

TABLE 1
Information about musical intervals and their expressiveness.

<i>Interval name</i>	<i>Sample notes</i>	<i>Theoretical status</i>	<i>Expressive function according to Cooke (1959, pp. 89-90)</i>	<i>Expressive function according to other authors*</i>
minor second	C-C,	dissonance	Semitonal tension down to the tonic, in a minor context: spiritless anguish, context of finality	Dissonant, painful, uptight, afflicted, discouraged, humiliated
major second	CD	dissonance	As a passing note, emotionally neutral. As a whole-tone tension down to the tonic, in a major context, pleasurable longing, context of finality	Dissonant, in suspense, tormented, sad, uptight, eager, pleasant
minor third	C-E _b	imperfect consonance	Concord, but a "depression" of natural third: stoic acceptance, tragedy	Painful, severe, languid, sweet, melancholy, frank, still, submitted
major third	C-E	imperfect consonance	Concord, natural third: joy	Sonorous, joyous, furious, strong, cheerful, pleasant, happy, right, pure, quiet, stable, shining
perfect fourth	C-F	perfect consonance	As a passing note, emotionally neutral. As a semitonal tension down to the minor third, pathos	Lugubrious, active, tense
augmented fourth	C-F _#	dissonance	As modulating note to the dominant key, active aspiration. As "augmented fourth", pure and simple, devilish and inimical forces	Hostile, averse, destructive, mysterious
perfect fifth	C-G	perfect consonance	Emotionally neutral; context of flux, intermediacy	Consonant, pleasurable, stimulating, gentle, acrimonious, healthy, agreeable
minor sixth	C-G _b	imperfect consonance	Semitonal tension down to the dominant, in a minor context: active anguish in a context of flux	Pleasant, consonant, painful, discontented, strained, distressing, active, unstable
major sixth	C-A	imperfect consonance	As a passing note, emotionally neutral. As a whole-tone tension down to the dominant, in major context, pleasurable longing in a context of flux	Pleasant, consonant, unstable, sweet, desirous, bright, tense
minor seventh	C-B _b	dissonance	Semitonal tension down to major sixth, or whole-tone tension down to minor sixth, both unsatisfactory, resolving again down to the dominant: "lost" note, mournfulness	Dissonant, sad, painful, empty, melancholy, severe, strained, bewildered, lugubrious, unsatisfied
major seventh	C-B	dissonance	As a passing note, emotionally neutral. As a semitonal tension up to the tonic, violent longing, aspiration in a context of finality	Dissonant, tense, bitter, disagreeable, gloomy, optimist
octave	C-c	perfect consonance		Consonant, easy, solemn, majestic, strong, severe, full, stable, energetic

*Castiglioni (1959), Galilei (1638), Gervasoni (1800), Giannelli (1801), Rousseau (1782), Steiner (1975), Tartini (1754).

TABLE 2

The expressive values of the intervals according to Willems (1977).

<i>Interval</i>	<i>Sensorial</i>	<i>Affective</i>	<i>Intellective</i>
Unisonous	fusion, smoothness	will, peace	insistence, serenity
Minor second	derangement, roughness	fear, anger	shyness, illness
Major second	movement, friction	wish, vulgarity	request, displeasure
Minor third	heaviness, shadow	sadness, pain	lament, discouragement
Major third	clearness, limpid	joy, happiness	hope, balance
Perfect fourth	hardness, cold	firmness, indifference	achievement, simplicity
Augmented fourth	fracture, heat	disdain, excitement	pretension, surprise
Diminished fifth	excitement, instability	restlessness, anxiety	doubt, uncertainty
Perfect fifth	balance, emptiness	love, calm	certainty, mastery
Minor sixth	upsetting, penumbra	suffer, melancholy	worry, pity
Major sixth	radiant, light	effusiveness, kindness	satisfaction, gratification
Minor seventh	dynamic, warmth	exaltation, love	lyricism, romanticism
Major seventh	limitation, wound	wickedness, hate	pride, rebellion
Octave	solid, stable	courage, exaltation	heroism, liberation

Phase relations between component tones were left to chance. The duration and pause of each stimulus interval were, respectively, 6 and 3 s, repeated up to a total duration of 2' 30", a timing considered to be appropriate for filling out the semantic differential. Stimuli were repeated in order to eliminate interference due to memory sound processes.

Because pure-sine waves are usually felt as strange and unfamiliar, a digital version of the sound of a cathedral organ (MIDI sound: 20/127) was used. The reproduction was well sampled and had plenty of harmonics so that its timbre emphasised the harmonic aspects of the bichords. Furthermore, using this timbre, the sounds could be protracted with the same loudness without any decay. The decision to use harmonic musical intervals instead of melodic ones was based on three factors: first, the simultaneity of component sounds underlines the aspect of consonance; second, temporal organisation is always characteristic of melodic intervals and thus melodic presentation could affect expressiveness, for example, a slow succession could be perceived as more quiet, peaceful and sad than a fast one, regardless of the interval; third, a melodic interval always has a direction: either ascending or descending and this can also influence the psychological interpretation of it. All stimuli were presented with headphones at a loudness of 75 dB measured with a Quest electronic type CA-12 sound level meter.

The intervals presentation order was randomised. In Figure 1 an example of presentation of all bichords is shown.

Bi-polar adjective rating scale battery. Thirty scales - with opposite adjectives rated from 1 to 7 - were used for the evaluation of musical interval expressiveness.

TABLE 3
 Fundamental frequencies, frequency differences, and frequency ratios of component tones used in forming musical interval stimuli.

	<i>Musical intervals</i>											
	min2nd	maj2nd	min3rd	maj3rd	per4th	aug4th	per5th	min6th	maj6th	min7th	maj7th	octave
High pitch bichords (Geometric mean frequency = 1510-38 Hz)												
Component tone												
Upper	1396.9	1568	1568	2093	1760	1760	1760	1864.7	1975.5	2093	1975.5	2093
Lower	1318.5	1396.9	1318.5	1760	1318.5	1244.5	1174.7	1174.7	1174.7	1174.7	1046.5	1046.5
Difference	78.4	171.1	249.5	333	441.5	515.5	585.3	690	800.8	918.3	929	1046.5
Low pitch bichords (Geometric mean frequency = 185.13 Hz)												
Component tone												
Upper	174.61	196	196	220	220	220	220	233.08	246.94	261.63	246.94	261.63
Lower	164.81	174.61	164.81	174.61	164.81	155.56	146.83	146.83	146.83	146.83	130.81	130.81
Difference	9.8	21.39	31.19	45.39	55.19	64.44	73.17	86.25	100.11	114.8	116.13	130.82
Frequency ratio	17/16	9/8	6/5	5/4	4/3	7/5	3/2	8/5	5/3	9/5	15/8	2/1

Note: All values, except those for frequency ratios, are expressed in Hz.