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Composing musical branes

Abstract

This paper presents the compositional logic of my most recent piece, *braneworlds*, a 15-minute work for seven musicians, according to three basic concepts: musical space, polymorphic counterpoint, and ‘branes’, as inspired by the popular book *Warped Passages* by experimental physicist Lisa Randall. The idea of musical space is outlined, in which musical parameters—conceived broadly as variable characteristics of music—are taken as dimensions and each work may define its own set of basic dimensions. Musical identities or objects are formed, located at different points within this space. The idea of ‘polymorphic counterpoint’, in which larger-scale internally-elaborated musical structures, rather than lines or points, are superimposed, is drawn upon as a method for exploring in a particularly direct manner the different degrees of identity and difference between objects along the different dimensions. To give this a clear structure across time, the work draws upon the concept of ‘branes’—lower-dimensional ‘slices’ of higher-dimensional realities—from theoretical physics. This is metaphorically adopted in this work to mean musical structures that are fixed for the duration of the work on one or more parameters, but free with regard to others.

In *braneworlds*, four core parameters are chosen to construct the musical space: temporal division, register, pitch, and dynamic contour. Within these, four branes are constructed to which groups of instruments are assigned. These branes fix these instrumental groups with regard to two parameters, but allow them freedom with regard to the other parameters. The branes are also constructed in a complementary sense, such that different groups occupy different ‘ends’ of the musical space, denying the possibility of a number of textures, but also allowing for a wide exploration of identity and difference.

In the course of composing the work, a number of weaknesses and gaps in the compositional logic were uncovered, such as the problem of intermediate values, hierarchies of parameters, and the impact of the sectional form on identity relations. Nonetheless, the logic of the construction of *braneworlds* provides a relatively systematic way of exploring possible relations of identity and difference between musical objects within a constrained space.

Composing musical branes

Liam Flenady

This paper outlines the core elements of the structure of *braneworlds*, a 15-minute work for seven musicians that I composed from May to August 2016,¹ inspired in part by theories outlined in the popular book *Warped Passages* by experimental physicist Lisa Randall (2005). The work was based on a theoretical framework according to which a composition creates a particular musical ‘space’, comprising a number of different parameters, which function as its ‘dimensions’. Within this space, musical objects are formed that exhibit different values in each of the relevant dimensions. In *braneworlds*, these musical objects are presented in ‘polymorphic counterpoint’, which is defined by the superposition of larger musical structures rather than lines or points in traditional counterpoint. This simultaneous presentation of objects provides the listener with a particularly strong experience of their mutual identity and difference. In order to structure this polymorphic counterpoint across time, the concept of *branes* was introduced, which was metaphorically interpreted to mean musical objects that for the entire duration of a work are fixed with regard to a certain number of parameters but free in others. A structure was created wherein different groups of instruments in the ensemble occupy partially opposed ‘branes’, denying the possibility of a unification of the ensemble in all parameters, but allowing for a vast range of relationships of identity and difference.

Through the composition of *braneworlds*, these ideas of musical space, polymorphic counterpoint, and musical branes were tested. A number of logical weaknesses were encountered within the compositional framework, such as the lack of a clear approach to intermediate values and the emergence of a hierarchy between core parameters. Nonetheless, the framework provided a generally coherent and stimulating means to systematically explore a wide range of possible identity combinations within a constrained musical space.

Musical ‘space’ and musical identities

The notion that music can be conceived of as a spatial field of relations is at least in part a legacy of the post-war serialist attempt to do away with previous logics of thematic development, and to replace it instead with a logic of exploring the possible constructions arising from a set of parameters (Grant, 2002, p. 158).

¹ *braneworlds* was premiered by Kupka’s Piano on October 7 at the Judith Wright Centre for Contemporary Arts in Brisbane, Australia.

While initially the goal of this early serialism was to base musical construction on the four presumed primary parameters of pitch, duration, timbre, and intensity, the concept of the musical parameter has since undergone a transformation. On the one hand, these earlier parameters are not entirely fundamental in any case, since ultimately all parameters can theoretically be reduced to structures of simply amplitude and time (Harper 2011, p. 78). On the other hand, these original four can today be seen as fairly “pedestrian” options compared with more imaginative ways of understanding and constructing sounds, such as according to density, tension, or distance (Rutherford-Johnson 2011, p. 6). As such, the term ‘parameter’ is taken here to mean any property of music that can be varied by increasing or decreasing its value.

