Supporting Information

Palmer et al. 10.1073/pnas.1212562110

SI Text

In this section, we analyzed the face–color associations for each color appearance dimension. For saturation, the colors were that were chosen as appropriate for neutral/calm faces, and both levels of sad faces were quite desaturated (i.e., grayish) (Fig. 6), perhaps because the pictures themselves were gray-scale. Relative to this baseline, however, colors of increasingly higher saturation were chosen for both happier faces [$F(2,46) = 36.37$, $P < 0.001$] and angrier faces [$F(2,46) = 11.28$, $P < 0.001$], with those for happy faces being more saturated than those for angry faces [$F(1,23) = 14.86$, $P < 0.01$]. For lightness, the colors chosen as appropriate for happy faces were reliably lighter [$F(2,46) = 13.33$, $P < 0.001$] than neutral faces and those for angry faces [$F(2,46) = 35.06$, $P < 0.001$] and very sad faces [$F(2,46) = 17.42$, $P < 0.001$] were reliably darker than neutral, with colors for angry faces being darker than colors for sad faces [$F(1,32) = 21.72$, $P < 0.001$]. For redness/greenness, neutral and sad faces were slightly greenish, with very happy faces being redder than very sad faces [$F(1,23) = 5.66$, $P < 0.05$], and both levels of angry faces being reliably redder (or less greenish) than the sad faces [$F(1,23) = 55.39$, $P < 0.001$]. For yellowness/blueness, neutral, angry, and slightly sad faces were associated with slightly bluish colors, very sad faces being more strongly associated with bluish colors than very angry faces [$F(1,23) = 13.33$, $P < 0.001$] and both levels of happy faces were reliably associated with yellower colors than angry faces [$F(1,23) = 20.00$, $P < 0.001$].

