3
How to Use the Method for Evaluating and Comparing the Sound of Chords

3.1 The five layers

The sound of each chord illustrated in this book is expressed in Appendix A (The Method for Evaluating and Comparing the Sound of Chords)) in two graph layers and two chart layers. There is one additional name layer. Each of these layers identifies the chord by the performed chordal pitches set out in transpositional twelve-point circular space, and is grouped with the other members of its transpositional set class.

The first graph layer shows the similarity of each chord to the harmonic series. The degree of similarity is expressed as a percentage.

The first chart layer shows the spectral pitches and weights for each chord. The spectral pitches are shown in declining order as reflected in their diminishing weights. If two spectral pitches have the same weight, they should be treated as equivalent even though they are displayed in sequence.

The second graph layer shows the degree of root clarity or ambiguity of each chord. If the chord has a degree of root clarity, it is expressed as a percentage above the horizontal black line which represents 0%. Where the chord lacks root clarity and is ambiguous, the percentage is shown as 0% and the degree of root ambiguity is shown as falling into one of three categories: 2, 3 or 4 or more (4+) equal roots.

The second chart layer shows the root candidates and weights for each chord. The root candidates are shown in declining order as reflected in their diminishing weights. If two root candidates have the same weight, they should be treated as equivalent even though they are displayed in sequence.

The final layer in this method contains various names for chords. In some cases, the pitches in a chord may also be used as a scale. If so, the name of the scale may also be given. A geographic identifier may also be provided for specific names.

In every transpositional set class that does not have two or more ambiguous roots, the use of "first inversion" in a name is restricted to the first counter-clockwise rotation of the root position chord.

3.2 Evaluating and comparing the sound of chords

The degree of similarity of a chord to the harmonic series (hsim) appears to be closely related to the concepts of consonance and dissonance. Bowling and Purves have concluded that:

> In light of present evidence, the most plausible explanation for consonance and related tonal phenomenology is an evolved attraction to the harmonic series that characterize conspecific vocalizations, based on the biological importance of social sound signals. If correct, this explanation of consonance would rationalize at least some aspects of musical aesthetics. [26]

A high degree of harmonic similarity appears to be comparable to a high degree of consonance. Likewise, a low degree of harmonic similarity seems to be equivalent to a high degree of dissonance. The algorithm that determines the degree of similarity of a chord to the harmonic series provides a means of evaluating the sound of every possible chord in a manner that is free of cultural bias and the limitations of incomplete experimental data derived from human listeners.

The harmonic similarity of chords can be viewed and compared across all first graph layers in Appendix A. Collectively, if strung end to end, these layers look like the skyline of a large city.

For convenience, Figure 3.1 shows the harmonic similarity of all single pitches, two-pitch chords (intervals) and three-pitch chords (triads and trichords) in declining order. None of these chords has greater similarity to the harmonic series than single pitches.

Harmonic similarity percentages	Chords	Member of transpositional set class
100.00 %	**Single pitches (0)**	**TSC1-1**
66.67 %	Perfect fifths (0-7)	TSC2-5
50.00 %	Perfect fourths (0-5)	TSC2-5
46.67 %	Major sixths (0-9)	TSC2-3
	Minor triads in root position (0-3-7)	TSC3-11A
	Major triads in root position (0-4-7)	TSC3-11B
46.30 %	Add 9 omit 3 trichords (0-2-7)	TSC3-9
	Suspended triads (0-5-7)	
45.74 %	Third inversion dominant seventh sus 4s (0-2-7-9)	TSC4-23
45.56 %	First inversion minor triads (0-4-9)	TSC3-11A
	Second inversion major triads (0-5-9)	TSC3-11B
45.19 %	0-7-9 trichords (0-7-9)	TSC3-7A
	0-2-9 trichords (0-2-9)	TSC3-7B
44.82 %	Minor seventh tetrachords (0-3-7-10)	TSC4-26
44.17 %	Major seventh tetrachords (0-4-7-11)	TSC4-20
43.15 %	Second inversion major triad add sixes (0-2-5-9)	TSC4-26
	Major triad add sixes (0-4-7-9)	
42.96 %	Ute Tritonic scale as trichords (0-3-10)	TSC3-7A
	0-7-10 trichords (0-7-10)	TSC3-7B
	Perfect quartal trichords (0-5-10)	TSC3-9
41.85 %	Perfect quartal tetrachords (0-3-5-10)	TSC4-23
	Dominant seventh suspended fourths (0-5-7-10)	
41.67 %	0-4-11 trichords (0-4-11)	TSC3-4A
	0-7-11 trichords (0-7-11)	TSC3-4B
41.30 %	Third inversion major add 2 tetrachords (0-5-7-9)	TSC4-22A
	Third inversion Mistuned Historical Church Bell 8s (aural) (0-2-4-9)	TSC4-22B
40.74 %	Genus Primum scale as chords (0-2-5-7)	TSC4-23
40.65 %	Second inversion minor add 2 tetrachords (0-4-9-11)	TSC4-14A
	Second inversion major add 4 tetrachords (0-2-7-11)	TSC4-14B
40.05 %	Minor sixth tetrachords (0-3-7-9)	TSC4-27A
	Third inversion dominant seventh chords (0-2-6-9)	TSC4-27B
40.00 %	Major thirds (0-4)	TSC2-4
	Second inversion major seventh tetrachords (0-4-5-9)	TSC4-20
39.07 %	Major add 2 tetrachords (0-2-4-7)	TSC4-22A
	Minor add 4 tetrachords (0-3-5-7)	TSC4-22B

38.94 %	Half-diminished sevenths (0-3-6-10)	TSC4-27A
	Dominant sevenths (0-4-7-10)	TSC4-27B
38.89 %	Third inversion major seventh tetrachords (0-1-5-8)	TSC4-20
	First inversion major seventh tetrachords (0-3-7-8)	
38.52 %	Second inversion major add 2 tetrachords (0-3-8-10)	TSC4-22A
	Mistuned Historical Church Bell 8s (aural) (0-2-7-10)	TSC4-22B
38.15 %	First inversion minor add 2 tetrachords (0-1-5-10)	TSC4-14A
	Third inversion major add 4 tetrachords (0-5-9-10)	TSC4-14B
38.11 %	Major seventh plus four tetrachords (0-4-6-11)	TSC4-16A
	0-5-7-11 tetrachords (0-5-7-11)	TSC4-16B
38.06 %	Minor-major sevenths (0-3-7-11)	TSC4-19A
	Augmented major sevenths (0-4-8-11)	TSC4-19B
37.78 %	Second inversion minor triads (0-5-8)	TSC3-11A
	First inversion major triads (0-3-8)	TSC3-11B
	Major-minor tetrachords (0-3-4-7)	TSC4-17
37.59 %	Minor add 2 tetrachords (0-2-3-7)	TSC4-14A
	Major add 4 tetrachords (0-4-5-7)	TSC4-14B
37.28 %	0-1-5-7 tetrachords (0-1-5-7)	TSC4-16A
	0-2-6-7 tetrachords (0-2-6-7)	TSC4-16B
	0-4-6-9 tetrachords (0-4-6-9)	TSC4-27A
	Second inversion dominant seventh chords (0-3-5-9)	TSC4-27B
37.22 %	Third inversion minor-major sevenths (0-1-4-8)	TSC4-19A
	0-4-7-8 tetrachords (0-4-7-8)	TSC4-19B
37.14 %	0-6-7 trichords (0-6-7)	TSC3-5A
	0-1-7 trichords (0-1-7)	TSC3-5B
	First inversion diminished triads (0-3-9)	TSC3-10
	Second inversion diminished triads (0-6-9)	
37.13 %	0-2-9-11 tetrachords (0-2-9-11)	TSC4-10
36.91 %	0-1-7-8 tetrachords (0-1-7-8)	TSC4-8
36.72 %	0-3-9-10 tetrachords (0-3-9-10)	TSC4-13A
	Mistuned Historical Church Bell 7s (0-1-7-10)	TSC4-13B
36.67 %	0-7-8 trichords (0-7-8)	TSC3-4A
	0-1-8 trichords (0-1-8)	TSC3-4B
	Augmented triads (0-4-8)	TSC3-12
	First inversion minor-major sevenths (0-4-8-9)	TSC4-19A