Richard Barrett (2012) has argued in his article *Stockhausen Today and Tomorrow* that the core of Stockhausen’s serialist thinking conceives of parameters in a similarly broader, less essentialist sense, while also treating these as spatial dimensions of a work. He identifies three central components to this idea:

- (a) identifying the parameters which are to be the focus of a composition, the “dimensions” in which it will exist;
- (b) assigning minimum and maximum values to these parameters and in doing so establishing a “space” with those dimensions;
- (c) making musically-significant movements across those parametric dimensions, or to put it another way, making a journey of discovery through the space they create.

It’s not a question of relating everything to a “series” but of relating everything to everything else.

This idea that music can be conceived of as space has been further elaborated by Adam Harper (2011), who proposes the concept of ‘music space’ as “a notional phase space that can constitute all possible art objects ... that relate primarily to the production of sound” (p. 81). This space is effectively infinitely variable, since any aspect of the production or reception of sound can be considered a parameter or ‘dimension’ (Harper prefers the term ‘variable.’) According to this idea, a musical work constitutes a subset or region of this vast space, where certain parameters are more fixed than others according to both their ranges and their ‘quantisation’, or, how far the extremes of the parameter extend, and how movement along this dimension is divided or structured (for instance, a scale played on the piano will both limit the potential pitch range as well as make discrete what is in reality a frequency continuum) (pp. 36–41).

Within this concept of a work, *braneworlds* emphasised the formation of musical objects that are defined by their relative position with regard to each of the different parameters or dimensions at play. This particular approach to the

construction of musical identities was influenced by Stockhausen's notion of a 'moment', wherein the identity of a region of music as a unified object depends on the stability of a number of 'characteristics', or particular parametric values, over a period of time (Maconie, 1989, p. 63). As such, I was interested in creating objects with clearly defined durations throughout which they occupy a particular position in the multi-dimensional space created by the logic of the work.

This also meant thinking in terms of the relative position each object occupies with respect to each other object. The structuring principle of the work was to 'compare' identities within this space. For instance, one object may be 'close' (similar) to another object in one dimension, while being far away (different) in another, and so on, leading to a vast multi-dimensional field of relations between objects.

Polymorphic counterpoint

The particular focus of *braneworlds* (as it is in my current doctoral study) was not just on how the musical space of a work can be explored, as Barrett (2012) suggests, nor simply what identities can be created within it, but principally on how the form of a work can bring about intense experiences of the various degrees of difference or similarity between objects within this space.

At the heart of this approach is a new concept of polyphony, or as I prefer to call it, 'counterpoint' – this is because, as should become clear, my emphasis is on the comparison or contrast (*counter*) of different points within this multi-dimensional space (*point*). As Claus-Steffen Mahnkopf (2002) has argued, the "essential polyphonic relationships" of today are not about simple 'note-against-note' relationships, but, instead

those between "forms," i.e., rhythmic and syntactical units (lines, parts of lines, morphemes, "figures," "gestures" etc.). Polyphonic relationships therefore emerge between units already internally connected, not between separate, pointillistically positioned elements. (p. 40)

In this view of contemporary counterpoint, therefore, the 'polymorphy', or differentiation of 'shape' or identity, of the elements is of a far greater importance than previous polyphonic approaches (p. 40-41). This idea of a fundamentally polymorphic counterpoint is not entirely new, of course. As Rudolph Reti wrote in the late 1950s, whereas the polyphony of the Second Viennese School as much as Stravinsky (however different) had a generally linear, classical logic, "Ives for the first time in history establishes, or at least tries to establish, in quite a number of his compositions a *polyphony of groups*" (1962, p. 172). As in Mahnkopf's conception, the core musical elements of this kind of counterpoint are "not lines but full musical entities" that have their own internal structures (p. 173).

In composing *braneworlds*, two logically distinct aspects to this idea of counterpoint were separated: firstly, the construction of identities and relations in the abstract musical space of the work, and secondly, their formal deployment in the time of the work. On the one hand, Barrett (1998, p. 17) has pointed out that the “spatial view of musical relationships” associated with serialism in a broad sense, positions itself as “outside time”. This means that the relations of identity and difference between musical objects in a space are not, logically speaking, affected by their position in the work, which is indicated by the post-war serialist composers’ interest in the notion of ‘open form’. On the other hand, the idea behind the construction of *braneworlds* is that placement in time in the work – what is generally called musical ‘form’ – has a profound effect on the strength *for perception* of these relations. As such, it is not the relations of identity between two objects themselves that are directly manipulated but the *degree of presence for perception* of these relations of identity. Thus, the closer two musical objects are presented within the form of a work, the more perceptually intense their similarity and difference will be; the further apart these two objects, the less perceptually intense this comparison will be. The most extreme case of formal proximity is that of simultaneity, or counterpoint.

