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Recent Diatonic Theory and Curwen's Tonic Sol-Fa Method: Formal Models for a Kinesic-Harmonic System

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Inspired by educational reformer Pestalozzi, and communicating closely with such scientists as Helmholtz and Ellis, John Curwen developed in the mid-1800s a theory of "mental effects" and a set of handsigns to help teach sightsinging, music dictation, and tonal harmony according to his tonic sol fa method. Arguably the most comprehensive approach to music training since medieval solmization, Curwen's pedagogy helped spread European principles to millions of teachers and students on every continent. It remains influential to the present through such adaptors as Kodály.

Mental Effects Central to Curwen's method is the notion of "mental effects." For Curwen, "physical effects" comprise simple causal sequences, e.g., from physical frequency to phenomenal, perceived pitch. By contrast, "mental effects" involve "relations," e.g., among the consequences of such perceptual acts, as in the widespread musicians' distinction between relative and absolute pitch. Depending on its location within the major scale's interval pattern, each of the 7 syllables in Curwen's movable-doh system (doh, ray, me, ...) embodies a distinct mental effect or perceptual category: "doh-ness" or "ray-ness," as it were, as distinguished from a particular pitch.

That there are 7 such distinct categories in a diatonic scale is expressed by the phonetic uniqueness of each syllable, especially its initial consonant (d, r, m, ...) and can be justified in current theory by the fact that each degree occupies a distinctive place in the pattern, forming a unique interval configuration with the others. E.g., doh is 2, 4, 5 semitones below, and 1, 3, 5 above, the scale's other notes, whereas ray is 2, 3, 5 below and 2, 3, 5 above the others. In more recent terms, each degree has a unique "constellation" or "panorama." As in the medieval concept of modal affinities, the doh and ray constellations are, severally, more similar to soh's (2, *4*, 5 below; 2, 3, 5 above) than to each other, a fact readily predicted by distances among these degrees on the "circle of fifths," or in current theory, in a cycle of transpositions up or down 5 semitones (T±5 mod-12).

Among the 7 syllables of Curwen's relatively modern system, doh is a p 5th below the phonetically similar soh, as is me below te. These phonetically parallel syllable-pairs form major 3rds, as does the phonetically similar pair fah-lah, inherited from medieval solmization and comprising the only other major 3rd in a diatonic scale. That there should be precisely three intervals of four semitones in the diatonic scale is also readily predicted by current theory.

The phonetically similar syllables me and te also draw attention to the fact that there are precisely 2 semitones in the diatonic scale, of which they form the lower components, "half an octave apart." This aspect of the diatonic scale is definitive in current formulations of "maximal even-ness" by Clough and Douthett. Moreover, the recent music-theoretical idea of maximal even-ness emphasizes ways in which such pitch-class collections as the diatonic, "white-key" scale are extremely privileged, i.e., in similarity/simplicity, by contrast with other possible interval patterns.

Curwen himself stressed precise interval patterns through his "modulator," an adaptation of Glover's "Norwich sol-fa ladder," a chart with syllables arranged vertically at distances proportional to the intervals between them. Curwen's graphic display was further correlated to (General) Thompson's fine distinctions in just intonation. Each syllable was associated also with particular words to convey as precisely as possible its mental effect within the entire scale. Especially in the earliest stages, students did not learn to read music in standard staff-notation. Instead, Curwen devised a "New Notation," employing the first letter of each syllable plus diacritics and punctuation (apostrophe, colon, period, etc.) to denote precise values of register and rhythm. His aim in formal music training was to develop and exploit as far as possible mental effects, i.e., the "ear" of the neophyte musician, as a basis for learning.

Handsigns Curwen also introduced handsigns to convey relative pitches and their mental effects without recourse to graphic, typographic, spoken, or sung syllables. Especially valuable for conveying simultaneous tones in a classroom, the individual handsigns were uniquely associated with particular mental effects, scale degrees, syllables, etc. Adapted to Kodály's 20th-century curriculum, such manual signs are still used widely in Europe and North America.

Plausibly because of great speech divergences among his students and his considerable reliance on printed materials, Curwen's textbooks emphasized clear distinctions in pronunciation. Taking as his point of departure Ellis's work in phonetics, Curwen explicitly conceived syllables as articulative, not merely sonic, and implicitly anticipated "motor phonetics" and recent work in the computer simulation of speech and song. In this way, Curwen's handsigns can be understood as a relatively "large-motor" approach to grasping mental effects, additional to the relatively "fine-motor" resources of syllables.