	0-1-5-9 tetrachords (0-1-5-9)	TSC4-19B
36.63 %	0-4-5-11 tetrachords (0-4-5-11)	TSC4-8
	0-6-7-11 tetrachords (0-6-7-11)	
36.48 %	First inversion major triad add sixes (0-3-5-8)	TSC4-26
36.35 %	Diminished M7 chords (0-1-4-7)	TSC4-18A
	0-3-6-7 tetrachords (0-3-6-7)	TSC4-18B
36.02 %	0-2-4-11 tetrachords (0-2-4-11)	TSC4-11A
	0-7-9-11 tetrachords (0-7-9-11)	TSC4-11B
35.93 %	Third inversion minor add 2 tetrachords (0-5-7-8)	TSC4-14A
	First inversion major add 4 tetrachords (0-1-3-8)	TSC4-14B
35.79 %	Third inversion diminished M7 chords (0-5-6-9)	TSC4-18A
	0-3-4-9 tetrachords (0-3-4-9)	TSC4-18B
35.74 %	First inversion major add 2 tetrachords (0-2-5-10)	TSC4-22A
	Mistuned Historical Church Bell 8s (calculated) (0-5-8-10)	TSC4-22B
35.61 %	0-6-7-9 tetrachords (0-6-7-9)	TSC4-13A
	0-2-3-9 tetrachords (0-2-3-9)	TSC4-13B
	0-6-7-10 tetrachords (0-6-7-10)	TSC4-Z15A
	0-3-4-10 tetrachords (0-3-4-10)	TSC4-Z15B
	0-2-7-8 tetrachords (0-2-7-8)	TSC4-16A
	0-5-6-10 tetrachords (0-5-6-10)	
	0-4-5-10 tetrachords (0-4-5-10)	TSC4-16B
	0-1-6-8 tetrachords (0-1-6-8)	
35.56 %	First inversion major-minor tetrachords (0-1-4-9)	TSC4-17
	Third inversion major-minor tetrachords (0-5-8-9)	
35.19 %	0-1-3-10 tetrachords (0-1-3-10)	TSC4-10
	0-7-9-10 tetrachords (0-7-9-10)	
35.18 %	0-2-5 trichords (0-2-5)	TSC3-7A
	0-3-5 trichords (0-3-5)	TSC3-7B
35.05 %	0-2-8-9 tetrachords (0-2-8-9)	TSC4-Z15A
	0-1-7-9 tetrachords (0-1-7-9)	TSC4-Z15B
	0-4-9-10 tetrachords (0-4-9-10)	TSC4-Z29A
	0-1-6-10 tetrachords (0-1-6-10)	TSC4-Z29B
34.92 %	Diminished sevenths (0-3-6-9)	TSC4-28
34.78 %	Raga Sumukam scale as chords (0-2-6-	TSC4-Z29A

	11)	
	0-5-9-11 tetrachords (0-5-9-11)	TSC4-Z29B
34.63 %	0-2-9-10 tetrachords (0-2-9-10)	TSC4-11A
	0-1-8-10 tetrachords (0-1-8-10)	TSC4-11B
34.50 %	All-interval tetrachord Bs (0-1-3-7)	TSC4-Z29A
	0-4-6-7 tetrachords (0-4-6-7)	TSC4-Z29B
34.44 %	0-1-5 trichords (0-1-5)	TSC3-4A
	0-4-5 trichords (0-4-5)	TSC3-4B
	Italian sixths (0-4-10)	TSC3-8A
	Second inversion major flat 5 trichords (0-6-10)	TSC3-8B
	Second inversion minor-major sevenths (0-4-5-8)	TSC4-19A
	0-3-4-8 tetrachords (0-3-4-8)	TSC4-19B
34.37 %	Messiaen's Truncated Mode 5 scale as chords (0-1-6-7)	TSC4-9
34.13 %	Second inversion diminished M7 chords (0-3-8-9)	TSC4-18A
	0-1-6-9 tetrachords (0-1-6-9)	TSC4-18B
33.66 %	0-2-5-11 tetrachords (0-2-5-11)	TSC4-13A
	0-6-9-11 tetrachords (0-6-9-11)	TSC4-13B
33.61 %	0-3-4-11 tetrachords (0-3-4-11)	TSC4-7
	0-7-8-11 tetrachords (0-7-8-11)	
33.39 %	0-2-5-8 tetrachords (0-2-5-8)	TSC4-27A
	First inversion dominant seventh chords (0-3-6-8)	TSC4-27B
33.33 %	Minor thirds (0-3)	TSC2-3
	0-1-8-9 tetrachords (0-1-8-9)	TSC4-7
33.25 %	Fifth scale degree Balinese pentatonic triads (0-5-11)	TSC3-5A
	Second scale degree Balinese pentatonic triads (0-6-11)	TSC3-5B
33.11 %	0-4-10-11 tetrachords (0-4-10-11)	TSC4-5A
	0-1-7-11 tetrachords (0-1-7-11)	TSC4-5B
33.02 %	0-1-5-6 tetrachords (0-1-5-6)	TSC4-8
32.83 %	Dream chords (0-1-2-7)	TSC4-6
	0-5-6-7 tetrachords (0-5-6-7)	
32.74 %	First inversion diminished M7 chords (0-3-6-11)	TSC4-18A
	0-5-8-11 tetrachords (0-5-8-11)	TSC4-18B
32.70 %	Diminished triads (0-3-6)	TSC3-10
32.50 %	Second inversion major-minor	TSC4-17

	tetrachords (0-3-8-11)	
32.42 %	Messiaen's Truncated Mode 5 Inverse scale as chords (0-5-6-11)	TSC4-9
32.41 %	0-7-8-10 tetrachords (0-7-8-10)	TSC4-11A
	Warao tetratonic scale (Native South America) as chords (0-2-3-10)	TSC4-11B
32.33 %	French sixths (0-4-6-10)	TSC4-25
32.28 %	0-1-4-10 tetrachords (0-1-4-10)	TSC4-12A
	0-6-9-10 tetrachords (0-6-9-10)	TSC4-12B
32.09 %	Third inversion augmented sevenths (0-2-6-10)	TSC4-24
	Augmented sevenths (0-4-8-10)	
32.00 %	0-1-6-11 tetrachords (0-1-6-11)	TSC4-6
	0-5-10-11 tetrachords (0-5-10-11)	
31.72 %	All-interval tetrachords A (0-1-4-6)	TSC4-Z15A
	0-2-5-6 tetrachords (0-2-5-6)	TSC4-Z15B
31.67 %	0-1-4-5 tetrachords (0-1-4-5)	TSC4-7
31.59 %	Webern trichords (0-1-6)	TSC3-5A
	0-5-6 trichords (0-5-6)	TSC3-5B
31.43 %	Tritones (0-6)	TSC2-6
31.22 %	Second inversion Italian sixths (0-2-6)	TSC3-8A
	Major flat 5 trichords (0-4-6)	TSC3-8B
30.98 %	Second inversion augmented sevenths (0-2-4-8)	TSC4-24
	First inversion augmented sevenths (0-4-6-8)	
30.89 %	0-3-5-11 tetrachords (0-3-5-11)	TSC4-Z15A
	0-6-8-11 tetrachords (0-6-8-11)	TSC4-Z15B
30.61 %	0-1-3-6 tetrachords (0-1-3-6)	TSC4-13A
	0-3-5-6 tetrachords (0-3-5-6)	TSC4-13B
30.33 %	0-1-5-11 tetrachords (0-1-5-11)	TSC4-5A
	0-6-10-11 tetrachords (0-6-10-11)	TSC4-5B
	0-3-9-11 tetrachords (0-3-9-11)	TSC4-12A
	0-2-8-11 tetrachords (0-2-8-11)	TSC4-12B
30.18 %	Prime number seventh Bs (0-1-3-5)	TSC4-11A
	0-2-4-5 tetrachords (0-2-4-5)	TSC4-11B
30.05 %	0-5-6-8 tetrachords (0-5-6-8)	TSC4-Z29A
	0-2-3-8 tetrachords (0-2-3-8)	TSC4-Z29B
30.00 %	Minor sixths (0-8)	TSC2-4
	0-8-9 trichords (0-8-9)	TSC3-3A
	0-1-9 trichords (0-1-9)	TSC3-3B