In his book *A Union of Diversities*, Larry Starr (1992) points to the specific experiential intensity of the vertical layering (as opposed to horizontal juxtaposition) of stylistically heterogeneous groups in the works of Charles Ives:

When the styles are presented side by side, they can be seen as analogous in certain ways to thematic areas in more traditional compositions. When styles are super-imposed no such analogy is possible [...]. These works speak with particular forcefulness to life’s irresolutions and incongruities, to those coexisting aspects of existence that do not interact with – sometimes, do not even acknowledge – one another. (pp. 115-116)

So, while the question of where different identities appear in the succession of musical ideas of a work is important, *braneworlds* focussed on exploring how different vertical combinations of ideas could bring forward particularly intense feelings of the differences and similarities able to be produced within a given musical space.

Branes

In order to achieve this, the full ensemble of seven musicians was divided into four groups:

Group I: flute 1.

Group II: flute 2 (doubling alto flute and bass flute) and percussion (pitched and unpitched).

Group III: clarinet (doubling bass clarinet) and piano.

Group IV: cello and electric guitar.

This allowed for textures of up to four different musical objects at a time, and the structuring of the relative proximity or distance of the groups from each other across the course of the work became the primary formal concern.

Inspired by the idea of ‘branes’ as outlined in the book *Warped Passages* by theoretical physicist Lisa Randall (2005), each group was assigned to a ‘brane’ within the multi-dimensional space. A brane, Randall explains, is a lower-dimensional “slice” of a higher-dimensional space (p. 50). If physical reality has as many as ten or more spatial dimensions, as string theory posits (p. 16), our human universe would represent a three-dimensional brane within this extra-dimensional space. We are free to move about within the three dimensions, but are fixed with regard to the other dimensions.

Taking this as a metaphor, each group in *braneworlds* was located on a brane, meaning that each group has a number of dimensions, or parameters, in which it was largely fixed for the entirety of the composition, and others in which it was very free to move around. Four essential parameters were chosen that would play this deep structural role. These were the only parameters dealt with in the work, but these were the most fundamental in the establishment of the initial space of the work; others were dealt with on a more intuitive level as the composing progressed.

A number of parameters were fixed in advance by the context of the work and could not be chosen as parameters to structure. Timbre, for instance, was already largely fixed by the properties and build of the instruments and thus the groups could not move through this dimension with sufficient freedom for the purposes of the composition. Likewise, as spatial position is more or less unchanging in any performance context, it had to be ruled out. The four parameters essential dimensions were:

1. Temporal division of section lengths.
2. Register.
3. Pitch.
4. Dynamic contour.

Each parameter was given a ‘minimum’ and a ‘maximum’ value, as in Barrett’s above quote. These were partly based on the inherent properties of certain instruments. For instance, the guitar’s capacity for volume swells and the percussion’s natural decay influenced the idea of including ‘dynamic contour’ as an essential parameter. Likewise, the ‘minimum’ of the pitch dimension ended up being a 25-quarternote series and its underblown pitches on the flute (a technique

derived from my flute solo *warped passages*, also inspired by Lisa Randall (2005). The maximum and minimum values for each parameter were:

1. Temporal division:
 - Max: largest temporal division of each section, according to a scale of ‘tempo frames’ (see below): 17, 23, 31, 41, 53, 61, or 71.
 - Min: smallest temporal division of each section according to this same scale: 5, 7, 11, 13, 17, 19, or 23.
2. Register:
 - Max: within the top two and a half octaves of the ensemble range.
 - Min: within the bottom two octaves of the entire ensemble range.
3. Pitch:
 - Max: an expandable, non-tonal, sequence of major and minor triads.
 - Min: 25-quartertone series and its derivative pitches from flute underblowing.
4. Dynamic contour:
 - Max: crescendo.
 - Min: decrescendo.

This resulted in a total of eight extreme values. Since there were four groups, each group was assigned two values:

Group I (flute): Register max, pitch min.

Group II (flutes, percussion): Tempo min, dynamic contour min.

Group III (clarinets, piano): Tempo max, pitch max.

Group IV (cello and e-guitar): Register min, dynamic contour max.

Each group could move freely with regard to the two other essential parameters (and any other unspecified parameters), but was fixed with regard to the two above.

To aid with forming a relational space, a scale from one to five for each parameter was established, where one was the parametric minimum and five the maximum. As the compositional process developed, it became clear that often the in-between values were not precise, and had to be intuitively interpreted in the context of each section.

