Color of Sound - Chromaesthesia

DESCRIPTION

“There was a piece of music by a group called Uman. The first note was grey and it was like a band of grey with a slight curve to it, and it was a gradient - light grey going to dark grey - it had gold specks on it. The background was black but it was being broken up by other colors, moving shapes of fuchsia and there was a small like a click, almost like a drumbeat, something being struck, and as it was struck, a black shape appeared, and the shapes appeared from left to right, going horizontally across the bottom of this - like a movie screen that I was watching. And the shapes were so exquisite, so simple, so pure and so beautiful, I wanted somehow to be able to capture them, but they were moving too quickly and I couldn't remember them all. And it's kind of a pity because it was a year's worth of sculpture I was seeing in a few moments.” by Carol Steen

This is when a sound evokes the perception of a color. It has been recorded that an opera is like experiencing a painting. Sometimes each musical instrument has it's own color. In bi-directional hearing, the changing of a traffic light (or robot as it is referred to in other countries) evokes a bell-like sound.

One of the memorable creative experiences I have had is trying to capture colors and shapes of sound. I used set paper on the floor of my room along to the end and start painting one of my favorite composer's album. Trying to visualize the sound that I felt deep inside dragged me into an exciting and complicated adventure. As I painted, I discovered that the rules I created unconsciously had logical explanations behind. The lines, shapes and colors had reason to be formed in certain ways in my paintings. Color, placement and shape choices were made for reasons that my brain signaled before I conceived it. These memories in mind and the knowledge I have gained in art and the brain class I have decided my final project to be about colored hearing - chromaesthesia. My project will include researches about colored hearing by giving examples of lived experiences, synesthetic-art by looking at some of the pieces that are completed by synesthetic artists( Vasily Kandinsky) and non-synesthetic modern artist (Mondrian, Malevitch), and composers(Alexander Scriabin, Sir Arthur Sullivan), some scientific experiments that are done by scientists and adventurers (Newton, Stephen Malinowski, Lisa Turetsky, Jameson, Kastner, Bainbridge Bishop, Rimington), few examples of my own that I have experimented in past and the last, and a small processing application with live audio input to paint your own voice. (A project I would like to continue researching)

WHAT IS CHROMAETESIA?

The synaesthetic experience depends exclusively on the left brain and is associated with a decreased blood supply to the neocortex. This results in enhanced limbic expression. Therefore, we can assume that the system responsible for synaesthesia is located or influenced by the limbic system more than the neocortex. Additional support for this is that there is an emotional aspect associated with a synesthetic experience. In fact, in order to fulfill the diagnostic criteria for synaesthesia an emotional response must be present. We are irrational creatures by design and that emotion, not reason, may play the decisive role both in how we think and act. Additionally, our brains are not passive receivers of energy flux, but dynamic explorers that actively seek out the stimuli that interest them and determine their own contexts for perception. Because there are more projections from the limbic system to the neocortex than the other way around, the limbic brain easily overwhelms thinking. It is the limbic brain that determines the salience of that information. Therefore, an emotional evaluation ultimately informs our behavior. Our inner knowledge behind the curtain is largely inaccessible to introspective language, which means that what we feel about something is more valid than what we think or say about that something. Reason is just the endless paperwork of the mind.

Cases of synaesthesia may be idiopathic (developmental), with the person having experienced synaesthesia as long as they can remember, or non-idiopathic, resulting from a known etiology or mechanism which is acquired and produced synaesthesia.

The most prevalent form of synesthesia is known as audition colorée(chromaesthesia), the phenomenon of hearing of colors in music and vowels. Three psychological theories have been put forward for colored hearing synaesthesia. The doctrine of the unity of the senses or linkage theory, proposes that the perpetuation of a primitive perceptual experience in the limbic system is the root cause of color synaesthesia. As this system evolved, the perception was differentiated into two separate senses, hearing and vision. A similar theory, the crosstalk theory, holds that auditory and visual information pathways may cross in synaesthetes. These cross-modal neural connections may be numerically greater than usual or simply used in different ways. Some believe higher cognitive/cortical level processing (the limbic system is thought to be lower level) to be involved. According to this view, colored hearing synaesthesia is the result of a chain of mental associations, some of the intermediate links having dropped out of
awareness. For instance, a person may see red every time they hear a trumpet because of the red uniforms of a brass band. Feedback connections aid us in imagery, memory, sensory attention and other cognitive functions, but could they also result in synaesthesia? Auditory and visual information must meet somewhere in the brain or we could not process them in conjunction as they occur. These systems may contain feedback pathways normally but, in synaesthetes, they may be altered to include information from the other senses. Ramachandran’s studies show that chromaesthesia is the involuntary physical experience of a cross-modal association. Because the hearing center in the temporal lobes is close to the higher brain area that receives color signals from V4 sound-color synesthesia happens. He points out that the same effect could occur if the wiring—the number of connections between regions—was fine but the balance of chemicals traveling between regions was skewed. (cross activation) For instance, neighboring brain regions often inhibit one another’s activity, which serves to minimize cross talk. A chemical imbalance of some kind that reduces such inhibition—for example, by blocking the action of an inhibitory neurotransmitter or failing to produce an inhibitor—would also cause activity in one area to elicit activity in a neighbor. Such cross activation could, in theory, also occur between widely separated areas, which would account for some of the less common forms of synesthesia. Similarly, in some lower forms, the visual appearance of a letter might generate color, whereas in higher forms it is the sound. Chromaesthesia is perceived externally in peri-personal space, the limb axis space immediately surrounding the body, never at a distance as in the spatial teloreception of vision or audition where a synesthesia on hearing music, also see objects—falling gold balls, shooting lines, metallic waves like oscilloscope tracing— that float on a “screen” six inches from her nose. The experience is accompanied by a sense of certitude and conviction that what chromaesthetes perceive is real or valid. This accompaniment brings to mind that transitory change in self-awareness that is known as ectasy.