29.82 %	0-1-9-10 tetrachords (0-1-9-10)	TSC4-3
29.68 %	0-2-4-6 tetrachords (0-2-4-6)	TSC4-21
29.63 %	0-9-10 trichords (0-9-10)	TSC3-2A
	0-1-10 trichords (0-1-10)	TSC3-2B
29.55 %	First inversion French sixths (0-2-6-8)	TSC4-25
29.50 %	0-6-7-8 tetrachords (0-6-7-8)	TSC4-5A
	0-1-2-8 tetrachords (0-1-2-8)	TSC4-5B
	0-6-8-9 tetrachords (0-6-8-9)	TSC4-12A
	0-1-3-9 tetrachords (0-1-3-9)	TSC4-12B
29.13 %	0-2-4-10 tetrachords (0-2-4-10)	TSC4-21
	0-6-8-10 tetrachords (0-6-8-10)	
29.07 %	0-2-11 trichords (0-2-11)	TSC3-2A
	0-9-11 trichords (0-9-11)	TSC3-2B
	Prime number seventh As (0-2-3-5)	TSC4-10
28.94 %	0-2-3-6 tetrachords (0-2-3-6)	TSC4-12A
	0-3-4-6 tetrachords (0-3-4-6)	TSC4-12B
28.89 %	Minor sevenths (0-10)	TSC2-2
	0-1-4 trichords (0-1-4)	TSC3-3A
	0-3-4 trichords (0-3-4)	TSC3-3B
28.39 %	0-1-2-6 tetrachords (0-1-2-6)	TSC4-5A
	0-4-5-6 tetrachords (0-4-5-6)	TSC4-5B
28.15 %	0-2-4 trichords (0-2-4)	TSC3-6
27.88 %	First inversion Italian sixths (0-6-8)	TSC3-8A
	First inversion major flat 5 trichords (0-2-8)	TSC3-8B
27.46 %	0-2-8-10 tetrachords (0-2-8-10)	TSC4-21
27.31 %	0-2-3-11 tetrachords (0-2-3-11)	TSC4-3
	0-8-9-11 tetrachords (0-8-9-11)	
27.22 %	0-3-11 trichords (0-3-11)	TSC3-3A
	0-8-11 trichords (0-8-11)	TSC3-3B
27.04 %	0-2-10 trichords (0-2-10)	TSC3-6
	0-8-10 trichords (0-8-10)	
26.57 %	0-2-10-11 tetrachords (0-2-10-11)	TSC4-2A
	0-1-9-11 tetrachords (0-1-9-11)	TSC4-2B
25.92 %	0-1-3-4 tetrachords (0-1-3-4)	TSC4-3
25.74 %	0-8-9-10 tetrachords (0-8-9-10)	TSC4-2A
	0-1-2-10 tetrachords (0-1-2-10)	TSC4-2B
24.91 %	0-1-10-11 tetrachords (0-1-10-11)	TSC4-1
24.35 %	0-1-3-11 tetrachords (0-1-3-11)	TSC4-2A
	0-8-10-11 tetrachords (0-8-10-11)	TSC4-2B
24.07 %	0-1-2-4 tetrachords (0-1-2-4)	TSC4-2A

	0-2-3-4 tetrachords (0-2-3-4)	TSC4-2B
23.80 %	0-1-2-11 tetrachords (0-1-2-11)	TSC4-1
	0-9-10-11 tetrachords (0-9-10-11)	
22.96 %	0-1-3 trichords (0-1-3)	TSC3-2A
	0-2-3 trichords (0-2-3)	TSC3-2B
22.22 %	Major seconds (0-2)	TSC2-2
20.18 %	0-1-11 trichords (0-1-11) 0-10-11 trichords (0-10-11)	TSC3-1
19.63 %	0-1-2-3 clusters (0-1-2-3)	TSC4-1
18.33 %	Major sevenths (0-11)	TSC2-1
16.29 %	Chromatic clusters (0-1-2)	TSC3-1
13.33 %	Minor seconds (0-1)	TSC2-1

Figure 3.1 The harmonic similarity of all single pitches, two-pitch chords, three-pitch chords, and four-pitch chords.

It is not the purpose of this book to impose rules or restrictions on composers or to promote or discourage any particular way of composing. On the contrary, the purpose is to open up new opportunities. For example, a composer may wish to consider whether it would be useful to set upper and lower limits for the harmonic similarity of an entire composition, or just for elements such as specific movements, instruments, articulations, dynamics, motifs, rhythms, emotional expressions, operatic characters, and so on.

The root clarity and root ambiguity of chords can be viewed and compared across all of the second graph layers in Appendix A. Like the first layers, collectively, all of these layers resemble the skyline of a city.

For convenience, Figure 3.2 shows the root clarity or root ambiguity of all single-pitch, two-pitch, three-pitch and four-pitch transpositional set classes in declining order. Amongst these chords, only the dominant seventh chords and major triads (in root position and in all of their inversions inversion) have greater root clarity than single pitches.

Just as a composer may wish to consider whether it would be useful to set upper and lower limits for harmonic similarity, the same approach can be applied to degrees of root clarity and root ambiguity.

Root clarity percentages	**Transpositional set classes**	**Examples**
209.84 %	TSC4-27B	Dominant sevenths (0-4-7-10)
175.00 %	TSC3-11B	Major triads (0-4-7)
100.00 %	**TSC1-1**	**Single pitches (0)**

