

Facing Democracy: The Rapid Evolution of Percy Grainger's Texture

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Texture is a notoriously elusive musical parameter to define. Bruce Benward and Marilyn Saker simply classify it as 'the combination of a work's melodic, rhythmic and harmonic aspects.'¹ Yet the term also frequently appears in relation to other musical elements including the range and density of music,² orchestration, and timbre.³ In short, a vague notion of texture extends fluidly through most, if not all, musical elements and is broadly considered the product of their interaction. The Australian composer Percy Grainger (1882–1961), however, provides a strikingly less ambiguous account of his own conception of texture. In a 1916 letter to his biographer D.C. Parker, he states:

I believe that any originality that may exist in my "texture" can be brought home to the particular blend of horizontal and perpendicular that has always been my fate from my earliest childhood's composings beginnings ... My chords grow out of the

¹ Bruce Benward and Marilyn Saker, *Music: In Theory and Practice*, 7th ed. (Boston: McGraw Hill Higher Education, 2003), 131.

² Andrew Larson, *Textural and Harmonic Density in Selected Choral Works (1992–2003)* by Eric Whitacre (DMA thesis, University of Illinois, 2004), 7.

³ John Roscigno, *Percy Grainger's 'The Warriors—Music to an Imaginary Ballet.' Innovations in Orchestration. The Addition of the Melodic Percussion Section as an Equal Force in 20th Century Orchestral Writing* (DMA thesis, University of Arizona, 1998), 100.

moving paths of my polyphony, but I listen to the result as a *chordal result* rather than a polyphonous result ... Where my partwriting produces dischords and collisions it is not because my mind is so centered on polyphony that I ignore the harmonic results, on the contrary, I instinctively choose partwriting that will result in a *harmonic clash*, because that is what my ear yearns for, and yearns for *harmonically*.⁴

Referring in this same letter to texture as 'the weft of the [polyphonic] fabric' and 'the actual distribution of notes in a chord, [and] the critical or unconscious choice of inversions [sic],'⁵ Grainger considered texture a kind of musical fingerprint. Grainger cited Fryderyk Chopin and Cyril Scott as composers readily identifiable by the aural result of their textural choices. Bridging both the theoretical and the observational, Grainger's suggested definition marginalises the notions of texture relating to harmony, timbre and orchestration. This definition favours intervallic relationships, with the horizontal 'weft' of the various lines responsible for creating an aurally recognisable fingerprint.

It follows that this concept of texture, based on quantifiable intervallic tendencies, can be measured and described. Malcolm Gillies identifies 'the relation between chordishness and many-voicedness,' as being contained within a matrix of the vertical and horizontal axes.⁶ In other words, he suggests that Grainger's polyphonic methods can be traced through the interplay of these two dimensions: the horizontal path of the individual lines and the vertical result of their interaction. Taking a systematic and statistical approach highlighting the above characteristics would develop models extremely sensitive to change in the very fabric of composition.

With this in mind, the questions arise: what exactly was Grainger's own original musical fingerprint, and when did it develop? His life-long quest to create music emulating the forms of nature is well documented: from his experiences as a young boy watching the waves of Albert Park Lake, to transcending the human performer element with the 'free music' experiments toward the end of his life. As Margaret Hee-Leng Tan defines it, his ambition was to create 'music of ideal curvilinear freedom and flexibility, lacking bar accents as well as tonal restriction'⁷—music not restrained or affected by artificial systems, including tonality, defined structural forms and repetition. If one holds such liberated, un-quantified polyphony as the manifestation of his textural ideals, to what extent did Grainger achieve this in earlier works?

Gillies asserts in his article on Grainger's use of texture that, 'it was not really until his *Free Music* No.1 of 1934 that Grainger challenged the dominant-tonic hierarchy in a way that was more than incidental.'⁸ When looking at Grainger's published output, one would be inclined to agree with this statement. However, when looking at his incomplete and unrefined sketches there is cause for hesitation, with evidence of a youthful shift towards fully formed polyphonic freedom—a texture as statistically similar to his 'free music' as the Western notation system would stretch.

⁴ Percy Grainger, letter to D.C. Parker, 28 Aug. 1916, reprinted in *A Source Guide to the Music of Percy Grainger*, ed. Thomas Lewis (White Plains, NY: Pro / Am Music Resources, 1991), 11.

⁵ Grainger, letter to Parker, 28 Aug. 1916, in Lewis, ed., *A Source Guide to the Music of Percy Grainger*, 11.

⁶ Malcolm Gillies, "'A Musical Hyde Park Corner': Grainger's Use of Texture," *Australasian Music Research* 5, ed. Malcolm Gillies and Mark Carroll (Melbourne: Centre for Studies in Australian Music, 2000): 18.

⁷ Margaret Hee-Leng Tan, 'Free Music,' *Source Guide to the Music of Percy Grainger*, ed. Lewis, 154.

⁸ Gillies, 'A Musical Hyde Park Corner,' 21.

The purpose of this study is to examine this early move away from traditional tonal structures, towards intervallic equality and textural maturity by Grainger's own standards, culminating in the sketches for the *Marching Song of Democracy*. This move will be illuminated using three of Grainger's works to represent imitative (*Andante Con Moto*), transitive (*At Twilight*) and postulated mature stages (*Marching Song*). While Grainger describes his best tone art as that which 'tallies the streaming, surging, seething forces of the non-human nature,' he also tellingly added, 'or the wholly impersonal treads of mankind-as-a-whole (as in the *Marching Song of Democracy*).'⁹ The seemingly oppositional equivocation of nature and civilisation finds resolution in the pluralist strain of democracy, wherein minorities may thrive 'by making it difficult for any coherent majority to be formed,' thereby creating a dynamic struggle for equilibrium.¹⁰ This idea provides musical expression with an opportunity for equality that also embraces localised inequality parallel to nature, epitomised by Nathan Hesselink's second principle of democracy: individuality within collectivity.¹¹ This research forms a critical part of a much larger project which utilises a greater number of Grainger's own compositions, repertoire and analytical techniques.

Identifying such ideals of democratic and natural texture in polyphonic music was a two-stage process. Initially, pitches were converted into numerical form to create visual polyphonic maps of the studied works. This allowed the generation of horizontal and vertical data subsets used in subsequent analysis. The next stage centred on identifying the levels of pitch equality, interval equality and structural recognition. Positive results of equality and the shift towards it were therefore indicative of a developing polyphony akin to Grainger's 'free music' credo.

For both axes this was done through the use of modulo 12, an absolute system where pitch names were converted into numbers (e.g. A=0, A#=1, ... G#=11) to examine the frequency of consecutive pitch relationships.¹² The closed, cyclical nature of modulo 12 also allowed the creation of Chernoff Faces, a method for presenting multivariate data as human faces, to be outlined below.¹³ This was used to illustrate the multitude of data points in an accessible form and provide a visual sense of a work's relationship to conceptual equality. Due to its complex nature, analysis of the vertical axis was slightly more complicated, and required two further analyses to gain an accurate picture of the texture's characteristics. As such, testing for exact structural repetition and relative intervallic combinations were additional focuses.

Selected Works

In 1901, the eighteen-year-old Grainger began work on the *Marching Song of Democracy* in Frankfurt, inspired by the democratic themes pervading Walt Whitman's *Leaves of Grass*, a statue of George Washington observed while in Paris for the exhibition of 1900,¹⁴ and most

⁹ Tan, 'Free Music,' 154.