Core parameters

1. Temporal division

The parameter of temporal division was particularly important in this work. An early decision made in the planning of this work was that each group would have its own clicktrack, which facilitated a high level of temporal

dissociation between groups. These multiple clicktracks were synchronised by a Max/MSP patch created by composer Vincent Giles. Each formal section of the work (or ‘region’ as they were called in the score) was divided evenly according to a scale of ‘tempo frames’ that were made up of a range of prime numbers above 5, as shown in Table 1. The choice of prime numbers above 5 was to ensure that no simple ratio of, for instance, 1:2 could occur, and that each different division would yield a substantially differentiated tempo. Depending on the length of the section (sections ranged from 5 to 130 seconds in length) and the desired general speed of materials, a different level of the scale would be selected.

Table 1

Tempo frame	Min (1)	Intermediate (2-4)	Max (5)
1	5	7, 11, 13	17
2	7	11, 13, 17, 19	23
3	11	13, 17, 19, 23, 29	31
4	13	17, 19, 23, 29, 31, 37	41
5	17	19, 23, 29, 31, 37, 41, 43, 47	53
6	19	23, 29, 31, 37, 41, 43, 47, 53, 59	61
7	23	29, 31, 37, 41, 43, 47, 53, 59, 61, 67	71

Thus the scale of values for this parameter from one to five changed depending on the ‘tempo frame’. The value of 1 and 5 were always the minimum and maximum, and the value of 3 was always the middle or one of the two middle divisions. The values of 2 and 4 were significantly freer, especially in the higher tempo frames, being any number in-between the minimum and the middle, or the maximum and the middle, respectively.

Beyond this basic temporal structure, a further step was required to create a basic pulse for longer sections, since these values often yielded pulses with bpm's below 30, and sometimes below even 10. This was done by deciding on a basic subdivision of these major divisions. For instance, in Region 3, which has a total duration of 55.5 seconds, Group IV divided the section into 23 basic divisions, resulting in a bpm of 24.87. To give a basic pulse, these divisions were further subdivided by 7, to give a pulse bpm of 174.1.

In very short sections where the initial division already produced a fast pulse, this extra subdivision layer was generally not added, but pulses were

grouped together relatively intuitively into bar structures. This extra subdivision step meant that the surface rhythmic speed of a group located on the minimum of the temporal division parameter, but with a high subdivision, could theoretically be faster than one located on the maximum but with a low subdivision. This seemed to undermine the function of the minimum–maximum scale for this parameter. To correct this, the primary divisions had to be made relatively obvious to perception. Therefore, each division was usually translated as a bar, and each bar defined a particular event, based on one of their key parameters:

Group I: change of fingering.

Group II: decrescendo.

Group III: change of harmony.

Group IV: crescendo.

This meant that, while the surface speed could be fast in a group with a slow temporal division, it would still preserve a slow tempo in terms of the change of a fundamental element, whether that be pitch or dynamic shape.

In certain regions of the work, the metres were constant at the given number of subdivisions, producing a stable metre across the region; in other regions, this subdivision value was used as the average metre length, around which the metres varied according to three basic shapes: contracting length (acceleration), expanding length (contraction), and fluctuating values around the average. Where divisions were entirely even and all groups had different values in this parameter, this meant that there would be a long-range, complex polyrhythm on the level of their metric structure, with no common downbeat until the start of the following section. Where the subdivision was instead an average value and the metres changed, the parameter of temporal division would give an overall differentiation of speed of change in a more ‘statistical’ sense, giving an overall density and effect without having a determinate polyrhythmic relation to other groups. In either case, this approach to time meant that the four groups aligned rhythmically at the start of each region of the work, but were often independent from that point until the start of the next one.

One upshot of this relatively complex approach to temporal construction was that the idea of having a full score was abandoned, since the temporal relations between the parts were too complex for music notation software and would have been extremely time consuming to draft by hand. For *braneworlds*, therefore, there were only four parts—one for each group—and a basic form scheme to outline the basic overall structure.

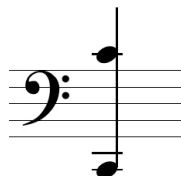
2. Register

The dimension of register was a relatively simple one for construction, and an extremely important one for perception. In general, the construction of register

was done by a trade-off between delimiting very distinct bands within which the groups operated, and giving the groups enough of a compass for internal variation. In the end, fairly wide compasses for the minimum and maximum values were decided upon, which led to a fair amount of overlap between registers, while allowing them to remain perceptually distinct. The maximum registral value was given by the register of the flute in pitch sequence as well as its underblowings, giving a range of:



The minimum registral value was defined by the low cello C, up to around middle C (with the occasional excursion to above pitches):



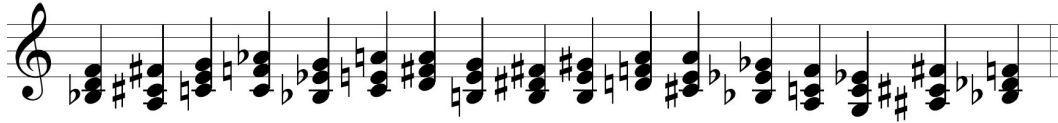
This low C was thus taken as the lowest note of the work, and as such the piano does not play any notes below this throughout.