Experiments show that hemispheric flows are low and inhomogenous to begin with, yet drop a further 18% on average in the left hemisphere during chromaesthesia. Such a decrease is impossible to obtain in a normal person with, for example, a drug. Even during an activation trial with amyl nitrate, which subjectively intensifies the synesthetic experience, regional blood flows are decreased compared to baseline on people with synesthesia. Normally, any physical or mental task, or any activation procedure (e.g., drug administration, carbon dioxide or oxygen inhalation), increases blood flow by five to ten percent. Most of the time cortical metabolism drops so low during chromaesthesia that would cause blindness, paralyziation, or other conventional sign of a lesion in non-chromaesthetics. Such a depression of cortical metabolism during a distinct behavioral state disturbs traditionalists, who regard the more recently-evolved cortex as the seat of higher analysis and reason, while assigning the limbic system (the sub-cortical ring of tissue that encircles the brainstem and is much older in evolutionary terms) to handle the more “primitive” functions of emotion, memory, and attention. The hippocampus is also necessary for experiencing other altered states of consciousness that are qualitatively similar to chromaesthesia. For example, the perceptions during LSD-induced choramesthesia, sensory deprivation, limbic epilepsy, release hallucinations, and the experiential responses during electrical stimulation of the brain possess a generic, elemental quality—just as they do in chromesthesia (Cytowic, 1989).

Research regarding musical pitch stimuli and the visual representations showed that when the pitch was regarded to be higher, the visual images were reported to be lighter in color, while pitches that were regarded as lower tended to produce visual images that were darker in color. This has been seen to occur in non-synesthetes in laboratory settings in the same frequency that synesthetic individuals report involuntary occurrences (Hubbard).
Based on these studies Cytowic has hypothesized that all human beings possess the ability to have synesthesia. He believes that as children, all humans are synesthetic, that only as they mature into adulthood, the part of the brain that allows for cross-modalities to occur represses those abilities, making most adults forget they have synesthesia (Cytowic, 1989 as cited in Cytowic, 1995).

Another prevalent idea is that synesthetes are merely being metaphorical when they describe the note C flat as “red” just as you and I might speak of a “loud” shirt or “sharp” cheddar cheese. Our ordinary language is replete with such sense-related metaphors, and perhaps chromaeteses are just especially gifted in this regard. Is this just a memory, or do you actually see the color as if it were right in front of you? When Ramachandran tried asking this question, he did not get very far. Some subjects did respond, “Oh, I see it perfectly clearly.” But a more frequent reaction was, “I kind of see it, kind of don’t” or “No it is not like a memory. I see the number as being clearly red but I also know it isn’t; it is black. So it must be a memory, I guess.”

Mechanistic explanations have been plentiful throughout synesthesia's history. The notion of crossed wires turns up repeatedly. As early as 1704, Sir Isaac Newton struggled to devise mathematical formulae to equate the vibration of sound waves to a corresponding wavelength of light. Goethe noted color correspondences in his 1810 work, Zur Farbenlehre. The nineteenth century saw an alchemical zeal in the search for universal correspondences and a presumed algorithm for translating one sense into another. This mechanistic approach was consistent with the then-common view of a clockwork universe based on Newton's uniform laws of motion.

Its phenomenology makes clear that chromaetesia is not an idea, but an experience. How does science approach this distinction between a first-person understanding of some experience and a third-person one that is supposedly objective? A lack of obvious agreement among chromaetesia compounds the apparent difficulty. In fact, this rather glaring problem - that two individuals with the same sensory pairings do not report identical, or even similar, chromaetesiac responses - has sometimes been taken as "proof" that chromaetesia is not "real." Scriabin and Rimsky-Korsakov, for example, disagreed on the color of given notes and musical keys. The examples below represent some different photisms.