¹⁰ Anthony Birch, *The Concepts and Theories of Modern Democracy* (London: Routledge, 2001), 76.

¹¹ Nathan Hesselink, 'Taking Culture Seriously: Democratic Music and its Transformative Potential in South Korea,' *World of Music* 49.3 (2007): 81.

¹² Modulo 12 shares the same foundations as musical set theory.

¹³ See Herman Chernoff, 'The Use of Faces to Represent Points in K-Dimensional Space Graphically,' *Journal of the American Statistical Association* 68.342 (June 1973): 361–8.

¹⁴ Percy Grainger, *Marching Song of Democracy* (New York: G. Schirmer, 1916), i–ii.

likely the unfolding events of Federation occurring in his homeland.¹⁵ *Marching Song*, like much of Grainger's output, was developed throughout his creative life and finally settled on as a work for SATB chorus and orchestral accompaniment in 1916.¹⁶ The *Marching Song* setting, however, like the later notated versions of the originally aleatoric 1912 *Random Round* fragments, is remarkable in that its final form represented a severe regression from Grainger's initial ambitious aims.¹⁷ Before deciding that instrumental colour was necessary, Grainger wrote that his original vision was:

for voice and whistlers only (no instruments), and ... performed by a chorus of men, women and children singing and whistling to the rhythmic accompaniment of their tramping feet as they marched along in the open air.¹⁸

The initial lack of orchestration for a wordless choral piece created a vastly different polyphonic challenge for the young Grainger, who responded by creating a remarkable web of dense, democratic polyphony unhindered by orchestral idiosyncrasy. The SATB chorus of the later published editions with occasional divisi parts was originally conceived as an impressive SSAATTTBaBBB score,¹⁹ with an additional three-part whistling ensemble, and featuring at times up to fifteen independent lines of melody. The sketches examined in this study exist on two separate leaves dated between 1 May 1901 and 19 September 1902, which joined to form the opening of the work. By applying Grainger's notion of intervallic texture to these sketches, it is postulated that they represent the earliest example of Grainger's fully formed musical fingerprint, predating many of his better-known accomplishments.²⁰ The polyphonic complexity he achieved within these homogenous vocal forces not only shows the completion of a radical textural transformation brilliantly portrayed in a pure medium, but also reflects the influences of nature and democracy central to his formal 'free music' experiments of the 1930s.

Before any argument could be made for a period of maturity, it was essential to firstly provide evidence for the hypothesised existence of an 'imitative period.' It is suggested that Grainger's early musical experiences, in formal piano and composition training in both Melbourne and Frankfurt, had a significant influence on his early derivative output. Thus, the *Intermezzo No. 2* from the Op. 119 *Klavierstücke* by Johannes Brahms (1893), studied by Grainger during his time in Frankfurt, was selected from a pool of his early piano repertoire. While numerous works from Grainger's repertoire were analysed in the original broader study, this work was selected as representative here as it belongs to the same decade as his early compositional efforts. Additionally, the Brahms miniature showed a high degree of

¹⁵ 'Today is a great day for Australia, they are trying to get Federation, and this is the day for the public to vote for or against it; and we should get it, it will be a great thing for the country.'—Francis McGee, letter to Percy Grainger, 26 May 1898. Reg. no. 10.0019, Grainger Museum, Melbourne (GM).

¹⁶ A later setting for band was also made in 1948.

¹⁷ Penelope Thwaites, *The New Percy Grainger Companion* (Woodbridge: Boydell, 2010), 70.

¹⁸ Grainger, *Marching Song of Democracy*, i.

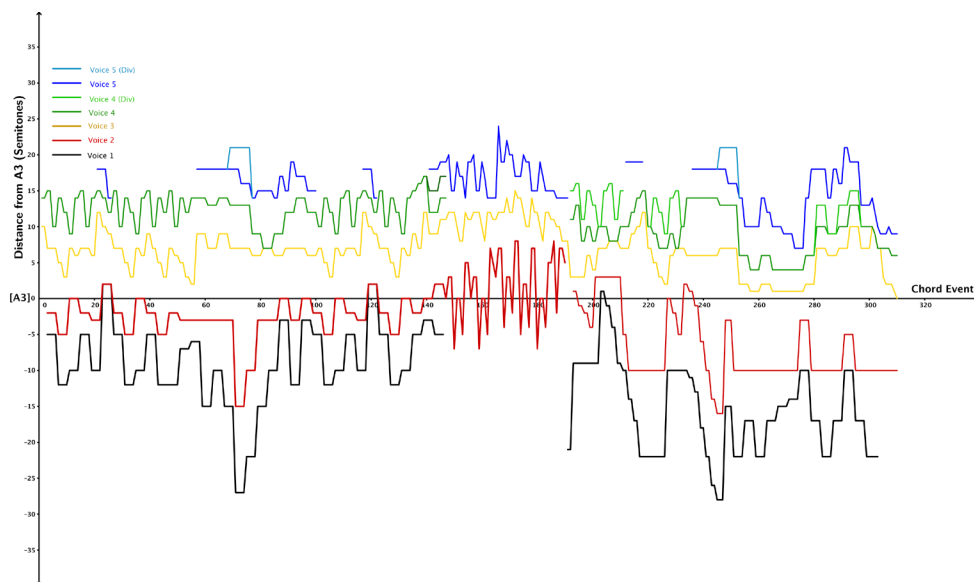
¹⁹ Curiously, the soprano and alto parts are specifically for boy sopranos and altos, effectively making an all-male chorus.

²⁰ Such works include *Free Music* No. 1 and No. 2, *The Warriors* and *Random Round*. The similarly important *Hill Songs*, perhaps the best known of Grainger's early works, also originate from 1901–1902. However, the *Marching Song* sketches represent a more advanced experiment in regard to textural maturity, largely due to the advantages of vocal homogeneity outlined above.

stylistic similarity at observational and auditory levels and, most importantly, contained clear polyphonic lines that could be traced.

The polyphonic map of the first section of the Intermezzo is shown in Figure 1, and numerous structural characteristics that are shared with Grainger's early piano music, as in Figure 2, are visible. These include the lengthy plateaus of the lower voices, clear parallel and similar relationships between neighbouring voices, closer intervals between higher voices, and an ABA structure accompanied by density and register shifts.

Figure 1. Polyphonic Map of Johannes Brahms's *Klavierstücke*, Op. 119, No. 2: Intermezzo, bb. 1–28. A3 is the A below Middle C (220Hz).



