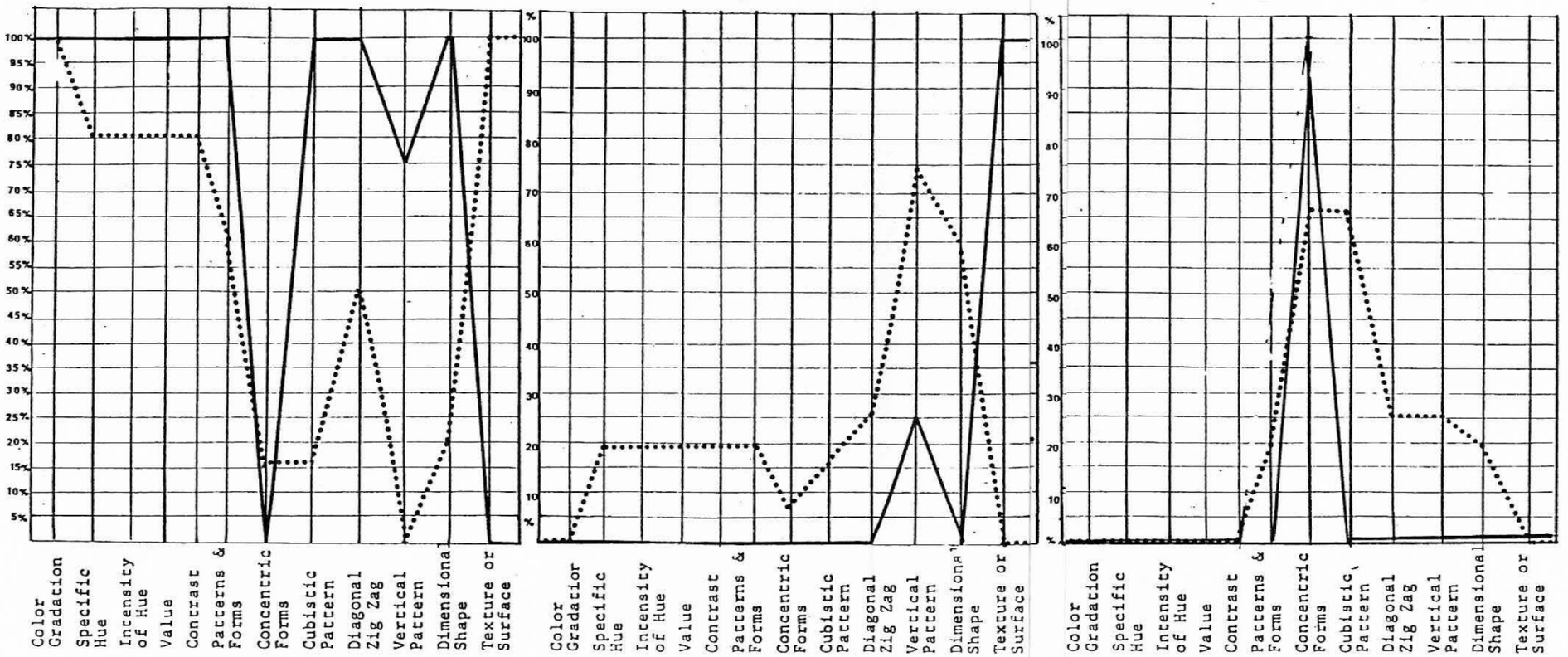


Percentage of Design Elements Related to the Quality of Sound
Figure 11

Form D

Rating of the design elements (n,0 - 10): female —— male .....

high relationship to music (7 - 10) mid relationship to music (3 - 6) low relationship to music (n - 2)

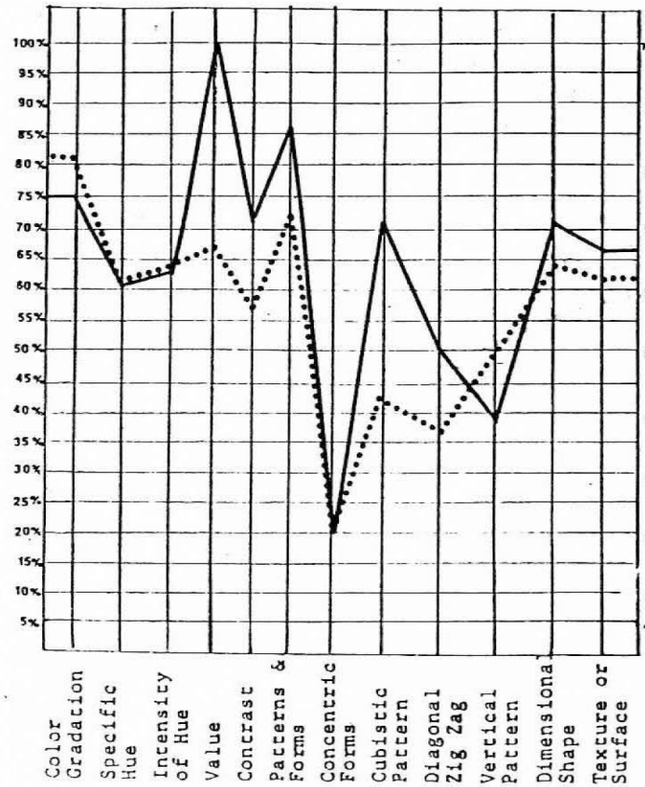


Percentage of Design Elements Related to the Quality of Sound
Figure 12

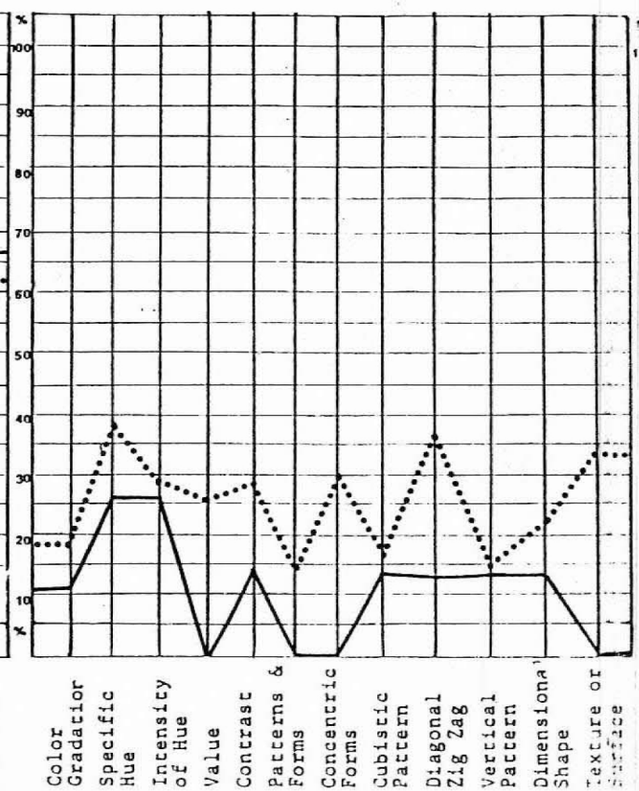
Form E

Rating of the design elements (n,0 - 10): female —— male .....