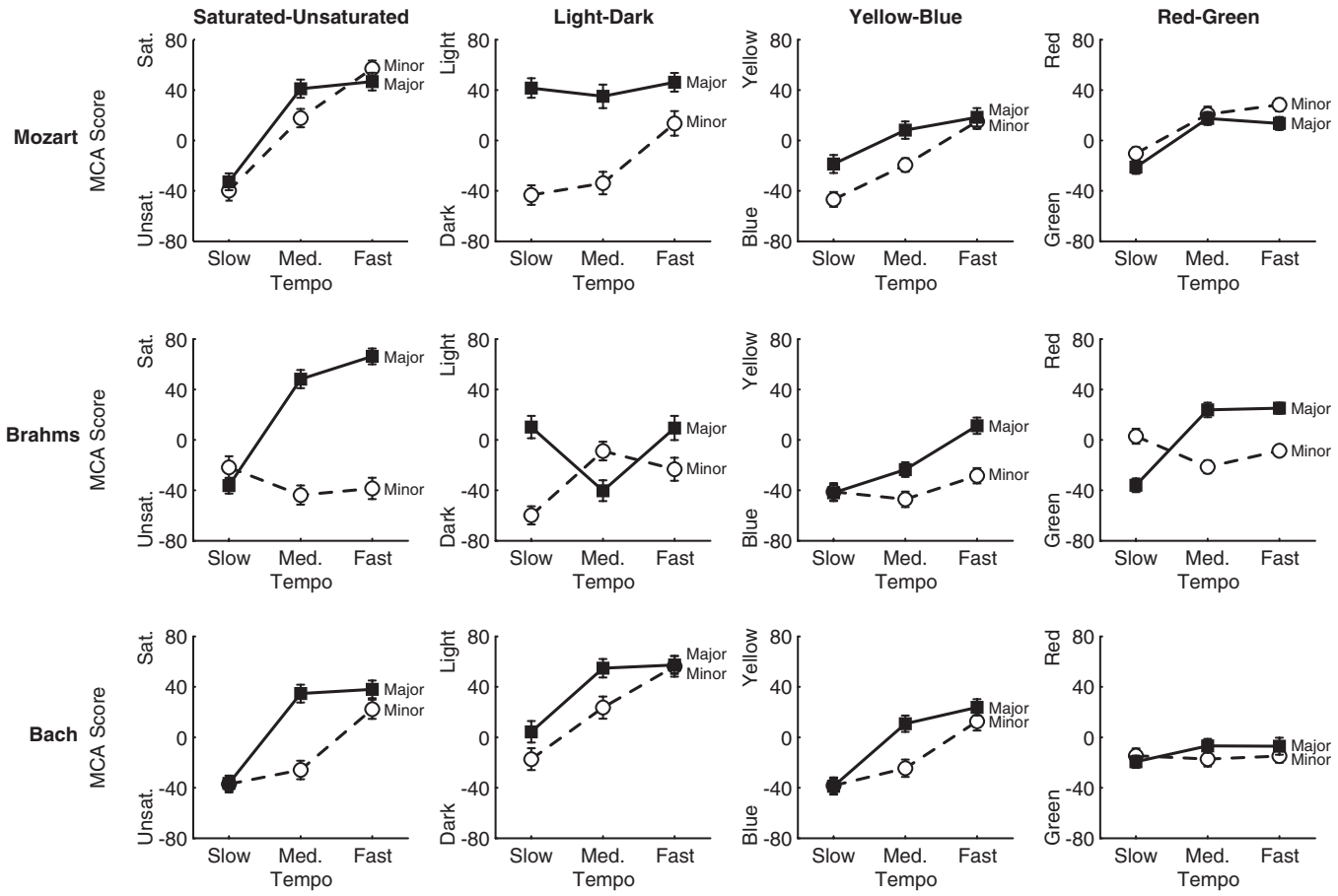

Fig. S1. Dimensional color associations for music composed by Mozart, Brahms, and Bach at slow/medium/fast tempi and in major/minor mode. The colors chosen as most/least consistent with the music for the saturation, lightness, yellowness/blueness, and redness/greenness dimensions were computed using the music–color association index (MCA) defined by Eqs. **1**–**3**. (Error bars represent SEMs.)

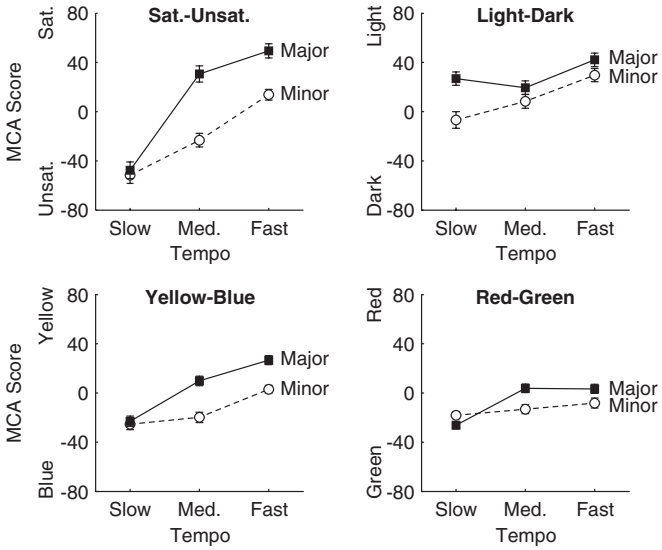

Fig. S2. Mexican participants' dimensional color associations for music at slow/medium/fast tempi and in major/minor mode for the saturation, lightness, yellowness/blueness, and redness/greenness of colors chosen as most/least consistent with the music, as computed using the MCA defined by Eqs. **1–3**. (Error bars represent SEMs.)