Triadic Tonality and Curwen's Handsigns I believe Curwen's handsigns comprise structures that illuminate one of the most difficult distinctions in music theory, namely, between scale and tonality. Drawing largely on the mathematical resources and findings of atonal music theory, recent accounts of scales, chords, and intervals have not yet responded fully to certain questions raised--or at least, begged, but certainly never answered adequately--by traditional tonal theories. E.g., in general--for generality is theory's defining specialty--how can one distinguish among, and inter-relate, consonance, dissonance, and resolution?

An outstanding, somewhat recent exception is Boretz's informal "outline of a musical system," already of great importance in the intellectual history of music because of its aim to connect tonal and atonal/serial theory. Although Boretz seems not to have been immediately aware of either as a precursor to his own system, pitch-class structures he delineates are clearly isomorphic with motor patterns among Curwen's handsigns and with standard discant/counterpoint techniques formulated and carried out as "common practice" by theorists, composers, performers, and improvisers of "modal" (arguably, "dyadic") music in the Middle Ages and Renaissance. In what follows, I attempt to extend in generality Boretz's formulation of triadic tonality. I draw into this extended discussion other, more recent studies in music theory. I also try to determine what aspects of music might be learned, albeit non-verbally, through Curwen's handsigns.

The main dichotomy in Curwen's handsigns is between the tonic triad and the other 4 degrees of the major scale. For tonic-triad degrees, the hand is continuous with the forearm, wrist unbent: for m, the palm is extended in the horizontal plane; for s, the same, but vertically; for d, a fist in m's horizontal plane. Within this group of 3 handsigns, m is medial in similarity between d and s, which contrast in the oppositions fist/palm, and horizontal/vertical.

These contrasts can be understood not just visually and "objectively" (e.g., from a spectator's viewpoint) nor only statically, but also kinesically, dynamically, and (inter-)subjectively, especially in transitions from one to another. Successive pairs of handsigns involve more or less similar directions/orientations and changes of particular muscles and tendons, e.g., the forearm's twist between s and m or d. The 4 non-tonic-triad degrees form melodic dissonances with the tonic triad and engage further motor contrasts. In all four, the wrist is bent or the forearm is twisted, and one or all fingers point to a single resolution (respectively, d, m, m, or s). The index finger points upward for t, downward for f, whereas all digits point upward for r, downward for l. Cross-cutting the upward-downward dichotomy, is a semitone/whole-tone dichotomy between the index finger and all fingers ('-' vs '='): t->d, r=>m<-f, s<=l. Finally, both t and l require a twist of the forearm in proceeding to or from their resolutions (d and s, respectively).

For Curwen, major tonality is more important than minor or other "modal" structures. Pre-eminent in any key are the triads on degrees d, s, and f (for which Curwen's chord symbols are D, S, and F). Accordingly, Curwen's handsign pattern can be understood as follows: t->d, r=>m, s; d m<-f

s<=l; i.e., each degree in S (t, r, s) and F (d, f, l) resolves stepwise to a particular degree in D (d, m, s), except s in S and d in F, which, as degrees in D itself, are already resolved. In more recent terms, whereas the octave modulus orders particular degrees in a one-dimensional, low-high cycle throughout all registers (d r m f s l t d r ...), Curwen's resolution pattern privileges 3 of these degree-classes (d, m, and s) and groups each of the other 4 degree-classes with one of these in an ordering, extending across all registers but bounded/broken by the opposite directions of t and l.

In general, an individual melodic dissonance is grouped with, and its handsign points toward, the tonic-triad degree-class to which it is closest. It might seem arbitrary to group r with m, rather than with d, for in current theory both are simply 2 semitones away from r. However, within just intonation, which Curwen adopted as his tuning framework, r ideally forms a smaller ratio with m (10/9=80/72) than with d (9/8=81/72). More important, I believe, grouping r only with m preserves the determinacy Curwen sought in general (plausibly for pedagogic ease). Even more important, I feel, this grouping fulfills a symmetry implicit in Curwen's triadic ideal, irrespective of the nice tuning distinctions he sought to inculcate (albeit as a secondary goal of his curriculum). In any event, whether understood in Pythagorean, just, or equally tempered terms, Curwen's resolution pattern rings true with the tonal practices he aimed to codify and teach to neophytes.