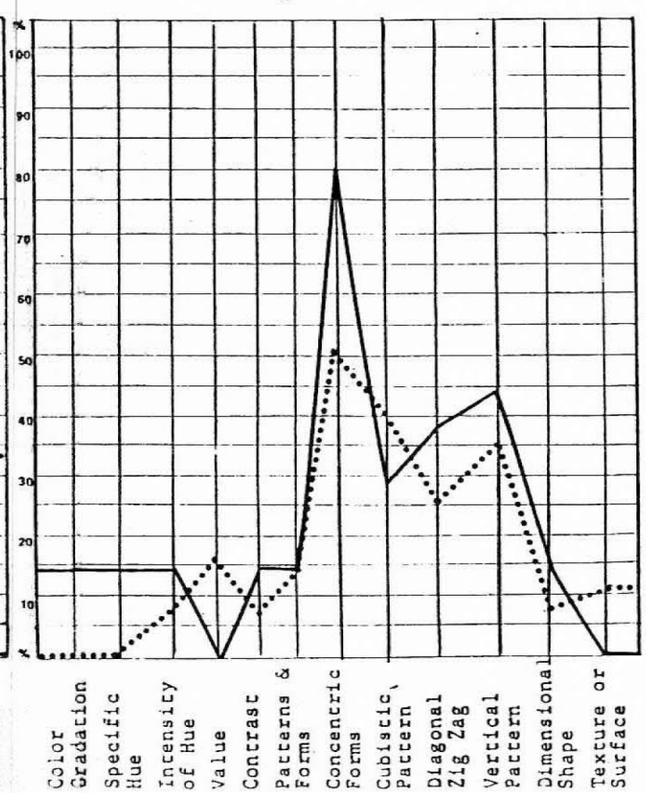
high relationship to music (7 - 10)



mid relationship to music (3 - 6)



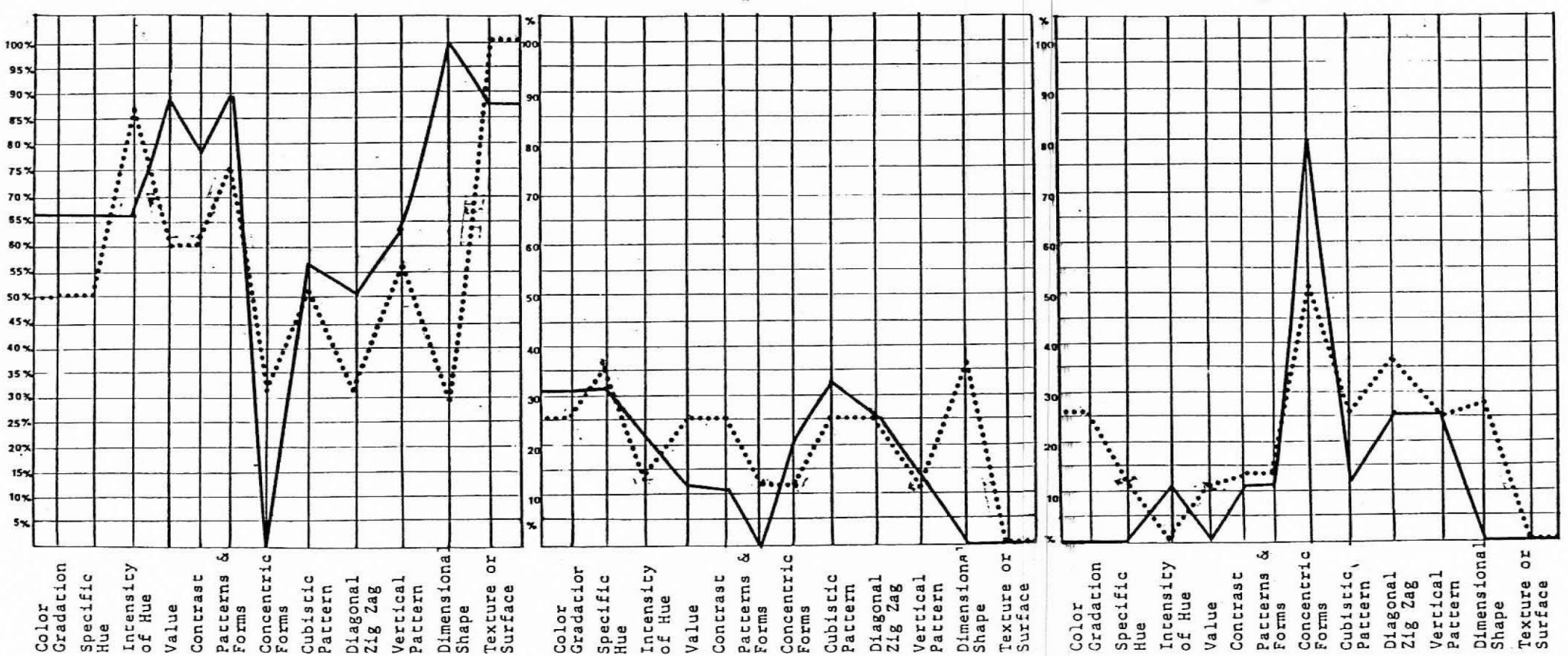
low relationship to music (n - 2)



Form F

Figure 13

Rating of the design elements (n,0 - 10): female —— male .....