As can be seen above, "Chromaetetics never see complex dream-like scenes or have otherwise elaborate percepts. They perceive blobs, lines, spirals, lattices, and other geometric shapes." Dr Richard Cytowic notes that the generic and restricted nature of synesthetic percepts bear a considerable likeness to a series of forms first developed by Heinrich Klüver in the 1920's known as Klüver's "form constants". These generic shapes are common to chromaetesia, hallucinations and are frequently seen in primitive art. Variations in photism color, brightness, symmetry, and shapes have been recorded to vary as a result of variation in musical stimuli. Tempo for instance effects the shape of a photism; the faster the music, the sharper and more angular the photism. That pitch has a direct effect on the size of a photism has also been recorded. It has been observed universally that photism size increases as auditory pitch decreases. In this way high pitched sounds produce small photisms and low pitched sounds produce synesthetic percepts that are large in size. Loudness also has an effect on the size of the photism perceived by a chromaetesie. Lawrence E. Marks shares his understanding of Chromaetetic response to music: "Just as the important dimensions of the auditory stimulus that are responsible for musical synesthesiae can be quite complex, so too can be the synesthetic responses themselves." "Visual sensations aroused by music need not be limited or confined to simple spots of color. Often the entire visual field fills with colors that change over time with the music; some subjects report several colors simultaneously, each color reflecting a particular aspect of the music." The study of chromesthetic phenomena often concerns itself with associations triggered by speech rather than music. This is perhaps due to the fact that speech is pathologically superior in its ability to evoke a synesthetic response. The component of speech that bears the greatest influence on the nature of the induced response is the sound of vowels. Both areas have tremendous significance in mapping out perceptual parallels between the modalities of hearing and vision. Firstly, when it comes to reports on musical synesthesia, we find that the important principles of visual-auditory association that manifest themselves in color music are basically the same principles that manifest themselves in colored vowels - that is, the relations of visual brightness and size to auditory pitch and loudness. Secondly, in an article published in 1968, Wayne Slawson showed that artificial two formant sounds are readily interpretable as vowels and as musical notes and that the vowel quality and musical timbre depend in similar ways on
the structure of the sound (formant frequency and spectrum envelope.

**HOW BRAIN PROCESSES VISUAL INFORMATION**

An understanding of the neurobiological factors at work requires some familiarity with how the brain processes visual information. "Human sensory systems mediate four attributes of a stimulus that can be correlated quantitatively with a sensation: Modality, intensity, duration and location. "The attributes of intensity, duration and location apply to all five sensory modalities: vision, hearing, touch, taste and smell. Each of these sensory modalities has sub modalities, which in the case of vision include color whilst in hearing they include pitch. Our perception of light arrives to the brain via a series of Photo-receptive rods and cones in the eye. Audition on the other hand uses information gathered by mechano-receptive hair cells in the ear that measure vibrations in air pressure. The nature of the differences between the five modalities is suggested by the disparate nature of these sensory receptors. Whilst both photo-receptors and mechano-receptors measure intensity, location and duration, they both also measure a property of frequency. After light reflected from a scene hits the cones (color receptors) in the eye, neural signals from the retina travel to area 17, in the occipital lobe at the back of the brain. There the image is processed further within local clusters, or blobs, into such simple attributes as color, motion, form, and depth. Afterward, information about these separate features is sent forward and distributed to several far-flung regions in the temporal and parietal lobes. In the case of color, the information goes to area V4 in the fusiform gyrus of the temporal lobe. From there it travels to areas that lie farther up in the hierarchy of color centers, including a region near a patch of cortex called the TPO (for the junction of the temporal, parietal and occipital lobes.) These higher areas may be concerned with more sophisticated aspects of color processing. For example, leaves look as green at dusk as they do at midday, even though the mix of wavelengths reflected from the leaves is very different.

**WHY DOES IT HAPPEN?**

Because the hearing center in the temporal lobes is close to the higher brain area that receives color signals from V4 colored-hearing synesthesia happens by cross wiring between V4 and the hearing area (both within the fusiform gyrus) or between higher color area (both in te TPO).

Chemical imbalance: The same effect could occur if the wiring-the number of connections between regions-was fine but the balance of chemicals traveling between regions was skewed. For instance, neighboring brain regions often inhibit one another’s activity, which serves to minimize cross talk. Cross activation could, in theory, also occur between widely separated areas, which would account for some of the less common forms of synesthesia. Similarly, in some lower forms, the visual appearance of a letter might generate color, whereas in higher forms it is the sound, or phoneme, summoned by that letter; phonemes are represented near the TPO.

Generic component: Perhaps a mutation causes connections to emerge between brain areas that are usually segregated. Or maybe the mutation leads to defective pruning of preexisting connections between areas that are normally connected only sparsely. If the mutation were to be expressed (that is, to exert its effects) in some brain areas but not others, this patchiness might explain why some synesthetes confine colors and numbers whereas others see colors when they hear phonemes or musical notes. People who have one type of synesthesia are more likely to have another, which adds weight to this idea.