97.06 %	TSC4-22A	Major add 2 tetrachords (0-2-4-7)
96.43 %	TSC4-Z29B	0-4-6-7 tetrachords (0-4-6-7)
94.29 %	TSC3-7B	0-7-10 trichords (0-7-10)
77.42 %	TSC4-18A	Diminished M7 chords (0-1-4-7)
77.39 %	TSC4-10	0-7-9-10 tetrachords (0-7-9-10)
76.79 %	TSC4-17	Major-minor tetrachords (0-3-4-7)
	TSC4-19B	Augmented major sevenths (0-4-8-11)
75.24 %	TSC3-8A	Italian sixths (0-4-10)
75.00 %	TSC2-5	Perfect fifths (0-7)
	TSC3-5A	Webern trichords (0-1-6)
	TSC3-5B	0-1-7 trichords (0-1-7)
66.86 %	TSC4-22B	Minor add 4 tetrachords (0-3-5-7)
64.52 %	TSC4-13B	Mistuned Historical Church Bell 7 as chords (0-1-7-10)
63.93 %	TSC4-4B	0-7-10-11 tetrachords (0-7-10-11)
	TSC4-Z15A	All-interval tetrachord As (0-1-4-6)
57.14 %	TSC4-20	Major seventh tetrachords (0-4-7-11)
55.56 %	TSC2-4	Major thirds (0-4)
	TSC3-3A	0-1-4 trichords (0-1-4)
	TSC3-3B	0-1-9 trichords (0-1-9)
55.00 %	TSC3-10	Diminished triads (0-3-6)
51.62 %	TSC4-21	0-2-4-6 tetrachord (0-2-4-6)
48.39 %	TSC4-12A	0-1-4-10 tetrachords (0-1-4-10)
39.29 %	TSC3-9	Suspended triads (0-5-7)
	TSC4-6	Dream chords (0-1-2-7)
	TSC4-14A	Minor add 2 tetrachords (0-2-3-7)
	TSC4-16A	Major seventh plus four tetrachords (0-4-6-11)
32.38 %	TSC4-27A	Half-diminished sevenths (0-3-6-10)
31.43 %	TSC4-5A	0-4-10-11 tetrachords (0-4-10-11)
	TSC4-Z15B	0-2-5-6 tetrachords (0-2-5-6)
	TSC4-Z29A	All-interval tetrachord Bs (0-1-3-7)
21.74 %	TSC3-7A	Ute Tritonic scale as trichords (0-3-10)
16.57 %	TSC4-11A	0-7-8-10 tetrachords (0-7-8-10)
12.90 %	TSC4-13A	0-6-7-9 tetrachords (0-6-7-9)
12.82 %	TSC4-14B	Major add 4 tetrachords (0-4-5-7)
12.50 %	TSC3-4A	0-1-5 trichords (0-1-5)
	TSC3-4B	0-1-8 trichords (0-1-8)
	TSC3-11A	Minor triads (0-3-7)
	TSC4-4A	0-7-8-9 tetrachords (0-7-8-9)
	TSC4-5B	0-1-7-11 tetrachords (0-1-7-11)
	TSC4-7	0-7-8-11 tetrachords (0-7-8-11)
	TSC4-18B	0-3-6-7 tetrachords (0-3-6-7)
	TSC4-19A	Minor-major sevenths (0-3-7-11)
11.11 %	TSC3-8B	Major flat 5 trichords (0-4-6)
	TSC4-3	0-1-3-4 tetrachords (0-1-3-4)

10.06 %	TSC3-6	0-2-4 trichords (0-2-4)
	TSC4-2A	0-1-2-4 tetrachords (0-1-2-4)
	TSC4-2B	0-2-3-4 tetrachords (0-2-3-4)
	TSC4-11B	0-2-4-5 tetrachords (0-2-4-5)
7.84 %	TSC4-26	Major triad add sixes (0-4-7-9)
6.67 %	TSC2-2	Minor sevenths (0-10)
	TSC3-1	Chromatic clusters (0-1-2)
	TSC3-2A	0-1-3 trichords (0-1-3)
	TSC3-2B	0-2-3 trichords (0-2-3)
5.98 %	TSC4-16B	0-2-6-7 tetrachords (0-2-6-7)
5.14 %	TSC4-24	Augmented sevenths (0-4-8-10)
4.62 %	TSC4-23	Dominant seventh suspended fourths (0-5-7-10)
0.36 %	TSC4-12B	0-3-4-6 tetrachords (0-3-4-6)
0 % – 2 equal roots	TSC2-1	Minor seconds (0-1)
	TSC2-3	Minor thirds (0-3)
	TSC2-6	Tritones (0-6)
0 % - 2 equal roots	TSC4-1	0-1-2-3 clusters (0-1-2-3)
	TSC4-8	0-1-7-8 tetrachords (0-1-7-8)
	TSC4-9	Messiaen's Truncated Mode 5 scale as chords (0-1-6-7)
	TSC4-25	French sixths (0-4-6-10)
0 % – 3 equal roots	TSC3-12	Augmented triads (0-4-8)
0 % - 4 equal roots	TSC4-28	Diminished sevenths (0-3-6-9)

Figure 3.2 The root clarity or root ambiguity of all single-pitch, two-pitch, three-pitch and four-pitch transpositional set classes.

In practice, the suitability of a root candidate may vary by the octave in which it is placed beneath a chord. However, there is no requirement to place a root candidate beneath a chord – consider any octave.

3.3 Spectral-pitch and root-candidate substitutions within the same cardinality

Below, Figure 3.3 to Figure 3.6 show how these substitutions work using major triads in root position (0-4-7) as the starting point. They also show the extent to which the harmonic similarity and root clarity of the first and second chord are different.

There are only three close one-pitch substitutions from tonic major triads in root position (0-4-7) to other three-pitch chords, that retain the same degree of harmonic similarity as the tonic (Figure 3.3 and Figure 3.4). The first is spectral-pitch movement from tonic major triads to mediant minor triads in root position (I → iii); the second is root-candidate movement from tonic major triads to submediant first inversion minor

triads (I → vi); and the third is root-candidate movement from tonic major triads to 0-7-9 trichords.

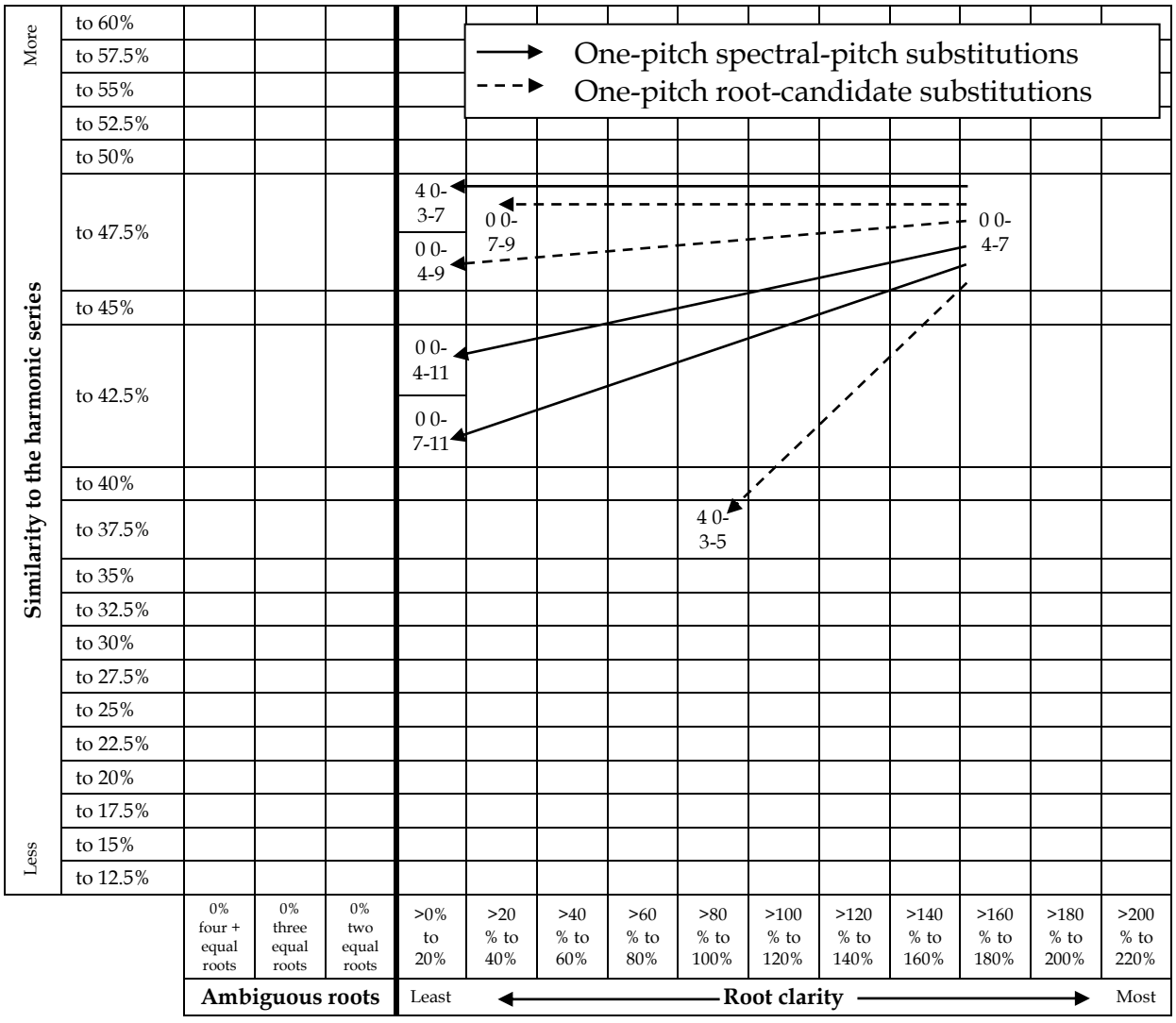

Figure 3.3 One-pitch spectral-pitch and root-candidate substitutions from major triads in root position (0-4-7) to other three-pitch chords.