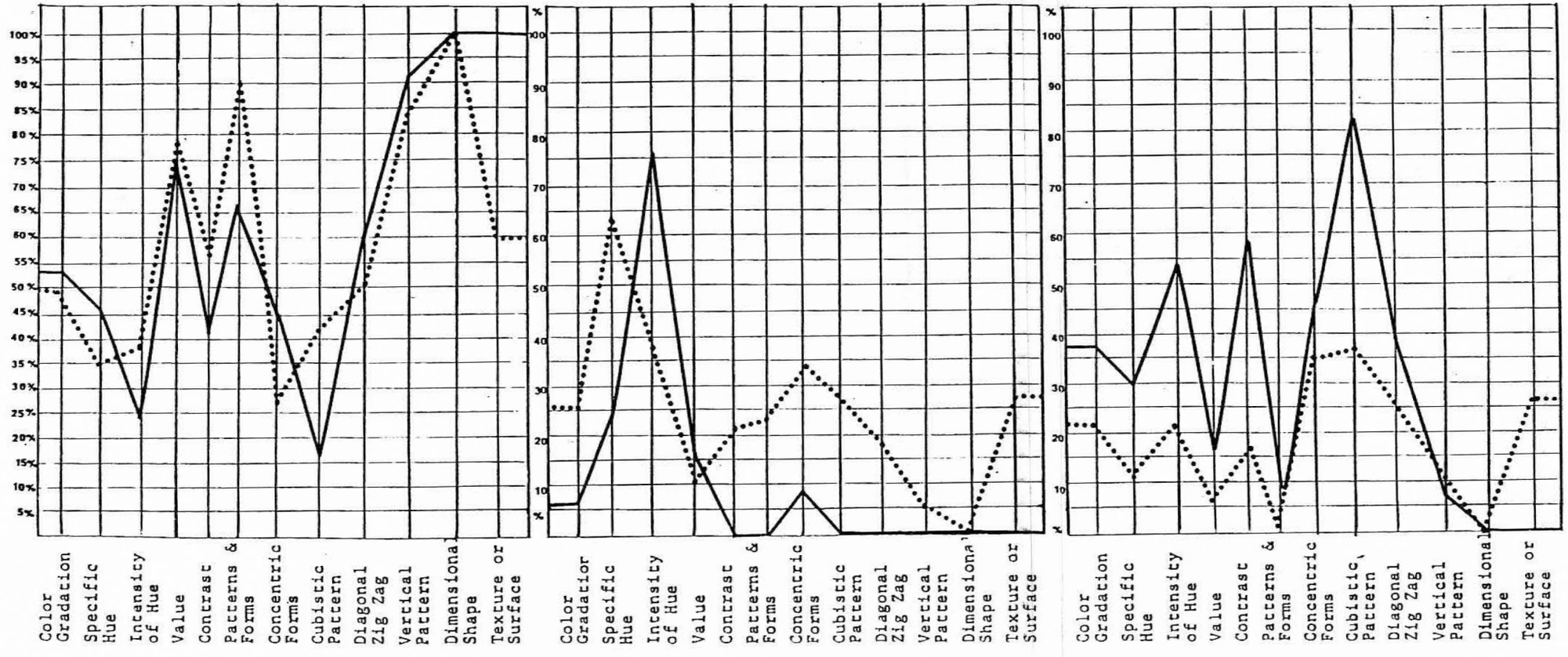
Percentage of Design Elements Related to the Quality of Sound
Figure 14

Form G

female —— male .....

Rating of the design elements (n,0 - 10):

high relationship to music (7 - 10) mid relationship to music (3 - 6) low relationship to music (n - 2)

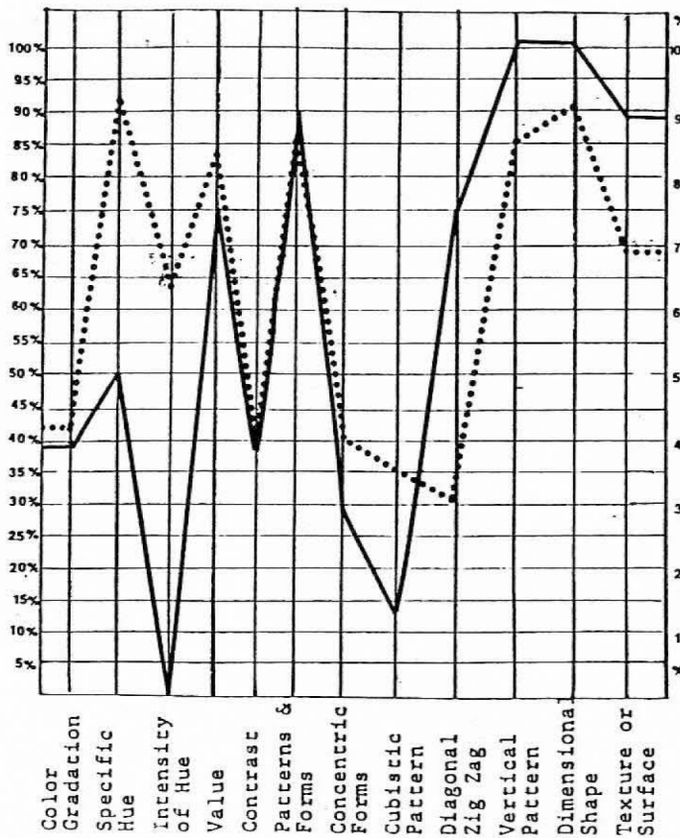


Percentage of Design Elements Related to the Quality of Sound
Figure 15

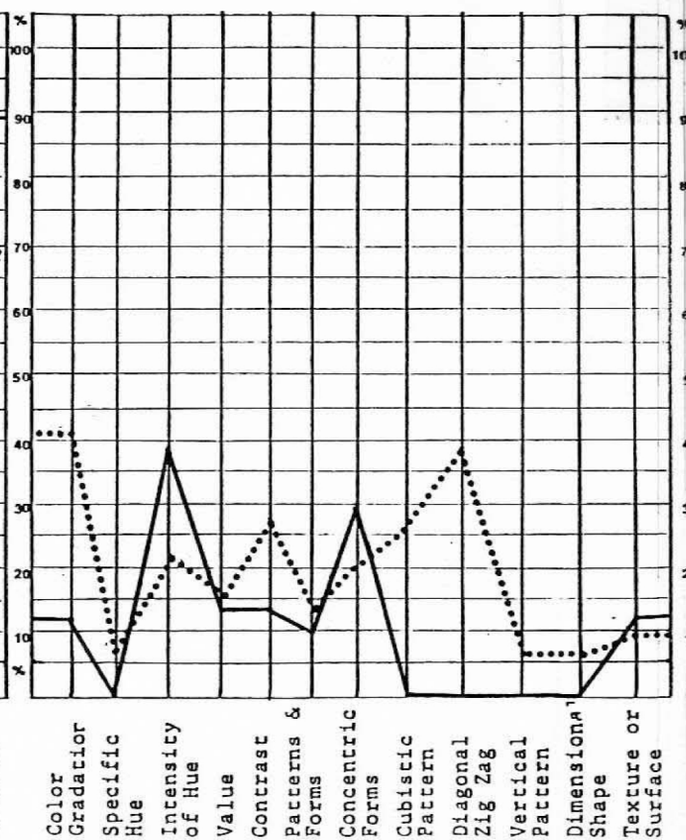
Form H

Rating of the design elements (n,0 - 10): female —— male .....