The Andante Con Moto (1897) visualised in Figure 2 was chosen as representative of Grainger's imitative style, which is a well-documented quality of Grainger's early piano pieces and possibly the reason behind their frequent dismissal as frivolous works. Such impressions originate with Grainger's contemporaries, with Scott noting Grainger's early 'Handelian tendencies',²¹ a view that John Bird reinforces with his evaluation of them as 'very derivative and written in a sort of Bach/Handel/Mozart/Haydn pastiche'.²² Even Grainger himself obliquely indicates the derivative tendencies of his 'then Handel-like style of composition'.²³

The fruits of Grainger's unhappy compositional studies under Ivan Knorr in Frankfurt also show evidence that his writing imitated the contemporary works of his era, with Wilfred Mellers stating that Grainger's four *Klavierstücke* 'are in style a long way after the slighter piano pieces of Schumann and Brahms',²⁴ and Penelope Thwaites remarking that the Rondo for two pianos is 'clearly a Brahmsian effort,' in reference to this creative era.²⁵ Though well-

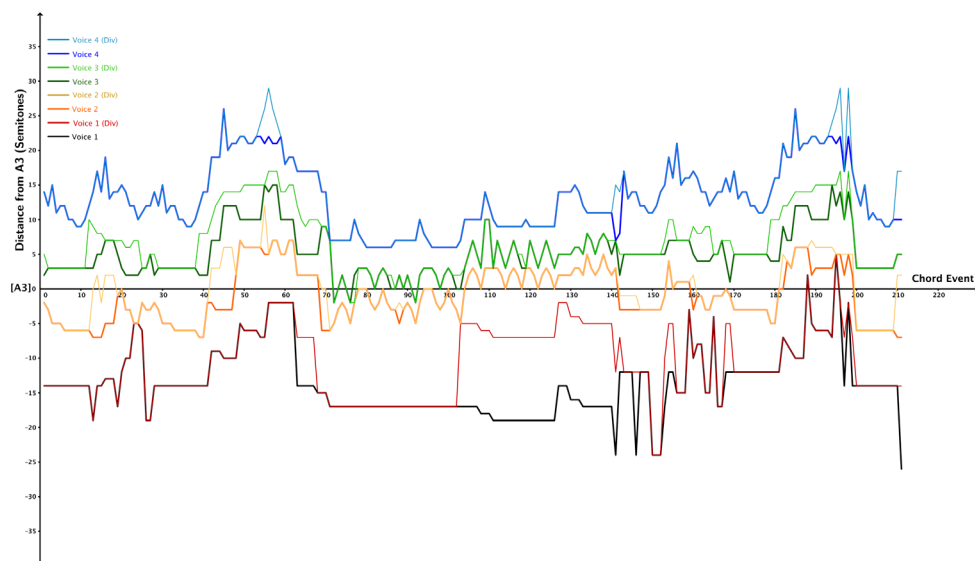
²¹ John Bird, *Percy Grainger* (South Melbourne: Macmillan, 1977), 35.

²² Bird, *Percy Grainger*, 33.

²³ Bird, *Percy Grainger*, 115.

²⁴ Wilfred Mellers, *Oxford Studies of Composers: Percy Grainger* (New York: OUP, 1992), 11.

²⁵ Penelope Thwaites, *Percy Grainger, Piano Music for Four Hands*, CD liner notes (Sussex: Pavilion Records, 1993), 2.

Figure 2. Polyphonic Map of Percy Grainger's *Andante Con Moto*, bb. 1–60

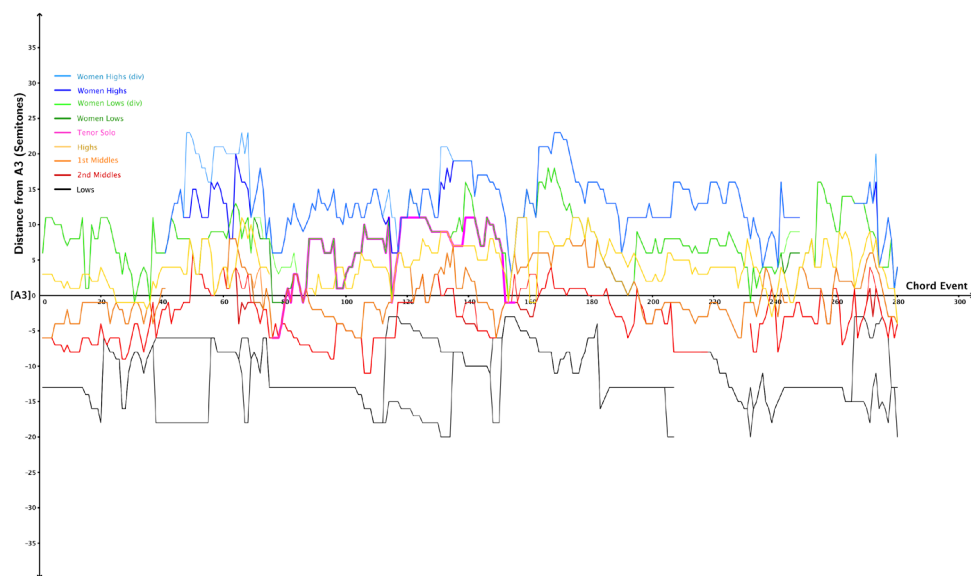
crafted and precocious, the works rarely attract academic attention and as the above comments imply, the early piano works represent Grainger at his most imitative, and therefore at his least idiosyncratic. Figure 2 shows that *Andante Con Moto* possesses the same traits as the Brahms *Intermezzo*, with vertical spacings, vocal relationships and structure following the same dependent behaviours.

Despite the small number of years between *Andante Con Moto* and the *Marching Song*, a transitional period was hypothesised. A slightly later work that exhibited signs of experimentation and veered away from the pianistic medium was required for comparison. The choral work *At Twilight* (see Fig. 3), originally set to part of the Kipling text *The Rhyme of the Three Sealers*, provided an excellent transitive model. Although it was composed between 1900 and 1909, over half the work is listed as sketched in October 1900 (or before), in Frankfurt.²⁶ *At Twilight*, however, still retains hallmarks of traditional polyphony.²⁷ In Figure 3, we can see the increased polyphonic freedom in the form of linear merging and intertwining, as well as a much denser format. Aspects such as the static, leaping tendencies of the bass and the communicative necessity of the text, however, limit the freedom of movement.

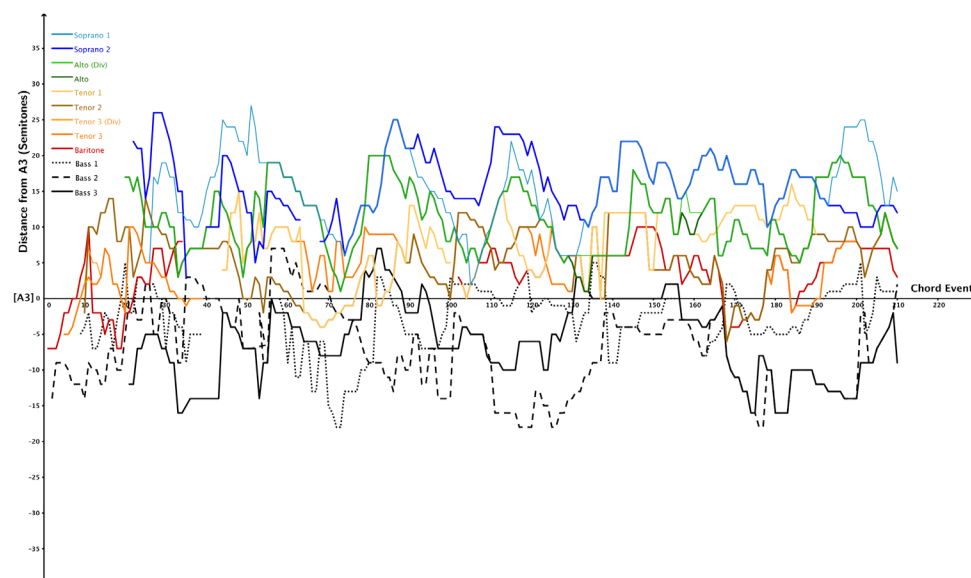
Finally, the analysis of the *Marching Song* sketches (see Fig. 4) demonstrate a radical degree of liberation and a democratic approach to composition. The entangled web of voices facilitates the absence of observable structure and dependent relationships in either axis. The overlapping of voices is considerably more noticeable and numerous polyphonic lines usurp vocal roles such as traditional bass and soprano voicing. The analogous democratic element is observed in the inherently melodic behaviour of each line; no single voice dominates and independence of motion is largely preserved. As Grainger would much later describe of the concept of 'free music,' it shows how 'the melodic lines may slide and glide to any depths and

²⁶ Percy Grainger, *At Twilight*, 1909, unpublished music score, MG3-4-1, GM, 18.