At each point of the work, the groups occupying the maximum or minimum values would tend to stay within a much smaller registral compass than the full range given by this position. They would, however, always occupy the highest or lowest position in the ensemble texture. As such, the intermediate values were not given such clearly fixed registral bands across the entire work, but were determined at each region according to the context of which register within their overall compass the highest and lowest groups were playing.

3. Pitch

The pitch parameter did not have a logical minimum and maximum in the same way as register, for instance. Instead, it was built around two conflicting pitch frameworks. The 'maximum' value was attributed to a sequence of alternating major and minor triads, intentionally avoiding a tonal centre, and root motions of semitones and minor thirds were generally avoided. The sequence was partially palindromic, at the middle it was reversed but chords swapped their type from major to minor or minor to major:

B♭M F♯m CM Fm E♭M Am DM Em BM EM Dm AM E♭m FM Cm F♯M B♭m



This was expandable and contractible by intuitively interpolating new triads or sequences of triads at various points along this original sequence, always preserving its basic characteristics.

The ‘minimum’ value was assigned to the following pitch sequence and its underblown pitches, produced by a change in embouchure shape, intensity of air stream, and sometimes position of the flute. In the figure below, the high notes are the fingered pitches, all notes underneath are possible underblown pitches. Pitches were approximated to the eighth-tone, though these were often very unstable.



The specific qualities of these underblown notes could obviously not be replicated in all other groups, however, the pitches themselves were transposable to the registers of other groups.

Finding clear intermediate values for this parameter was difficult, and a number of loose strategies were adopted across the course of the work, for example: for the close-to-minimum value (2), the above pitch sequence was varied, its ordering changed and/or new pitches added, and usually the number of underblown notes present was reduced; for the close-to-maximum value (4), the chord sequence was normally varied by adding different repetitions of smaller sequences of chords within the progression, or by having two variations of the chord sequence played simultaneously, preserving the presence of triads, but with more dissonant and complex sonorities. In the case of the middle value (3), an intuitive atonal pitch sequence was used, which was more or less equidistant from both pitch sequences, though technically not ‘between’ them.

4. Dynamic contour

Rather than fix ‘dynamics’ themselves (where one group would always play *pp* and the other *ff*, for example), which would limit the degree of control over dramatic shape in the work as well as potentially leading to rigid hierarchies between groups, the dynamic contour of the groups was fixed. Again, as with the

pitch parameter, the terms ‘minimum’ and ‘maximum’ were a little misleading, signifying here the two opposite poles on a spectrum from decrescendo to crescendo. This meant that the five different values translated as: 1 = decrescendo each division/bar; 2 = general decrescendo, though not necessarily in sync with the division structure; 3 = stable or generally fluctuating dynamics; 4 = general crescendo; 5 = crescendo each division/bar. As with other parameters, these intermediate values were not hard and fast, but often intuitively determined at each section.

This parameter was sometimes problematic at fast tempos, since crescendos and decrescendos were generally not possible on each division in very short sections, for instance, where each division had a duration of less than half a second. In this context, the ‘rule’ of the work requiring each division manifest a decrescendo was usually broken, and instead crescendos were applied to small groups of divisions.

One further issue with the use of parameters that emerged in the work was that an unanticipated hierarchy emerged. Upon listening to the work, it was evident that the registral placement of objects was primary in their differentiation, followed by temporal division, then pitch, and finally dynamic contour. This was a logical weakness in the work, and suggests that the idea of musical ‘space’ needs a nuanced interpretation, where dimensions are not assumed to be equal.

Ensemble identity relations

Despite some of the logical weaknesses, the parametric structure outlined gave sufficient space for the differentiation of musical objects. At the same time, the structure also limited the number of possible musical objects. On the one hand, a musical object with the characteristics of being played by a flute, in the high register, with quartertones, very fast, and crescendo was completely possible in the work; on the other hand, an object with the characteristics of being played by a flute, in the high register, with major and minor arpeggios, very fast, and crescendo, was not possible.

The ‘brane’ construction of the work played a role not only in the limiting of the set of possible abstract musical entities but also in their simultaneous layering in the work. If each of the groups was differently fixed with regard to two out of the four parameters, then it is impossible that all four groups could have unified characteristics on all four dimensions. For instance, a texture could have existed in which groups I, II, and IV could play in the same tempo, but not group III; groups II, III, and IV could play in the same harmonic field, but not group I; groups I, II and III could play in the same high register, but not group IV; and groups I, III and IV could have the same crescendo dynamic contour, but not group II.