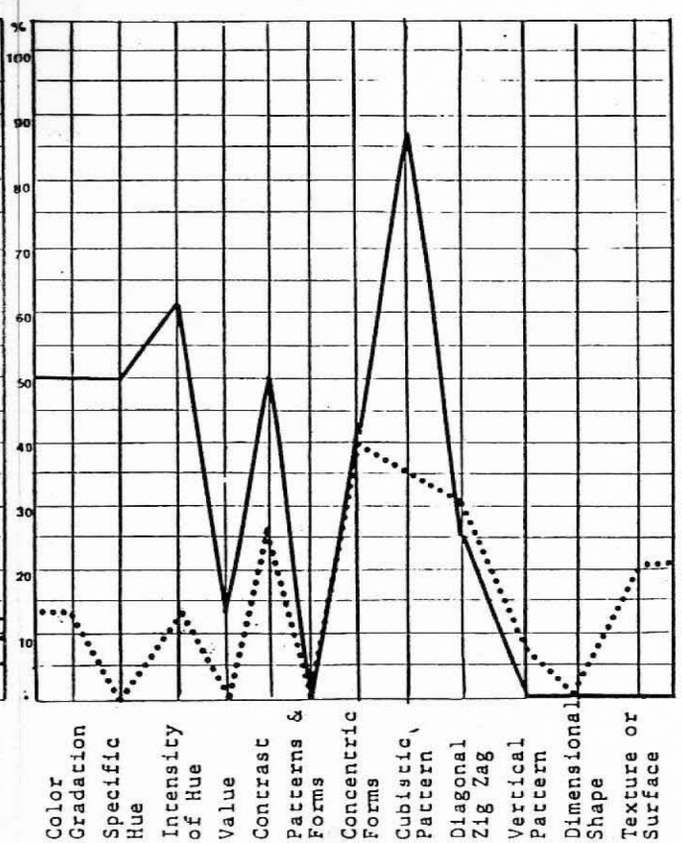
high relationship to music (7 - 10)



mid relationship to music (3 - 6)



low relationship to music (n - 2)

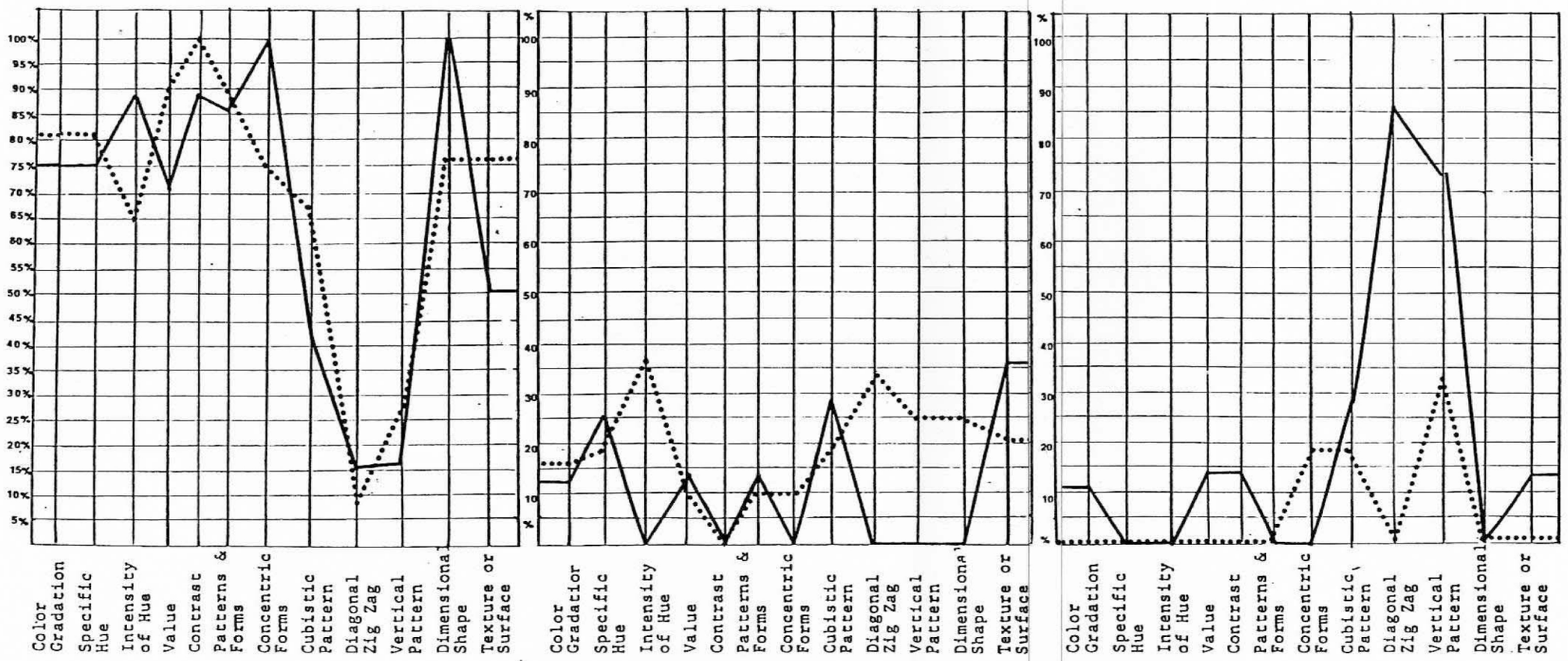


Percentage of Design Elements Related to the Quality of Sound
Figure 16

Form I

Rating of the design elements (n,0 - 10): female —— male .....

high relationship to music (7 - 10) mid relationship to music (3 - 6) low relationship to music (n - 2)



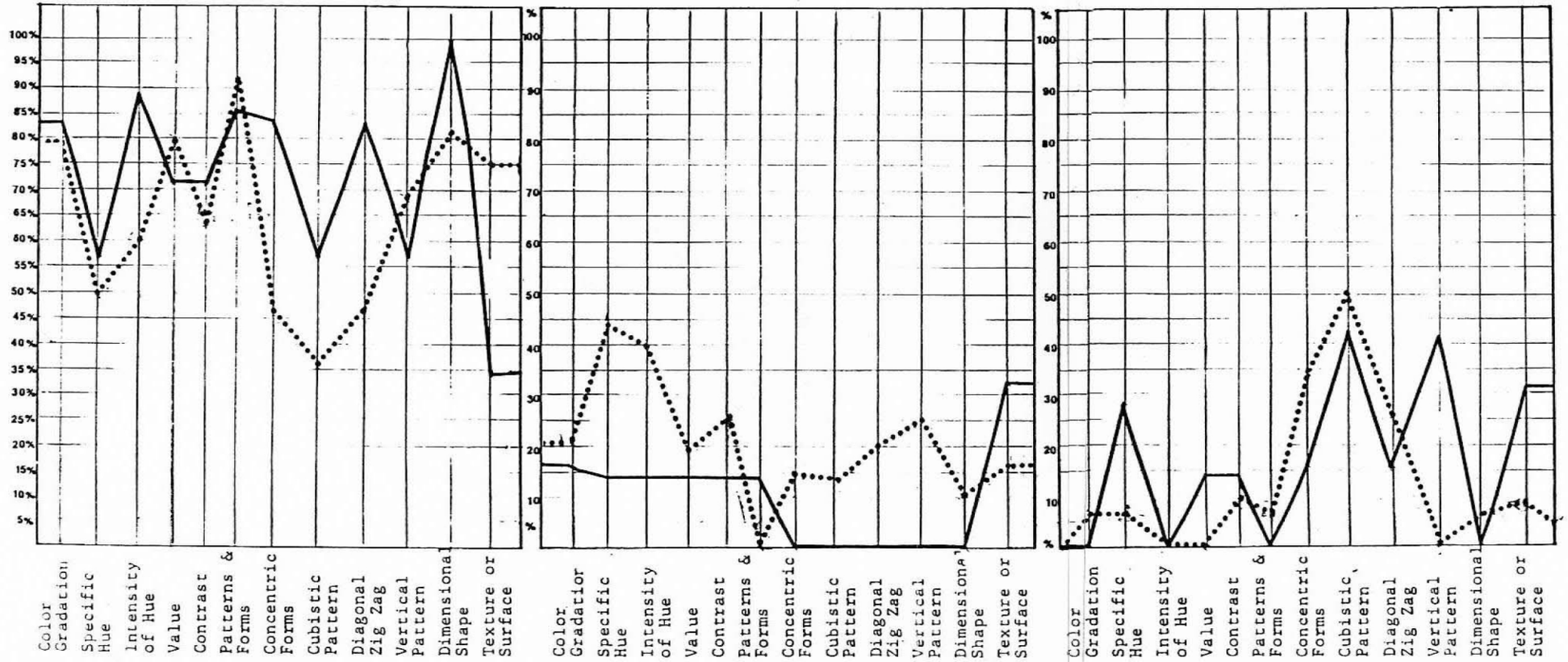
Percentage of Design Elements Related to the Quality of Sound
Figure 17