²⁷ Thwaites, *New Percy Grainger Companion*, 178.

Figure 3. Polyphonic Map of Percy Grainger's *At Twilight*, bb. 1–63

heights of (practical) tonal spaces ... they have freedom of movement.'²⁸ As Figure 4 shows, this leads to a highly anarchical result.

Figure 4. Polyphonic Map of Percy Grainger's *Marching Song of Democracy Sketches*, bb. 1–24

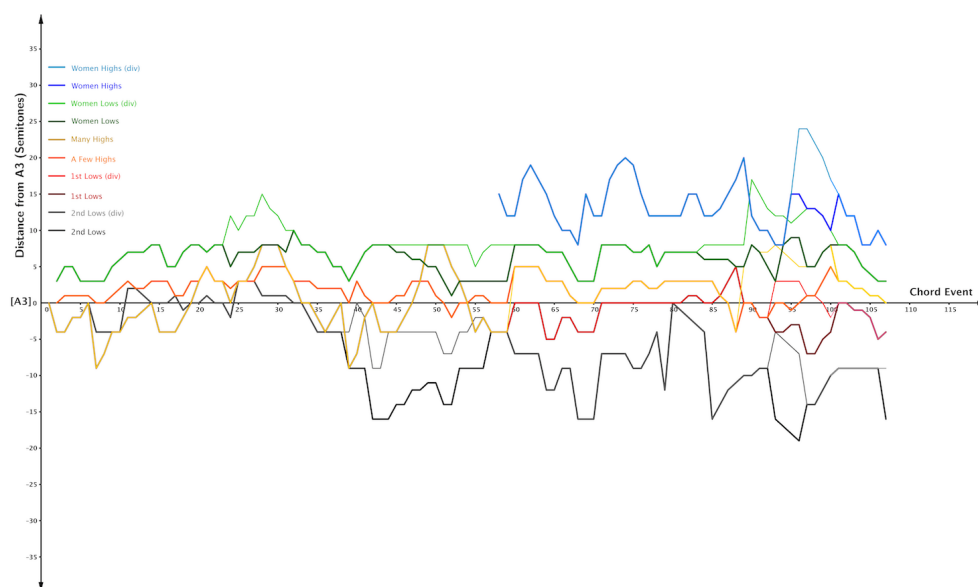
These polyphonic maps follow the trend of Grainger's compositional output from salon piano pieces, through Kipling-inspired choral music, before arriving at wordless choir via the influence of Walt Whitman and democratic ideals. It is not suggested that all of Grainger's subsequent works contained this same degree of polyphonic liberation. Compositional

²⁸ Percy Grainger, quoted in Thwaites, *New Percy Grainger Companion*, 70.

refinement, the exploration of orchestral colour and the experimental, and Grainger's general eclecticism, had profound effects on his texture. Furthermore, not only is music with mixed orchestration sub-optimal for this form of analysis, but instrumental idiosyncrasies and limitations place restrictions upon the free melodic movement of the vocal line.

The emergence of this liberated polyphony does, however, appear in his output frequently, and is particularly visible in the medium that best approximated his later 'free music' machines: the wordless choir. For instance, the opening half of the 1928 *Australian Up-Country Song* (see Fig. 5) is composed using the same close-knit and tangled behaviours of both the *Marching Song* and the *Free Music* No.1 and No.2, before reverting to a more traditional chorale setting. Therefore, it is suggested that the texture most closely identified with the mature and, by Grainger's own admission, most original writing, was first achieved in the 1901 sketches, restrained only by the quantified nature of pitch and rhythm.

Figure 5. Polyphonic Map of Percy Grainger's *Australian Up-Country Song*, bb. 1–21



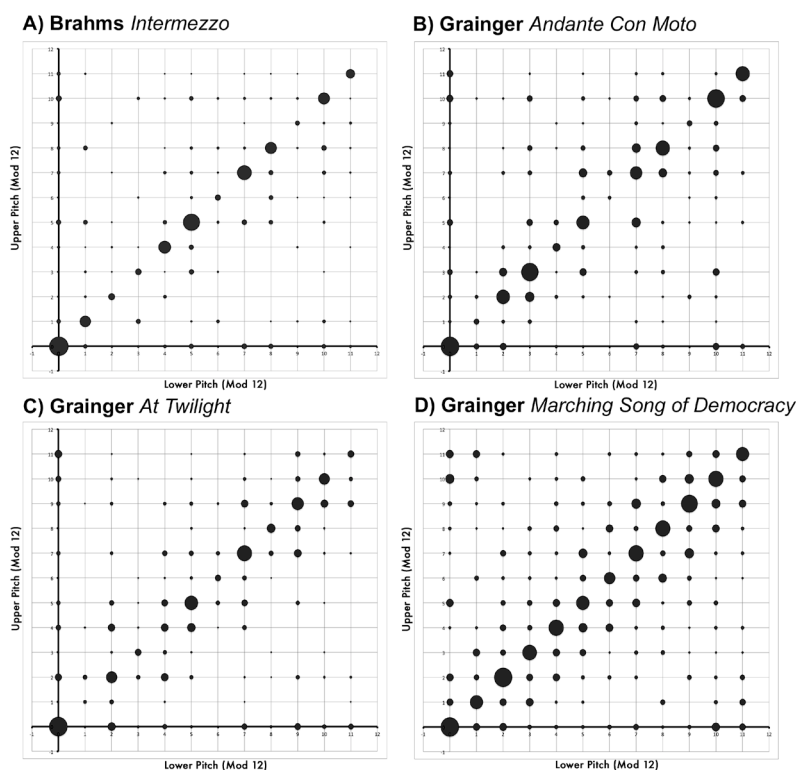
Horizontal Analysis

As statistician and composer Jan Beran observes, 'in music that is based on scales, pitch (modulo 12) is usually not equally distributed',²⁹ and so arranging data in this fashion became an ideal test for measuring and comparing pitch equality. As stated earlier, the cyclical nature of the twelve-tone scale made it possible to examine a piece's horizontal network preferences within a modulo 12 framework, where each pitch was translated into a number depending on its note name. This effectively condensed the pitches used in each piece into a single octave, and allowed them to be grouped into pairs of neighbouring intervals, thus identifying all the motions any given pitch makes. The data was then permuted (rotated) for each piece so that the most frequent pitch (most often the tonic) became the central pitch (positioned along the lines $x=0$, $y=0$) with the others following incrementally in semitones.

²⁹ Jan Beran, *Statistics in Musicology* (Florida: CRC Press LLC, 2003), 64.

