LINKING SOUND AND COLOR SPECTRA

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The rainbow provides a natural model of the color spectrum that human beings identify, reach for, and imitate. Evidence from antiquity and mythology suggests that intuitions based on the rainbow's occurrences existed yesterday as well as today. Likewise, human beings identify, reach for, and imitate the sound spectrum. Evolved and evolving organizations of music and sound show this. We continue to imitate these natural spectra. As a result, our ability to form an image, linking sound and color, becomes more identifiable and within reach

Recently, archeologists, musicologists, and acoustical scientists provided information about Bronze Age China A ruler's tomb contained, among other musical instruments, thousands of pounds of bronze bells. Their tunings resemble the Pythagorean system of ancient Greece. The bells' exhibited a pentatonic leaning. The tones of the scale, specified in fixed-do (i.e., C is do) are: do, re, me, _, sol, la, _, _ (i.e., CDE_GA__)

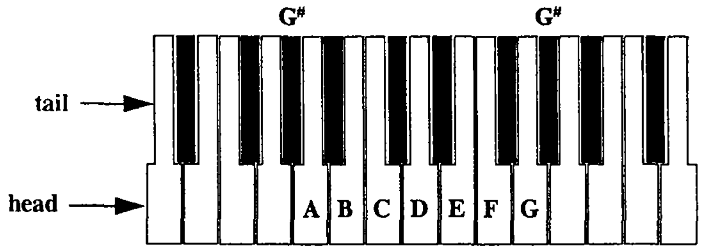
Pythagoras' twelve-pitch (i.e., the chromatic octave), twelve-key system is evident at the conventional piano keyboard. Admittedly discrete, the piano is functionally a relational map. Its surface is aesthetic and kinesthetic but also provides an evolutional view of music and sound organization While this format allows much latitude in sonority, other formations exist.

Students of Western Music, for example, quickly discover the Gregorian Chant of the Middle Ages and its system of modes. Thought to be derived from Ancient Greece, these modes have seven common names: Aeolian, Locrian, Ionian, Dorian, Phrygian, Lydian, and Mixolydian

At the piano keyboard a white key scale typically represents each mode: A to A for Aeolian, B to B for Locrian, C to C for Ionian, D to D for Dorian, etc.

Music pitches have seven common names. Diatonic scales have five wholetones and two semitones in common. Scales build within an octave. Two tetrachords define each mode. The piano keyboard contains two mirror formations. Both are Dorian and decidedly symmetrical. The white key axis of symmetry is D. The black key axis of symmetry is $G^{\#}$.

Dorian Mirror



Geometrically, tail locations specify symmetry. While the D axis is itself unique, G and A are unique reflectors (i.e., without other reflectors or duplicates). All other white keys are reflectors with duplicates (i e., C reflects B and E. C duplicates F.).

Musically, children at the piano often mirror right and left hands. One view of the 'D' Dorian Mirror begins with thumbs on D. Fingers then press keys outward. Ascending right: DEFG (i.e , re, me, fa, sol) builds the first tetrachord. Descending left: DCBA (i.e , re, do, ti, la) builds the second and mirrors the first. Chromatically, the octave occurs at $G^{\#}$.

In alphabetical order A is alpha, G is omega. In chromatic alphabetical order, A^{b} and $G^{\#}$ (i.e., enharmonically equivalent) are alpha and omega. The G, $G^{\#}$, A core formation links the 'D' Dorian tetrachords and appears stable. Colors also have seven common names: VIBGYOR with a red, red-violet, violet core formation that appears stable.