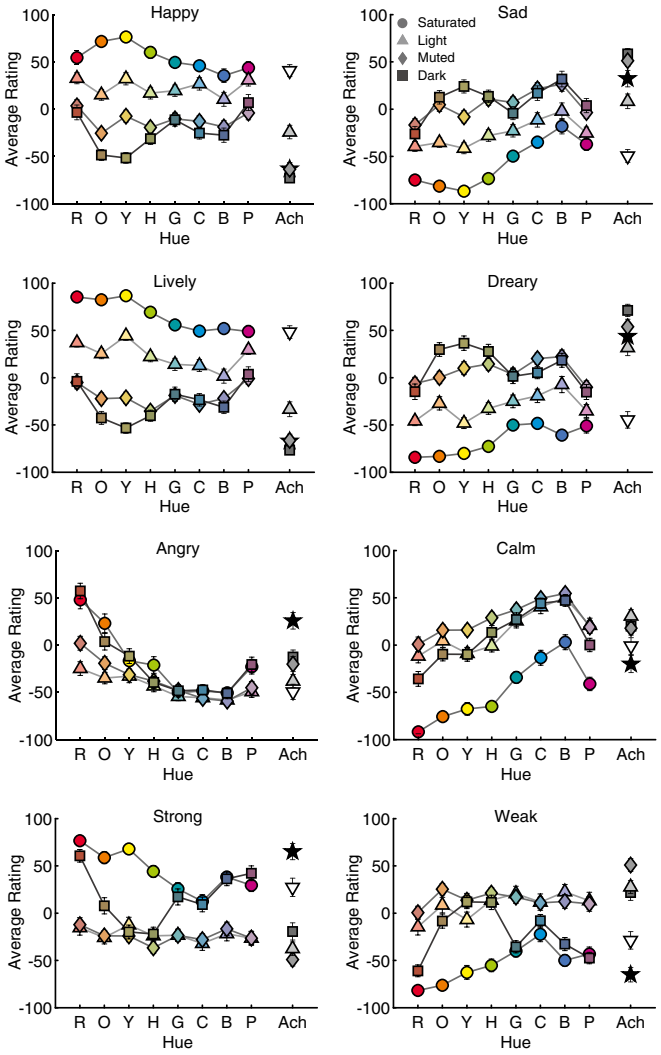

Fig. S3. Color–emotion associations (experiment 1) for the 32 chromatic colors as a function of hue (*x* axis) for the saturated (circles), light (triangles), muted (diamonds), and dark (squares) cuts. The points above the "Ach" tick on the *x* axis are for the achromatic colors: white (downward triangles), A3 (upward triangles), A2 (diamonds), A1 (squares), and black (stars). A separate hue (8 hues) by cut (4 cuts) ANOVA was conducted for each emotion. For all emotions (happy, sad, lively, dreary, angry, calm, strong, and weak), there were main effects of hue [$F(7,329) = 4.72, 15.80, 10.26, 7.74, 48.13, 49.43, 14.93, 12.07$, $P < 0.001$), cut $F(3,141) = 113.16, 91.99, 182.78, 93.62, 15.19, 79.01, 60.42, 61.36$, $P < 0.001$], and hue x cut interactions [$F(21, 987) = 8.99, 6.84, 10.78, 8.77, 7.98, 3.11, 12.08, 8.95$, $P < 0.001$], respectively. Happier and livelier (less sad and dreary) colors are lighter and more saturated. They are also yellower, but yellowness is confounded with lightness. Angrier colors are redder, darker, and more saturated, whereas calmer colors are bluer and less saturated. Stronger (less weak) colors are warmer, darker, and more saturated. (Error bars represent SEMs.). Letters across the *x* axis represent the following: R, red; O, orange; Y, yellow; H, chartreuse; G, green; C, cyan; B, blue; P, purple; Ach, achromatic.