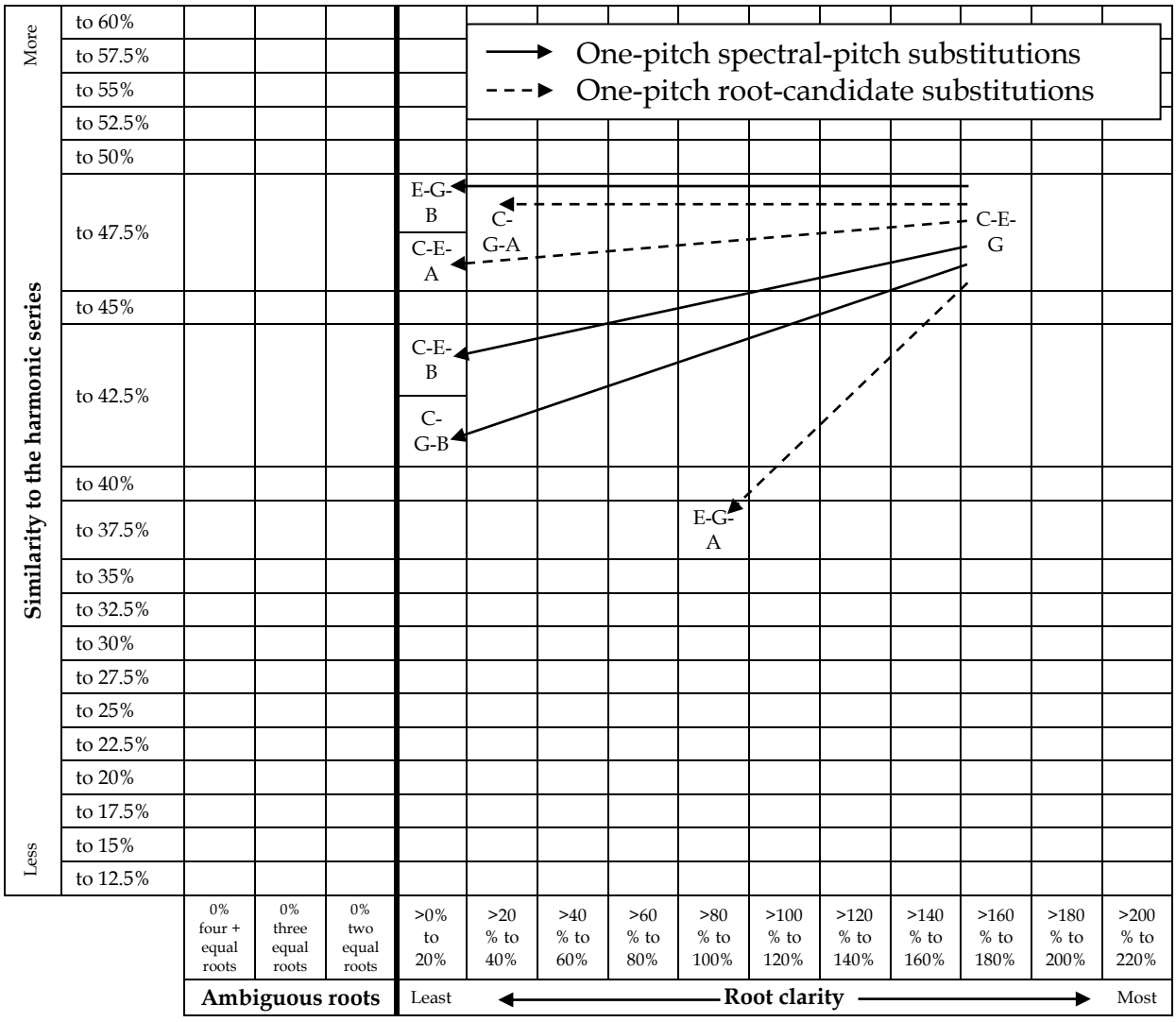

Figure 3.4 Letter names for one-pitch spectral-pitch and root-candidate substitutions from C major triads in root position (C-E-G) to other three-pitch chords.

There are only two close two-pitch substitutions from tonic major triads in root position (0-4-7) to other three-pitch chords, that retain the same degree of harmonic similarity and root clarity as the tonic (Figure 3.5 and Figure 3.6). The first is spectral-pitch movement from the tonic to the dominant major triads (I → V), and the second is root-candidate movement from the tonic to the subdominant major triads (I → IV).