Form K

female —— male .....

Rating of the design elements (n, 0 - 10):

high relationship to music (7 - 10) mid relationship to music (3 - 6) low relationship to music (n - 2)



APPENDIX C

PLATES

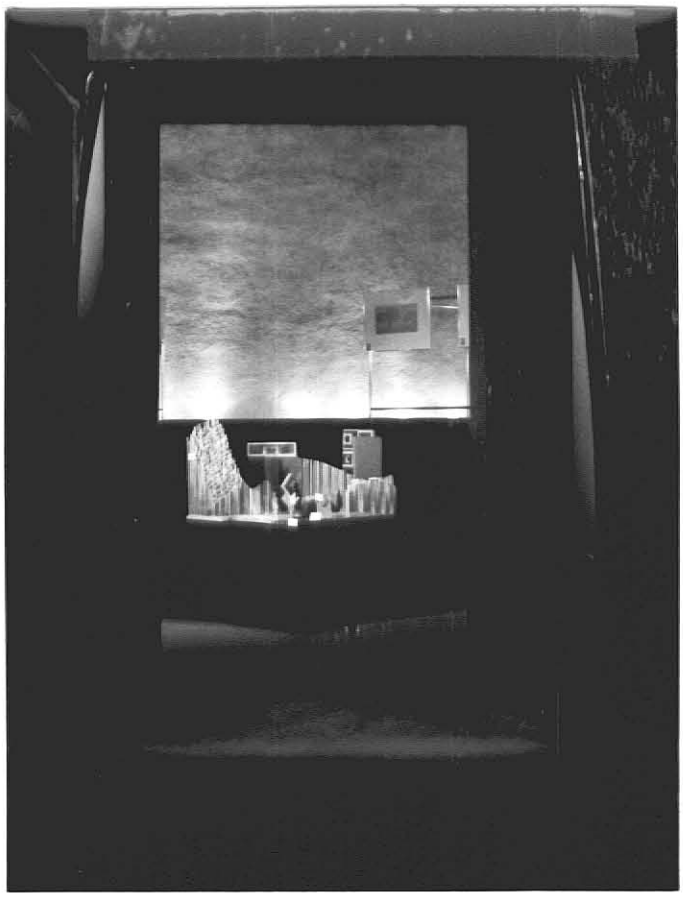


PLATE NO. 1

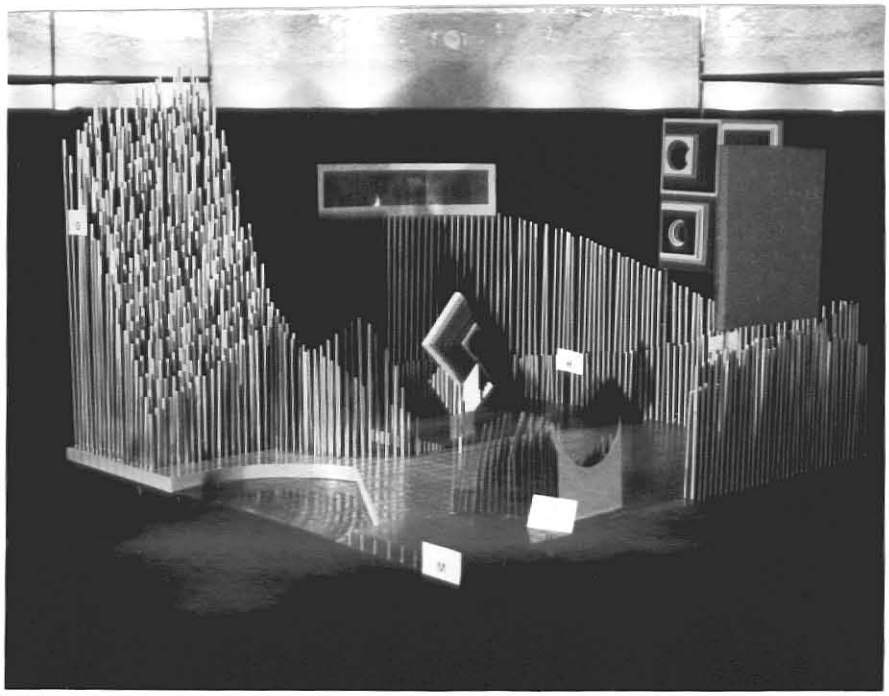
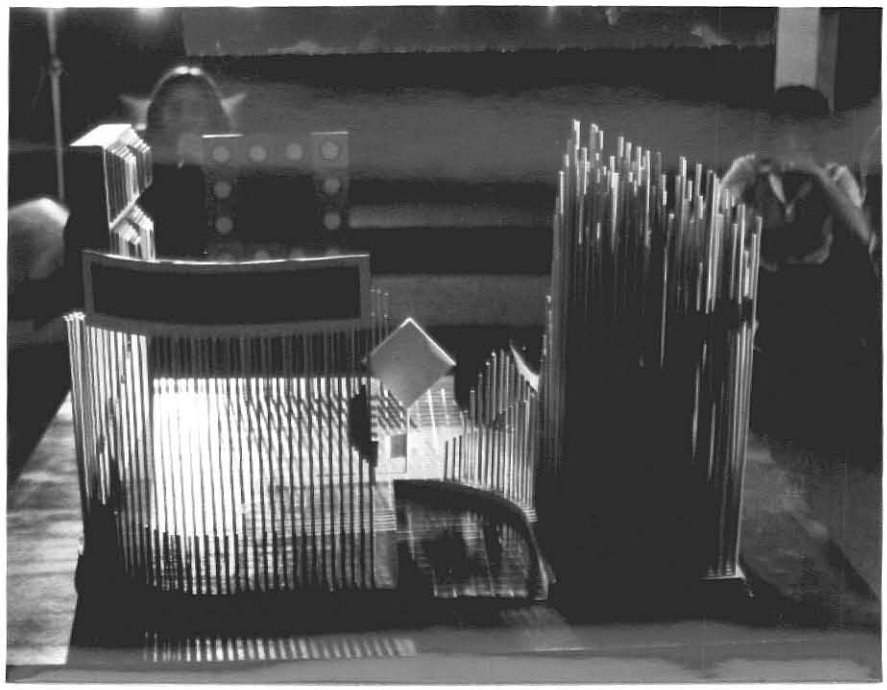