Within this constrained space, the goal of the work was to explore a large number of combinational possibilities of different identity structures, from highly unified textures to highly dissociated ones.

First of all the possible vertical texture combinations (which groups or instruments play when) were explored in a relatively comprehensive sense, resulting in a high degree of differentiation of textural density. Table 2 shows the final structure in the work itself, where ‘regions’ are the sections of the work; x signifies that the whole group plays; and x¹ signifies that one of the two instruments in the group plays:

Table 2

		REGIONS																						
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
GROUPS	I	x	x	x	x		x	x	x		x	x	x		x		x			x		x	x	x
	II	x		x		x	x ¹	x	x ¹		x		x	x		x	x	x		x				x ¹
	III			x	x			x	x ¹	x	x			x	x ¹		x	x		x	x		x	x ¹
	IV			x	x	x		x	x ¹		x	x	x				x	x	x		x	x		x ¹

This equals:

- Four group solos.
- Three duos between single instrument in different groups.
- Six duos between different groups.
- Four trios between different groups.
- Two quartets between single instruments in different groups.
- Four tutti sections.

Once this was established, the possible combinations of parametric identity between groups, given the ‘brane’ structure outlined above, were developed. A number of basic ensemble relationships that gave structure to the possible identity relations within the work were established, while leaving their precise realisation fairly free until the notational stage:

- ‘Stratified’: Each group had a separate set of values in each parameter, so as to create a maximally differentiated polyphony.
- ‘Dom-1’ (‘1-dominated’): Each group adopts, to the extent that it can, the fixed values of Group I: Group II, register max and pitch min; Group III, register max; Group IV, pitch min.
- ‘Dom-2’: Each group adopts, to the extent that it can, the fixed values of Group II: Group I, tempo and dynamic contour min; Group III, dynamic contour min; Group IV, tempo min.
- ‘Dom-3’: Each group adopts, to the extent that it can, the fixed values of Group III: Group I, tempo max; Group II, pitch max; Group IV, tempo and pitch max.

- ‘Dom-4’: Each groups adopts, to the extent that it can, the fixed values of Group IV: Group I, dynamic contour max; Group II, register min; Group III, dynamic contour max and register min.
- ‘Bifurcation’: Groups I and II unify, register max, tempo min, pitch min, dynamic contour min; Groups III and IV unify, register min, tempo max, pitch max, dynamic contour max.
- ‘Heterophony/micropolyphony’: High degree of similarity (usually including register) between parameters of two or three groups.
- ‘Homogeneity’: homogeneity of materials in other parameters, despite stratification along the four major parameters.

These core identity relationships were not all pre-compositionally distributed across the regions. The piece was composed region-by-region, assigning one of these relationships to a region, then fleshing it out by fixing other parameters (such as general dynamic level, whether each group was internally in unison, heterophonic or polyphonic, etc) and then notating the score (where decisions about melodic contour, phrasing, articulation and ornamentation, etc. were made). As the regions were composed, a full picture of the work began to emerge and an overall dramatic contour intuitively took shape, based largely on creating relations of contrast or similarity between adjacent regions.

Upon listening to the work, it became evident that it had a highly sectional structure, since each group would alter its identity at the start of each region, at the same time as all others. While this was partly a conscious compositional decision, the degree to which this would undermine the difference between groups on a macro-scale was unanticipated. This was partly due to the fact that the relationship between the groups and the temporal divisions was not considered as having an impact on the identity on the objects presented; yet, in reality, such a relationship was also a parameter that had an important role in structuring musical identities. While this does not undermine the logic of the work as it was constructed, it did give the groups a higher degree of unity than intended, potentially lessening the impact of their differentiation according to the brane structures. This indicates that, while identity relationships can be conceived of as ‘outside time’, their formal deployment in the work *also* had an effect on their identity – partly contradicting one of the hypothetical principles of the work.