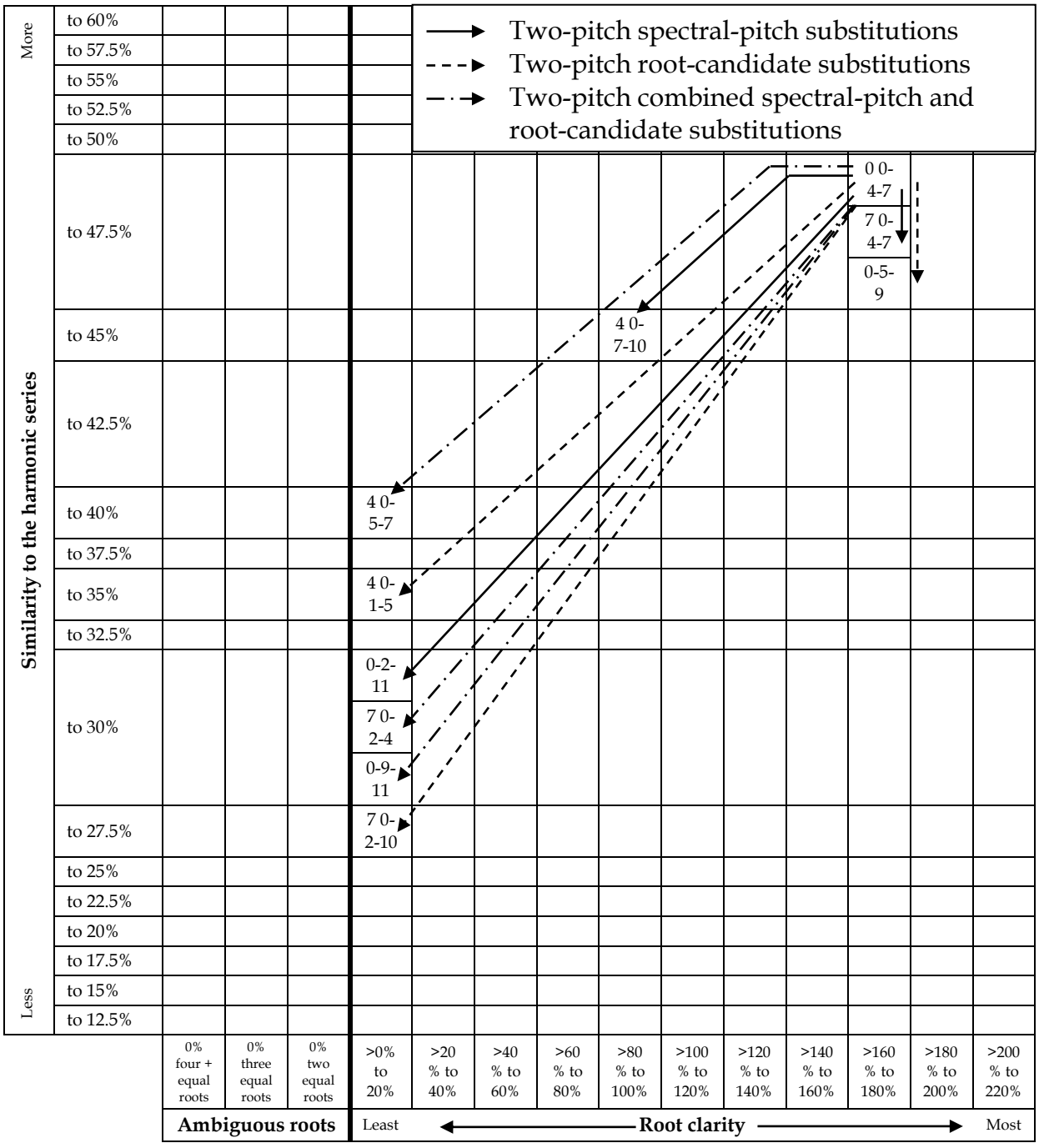

Figure 3.5 Two-pitch spectral-pitch and root-candidate substitutions from major triads in root position (0-4-7) to other three-pitch chords.

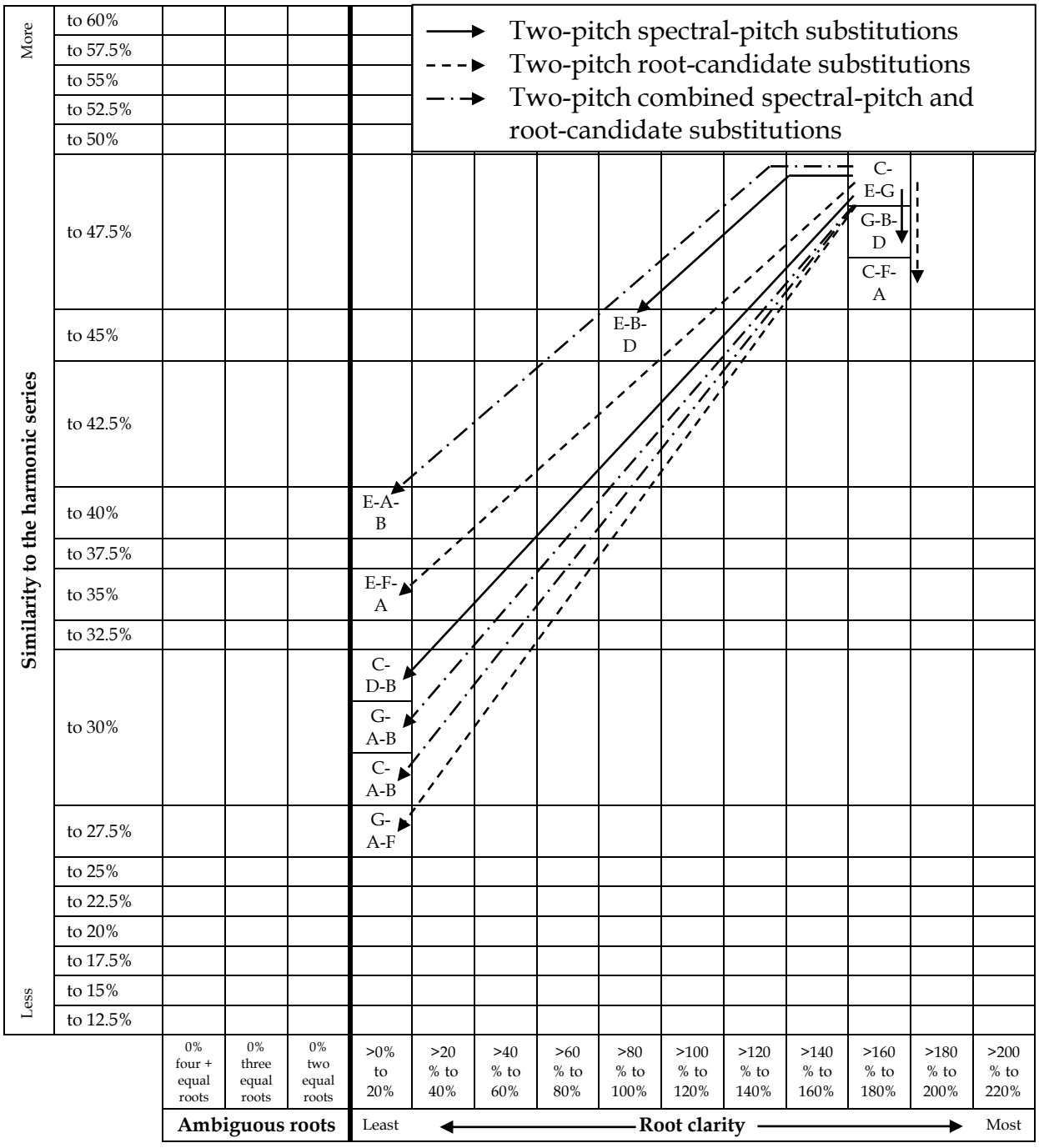

Figure 3.6 Letter names for two-pitch spectral-pitch and root-candidate substitutions from C major triads in root position (C-E-G) to other three-pitch chords.

3.4 Changing the cardinality of chords

The cardinality of a chord can be increased by adding one or more of its spectral pitches to the performed pitches in the chord. The spectral pitches at the top of the series should

fit better with the performed pitches of the chord than the spectral pitches at the bottom of the series, with the qualification that spectral pitches with the same weight should fit equally well.

Likewise, the cardinality of a chord can be increased by adding one or more of its root candidates to the performed pitches in the chord. The root candidates at the top of the series should fit better with the performed pitches of the chord than the root candidates at the bottom of the series, with the qualification that root candidates with the same weight should fit equally well.

The cardinality of a chord can also be increased by adding a combination of its spectral pitches and root candidates.

In each instance, the similarity of the new chord to the harmonic series and the clarity of its root can vary.

In Figure 3.1 and Figure 3.2, the single pitch serves as a useful benchmark, as it reflects a single human voice when speaking or singing.

Figure 3.7 shows the spectral-pitch pathway from single pitches. Each of the chords in the pathway divides the octave nearly evenly (compare Figure 2.3 with Figure 3.7).

Figure 3.8 shows the sequential root-candidate pathway from single pitches. Each of the chords in this pathway also divides the octave nearly evenly (compare Figure 2.3 with Figure 3.8). Since virtual roots are heard in an octave below the performed chordal pitches, this chart places the root of each chord below the previous chord in the pathway. This approach moves us away from transpositional twelve-point circular space into a descending transpositional twelve-point circular spiral, to some degree. It is a bridge between the transpositional twelve-point circular space used in our method and the more complex psychoacoustics spaces in which we hear performed chordal pitches.