Our insights into the neurological basis of synesthesia could help explain some of the creativity of painters, poets and novelists. According to one study, the condition is seven times as common in creative people as in the general population. One skill that many creative people share is a facility for using metaphor. Their brains are set up to make links between seemingly unrelated domains. Just as chromaesthesia involves making arbitrary links between seemingly
unrelated perceptual entities such as colors and sound, metaphor involves making links between seemingly unrelated conceptual realms.

In addition to clarify why artists might be prone to experiencing chromaesthesia, is that this trait may have set the stage for the evolution of abstraction-an ability at which humans excel. The TPO (and the angular gyrus within it), which plays a part in the condition, is normally involved in cross modal synthesis. It is the brain region where information from touch, hearing and vision is thought to flow together to enable the construction of high-level perceptions.

ART AND CHROMAETESIA

Traditionally, the arts have been separated into disciplines delimited by medium and other criterion. Painting and music for example are delimited by, amongst other things, the different senses by which they are perceived - we hear music and see painting. One of the great dreams of the romantic tradition has been that works particular to each artistic discipline might be meaningfully represented in another artistic discipline. One of the great challenges to the inter-disciplinary translation of artworks has been the development of a system of mapping perceptual attributes between each of the five human senses. By mid-nineteenth century chromaesthesia had intrigued an art movement that sought sensory fusion, and a union of the senses appeared more and more frequently as an idea. Multimodal concerts of music and light (son et lumiere), sometimes including odor, were popular and often featured color organs, keyboards that controlled colored lights as well as musical notes. Whilst mapping between sculpture and painting may be achieved in a very literal way, mapping between music and painting has always presented itself as more of a challenge.

Chromaesthesia may be considered as interactions in polysensory system. It should be emphasized that not only external exteroreceptive sensations, such as hearing, sight, etc., but internal interoreceptive sensations are at work. Interoreceptive sensations cause internal state changes in physical organs resulting in how one feels himself. In addition, relational proprioceptive sensations impact the location of the body in space, as in the case of vestibular and weight perception.

In chromaesthesia, higher cognitive processes participate, even if they may operate at a subconscious level. This is a form of non-verbal thinking, as is visual and musical thinking. Audio-visual synaesthesia forms relationships between visual and musical thinking.

Chromaesthesia is an essential characteristic of artistic thinking promoting the realization of mediating compensation for the incompleteness of sensuality, itself. The relative indifference of an artistic image to specific limited nature of its form and the universality of artistic phenomenon can be explained through a chromaesthetic analysis. Concurrently, all art operates in a chromaesthetic complex, those inherent to its particular form and a chromaesthetic fund of a common artistic space-time. Some of the most common relationships between the audible and visible worlds in art are:

Dynamics in music - Dynamics of gesture, both its movement in space and changing in brightness
Melodic development - Character and dynamics of drawing
Music tempo - Speed of movement and transformation of visual images
Music rhythm and meter - Spatial and temporal accents in the visual arts
Timbre development - Color development
Tonality change - Development of coloring of the whole picture or color plane
Mode changing (minor and major shifts) - Lightening or darkening
Analogies between melody and mechanical motion are tied to the audio-proprioceptive synesthesias. These analogies may be quite interesting - for instance, theories on the "kinetic energy" of sound, by E.Kurt; on "sound body" and "sounding matter," by B.Asafiev; and, especially, on "audio space," by G.Revesh, A.Weliek and E.Nazaikinsky. Audio space may even have its own coordinates: depth (texture), vertical (melodies), horizontal (architectonics of music pieces as a whole).

Hypothetical synesthetic analogy-between perception of terrestrial gravity and modal gravity in music (suggested as far back as the 1920s by B.L. Yavorsky) can help to deepen comprehension of the nature of the audio space in which the sound body moves. The analogy has remained a hypothesis until now because its proof has been impossible for traditional musicologists and psycho-physiologists, who have separately tried to determine its validity. It can be recalled that modal organization is the most specific characteristic of music, sharply distinguishing it from the other arts. Modal organization in music, along with humans' psychological ability to react to sound independently, is responsible for the phenomenon of melody - combining sequences of single sounds into integral sound configurations, which act in the perceived audio space. Let us compare such peculiarities of hearing with human vestibular apparatus functions that give information about a person's position and motion in space in response to Earth's gravitational field and acceleration.

Yavorsky believes that regular shifting between various forms of balance (stability) and imbalance (instability) in music is the key to understanding the psychophysiological bases of different constructions in art. It is well known that gravity shows its worth in all kinds of art - in painting and in architecture (compositional balance), in choreography (with its art-linguistic structures built by a continual fight against gravity in general).

In music, analogously, the propensity of imbalance to resolve into balance has basic significance in musical dynamics, namely for "mode building," where modes are thought by Yavorsky to be a sum total of gravitational pulls on the unbalanced sounds, resolving them into balanced ones. Modal rhythm characterizes the process of modal development unfolding in time. Timbre and dynamics emphasize and accentuate the bounds of gravity, and tempo emphasizes the rate of change of these bounds, according to Yavorsky.