PLATE NO. 2

PLATE NO. 4



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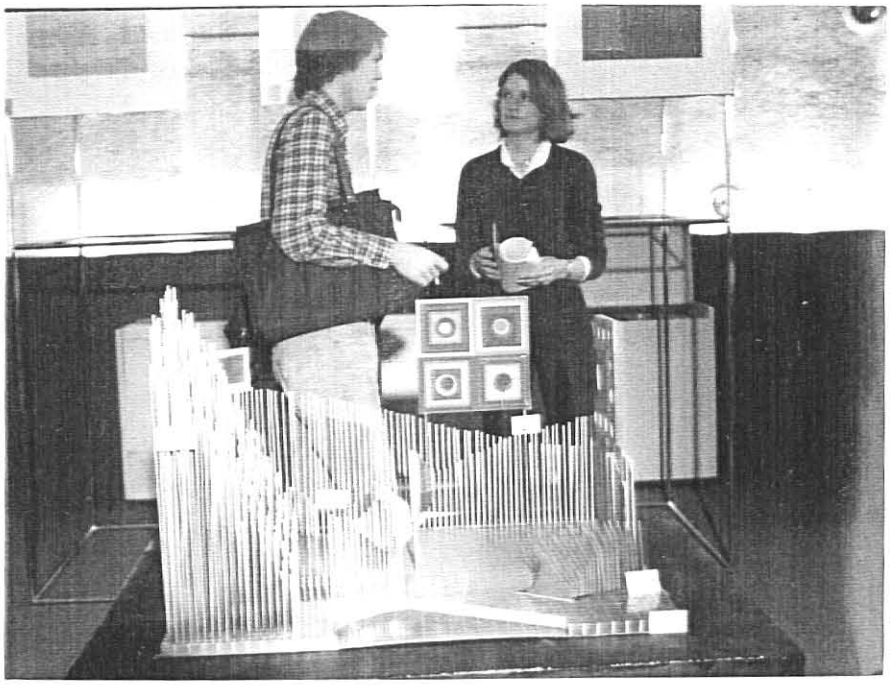

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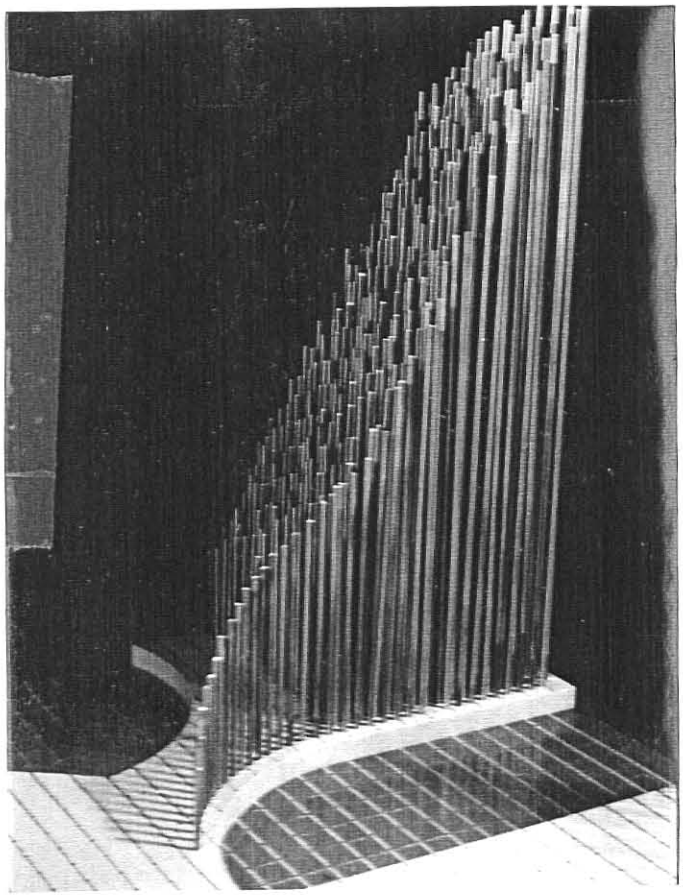

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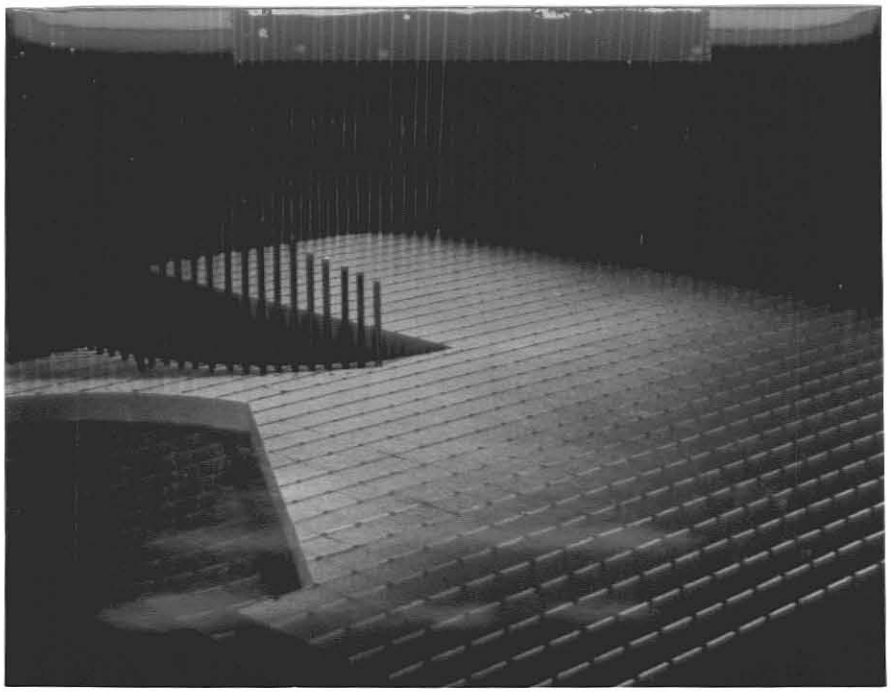