Four examples

To demonstrate the types of basic ensemble identity frameworks deployed in the work, this section demonstrates representations of the structures of four of

its 23 regions.² Obviously, representing four-dimensional space on a two-dimensional surface is somewhat of a challenge. In these representations, the x-axis represents the temporal division parameter and the y-axis is the register. The shape (from triangle to circle) represents the pitch parameter:



The shade (from white to black) represents the dynamic contour:



Region 10: Group III-dominated

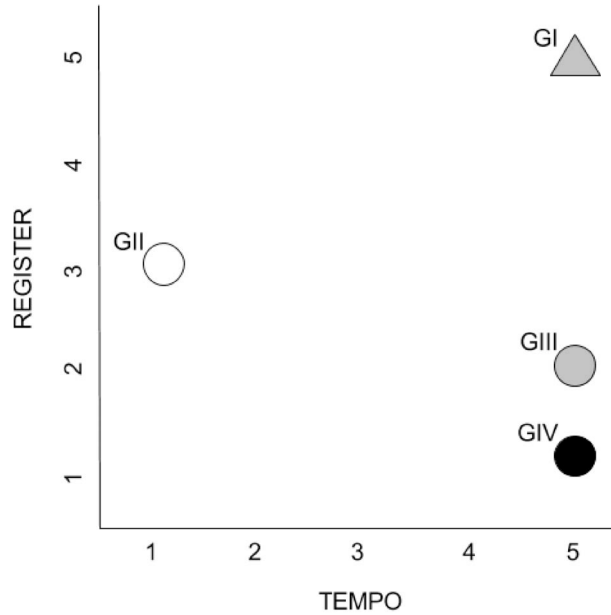
Region 10 was based on the fixed parameters of Group III. This means that Group I adopts the tempo maximum, Group II the pitch maximum, and Group IV the tempo and pitch maximum. Any remaining free parameters in each group were intuitively given values. The structure is as follows:

Table 3

	Group I	Group II	Group III	Group IV
Tempo	5	1	5	5
Register	5	3	2	1
Pitch	1	5	5	5
Dynamic Contour	3	1	3	5

2 For the scores for each group, as well as a complete graphic guide score and a recording, please visit my website: www.usageandcontinuation.com/works

This can be represented by the following figure:



This shows that Groups I, III and IV are unified in terms of temporal division, while Group II remains distinct; at the same time, Groups II, III, and IV are unified on the pitch level, while Group I remains distinct.

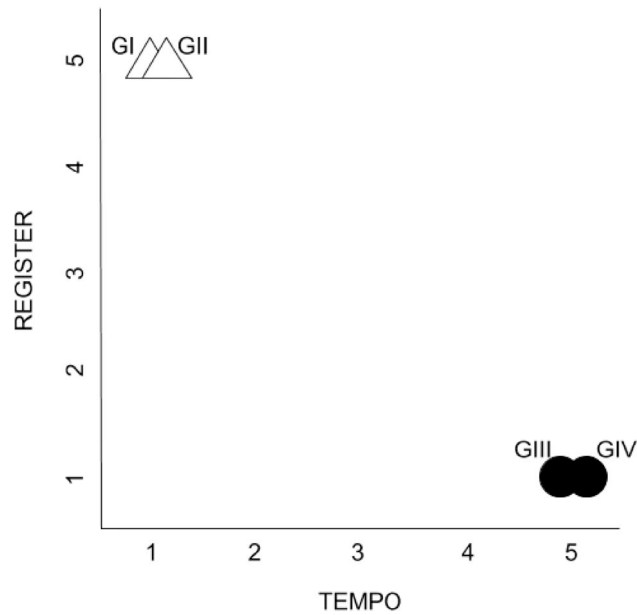
Region 16: Bifurcation

This region, in a way the simplest core identity relationship besides solos, divides the ensemble into two sets of groups: Groups I and II and Groups III and IV are entirely unified at opposite ends of the four parameters:

Table 4

	Group I	Group II	Group III	Group IV
Tempo	1	1	5	5
Register	5	5	1	1
Pitch	1	1	5	5
Dynamic Contour	5	5	1	1

This is represented as such:



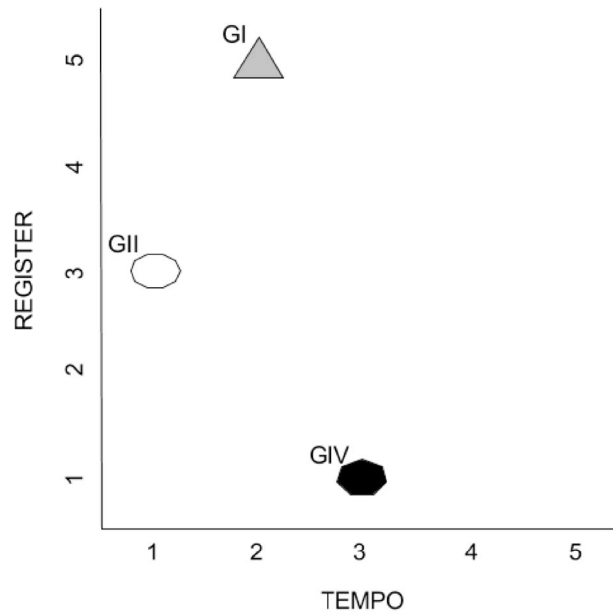
Region 12: Stratification

This region features only three of the four groups, and tries to have the highest degree of differentiation possible between them.