Every musician has his own semantics of tonalities, his own emotion-notional and symbolic evaluation of them, that is being formed in the course of upbringing and creation. It can't be the same and single for all people, as it was supposed in 18 c. by the exponents of the so-called "theory of affects" (or, more widely, "the normative aesthetics"). The tonality semantics depends on age, on art school, on style in which the musician works, in brief, on history and art context and also on his personal creative preferences. So, differences are inevitable, but it does not mean that there is a realm of absolute chaos. Composer R.Schumann noted it very expressly in his well-known work titled "The Characteristics of Tonalities" : "We can't say that this or that feeling, if it has to be fully expressed, calls for translation into music by means of namely this and not any other tonality", - he wrote. But we also can't agree with those who "asserts that in every tonality everything can be expressed", - considers Schumann. And, correspondingly, particular semantics of colors can be formed in every cultivated individual. And it is natural to expect that "similar to one another" (as Sabaneiev said) colors and tonalities can connect in conscience of an interested individual into association.

The Russian composer Alexander Scriabin(1872-1915) who was interested in the psychological effects of the simultaneous experience of color and sound started at a more complex level of synesthetic experiences. He started from a system of color-key correspondences instead of color-tone correspondences. He investigated the emotional aspects of synesthetic experiences of color during the change of one musical key to another.

He characterized the colors: his red is a "color of Abaddon", blue and violet - colors of "reason", "spiritual" colors. Therefore, their juxtapositions are quite matter-of-course: C-dur, F-dur - are red and Fis-dur - deep blue. For Scriabin just these associations were the most evident and vivid. In the Scriabin Museum's archives a list without date and title has remained, but it is filled by his own hand and there - several different versions of correlations between various notes and colors are written. We can see that the composer builds up a conception. It is hard to judge - to what, concretely, it applies, but the connection of this list with "colored hearing" or the "Luce" part is obvious. And the main point here is that also Sabaneiev specially records in his reminiscences about Scriabin - the mental, conscious character of his correlations. The composer did not want to believe that his associations were not compulsory for everyone. He believed that they were universal. "It can't be personal, - said Scriabin firmly. - There must be a principle, must be oneness. Game of chances - is ripple on the surface, and the essential must be common". In searching for the common Scriabin builds up a system of color-tonal analogies: "The three clear to me colors gave me three bearings", - said he, confessing that the rest colors are derived by him "theoretically". In his natural aim to put in a system all associations he juxtaposed the "allied colors" (arranged in spectrum) and the "allied tonalities" (as it is known, this alliance is obvious when they are arranged into the so-called "circle of fifths"). "Having taken cognizance of this consistency, - Sabaneiev writes, - Scriabin found the dropped out links of the scale of color-sound
accordance and had to come to the inner agreement that he was right in his theoretical premise. In other words, he began to search in the depth of his apprehension those associations that derived from his theory, and made sure that it is not difficult to call them in”.

According to Scriabin the presentation of the right color corresponding with music works as “a powerful psychological resonator for the listener”. Invited by the experimental psychologist Myers, Scriabin presented his ideas in London. Scriabin explained to Myers that whenever the tonality of a musical piece changes, the color will change too: “color underlines the tonality; it makes the tonality more evident”. Sometimes he perceived a change in color sooner than the change in key. The addition of color to music would intensify both the auditory and visual effect simultaneously, according to Scriabin.

ALEXSANDER Scriabin’s system of colored musical keys:

Vasilly Kandinsky (1866-1944) had perhaps the deepest sympathy for sensory fusion, both synesthetic and as an artistic idea. He explored harmonious relationship between sound and color and used musical terms to describe his paintings, calling them “compositions” and “improvisations.” His own 1912 opera, Der Gelbe Klang (“The Yellow Sound”), specified a compound mixture of color, light, dance, and sound typical of the Gesamtkunstwerk. Kandisky yearned to push aside analytic explanations and move himself and his audience closer to the quality of direct experience that synesthesia typifies. There is an important clue in his famous dictum “stop thinking” that relates to one of synesthesia’s implications in reversing the roles of reason and emotion. Kandisky grasped that creativity is an experience, not an abstract idea, and that a mind that incessantly analyzes what is there impedes that experience.