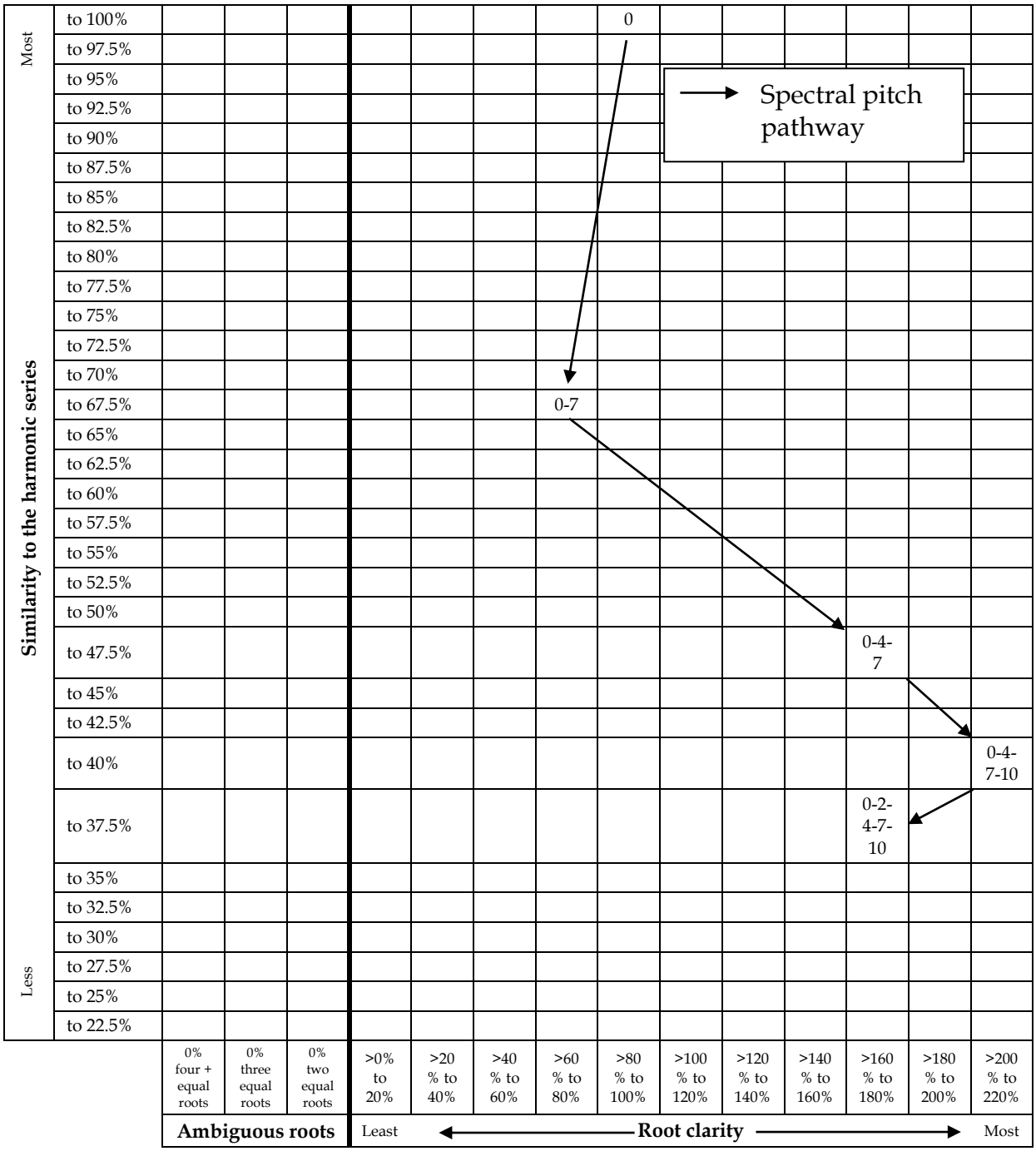

Figure 3.7 The spectral-pitch pathway from single pitches.

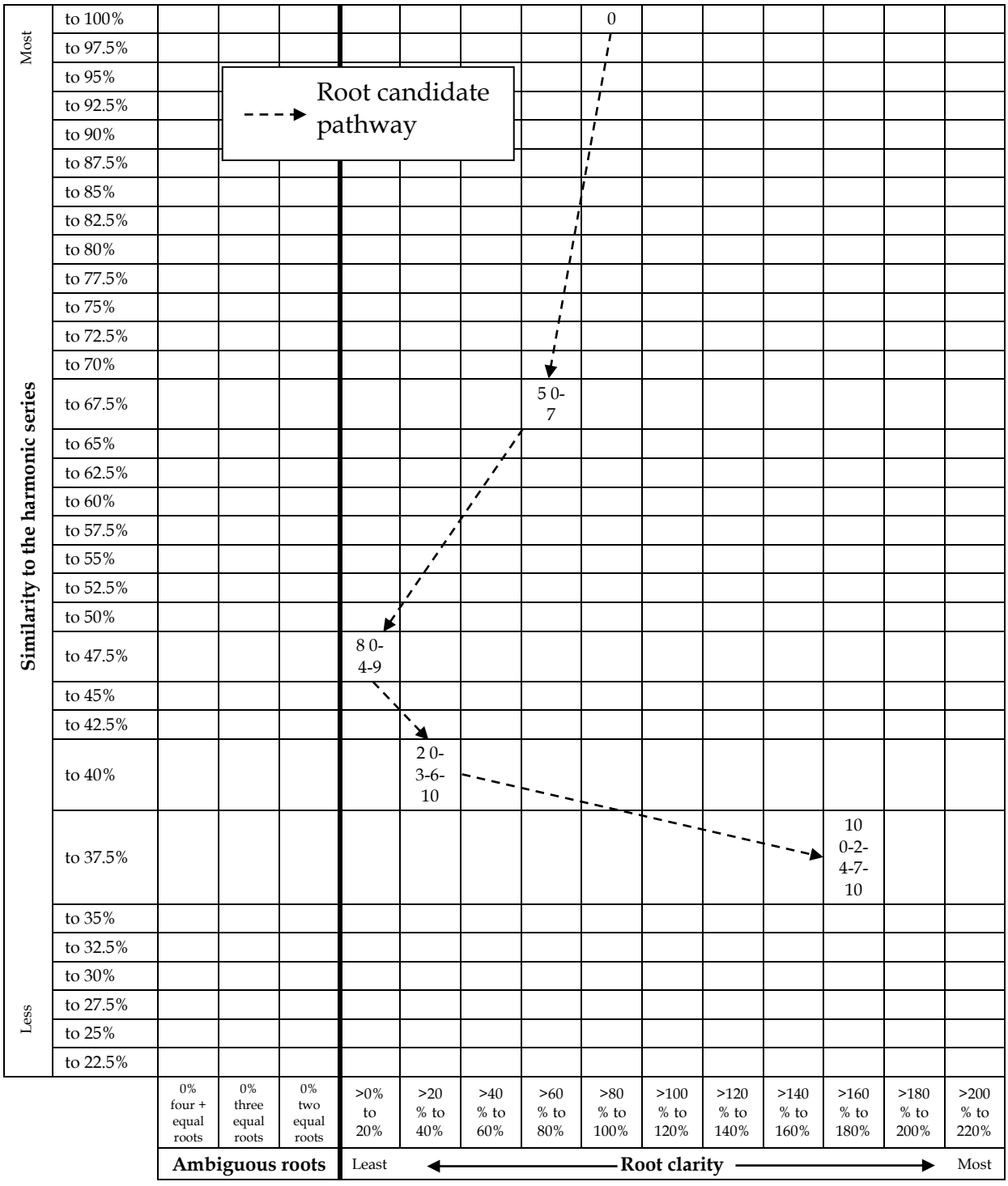

Figure 3.8 The root-candidate pathway from single pitches.

Figure 3.9 shows the spectral-pitch pathways from major triads in root position (0-4-7). There are alternative routes where two spectral pitches have the same weight. Major triads in root position also appear in Figure 3.7. The difference between these two charts

is that Figure 3.7 shows a spectral pathway that is based on the spectral pitches of single pitches, while Figure 3.9 shows the spectral pathways of major triads in root position. They are distinct pathways that lead in different directions. The chords in the spectral-pitch pathways from major triads do not divide the octave nearly evenly.