Table 5

	Group I	Group II	Group III	Group IV
Tempo	2	1	-	3
Register	5	3	-	1
Pitch	1	4	-	3
Dynamic Contour	3	5	-	1

Which yields the following figure:



This shows the high degree of differentiation between the three groups, with no clear way of dividing the three into any higher groupings based on similarity.

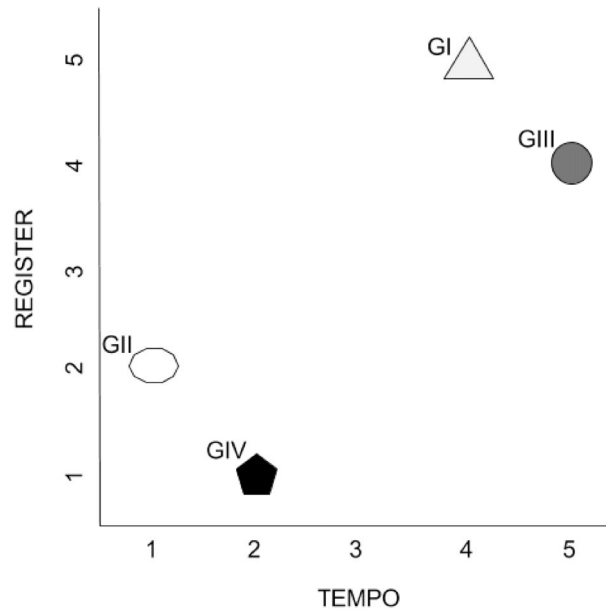
Region 7: Stratification with homogeneity

As with Region 12, this region attempts to have the highest possible degree of differentiation between groups across the four parameters. However, Region 7 represents an extreme example of the potential disjunct between the abstract identity formation and the perceived relations in the sounding work, since in all other aspects, the materials between groups were homogeneous: short chordal attacks at the start of each bar alternating with repeated tenuto chords repeated at regular pulses through each bar.

Table 6

	Group I	Group II	Group III	Group IV
Tempo	4	1	5	2
Register	5	2	4	1
Pitch	1	4	5	2
Dynamic Contour	2	1	4	5

The representation of the identity relationships at the level of the four core parameters appears like this:



On the level of all their other attributes, this is perhaps one of the most materially unified regions in the work. However, through this material homogeneity, the nature of this parametric structure nonetheless presents itself, with highly registrally stratified chords moving at different tempos, in different pitches, with different dynamic shapes.

Conclusion

braneworlds (2016) follows a conception of music in which parameters are seen as dimensions of a musical space, each with a certain range and internal structure. The parameters available in this conception are not limited to the four normally associated with integral serialism, but can be any composable property of music. In *braneworlds* the primary structured parameters were temporal division, register, pitch, and dynamic contour. These parameters were given minimum, intermediate, and maximum values, which defined the abstract ‘space’ of the work. Through composing the work, I discovered a number of limitations to this framework. Firstly, the intermediate values for parameters were often quite difficult to specify, particularly in the pitch and dynamic parameters, but also in

that of register. This led to a number of ad hoc solutions during the notation process. Additionally, from a perceptual point of view, a hierarchy seemed to emerge between the four, such that registral and temporal distinction played a greater influence on whether objects would appear as distinct or separate entities than the pitch and dynamic contour parameters.

Within the space created by these parameters, *braneworlds* focussed on the simultaneous presentation of musical objects, drawing upon the idea of ‘polymorphic’ counterpoint, which foregrounds the relations of difference and identity of musical objects. Another limitation to the framework was that in order to have a high degree of control over the various combinations of identities presented simultaneously, each formal ‘region’ of the work presented an entirely different identity structure. The result of this was that the work had a highly ‘sectional’ quality, reducing the degree of difference between each group on a macro-scale, since all identities conformed to the same macro-temporal divisions.

Despite these logical weaknesses and gaps between conception and realisation, I feel that the structure of *braneworlds* – its four core parameters, its polymorphic counterpoint, and its four instrumental groups located on branes – provided a relatively robust structure in which to explore a vast number of combinations of identity types. This framework helped to generate structures that might not otherwise have been conceived, including those that contradicted the identity schema (e.g. Region 7), but that nonetheless were profoundly influenced by it. The refinement of this approach, including a more nuanced understanding of the different weighting and internal structures of parameters, and a more flexible approach to macro-time, will be the focus of my next compositional endeavours.

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