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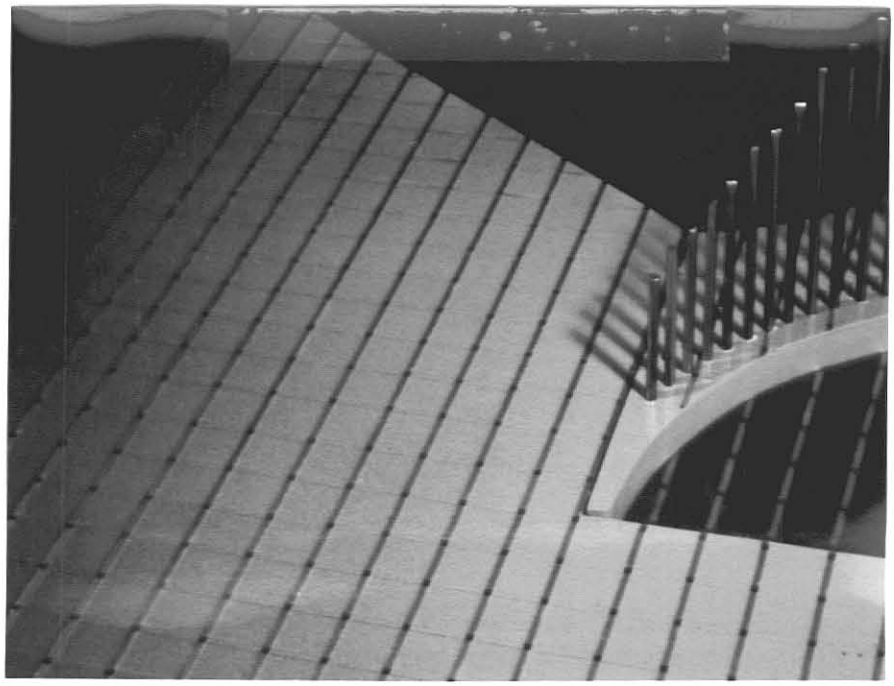

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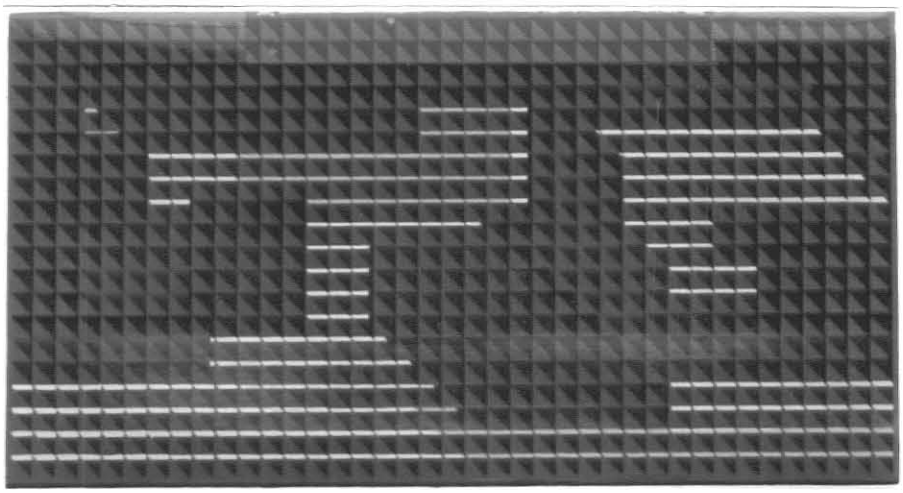

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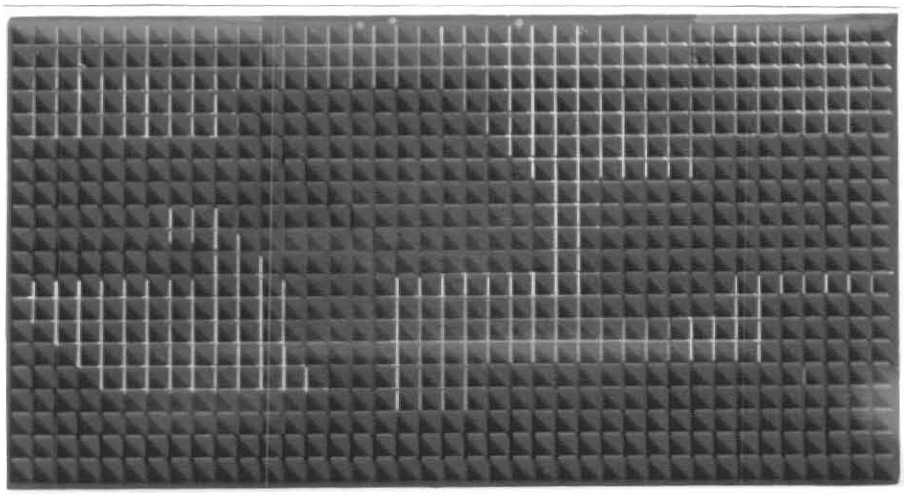

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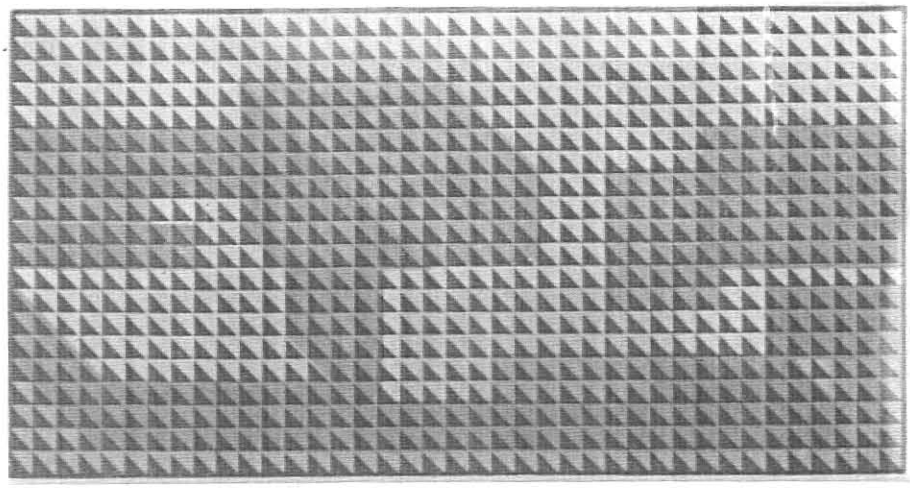