Color Theory according to Wassily Kandinsky: “Concerning the Spiritual in Art”

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Musical Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>yellow</td>
<td>“warm,” “cheeky and exciting,” “disturbing for people,” “typical earthly color,” “compared with the mood of a person it could have the effect of representing madness in color […] an attack of rage, blind madness, maniacal rage.”</td>
<td>loud, sharp trumpets, high fanfares</td>
</tr>
<tr>
<td>blue</td>
<td>deep, inner, supernatural, peaceful “Sinking towards black, it has the overtone of a mourning that is not human.” “typical heavenly color”</td>
<td>light blue: flute darker blue: cello darkest blue of all: organ</td>
</tr>
<tr>
<td>green</td>
<td>mixture of yellow and blue stillness, peace, but with hidden strength, passive “Green is like a fat, very healthy cow lying still and unmoving, only capable of chewing the cud, regarding the world with stupid dull eyes.”</td>
<td>quiet, drawn-out, middle position violin</td>
</tr>
<tr>
<td>white</td>
<td>“It is not a dead silence, but one pregnant with possibilities.”</td>
<td>“Harmony of silence”, “pause that breaks temporarily the melody”</td>
</tr>
<tr>
<td>black</td>
<td>“Not without possibilities […] like an eternal silence, without future and hope.” Extinguished, immovable</td>
<td>“final pause, after which any continuation of the melody seems the dawn of another world”</td>
</tr>
<tr>
<td>gray</td>
<td>mixture of white and black “immovability which is hopeless”</td>
<td>soundless</td>
</tr>
<tr>
<td>red</td>
<td>alive, restless, confidently striving towards a goal, glowing, “manly maturity” Light warm red: strength, energy, joy; vermilion: glowing passion, sure strength Light cold red: youthful, pure joy, young</td>
<td>“sound of a trumpet, strong, harsh” Fanfare, Tuba deep notes on the cello high, clear violin</td>
</tr>
<tr>
<td>brown</td>
<td>mixture of red + black dull, hard, inhibited</td>
<td></td>
</tr>
<tr>
<td>orange</td>
<td>mixture of red + yellow radiant, healthy, serious</td>
<td>middle range church bell, alto voice, “an alto violin, singing tone, largo”</td>
</tr>
<tr>
<td>violet</td>
<td>mixture of red + blue “morbid, extinguished […] sad”</td>
<td>English horn, shawm, bassoon</td>
</tr>
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</table>
Amy Beach (1867-1944). American pianist and composer. Amy's association of certain colors with certain keys. For instance, Amy might ask her mother to play the 'purple music' or the 'green music.' The most popular story, however, seems to be the one about Amy's going on a trip to California and notating on staff paper the exact pitches of bird calls she heard. Amy's mother encouraged her to relate melodies to the colors blue, pink, or purple, but before long Amy had a wider range of colors, which she associated with certain major keys. Thus C was white, F-sharp black, E yellow, G red, A green, A-flat blue, D-flat violet or purple, and E-flat pink. Until the end of her life she associated these colors with those keys.

Day, Sean A fairly unknown composer, who has written few works in his spare, hobby time. Sean Day synesthetically "sees" colors corresponding to musical timbres; each instrument has its specific color. Click HERE to hear one of his compositions, Absence, a duet for flute and cello. For Sean Day, are synesthetically flashes, cellos are dark cherry wood with green flecks. Below is the painting by listening to this beautiful melody.

Drummer Elvin Jones said playing with Coltrane was like "a young boy going to the circus and stopping at the stand selling cotton candy and ice cream cones." He was still playing with scarcely diminished enthusiasm when he died Tuesday at the age of 76. Jones played with dynamic power, often setting rhythm upon rhythm, pushing and pulling the music along in an interaction with other musicians that some have called a circle of sound. His drumming was constantly active, a sort of continuous solo without losing rhythmic clarity, adding punctuations and annotations and a flow of inspiration to both solos and ensemble playing. "I can see forms and shapes in my mind when I solo, just as a painter can see forms and shapes when he starts a painting," he told Whitney Balliett, the New Yorker writer. "And I can see different colors. My cymbals will be one color and my snare another color and my tom-toms each a different color. I mix these colors up, making constant movement. "Drums suggest movement," he said, "a conscious, constant shifting of sounds and levels of sound. My drumming can shade from a whisper to a thunder. I'm not conscious of the length of my solos, which I've been told have run up to half an hour. When you develop a certain pattern, you stay with it until it's finished."

"Musical graphics," method which involves methods of painting and drawing music (generally resulting in abstract visual compositions) was first used for educational and psychological purposes by O. Rainer who published the results of his experiments in his book "Musikalische Graphik". After he died in 1941, his work was continued by G. Zundeman and B. Ernst. In 1962, musical graphics was introduced into the curriculum of the Vienna Academy of Music and Fine Art, out of which developed the Musical Graphics Institute, where a special museum dedicated to the best works was established. The experience of the institute proves the effectiveness of drawing music in pedagogical and psychological research involving audio-visual associations.

The methods of musical graphics have followers all over the world. The experiments by I. Vanechkina, I. Trofimova in Soviet Union pursued two types of objectives: scientific (studying the psychological regularities of color-hearing synesthesia) and pedagogical (testing the efficiency of the method in education). The scientific objective necessitated investigating the way music is reflected in drawings - from distinct musical aspects such as melody, harmony, mode, timbre, tempo, texture and dynamics to a more general impression of program music and non-program music in different styles and characters.