The common feature of this data is a central diagonal line, as can be seen in the bubble graphs of Figure 6.³⁰ This indicates that static motion (while one or more non-static motions occur in other voices) plays a major role in all studied works. However, Brahms's *Intermezzo* and Grainger's *Andante Con Moto* and *At Twilight* all show distinct inconsistencies along this line, with data concentrated in certain points—such as perfect fourths (5, 5) and fifths (7, 7)—and largely absent in others such as the tritone (6, 6). This reflects the existence of a tonal hierarchy where not all pitches are considered equal. This pattern also holds for examining these graphs from a vertical or horizontal perspective. For instance, there is a consistent aversion of motions to and from the tritone along both the lines $x=6$ and $y=6$, while non-static data ($x \neq y$), representing prioritised motions, is asymmetrical, and more likely along lines of tonal relevance. Conversely, this is also evident in the absence of numerous data points, where a large proportion of combinations do not occur at all on the 12 x 12 grid.

Figure 6. Horizontal Relationships in Modulo 12



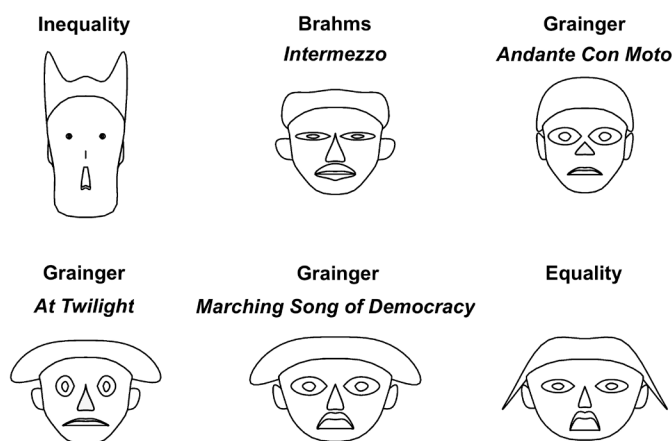
In contrast, analysis of the *Marching Song* sketches reveals a much stronger central diagonal line with a high degree of consistency, making the central pitch (0, 0) less significant. Further, the data distributes evenly on either side of this line to a much greater extent, with a significant spread running parallel to the $x=y$ line, indicating that the likelihood of non-static pitch motions

³⁰ The diameters are normalised so that the largest 'bubble' in each graph is the same size and the others are proportionately diminished.

are not based on tonal hierarchies. Instead, they are governed simply by the proximity of one pitch to another, a principle essential to the gliding tones of the later Free Music pieces. Finally, the number of unexplored pitch relationships is greatly reduced in this graph, showing a more even and natural distribution. These linear results could be achieved through careful systematic determination to ensure such equality. Conversely (and much more likely in this case), this could also be achieved through a total disregard for harmonic governance and a preference for autonomous polyphonic lines. This result presents strong evidence that Grainger developed a horizontal style of composition, where the motions of each part are not dependent on a harmonic framework. Rather the opposite is true: the vertical harmonies are created by independent, localised motions of melodically driven voices.

To visually communicate the relative distances of these pitch relationships from equality, six Chernoff faces were prepared (see Fig. 7) for the four studied works, as well as two additional models to visually represent inequality and equality. For inequality, the facial parameters were governed by a hypothetical, minimalist piece where one central pitch is repeatedly performed against a small percentage of other pitches. For equality, the hypothetical piece gave each of the 144 grid points equal data values, meaning all pitches and their movements were distributed evenly.

Figure 7. Chernoff Face Representations of Horizontal Relationships



Fifteen parameters were required to construct the faces: twelve proportional parameters, relating to height and width of features, and three structural parameters, affecting the overall shape of certain aspects as outlined in Table 1. Conveniently, the vertical sum of each interval ($x=0, \dots x=11$) in Figure 6 provided the proportional data, and allowed the three additional descriptive variables to be derived. These were the standard deviation of the x data expressed as a percentage (face structure), the percentage of unused pitch relationships (smile) and the percentage of static motion data (hair). Due to the tonal inequality of chromatic relationships³¹ and the need to meaningfully pair height and width for each of the features, the circle of fifths was used to provide logical order to this arbitrary relationship by reflecting the assumed

³¹ For example, the tonic and the semitone above it are more imbalanced than the mediant and subdominant.

tonality of the works. Table 1 summarises the choice of parameters for this study, and Table 2 shows the values for the facial shapes.

Table 1. Parameters for Chernoff Faces used in Figures 7 and 14

Parameter	Data Variable
Height of Face	x=0
Width of Face	x=7
Structure of Face	Standard Deviation
Height of Mouth	x=2
Width of Mouth	x=9
Smiling	% of Unused Relationships
Height of Eyes	x=4
Width of Eyes	x=11
Height of Hair	x=6
Width of Hair	x=1
Style of Hair	% of Static Data
Height of Nose	x=8
Width of Nose	x=3
Height of Ear	x=10
Width of Ear	x=5

Table 2. Special Parameter Values used in Figure 7

Piece	Standard Deviation	Unused Relationships (%)	Static Data (%)
Brahms Intermezzo	6.44	34.72	14.34
Grainger Andante Con Moto	5.65	34.72	17.51
Grainger At Twilight	5.65	16.67	25.94
Grainger Marching Song of Democracy	1.72	2.78	38.17

In Figure 7, the inequality face clearly stands out, with the highly unusual music largely devoid of motions outside of its chosen central pitch. The equality face, with more balanced features, is generally more relatable to the others. It is clear, however, that the *Marching Song* sketches are closest to equality in all regards, while the others show distortions in one or more features.

The most challenging element in creating Chernoff Faces is their subjectivity and the fact that the end result greatly 'depends on the order of the variables.'³² For instance, an outlying parameter governing ear height could have less of a psychological effect on a viewer than if it affected mouth shape.³³ Despite this, the very low standard deviation value creates

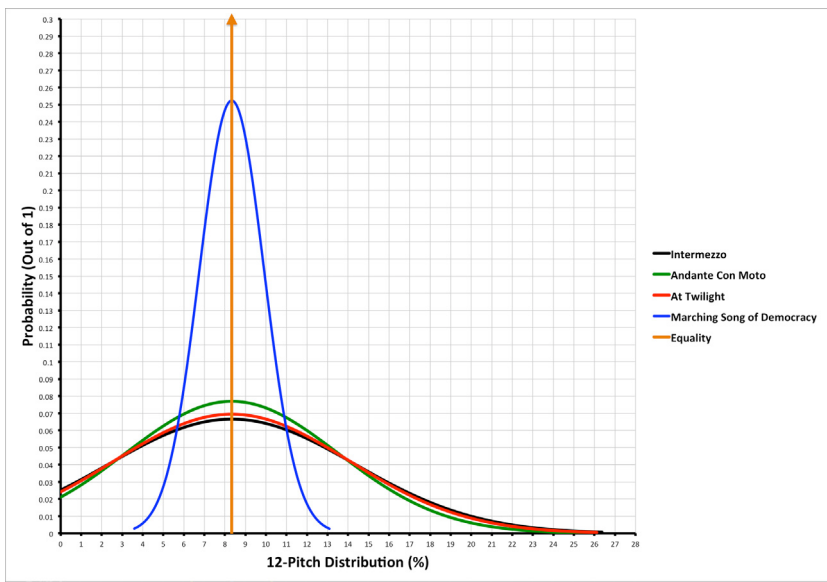
³² Beran, *Statistics in Musicology*, 65.

³³ Beran, *Statistics in Musicology*, 64.

permutations of data for the *Marching Song* which would have relatively little effect on its closeness to equality. The other faces, however, with their varied pitch preferences, would undergo more dramatic shifts. While this highlights the problems associated with Chernoff Faces, the fact that such changes are muted in proportion to their consistent closeness to equality also highlights their meaningfulness while presenting data in a subjective yet accessible fashion.

