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# The application of memetic analysis to electroacoustic music

M. ADKINS

Music Department, University of Huddersfield, Queensgate, Huddersfield, HD1 3DH, UK  
m.adkins@hud.ac.uk

## Abstract

Richard Dawkins' concept of the meme was first formulated in his book *The Selfish Gene* (Oxford, 1976). In *The Memetics of Music: A Neo-Darwinian View of Musical Structure and Culture* (Ashgate, 2007), the first substantial text applying the concept of memetics to music, Steven Jan proposes a theory of music and an associated analytical method centred on the meme. For Jan, memes are a multitude of musical 'units' or 'replicators' that are transmitted by imitation both within, and across genres of music. Jan's study focuses primarily on the application of memetics to the analysis of classical music. This paper will assess the contribution of memetic analysis to electro-acoustic music.

## 1. Introduction

The artist and sculptor Eduardo Paolozzi wrote that, '*all human experience is just one big collage*' [1]. This idea is given a more rigorous grounding in the writings of memetic theorists such as Dawkins (1976/1989), Dennett (1990), and Jan (2007), who maintain that our culture is essentially an interconnecting network of memes. The all pervasiveness of the meme is clearly demonstrated by Richard Dawkins in *The Selfish Gene* where he writes that, '*examples of memes are tunes, ideas, catch-phrases, clothes fashions, ways of making pots or building arches...*' [2] and that the three characteristics for the successful meme are its copying-fidelity, its fecundity, and its longevity.

Memes are neuronally-encoded cultural information and their phenotypic products (behaviour and artefacts) spread through a process of imitation from one individual's memory to another. The neuropsychologist, Paul Broks maintains that,

the harder one stares into the machinery of the brain, the starker the realisation that there is no one in there. There is no inner sanctum of the self. Neural networks have a life and logic of their own. There is no one running the show. The self is a shadow-puppet shaped by the firings of a hundred billion brain cells. [3]

Broks' writing strongly echoes Susan Blackmore's concept of the self as a vast collection of mutually compatible memes, or a memeplex, that she terms the 'selfplex' [4] and Daniel Dennett who writes that the '*haven all memes depend on reaching is the human mind, but a human mind is itself an artefact created when memes restructure a human brain in order to make it a better habitat for memes.*' [5]

Memetics thus challenges our idea of the composer and original conscious intentionality or agency. Whilst it is a rather romantic notion to think of the composer as a vessel or a medium through which inspiration flows to create a new composition, to think of the composer as a vessel infested by musical memes in competition with one another to propagate themselves and thus extend their longevity is somewhat less attractive. Jan writes that, '*memetics maintains that conscious intentionality, the fundamental attribute of the human mind, is not some unitary presence, but the resultant construct of a multitude of memes in constant competitive interplay.*' [6] Jan also states that the identification of memes can tell us much about '*both local issues of musical structure and organization, and global issues of musical style configuration and its diachronic change.*' [7]

## 2. Defining the Meme in Music

In attempting to define the meme in music we need to identify what exactly is being replicated. When listening to baroque or acousmatic music, or free improvisation there are clear musical and gestural patterns that allow us to differentiate clearly between them. Similarly, it is possible to identify small units of sound material that occur in a number of works by different composers. Jan has identified such units in the music of Mozart, Haydn and Beethoven. The identification of memes in this instance facilitates a discussion as much about musical culture and its evolution as it provides a mechanism for understanding individual works. Meyer's hierarchy of style provides a useful model for the differing levels at which memes are replicated within music. Meyer identifies six levels:

- (1) Intraopus style - the totality of memes that are replicated within a single work
- (2) Style of a period in the life of a composer
- (3) Idiom – the style of a composer within a particular cultural community
- (4) Dialect – the style of a cultural community defined either geographically or chronologically

(5) Rules – the system of musical organization

(6) Laws – these are the biologically - and physically/acoustically defined attributes of perception and cognition.