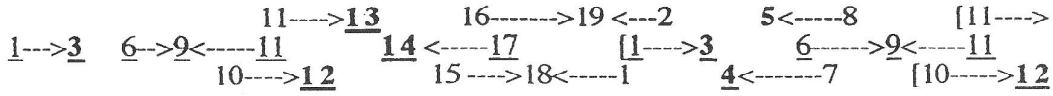
In semitone-sizes, dms, fld, and str are identical: 047. Hence, each is a transposition of the others: fld is T5dms; str is T-5dms. In generic, scale-degree intervals, these triads are also identical (024) and transpositions of each other: fld is T3dms; str is T-3dms. More precisely, dms, transposed up 5 semitones/3 scale degrees and down 5 semitones/3 scale degrees, yields all and only the notes of the diatonic collection: drmfslt. Curwen explicitly specifies this relation between the three triads and the entire scale as a basis for according these central sonorities privileged status within his theory of harmony.

Whereas one could list many isolated features of Curwen's triadic pattern of melodic resolution, a more unified account of their inter-relationships results from describing systematically the general pattern of which the handsigns are an instance, and conversely, by identifying traits that distinguish it from other, seemingly cognate possibilities. In this way, one can begin to specify more precisely the "class" or "category" of motor routines learned in using handsigns.

Mathematical Aspects Musically, Curwen's pattern can be understood as embodying voice-leading connections, i.e., a cross-registral "trio" of degree-class "voices." Other plausible structures include a "solo," "duet," "quartet," "quintet," ..., comprising a similarly centric, interleaved arrangement of monads, dyads, tetrads, pentads,..., i.e., of "chords" having 1,2,4,5, ... degrees. Mathematically, if the number of degrees in the central, "tonic" chord is n=(1),2,3,4,..., the number of degrees in the scale it generates by transposition must be 3n-2 (since both non-tonic chords share a unique common tone with the tonic chord). Registrally consecutive tones in each chord can be no more than 3, and no fewer than 2, degrees apart (because of constraints comprising adjacency and registrally directional mapping of the central chord one-to-one and onto the other two). The number of 2-degree intervals in a chord must be 2 (for if this number is set at p and the number of 3-degree intervals is q, 2p+3q=3n-2; however, n=p+q; thus, p=2 and q=n-2). In general, chords having more tones have more intervals of 3 degrees. Most precisely, Curwen's pattern requires that the central, "tonic" chord consist of an odd number of tones (i.e., 4n±1) arranged maximally evenly and transposed upward and downward a "major half-octave" (3n-1/2 degrees) to yield its dominant and subdominant, respectively (again, by virtue of restrictions involving adjacency, registrally directional mapping, and common-tones).

Each resolution pattern is symmetrically arranged around a tonic half-octave: degrees (1 and 1), 1 and 5, 1 and 8, 1 and 11,..., whereas degrees (1),3, 11, 6,... are "medial," i.e., "thirds." (For chords of 4n+1=(1),5,9,13,...degrees, this "medial" degree is not registrally "on the way up from" the chord's "root" to its "fifth," as its major half-octave comprises an odd number of consecutive intervals, specifically, ((4n+1)+1)/2=2n+1.) In the well-known instance of diatonic, 7

scale degrees are distributed maximally evenly among 2(7-1) = 12 semitones (specifically, for major: 2212221 semitones upward). This, and the corresponding match of semitone-sizes among the diatonic scale's three central triads--whether major (047) or minor (037) -- suggests, especially for chord-scales of 4n-1=7,11,15, ... degrees, the possibility of distinguishing, more generally, between major and minor along such lines. At the level of scale-degrees (in contrast to semitones, or more generally, "microtones"), there is no difference between the "thirds" within such chords. Nonetheless, each of these scalar chords contains not only such "neutral thirds" as 5 (=2+3 and 3+2 in the 7-degree chords of the 19-degree scale), but also such contrasting versions as 6 (=3+3). Indeed, because they comprise three minimally overlapping, maximally even chord-scales, such structures can "fractionate" into three subscales, each internally manifesting the Curwen resolution pattern (complete with the major-minor distinction, e.g., between 6 and 5, as well as relatively narrow "t-d" and "m-f" intervals etc.), but centred on a different tonic-chord (e.g., a chord-degree higher) than the larger scale they comprise:



This structural disjunction corresponds to the requirement for minimal overlap, which distinguishes transpositions that yield Curwen's resolution pattern *within* a scale from those that yield chromaticism or modulation *beyond* a scale, where, for example, overlap cannot sink to such a minimum for diatonic construed mod-12). As in Agmon's formulation of chord-relations, adjacent degrees and common tones play a basic role. In contrast to Cohn's formulation of chords that cycle infinitely stepwise within a scale, Curwen structures implode and explode "fractally," as it were: hence the inclusion of 1-degree "chords," comprising 0-degree intervals--not just a mathematical curiosity, but a structural limit constituting "closure" in a totally ordered hierarchy.