The music drawing itself was done by experimental and control groups of pupils. In the control group, traditional music classes, without drawing, were held. In the experimental group, the same musical works were studied but with the application of the method of musical graphics. The children had a preliminary acquaintance with the general
aspects of music such as melody, harmony, tempo, etc. and aspects of painting such as drawing, coloring, composition, etc. The children were asked to listen intently to a piece of music, then they participated actively in an analysis of its structure and content. Only after that did the children begin to draw.

Musical graphics by a 17-year-old schoolgirl: music by A.Scriabin: Dark Flame. The student was asked to listen to the music without knowing the name of the piece. However, she was able to show the essence of this piano piece through both lines and colors.

Olivier Messiaen was a composer who wrote several compositions over the period from 1929 to 1974. He was most interested in using his synesthesia to present a pictorial story to his audience. He tried to write his music in such a way that the colors he visualized would paint a scene that the audience would be able to understand and appreciate. For example, in one piece of music, Messiaen wove together the chords in such a way that to him, he saw a sunrise and a sunset. He used different instrumentation and dynamics to attempt to convey this imagery to the audience. Messiaen used his synesthesia in such a way that he gave his audience a better perspective of the piece of music being performed (Bernard). Psychologists have studied individuals like Messiaen in an effort to figure out what actually occurs in the brain during synesthetic experiences and have tried to relate this to those individuals who do not have synesthesia.

SOURCES

"Musical Graphics" - methods of painting and drawing music (generally resulting in abstract visual compositions). These methods were first used for educational and psychological purposes by O. Rainer, an Austrian, who published the results of his experiments in his book "Musikalische Graphik". In 1926 he established the Musical Graphics Society and published the journal "Archiv der Musikalische Graphik" in Vienna. After he died in 1941, his work was continued by G. Zundeman and B. Emst. In 1962, musical graphics was introduced into the curriculum of the Vienna Academy of Music and Fine Art, out of which developed the Musical Graphics Institute, where a special museum dedicated to the best works was established. The experience of the institute proves the effectiveness of drawing music in pedagogical and psychological research involving audio-visual associations (or concomitant audio and visual perceptions-a form of synesthesia).
The music drawing itself was done by experimental and control groups of pupils. In the control group, traditional music classes, without drawing, were held. In the experimental group, the same musical works were studied but with the application of the method of musical graphics. The children had a preliminary acquaintance with the general aspects of music such as melody, harmony, tempo, etc. and aspects of painting such as drawing, coloring, composition, etc. The children were asked to listen intently to a piece of music, then they participated actively in an analysis of its structure and content. Only after that did the children begin to draw.

http://prometheus.kai.ru/sines_e.htm

**The Music Animation Machine**

"An elegantly clever way to visualize complex music" - Kevin Kelly, *Whole Earth Review*

Stephen Malinowski and his wife Lisa Turetsky have created a page demoing Malinowski's Music Animation Machine, which represents works of music in color as a sequence of moving bars and blocks accompanying the score. In some ways this is analogous to colored hearing synesthesia.

http://www.well.com/user/smalin/mam.html

**Synthetic Synesthesia: Mixing Sound With Color**

An interface is described that uses color and spatial relations to provide an intuitive interface for sound manipulation. A simple geometric shape, called the Geometric Sound Mixer (GSM), is used to mix sounds. Timbre is represented as color within the GSM; the relative loudness of these sound sources is represented visually by the color mixture.

http://citeseer.ist.psu.edu/cachedpage/392436/2

**A program for representing sounds visually**

This is a program for representing music graphically, as a curuscating field of fog, stars and/or glowing lines. It is intended as a visual accompaniment to music. The representation goes beyond conventional frequency analysis displays by combining a fourier analysis with stereo positioning information, making it possible to distinguish individual instruments, vocalists or effects by location, shape and color.

Sound inputs can be obtained from a CD, line input, the ESD sound daemon or via piped-in PCM data.

http://pdo.debian.net/testing/sound/synaesthesia

**Synesthesia - synesthesia**

'Synesthesia's Interactive Dance Club is an unprecedented multi-participant environment in a dance club setting featuring interactive music, lighting and live computer-generated imagery.

http://synesthesia.com/site/mainframe.html


Ramachandran - Synaesthesia—AWindow IntoPerception, Thought and Language

http://psy.ucsd.edu/chip/pdf/Synaesth_JCS.pdf
http://psy.ucsd.edu/chip/pdf/Synaesth_P_Roy_Soc.pdf

SIR ISAAC NEWTON'S COLOUR MUSIC WHEEL. - The colours of the spectrum, as they appeared in "Opticks" of 1704, are shown in sequence from red to violet, as wedges between musical notes. This diagram delineates an idealized musical system, as the metaphorical framework for the newly-discovered pure colours of sunlight.