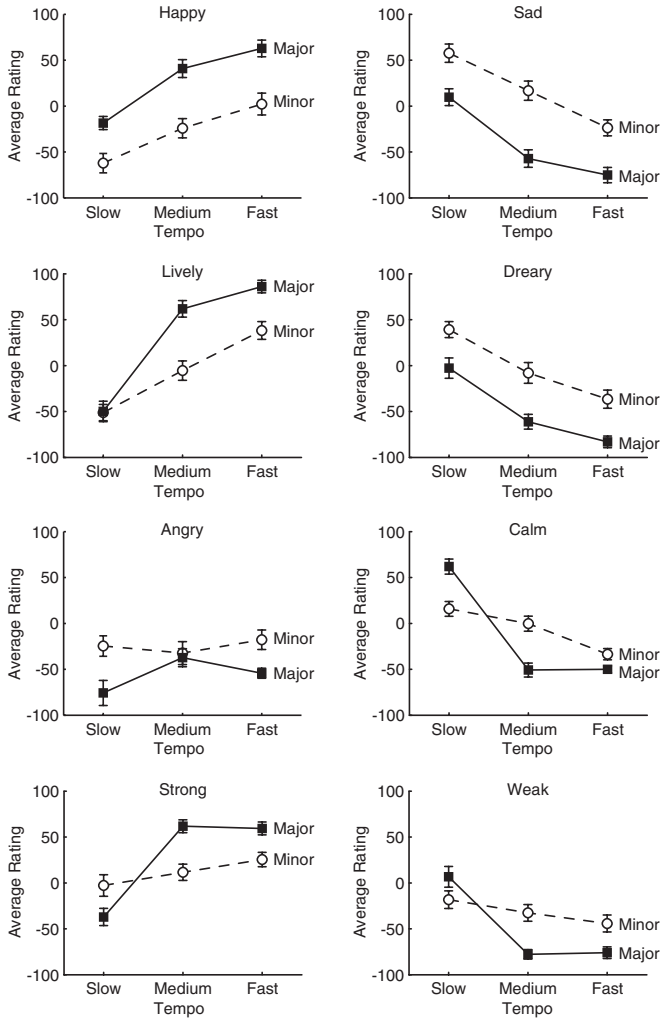

Fig. S4. Music–Emotion Associations (experiment 1) as a function of tempo (*x* axis) for music in the major (filled symbols) and minor (open symbols) modes. Music that was major was happier, less sad, livelier, and less dreary, [$F(1,47) = 159.66, 201.32, 186.35, 140.32$, $P < 0.001$] and the same was true of music that was faster [$F(2,94) = 195.76, 241.19, 526.61, 146.28$, $P < 0.001$] respectively. The major vs. minor differences increased as tempo increased for happy, sad, and lively [$F(2,94) = 6.91, 11.77, 86.93$, $P < 0.01, 0.001, 0.001$, respectively], but not for dreary [$F(2,94) = 1.27$, $P = 0.29$). Music that was minor [$F(1,47) = 76.18$, $P < 0.001$] and faster [$F(2,94) = 9.23$, $P < 0.001$] was angrier but there was an interaction such that difference in mode was only present for the slow and fast selections [$F(2,94) = 27.2$, $P < 0.001$]. Slower music was calmer, weaker and less strong [$F(2,94) = 214.05, 92.3, 28.31$, $P < 0.001$, respectively] and there was a mode by tempo interaction due to major music being rated as calmer, weaker, and less strong at the slow tempo and minor music being calmer at faster tempos [$F(2,94) = 104.77, 7.63, 10.09$ $P < 0.001$, respectively].

Table S1. International Commission on Illumination (CIE) 1931 xyY values and Munsell values for the 32 chromatic colors and CIE 1931 xyY values for the five achromatic colors (CIE Illuminant C)