Empirical Hypotheses How might one conclude that a Curwen pattern is actually functioning, e.g., in an experimental setting? Such a structure is syntactical and hence no more immediately observable than the grammar of a language or dialect. Moreover, just as in the production or perception of speech, where more than one syntax can compete, other musical systems (e.g., dyadic/modal) can vie with triadic tonality of the Curwen type. Nonetheless, in analyzing (e.g., probe-tone) data, one would expect a central chord to dominate responses if Curwen tonality is effective. Further, one would also expect neighbour-tone responses, not merely as parts of a central chord's complement within a particular scale, but also as unresolved portions of the central chord's voices. Indeed, if chords and scales functioned independently as agents of probe-tone responses, such alternatives as fah and fe, and te and tay would be equiprobable as responses to such "gapped," elliptical stimulus-sets as drmsl. By contrast, all other factors held constant, fah and te are to be expected if Curwen symmetry is a reinforcer.

If similarity/simplicity relations are reinforcers, common chords should be relatively favoured over diminished triads. 3 major vs 3 minor triads should be favoured behaviourally as subgroups over other divisions of these 6 into 2 groups of 3; similarly for other "maximally frequent" chords in other, microtonal systems, for which Clough and Myerson precisely predict multiplicities. In this sense, triadic voice-leading is a capacity of diatonic "waiting to be reinforced." As Boretz's account suggests, "trio" frameworks, as such, actually favour such sonorities as stf and (it inverse) tfl over trf, and even over rfl in major and str in (natural) minor. Whereas delicate non-pitch (i.e., timbral , micro-rhythmic/loudness) factors are all one can cite in defence of Curwen's apparently Euro-centric privileging of major (as well as root position, dominant skewing, and raised leading-tones), one must acknowledge that Curwen's formulation itself has been for more than a century a worldwide factor in shaping production, perception, cognition, and conceptualization at all levels of formal training. Arguably, the closed, "totalizing," hierarchical structure of Curwen tonality has been a powerful agent of European aesthetic hegemony, enabling quick "overlearning" of authoritative, tonal structures, while erecting barriers to subsequent fluency in "other" possibilities.

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FIGURES

Curwen patterns for 3-, 5-, and 7-degree "tonic" chords

n=3 3n-2=7 chord-cycle: 2 2 3

resolutions: 0----->**1** 2----->3<-----4 **5**<------6

"dominant" T+4 0 2 5
"tonic" 1 3 5
"subdominant" T-4 1 4 6

n=5 3n-2=13 chord-cycle: 2 3 2 3 3

resolutions: 0-->**1** 2-->3<--4 5-->6<--7 **8**<--9 10-->11<--12

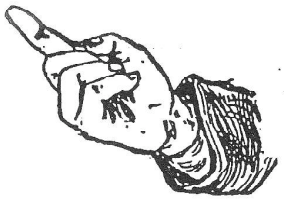
"dominant" T+7 0 2 5 8 10
"tonic" 1 3 6 8 11
"subdominant" T-7 1 4 7 9 12

n=7 3n-2=19 chord-cycle: 2 3 3 2 3 3 3

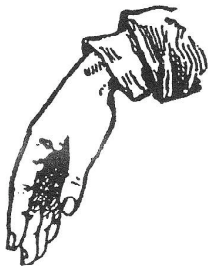
resolutions (transpositions T±10):
0-->**1** 2-->3<--4 5-->6<--7 8-->9<--10 **11**<--12 13-->14<--15 16-->17<--18

Curwen handsigns and mental effects for the diatonic scale (after Cringan)

SOH: The grand or bright tone

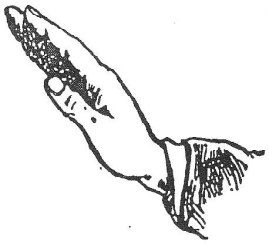


TE: The piercing or sensitive tone

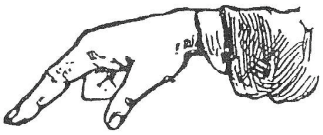


LAH: The sad or weeping tone

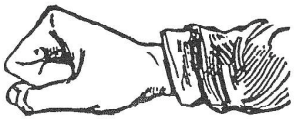
ME: The steady or calm tone



RAY: The rousing or hopeful tone



FAH: The desolate or awe-inspiring tone



DOH: The strong or firm tone