See: MUSIC FOR MEASURE: On the 300th Anniversary of Newton's "Opticks"

"PIANO KEYBOARD/LAKE", by Frantisek Kupka, 1909. - In one of the very rare examples of major painting directly based on a colour-music code, the Czech artist Frantisek Kupka payed homage to Helmholtz in "Piano Keyboard/Lake". At the bottom of the canvas, a hand is shown playing the A major chord that is basic to Helmholtz's scheme, while the colours themselves are almost exclusively tonal varieties of the Young-Helmholtz primaries, red, green and blue-violet.

http://www.sensequence.de/proj/projen.html#dreamcolor
THE PROBLEM OF SYNAESTHESIA IN THE ARTS - B.Galeyev - The term synaesthesia came into art theory vocabulary over 100 years ago. Now it is quite popular in aesthetics, although there still is no uniform definition of its bounds. Synesthesia is first of all intersensory psychological relationships, as they are displayed in concrete fields: intersensory poetic tropes and stylistic figures colored and spatial images, inspired by music interactions between audio and visual arts
http://prometheus.kai.ru/yavorsk_e.htm#1


For Pianist, Music Unleashes Rainbows of Color - When pianist Laura Rosser performs, she hears more than sounds. She hears colors -- each note has its own associated hue. http://www.npr.org/templates/story/story.php?storyId=4602748

Professional musician distinguishes intervals with her tongue. - Ruth Francis

A Review of Synesthesia: Colored Hearing, Creativity and Research

Artistic and Psychological Experiments with Synesthesia - Crétien van Campen
http://fusionanomaly.net/synaesthesia.html

Characteristics of Sound and Color - Sound and color (light) both have a wavelike character but are very different. They are vastly different in both size and speed. Both color and sound cover a range of wavelengths, but color is not restricted to a single wavelength. The pitch of the note A has a frequency of 440 Hz. If notes were sounded around the A but of slightly smaller or greater frequencies, the result would produce pulses in the sound and an unclear tone. As the size of difference in frequency is increased, the sound would be dissonant and very unpleasant to listen to for an extended period of time. Sound is not continuous in this sense. Color on the other hand is continuous.
http://www.colortheory.org/SoundandColor.htm

SYNESTESIA SOFTWARE MUSIC - Lauri Gröhn - Music generated from pictures in five seconds.
http://www.synestesia.com/

Watch & Listen
http://www.well.com/user/smalin/mam.html

The Music Animation Machine - “An elegantly clever way to visualize complex music ... Others have attempted such. This is the first time I felt I’ve truly seen music.”
http://www.well.com/user/smalin/mam.html

MY PAINTINGS

I am not a chromaethesiatic but certain types of sounds evoke my imagination and take me into world of dancing lines, curves and colors. I certainly don’t see them in front of me but imagine them strongly. It is kind of seeing in mind and feeling inside. Sometimes I become part of the melody and start moving with it and coloring myself through it. Not every piece of music makes me feel passionate to paint it but certain composers such as Pavarotti make me get up and start painting. I often use this skill (Should I call it as skill?) to determine either a piece of music I am listening to is strong, passionate and creative enough to be a great hit or just a melody that will remain as is. I certainly don’t set any rules before I start painting. I place long papers on the floor, mix random colors on my palette, listen to the music once and if it makes me visualize the colors, shapes and the motion of it, I start painting as I listen to it. If someone sets a camera to track my eye movement would probably see my eyes following a path as my arms do when I paint. Most of the time I can not catch up with speed of the sound if it moves so fast so I stop playing the music to go back to where I left to capture the shapes and colors that I desperately seek to paint. After I am done painting, when I look at the art I just created, I experience the same feeling, hear the rhyme and visualize it moving and forming shapes again. When I try painting the same piece several times, I end up using the same colors and shapes and my paintings look just like the first one I painted.
Reading all about chromaesthesia and trying to understand my paintings of sound made me come up with few statements to explain why and how I paint melody:

- My paintings of sound are result of my creative imagination
- It is a personal experience and the method I use is not compulsory
- There are no rules set before and after
- My paintings of sound are combination of my emotions that are evoked by certain sounds and the melody itself that I am listening to
- Sound does not make me to see colors and shapes moving in front of my eyes but in mind
- I am aware of the environment, when I paint sound
- My emotion does not take over reason but cooperate with it
- Same music evokes similar emotions at different times and environments

Below are some of my experiments by listening to Pavarotti – my apologies for the quality of images

CONCLUSION
The current attempts by artists and psychologists to discover formal correspondence schemes of chromaesthesia have a long history of experiments in art and science, and it may be concluded that the phenomenon of chromaesthesia is difficult to control or manipulate. Artistic experiments, have uncovered interesting dynamic and emotional aspects of chromaesthetic perceptions and contributed to the phenomenology of chromaesthesia.

Current psychological studies into chromaesthesia have caught up with the booming brain research and are mainly involved in a search for organic substrates. Current artistic experimentation seems mostly involved with digital devices and a search for algorythms to translate music into images (e.g. visual music, animation). The present situation in artistic chromaesthesia research may be compared to the late nineteenth-century period of experimentation with color-organ technology. After that an era followed of fruitful artistic explorations and scientific testing of the psychological (perceptual and emotional) impact of sound-image devices and performances.