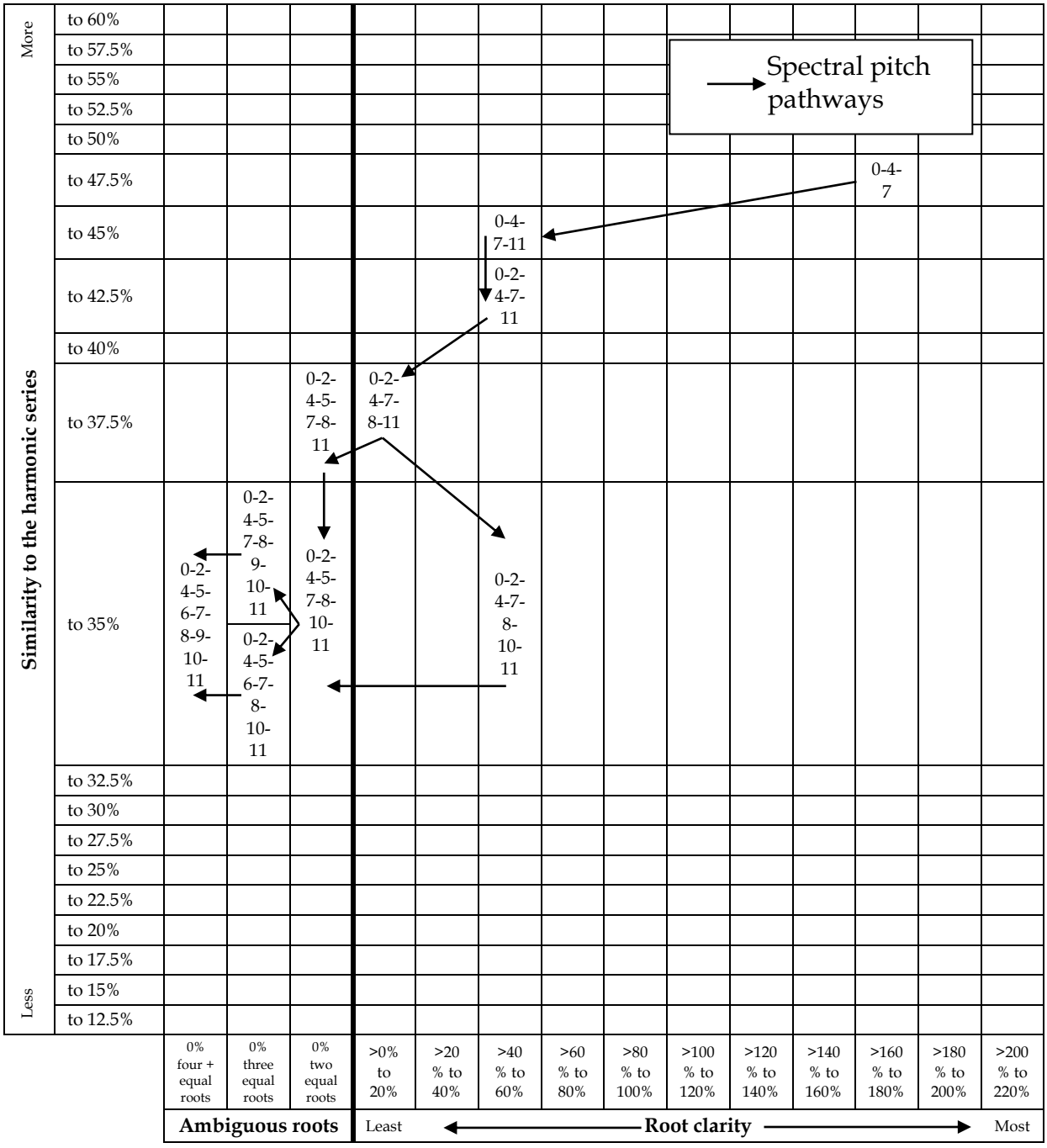

Figure 3.9 The spectral-pitch pathways from major triads in root position (0-4-7).

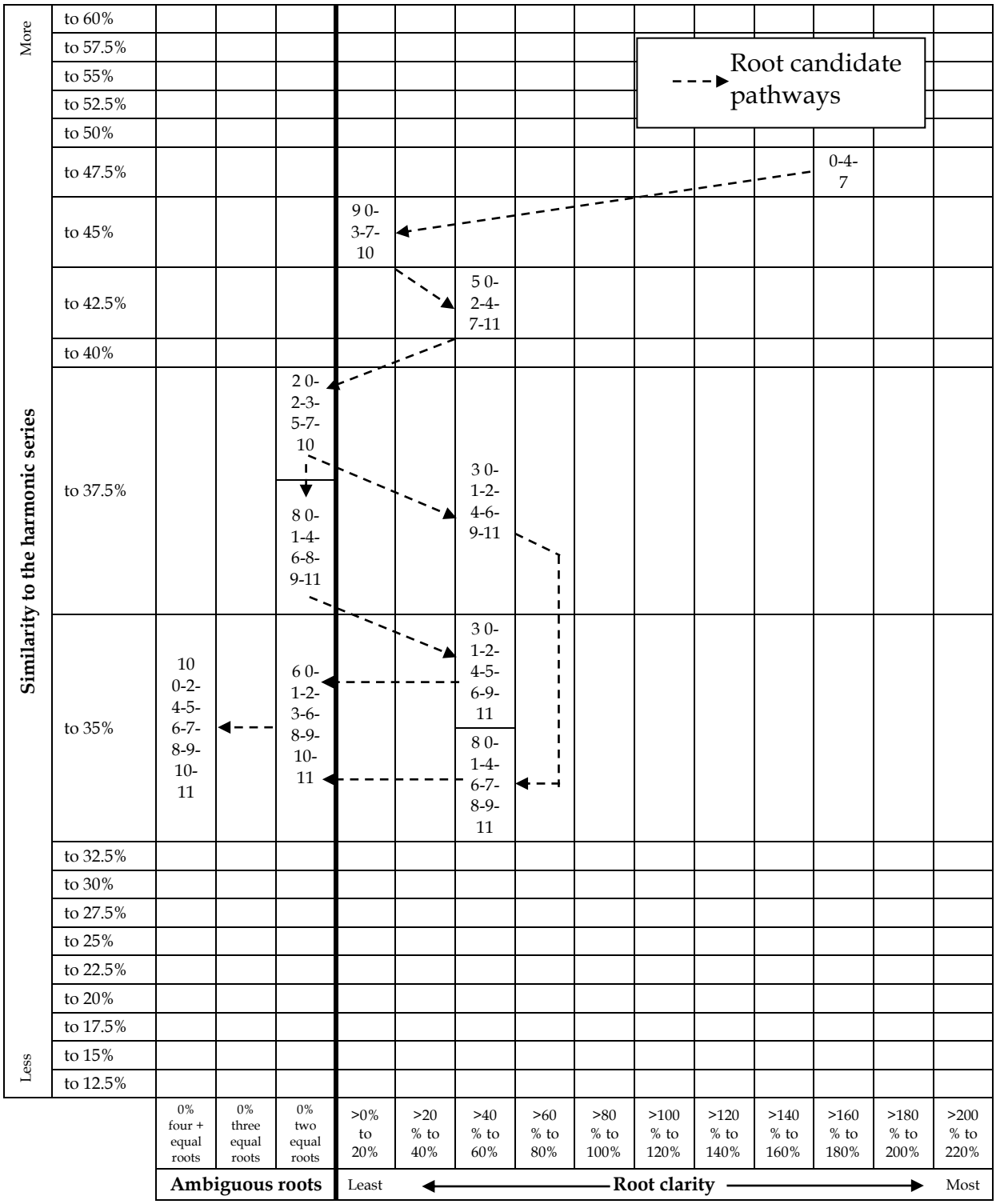

Figure 3.10 The root-candidate pathways from major triads in root position (0-4-7).

3.4 Conclusion

In my view, the result of this multi-layered approach is a unique and practical method that will allow composers to accurately evaluate the sound of any chord, and compare the sound of different chords. The method is easy to use but is not too long; it retains the key elements of the sound of chords at the sensory level. It also provides a springboard for composers to make more informed decisions about the implementation of chords in a musical composition by using different instruments, timbres, dynamics, articulations, registers and frequencies.