The proximity to equality is also particularly evident in the standard deviations of the special parameters in Table 2, with the *Marching Song* data dramatically closer to equality than the other works. Figure 8 shows the magnitude of this treatment of pitches as a series of normal distributions. In theoretical equality, all twelve pitches would be valued at 8.33% (100/12) and the standard deviation would be zero, creating a straight vertical line. However, when data is imbalanced and some pitches have large values at the expense of others, as in the three earlier works, the standard deviation increases and creates a curve that spreads out to encompass the wider range of interval percentages. The *Marching Song* sketches, however, have a substantially smaller standard deviation value as all the interval values occur much closer to the equal 8.33% value. This reinforces the case for Grainger’s abrupt, radical change in approach to composition, while the closeness of the earlier pieces, despite crossing mediums and composers, is also evident.

Figure 8. Standard Deviations of Horizontal Interval Equality



Vertical Analysis

Having observed an abrupt shift in the nature of Grainger’s horizontal polyphony, it is also important to evaluate how these various threads interact in a vertical sense. In the previous section, conversion of data to absolute pitch via modulo 12 was particularly suitable for examining horizontal lines, which tended to consist of smaller intervals under an octave. Conversely, the basic use of relative horizontal intervals could support both structured and unstructured melodic patterns. The reference to absolute pitch via modulo 12 is used to determine their exact nature as further investigation was beyond the scope of this study.

The opposite is true, however, when considering vertical sonorities, as their concurrent nature creates a new set of analytical challenges. Vertical relationships of musical texture could be meaningfully viewed as either relative (intervals creating particular moveable structures or substructures), or as absolute (pitches in modulo 12 to again measure the extent of tonal relationships). This required three separate processes to indicate the distinct characteristics of textural choices involved in each studied work, including repetition, equality and relative structure.

The first process, that of specific vertical structures, related most to Grainger's assertion that composers such as Chopin and Cyril Scott could be identified by their choice of harmony. Grainger's notion of texture as fingerprints deriving from the 'conscious or unconscious choice of inversions,' could be easily tested for deliberate vertical intervallic formations.³⁴ At this point it is worth differentiating between traditional notions of harmony and the more specific vertical notion of the multiple possible embodiments of a chord. For instance, a C major chord and its inversions as traditional harmonic functions can instead be considered in terms of interval spacings between notes, the latter being closer to Grainger's idea of the vertical textural component. Examples A to C in Figure 9 illustrate three versions of harmonically identical root position chords with their respective semitone intervals listed above. Figures C (C major) and D (D major), despite having no common pitches, are identical in their vertical intervals, and so from a relative perspective they represent a common structure at which a composer may frequently arrive, regardless of pitch or key.

Figure 9. Measuring Vertical Intervals

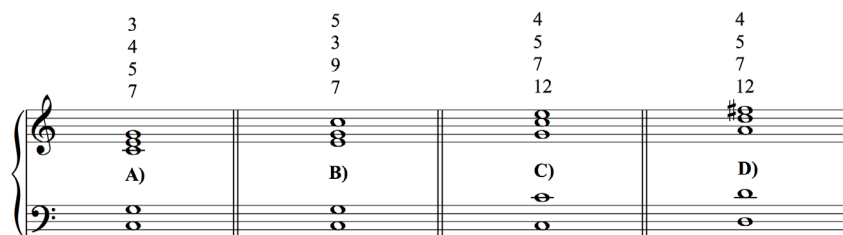
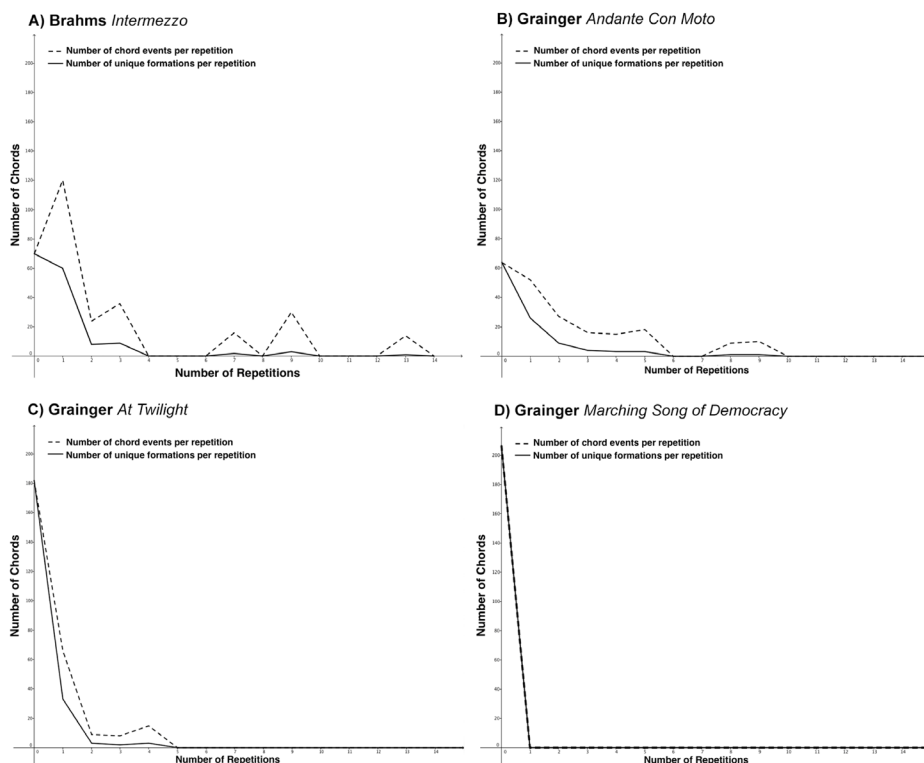


Figure 10 displays the incidence of frequent relationships in the total structure for each work, with the *x*-axis showing the number of times any given interval structure reoccurs and the *y*-axis indicating the number of chords in the piece affected. Each graph contains two multiplicatively related lines, the solid line showing the number of unique formations and the dotted line showing the number of chords affected. For instance, in the Brahms Intermezzo three distinct formations (solid line) occur nine times each, meaning that twenty-seven of the total chord events in the piece (dotted line) occur at that level of frequency. It is also important to note that one repetition means a formation occurs twice and so the value at *x*=0 represents the number of structures that have a one-off appearance in a work.

As can be observed in Figure 10, the Intermezzo is the only piece with the maximum *y* value occurring at a place other than *x*=0. While this does correspond with being the only studied piece not composed by Grainger, there is a more likely thematic cause: that the characteristic repeated chords of the piece, as shown in Figure 11, contribute greatly to the significant spike at *x*=1.

³⁴ Grainger, letter to Parker, 28 Aug. 1916, in Lewis, ed., *Source Guide to the Music of Percy Grainger*, 11.

Figure 10. Repetitive Incidences of Vertical Interval Structures

Figure 11. Johannes Brahms *Klavierstücke*, Op. 119, no.2: Intermezzo, bb. 1–3

Disregarding that particular anomaly, there are characteristics present that are shared with the earlier two Grainger works. While all these graphs show a steep general downward trend in the number of unique formations as repetition increases, an upward reversal of this trend occurs before the lines reach 0, occurring at $x=3$ (Intermezzo), $x=5$ (Andante Con Moto) and $x=4$ (At Twilight). Additionally the Andante Con Moto shares the Intermezzo's feature of isolated peaks at higher levels of repetition, suggesting that there are indeed vertical intervallic fingerprints within these works. *At Twilight*, however, shows evidence of a transitive nature, with a much steeper incline and no structures occurring more than five times.