PLATE NO. 12

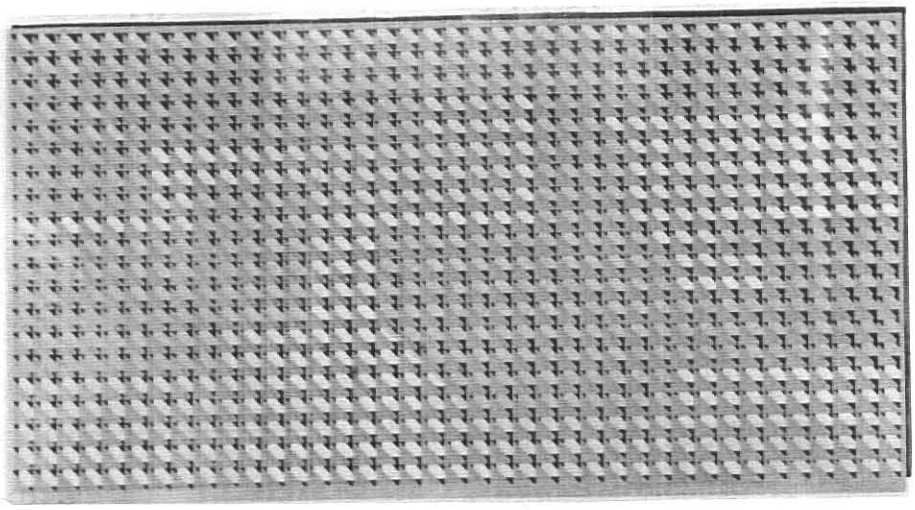

PLATE NO. 13

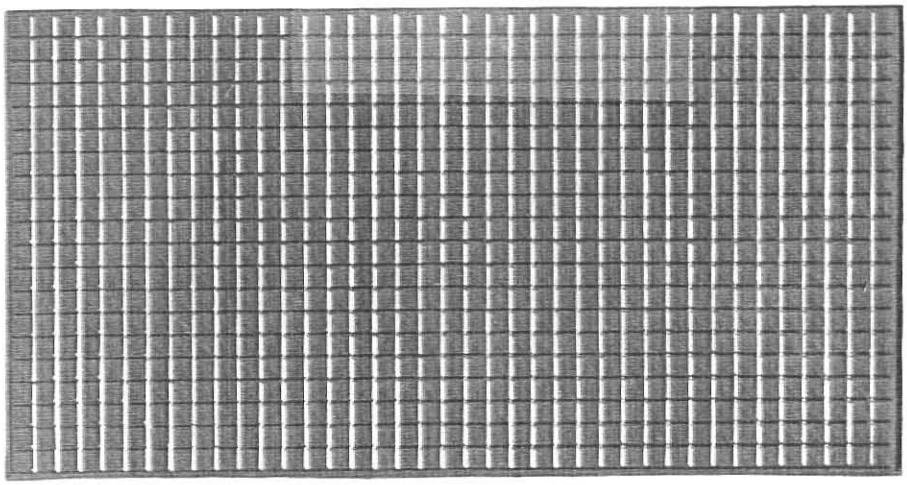

PLATE NO. 14

PLATE NO. 15

PLATE NO. 16

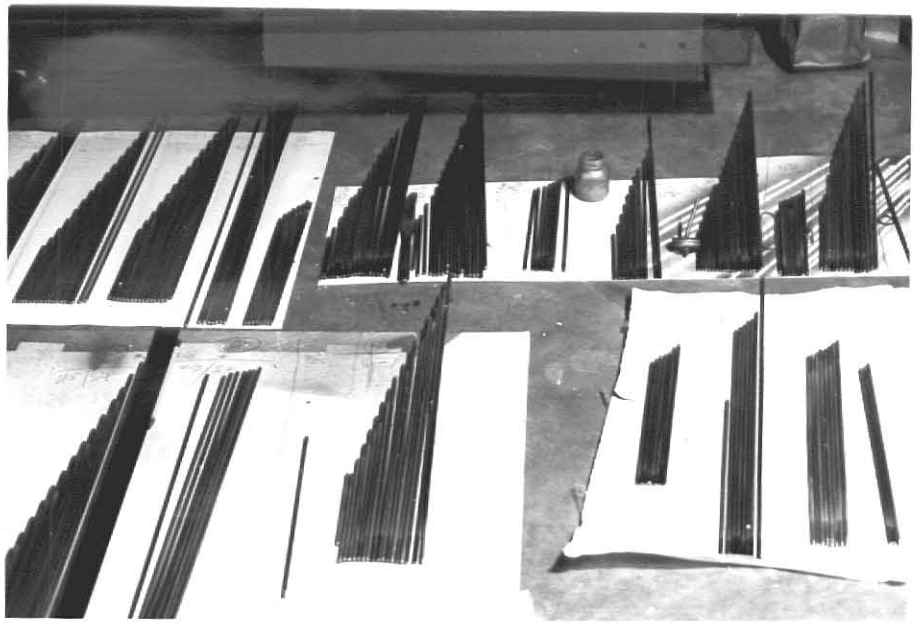

PLATE NO. 17

A STUDY OF THE INTER-RELATIONSHIP OF COLOR FORM AND MUSIC

REBECCA ALSTON

B.F.A. AUBURN UNIVERSITY, 1975

AN ABSTRACT OF A MASTERS THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTERS OF ARCHITECTURE

Department of Architecture

KANSAS STATE UNIVERSITY

Manhattan, Kansas

1981

ABSTRACT

An environment was designed and executed one-fourth the original scale of a future study. The pilot study tested concepts and schemes to determine if inter-relationships existed between color, form and the qualities of tone color of music. Similar and dissimilar responses between female and male participants were also determined from the results of the questionnaire.

The methods utilized in this study included designing and executing two and three-dimensional visual forms; interpreting selected excerpts within an ambient musical composition; placing the visual forms in an environmental space that was isolated from most other visual and auditory interferences; playing the musical composition at sequenced intervals while the forms were being viewed. A questionnaire was administered to provide data on perceived correlations between the quality of music and the overall color forms, and the quality of music and design elements such as color, texture and pattern.

Responses indicated that a definite relationship existed between the overall environment and the quality of music. Within this relationship the data indicated there was no significant difference between female and male perceptions. When viewers were asked to rate design elements of each form to the sound on a 0-10 scale, with N indicating a neutral reaction, most responses occupied either the upper or lower third of the scales. The design elements, therefore, had either a high or a very low relationship to the quality of the sound being played. Many viewers reported that the sounds were non-distinct, making it difficult to correspond the sound to one specific

form. They claimed, instead, that the sounds related to several forms all at once. Additionally, viewers indicated stronger correlations between the three-dimensional forms and the sound than with the two-dimensional forms.

In conclusion, a definite correlation existed between the quality of sound and both design elements and the forms. However, greater validity would have been achieved had the forms been based on greater contrasting sounds with varying tone color.

Women and men agreed closely, but not totally on the direct relationship between the environment and the quality of sound. They agreed only sporadically on which forms matched the sound. Although some differences were detected between female and male perceptions, the contrast was not enough to be considered significant.