Hue	Cut	CIE 1931 x	CIE 1931 y	CIE 1931 Y	Hue	Value/chroma
Red	Saturated	0.549	0.313	22.93	5 R	5/15
	Light	0.407	0.326	49.95	5 R	7/8
	Muted	0.441	0.324	22.93	5 R	5/8
	Dark	0.506	0.311	7.60	5 R	3/8
Orange	Saturated	0.513	0.412	49.95	5 YR	7/13
	Light	0.399	0.366	68.56	5 YR	8/6
	Muted	0.423	0.375	34.86	5 YR	6/6
	Dark	0.481	0.388	10.76	5 YR	3.5/6
Yellow	Saturated	0.446	0.472	91.25	5 Y	9/12
	Light	0.391	0.413	91.25	5 Y	9/6.5
	Muted	0.407	0.426	49.95	5 Y	7/6.5
	Dark	0.437	0.450	18.43	5 Y	5/6.5
Chartreuse	Saturated	0.387	0.504	68.56	5 GY	8/11
	Light	0.357	0.420	79.90	5 GY	8.5/6
	Muted	0.360	0.436	42.40	5 GY	6.5/6
	Dark	0.369	0.473	18.43	5 GY	4.5/6
Green	Saturated	0.254	0.449	42.40	3.75 G	6.5/11.5
	Light	0.288	0.381	63.90	3.75 G	7.75/6.25
	Muted	0.281	0.392	34.86	3.75 G	6/6.25
	Dark	0.261	0.419	12.34	3.75 G	3.75/6.25
Cyan	Saturated	0.226	0.335	49.95	5 BG	7/9
	Light	0.267	0.330	68.56	5 BG	8/5
	Muted	0.254	0.328	34.86	5 BG	6/5
	Dark	0.233	0.324	13.92	5 BG	4/5
Blue	Saturated	0.200	0.230	34.86	10 B	6/10
	Light	0.255	0.278	59.25	10 B	7.5/5.5
	Muted	0.241	0.265	28.90	10 B	5.5/5.5
	Dark	0.212	0.236	10.76	10 B	3.5/5.5
Purple	Saturated	0.272	0.156	18.43	5 P	4.5/17
	Light	0.290	0.242	49.95	5 P	7/9
	Muted	0.287	0.222	22.93	5 P	5/9
	Dark	0.280	0.181	7.60	5 P	3/9
Achromatic	Black	0.310	0.316	0.30		
	Dark gray	0.310	0.316	12.34		
	Med Gray	0.310	0.316	31.88		
	Light Gray	0.310	0.316	63.90		
	White	0.310	0.316	116.00		

Table adapted from Schloss et al. (1).

1. Schloss KB, Poggesi RM, Palmer SE (2011) Effects of university affiliation and "school spirit" on color preferences: Berkeley versus Stanford. *Psychon Bull Rev* 18(3):498–504.

Table S2. Musical selections from experiments 1 and 3

Composer/mode/tempo	Selection
Bach major fast	Brandenburg Concerto no. 2 in F major, BWV 1047, Allegro assai
Bach major medium	Brandenburg Concerto no. 3 in G major, BWV 1048, Ohne Satzbezeichnung
Bach major slow	Brandenburg Concerto no. 6 in B flat major, BWV 1051, Adagio ma non tanto
Bach minor fast	Orchestral Suite no. 2 in B minor, BWV 1067, Badinerie
Bach minor medium	Orchestral Suite no. 2 in B minor, BWV 1067, Rondeau
Bach minor slow	Brandenburg Concerto no. 2 in F major, BWV 1047, Andante
Brahms major fast	Symphony no. 4 in E minor, Opus 98, Allegro giocoso
Brahms major medium	Symphony no. 3 in F major, Opus 90, Allegro con brio
Brahms major slow	Symphony no. 2 in D major, Opus 73, Allegro non troppo
Brahms minor fast	Symphony no. 3 in F major, Opus 90, Allegro
Brahms minor medium	Symphony no. 3 in F major, Opus 90, Poco allegretto
Brahms minor slow	Symphony no. 1 in C minor, Opus 68, Adagio
Mozart major fast	Symphony no. 39 in E flat major, K 543, Finale allegro
Mozart major medium	Symphony no. 39 in E flat major, K 543, Menuetto allegro
Mozart major slow	Symphony no. 39 in E flat major, K 543, Andante
Mozart minor fast	Symphony no. 40 in G minor, KV 550, Allegro assai
Mozart minor medium	Symphony no. 40 in G minor, KV 550, Menuetto allegro
Mozart minor slow	Sinfonia Concertante for Violin, Viola, and Orchestra in E flat major, K364, Andante