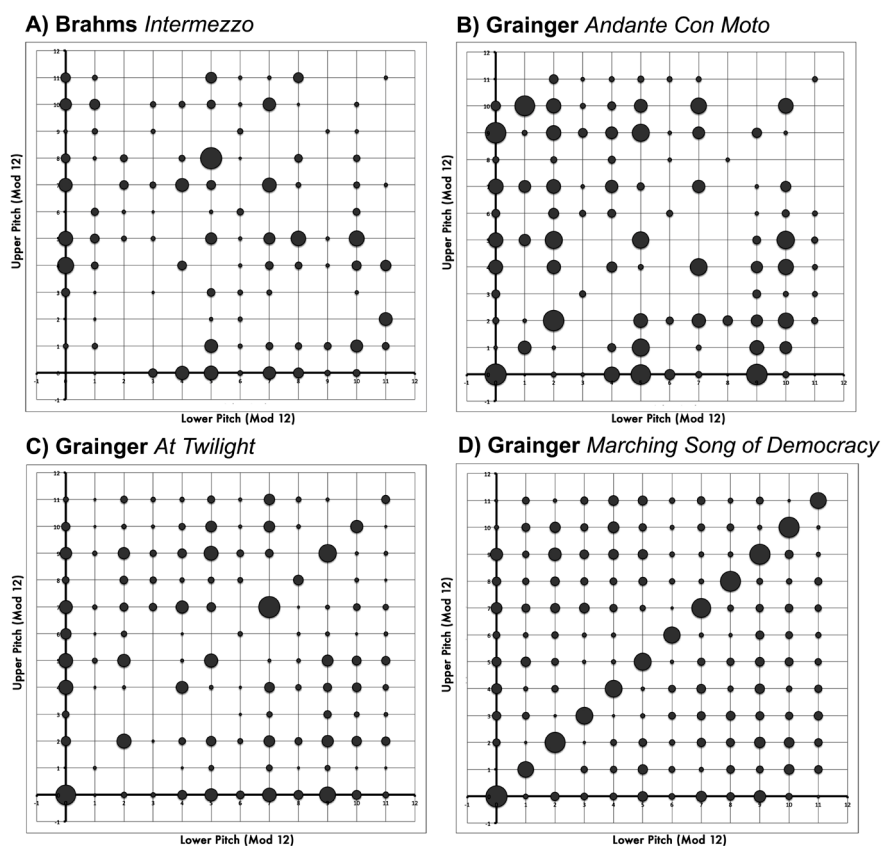
Statistically speaking, any level of repetition indicates deliberate structure; the likelihood of identical structural repetition is quite low in a randomly generated sample on works of this scale. Hypothetically, if the intervals between voices of a simple four-voice chorale were

randomly chosen, with vertical intervals between unison and an octave, the odds of an exact repetition occurring are one in every 2197 chord events. Each of these samples includes hundreds of chord events and the polyphony is vastly more complex. This indicates that the structuring of interval voicing is extremely deliberate despite the evidence of a reductive trend in *At Twilight*.

This leads to the remarkable choice of textures in the *Marching Song* sketches, where no two vertical formations are the same, indicated by 100% of the data residing at $x=0$. Statistically, this is to be expected in either a randomly generated work, or a work created without reference to pre-existing intervallic or harmonic systems. It also leads to the startling revelation that while Grainger claimed his texture was driven by 'vertical clashes resulting from horizontal polyphony,' it nevertheless was also characterised by the absence of a distinct harmonic sound. Rather, it is marked by the continual generation and exploration of new fresh intervallic combinations.

For the second stage of vertical analysis, parallel to the process of dealing with horizontal pitch equality, every incidence of adjacent pitches was converted to modulo 12 (note-names) and permuted so that the most frequently occurring pitch overall was positioned along the $x=0, y=0$ coordinates. These frequencies were then plotted in Figure 12.

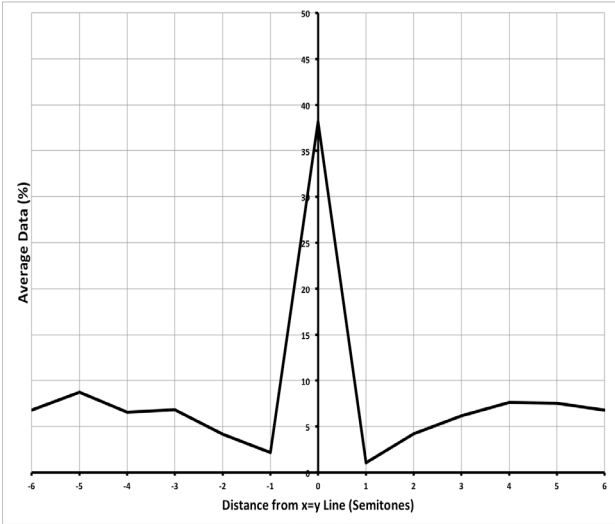
Figure 12. Vertical Relationships in Modulo 12



As with the previous analysis, a transition can be seen occurring in the pieces. The scattered plot of the Intermezzo, with several dominating combinations and many unused pitch combinations, can be compared with the slightly more symmetrical and ordered Andante Con Moto, where many pitches outside of the $x=y$ line predominate. *At Twilight* shows a significant reduction in unused pitch combinations and the emergence of a clear $x=y$ pattern (indicating unisons or octave multiples). As with the horizontal version, there is a clear sense of equality in the *Marching Song* sketches, with very little frequency deviation in the central line, and a remarkably even spread of pitch relationships that are not governed by external structure, but by the intervallic distance from the $x=y$.

Observing the lines both vertically and horizontally reveals the same general trend that applies to all notes in the chromatic scale. The most likely relationship is the unison (or the octave) and then a significant and symmetrical reduction for pitches between a minor and major second apart, before plateauing to a remarkably equal treatment of wider pitches. In other words, for the sketches, the likelihood of any given pitch being stacked upon another depends not on which pitch it is in the tonal system, but on the average probability distribution illustrated in Example 13. This provides an accurate representation of all vertical pitch relationships, relinquishing any reliance on a tonal priority and indicating the same sense of equality as witnessed in the horizontal analysis.

Figure 13. Average Interval Distance of Upper Pitches from Lower Pitches in the *Marching Song of Democracy* Sketches

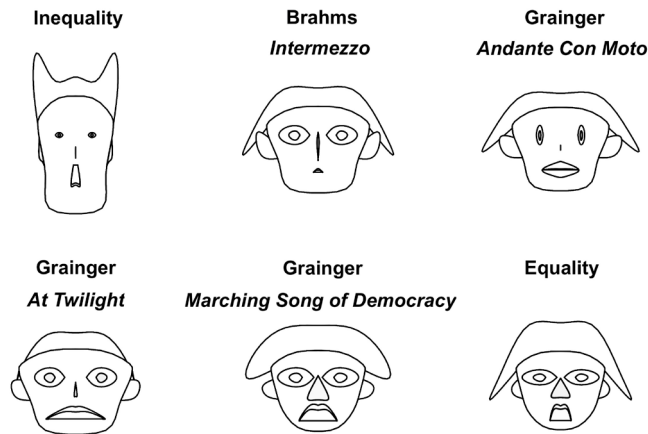


The Chernoff Face method was again used with identical parameter distribution (Table 1) to illustrate the ‘genetic’ relationship of each face to equality and inequality. Table 3 reveals the special parameter values for face shape, smile and hair, again showing much lower values for the *Marching Song*, with the exception of static data caused by the frequent merging of voices. As can be expected from the scattered data, Figure 14 shows the Intermezzo, Andante Con Moto, and *At Twilight* all with distorted features, albeit in different ways than from the horizontal analysis. The *Marching Song*, however, is largely unchanged from its proximity to equality, sharing the same proportionate features.