The identification of memes within each of these levels has been widely debated. Dawkins questions whether the meme works at the level of a whole ‘*work, a movement, a tune, a bar, [or] a chord?*’[8] Daniel Dennett states that ‘*these new replicators are, roughly, ideas.... complex ideas that form themselves into distinct memorable units.*’[9] In an attempt to provide a more concrete definition of the meme and a more analytically useful unit of reference, Jan adapts Dawkins description of the gene to describe the musical meme as,

...any portion of [musical patterning] that potentially lasts for long enough generations to serve as a unit of natural selection...a...unit that is small enough to last for a large number of generations and to be distributed around in the form of many copies...a unit which, to a high degree, approaches the ideal of indivisible particulateness.[10]

Musical patterning can operate at different structural levels. Examples are:

1) Structural memes – where composers employ a similar global structure repeatedly in a number of works (e.g. in Denis Smalley’s *Windchimes* (1987) and Andrew Lewis’s *Time and Fire* (1991) discussed below).

2) Topic Memes – which involves the association of a musical meme with a verbal-conceptual meme (e.g. the chromatically descending tetrachordal bass in classical music is associated with death, lament, or grief in the music of Purcell and Bach through to Beethoven, Wagner and Strauss. This association between the musical meme and the concept-meme is copied in all the brains of the members of a given cultural community. In electroacoustic music an example is the sound of crickets and exotic birds associated with the topic-meme of hot nocturnal-tropical environments.

3) Musico-operational memes – where a similar compositional or generative process is replicated between works despite the use of different musical material (e.g. a move from one pitch centre to another at the climax of a work, an example of which occurs in Andrew Lewis’s *Time and Fire* and Denis Smalley’s *Wind Chimes*)

4) Low-level memes – where a short cadential or melodic figuration is replicated from work to work (e.g. in electroacoustic music one such example is the sound of a door opening and closing a musical phrase. Although this sound configuration can also act as a musico-operational meme where the sounds are spectrally similar then low-level memes can be identified.

The assigning of memetic status is reliant on the identification of self-contained units or particles, regardless of the hierarchical level at which the musical unit in question is operating. A model by which the identification of memes and the perceptual groupings of alleles (an ‘alternative’ form of a meme, which has a similar configuration to a given meme and therefore comparable musico-formal characteristics) can be achieved is Eugene Narmour’s implication-realization model. His model, though not originally applied to memetics, identifies three initial criteria derived from generic gestalt closural principles for the segmentation of musical material:

(1) durational interference - a move from a short sound to a long sound

- (2) harmonic interference – a move from dissonant to consonant harmony
- (3) metre may also impose closure ‘*metric differentiation that is sufficiently emphatic by itself to segment a melodic line...*’[11]

Traditional analysis has predominantly concerned itself with the parameter of pitch and to a lesser extent rhythm. However, in electroacoustic music, timbre, spectral density, or the spectromorphology of a sound may all be important in the identification or ‘segmentation’ of a meme. A simple adaptation of Narmour’s implication model will provide a starting point for segmentation in electroacoustic music. Four other parameters can be included in addition to Narmour’s original three:

- (4) gestural/textural interference – a move away from a sustained texture by means of a strongly articulated sound object
- (5) timbral interference – a move from one spectrally distinct sound material to another
- (6) dynamic interference - a move from a quiet sound to a loud sound
- (7) registral interference – a move from a high to low sound or vice versa.

Segmentation by means of the criteria outlined above can be illustrated through Gestalt psychology. Gestalt psychology is concerned with perceptual principles that ascribe a continuous cause to a series of discontinuous elements or vice-versa. The main principles of Gestalt grouping are:

- 1) proximity – close elements are grouped together
- 2) similarity – like elements give rise to groups
- 3) common fate – elements changing in the same way will be grouped
- 4) the principle that elements are grouped so as to form familiar configurations (‘good figure’).