The 'D' Dorian mirror relates diatonic pitch names with color, based on conventional music analysis (i.e., from D outward) and typical computer color modeling. Computers often use the primary colors of light as a basis for color appearance. Given a numeric identity for red, green, and blue, three distinct solid colors and their solid complements: cyan, violet, and yellow appear Remaining colors appear based on or partial to these six solids These affinities relate to music functionality (i e., ti → do). While not fully explored, they appear somewhat consistent. Diatonic mirror wholetones and semitones relate to solid colors and partial colors

At the computer, Dorian mirror keyboard symmetry becomes a chromatic template or map linking pitch names with color. A baseline is present showing a pitch name and color correlation This baseline exhibits three music formations: pentatonic, diatonic, and chromatic.

Baseline Mirror and Affinity Map

256 Color, Sat = 240, Lum. = 120

G# Dorian Scale Pitch Names:	G#		A#	B		C#		D#		E#	F#		G#
G# Dorian Scale Steps:	1		2	3		4		5		6	7		8
Fixed-do Pitch Names:	si		li	ti		di		ri		mi	fi		si
F# Pentatonic Partial Colors:	*		*			*		*			*		*
Common Tritone Partial Colors.				*						*			
Chromatic Partial Color Affinities:	↘		↙	↘		↙		↘		↙	↘		↘
C Pentatonic Solid-Base Colors:		↓			↓		↓		↓			↓	
G# Dorian Scale Partial Colors:	RV		IV	I		GC'		GY		O	OR		RV
Hue Orbit (Multiply by 10):	22	20	18	17	16	10	8	6	4	2	1	0	22
D Dorian Mirror Diatonic Colors:		V		I	B		G		Y	O		R	
C Pentatonic Solid Base Colors:		↑			↑		↑		↑			↑	
Common Tritone Affinities:				↗						↖			
Common Tritone Partial Colors:				*						*			
C Pentatonic Solid-Base Colors:		*			*		*		*			*	
Fixed-do Pitch Names:		la		ti	do		re		me	fa		sol	
D Dorian Mirrored Scale Steps:		5		6	7		1		2	3		4	
D Dorian Mirror Pitch Names:		A		B	C		D		E	F		G	

The 'C' pentatonic formation relates five diatonic tones with five solid colors This resembles the Bronze Age China bells here mirrored: la, _, do, re, me, _, sol (i.e., A_CDE_G). Of the six solid colors, however, cyan appears with green (i.e., green-cyan) as a partial color. Its use is indirect. Also, an unusual gap exists between green-cyan and blue.

The diatonic formation adds two tones (i.e., the B and F common tritone) to the 'C' pentatonic formation. These semitones relate to two partial colors. Interestingly, the common tritone's reputation 'Diabolus in Musica' reflects somewhat in color.

The core formation is the basis for building the chromatic scale that adds the remaining black keys (i.e., $F^{\#}$ pentatonic) and five partial colors. These pitches and colors belong to '$G^{\#}$' Dorian (i.e., the black key axis). The '$G^{\#}$' Dorian scale superimposes the 'D' Dorian mirror. The common tritone (i.e., B and F or $E^{\#}$) is a pivot. It shows a 'C' and '$F^{\#}$' pentatonic shift between corresponding solid and partial colors. This completes the chromatic scale. The core formation values. red $\rightarrow$ G, red-violet $\rightarrow$ $G^{\#}$, violet $\rightarrow$ A show a recurring chromatic cycle.

The Dorian mirror shows a pitch name to color baseline as a basis on which to form an image. Primary color values and corresponding color attribute values: hue, saturation, and luminance proved useful in establishing the baseline. Although both convey the full chromatic baseline cycle, attribute values are more specific and reliable when primary color mixtures appear similar. On the baseline, hue orbits an axis. Saturation and luminance remain constant. Notably, hue and saturation are more typical in other color models. The need for appropriate mathematical and computer models exists. Intuitively, sound and color attributes determine the inferred image. Pitch determines hue. Timbre determines saturation. Luminance remains in question.

This effort invites further research. Ramifications of this work involve other disciplines. An important question concerns imitation. It is acceptable for computers to imitate human beings if we understand the machine's uses and limitations (i.e., sound and color are not discrete).