Table 3. Special Parameter Values Used in Figure 14

Piece	Standard Deviation	Unused Relationships (%)	Static Data (%)
Brahms Intermezzo	5.99	32.64	69.60
Grainger Andante Con Moto	5.18	29.86	55.29
Grainger At Twilight	5.73	29.86	50.59
Grainger Marching Song of Democracy	1.58	9.72	47.03

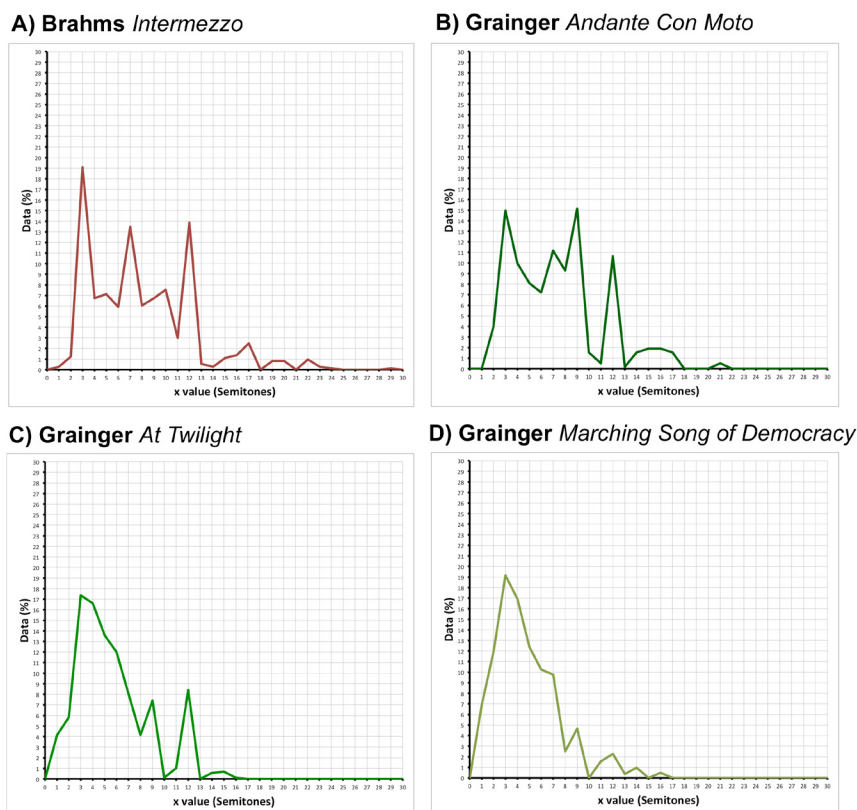
Figure 14. Chernoff Face Representations of Vertical Relationships



One inadequacy of the modulo 12 approach is its inability to distinguish between intervallic relationships equal to or greater than an octave due to its cyclical nature. While this feature had limited significance for horizontal interval analysis due to the overwhelming preference for smaller or static intervals, vertical structures (particularly the octave) play a large role in vertical texture. Another idiosyncrasy was the fact that the absolute modulo 12 system searched for relationships between specific pitches rather than in terms of relative interval frequencies. To counter this, a variation of the previous analysis was required to articulate the data from a relative intervallic perspective and to unravel the cyclical component to reflect wider intervals. For clarity, the bubble graphs similar to those produced in Figure 12 were reinterpreted as a line graph showing the frequency per vertical interval (see Fig. 15).

The important features in these graphs are the peaks and valleys, with large data spikes representing certain interval preferences. For instance, the *Intermezzo*, *Andante Con Moto*, and *At Twilight* all share a strong localised peak at $x=12$, indicating that the octave is a distinctive part of the texture. Being strongly tonal, it is unsurprising that minor and major thirds, fifths and octaves have a strong presence in these tonal works, and that in both the pianistic *Intermezzo* and *Andante Con Moto*, these intervals are in much sharper relief. *At Twilight* shows a more transitive approach, with considerably higher levels across the smaller intervals (major and minor seconds) and a smoother and gentler decline to wider intervals. Despite being a choral work, its octave spike is still significant, linking it to both the earlier works.

Figure 15. Distributions of Vertical Intervals



In contrast, the *Marching Song*'s interval priority is strongly dependent on proximity to the maximum x value ($x=3$). As such, the data is heavily skewed toward smaller intervals. The line follows a much smoother and almost exponentially decreasing curve, with fewer and smaller localised peaks, and the near absence of an octave spike. This is indicative of the absence of external interval structures, showing instead the result of average proximity (a minor third) of voices to one another. This information points to a compositional process where Grainger dramatically eschewed any artificial vertical structuring, with a closely-knit 'weft' emerging naturally as a result of the increasingly liberated horizontal component. Indeed, this data shows he had no conscious preference for any specific vertical trends.

Conclusion

From a vertical perspective, the shift of Grainger's tonally structured texture to the continually regenerated result of a close and freely knit horizontal polyphony is more gradual than the horizontal aspect. Evidence of a middle ground between these two extremes is represented by *At Twilight*. Although this was partially accommodated by the use of the versatile choral medium and the involvement of a greater number of voices, there is still evidence of tonal inequality influencing the work.

The ideal of music liberated from artificial structure are strikingly achieved in the *Marching Song of Democracy* sketches. This is confirmed and communicated in this article through

numerous statistical techniques, including the use of Chernoff Faces. This remarkable work by the young Grainger therefore represents the first occurrence of a completely linear and democratic method of composition, where all voices become a dense 'weft' of melodic textures. In his 1929 letter to Maurice Lowe, Grainger asked:

Should not the outlines of musical voices, in their normal condition, resemble the outlines of mountain ranges, each independent and individualistic in itself, but together forming block effects of majestic complexity?³⁵

The *Marching Song* sketches clearly achieve this mountain range of independence and equality, but fall short of Grainger's refined 'free music' concept by failing to break free from the quantified Western notation system. The principles at work in the *Marching Song* became a secondary consideration until they could be fully realised in his 'free music' experiments. However, returning to the idea of musical texture as an intervallic consideration, these sketches were the first emergence of perhaps the closest thing the eclectic and 'all-round' Percy Grainger ever had to a mature musical fingerprint. Through this analytical lens, Grainger's musical fingerprint is defined ironically by the sheer absence of distinctive structures, in favour of the autonomous result of democratic 'many-voicedness.'

About the Author

Philip Eames is a pianist, composer and PhD candidate in empirical musicology at the Sydney Conservatorium and has previously attained Masters degrees from both the Royal Northern College of Music (Manchester), and the Queensland Conservatorium. His research interests are diverse, encompassing performance practice, mathematics in music, and the works of Ives and Grainger.

³⁵ Percy Grainger, letter to Maurice Lowe, 19 Nov. 1929, reprinted in *The All-Round Man: Selected Letters of Percy Grainger 1914–1961*, ed. Malcolm Gillies and David Pear (Oxford: Clarendon Press, 1994), 101.