In James Tenney and Larry Polansky’s article *Temporal Gestalt Perception in Music* (1980), Gestalt principles of proximity and similarity are used as the basis for rules that govern the grouping of elements, clangs and sequences. They write that,

An element may be defined more precisely as a TG [temporal gestalt] which is not temporally divisible in perception, into smaller TGs. A clang is a TG at the next higher level, consisting of a succession of two or more elements, and a succession of two or more clangs – heard as a TG at the next higher level – constitutes a sequence. [12]

The rule that Tenney and Polansky outline related to proximity is defined as follows,

In a monophonic succession of elements, a clang will tend to be initiated in perception by any element which begins after a time-interval (from the beginning of the previous element, i.e., after a delay-time) which is greater than those immediately preceding and following it, ‘other factors being equal.’[13]

This definition is very similar to Lerdahl and Jackendoff’s Grouping Preference Rule 2b (Attack-point). Tenney and Polansky also outline a rule for similarity, which is a generalisation of their rule for proximity. What is interesting is that because their work is implemented using a

computer, the algorithm they use for segmentation has to be precise in its definition for the formation of [sound] objects and their relationships. In many computer-based musical systems that aim to automate analysis, Gestalt grouping principles and Lerdahl and Jackendoff's Grouping Preferences rules, which correspond to listeners' intuitions, are often employed when analysing a musical stream. Robert Rowe writes that for Tenney and Polansky,

The first manifestation of their precision is the definition of distance between two objects when those two objects are quantified along several independent dimensions. In this case, the dimensions are pitch, duration, intensity (loudness), and, to some extent, timbre. Tenney and Polansky consider such objects as points in a multidimensional perceptual space. The problem, then, is how to measure the distance between two points. [14] Rowe continues that,

...gestalt segmentation idea uses, in effect, the inverse of proximity and similarity to identify boundary lines between groups. In other words, when elements are not proximate and/or dissimilar, they tend to form the beginning and end of neighbouring clangs. [15]

What is clear from Tenney and Polansky's consideration of objects as points in a multidimensional perceptual space is that combining elements of difference or interference (as listed above) in several parameters enables the identification and segmentation of low-level grouping structures. The technique of multidimensional scaling has been further developed by Jehan (2004) [16] regarding timbral segmentation. Segmentation is also facilitated by Lerdahl and Jackendoff's Grouping Preference Rules which describe the conditions that determine which of a large number of possible hierarchical segmentations of any passage of music are actually likely to be perceived by listeners and the psychological impact of a particular musical meme, what Jan terms the perceptual-cognitive salience of a meme, and Delalande (1998) terms a sound object's 'pertinence'.

### **3. Memes in Electroacoustic Music**

Whereas in the analysis of a classical work the score, as a phenotypic output, aids the segmentation of pertinent or salient analytical units through the use of barlines, chords, and notes, in electroacoustic music there is no such pre-segmentation. Schaeffer and Henry's early attempts to notate their work were soon abandoned due to the complexity that was quickly reached in attempting to annotate all of the particular characteristics of a sound object. However, Schaeffer was keen to develop a taxonomy for electroacoustic music that would facilitate the analysis and discussion of works akin to traditional analytical techniques. Nattiez writes that,

From the outset *musique concrète* tried to demonstrate in practice... that criteria such as 'allure', but also 'grain', 'mass', 'momentum' [what Delalande (1998) [17] terms morphological characteristics as opposed to the sound object which is a morphological unit] are able to create through being varied from one object to the next a discourse similar to that created by pitch variation from one note to the next in traditional music... [18].

From a memetic perspective the subdivision into discrete units of information takes place by reference to other copies or co-indexes of that information or meme, through the identification of that portion of the pitch, rhythmic or timbral continuum that is replicated... For such a particle to be regarded as a meme, a unit of imitation, one must, by definition, isolate the copy/copies – which one might term the co-equal/s – of the particle, from which the particle is imitated, or which is/are derived by imitation of the particle... It will be understood that particularity, the segmentation of the symbolic stream, can only be defined by reference to coequality, the presence of analogous segments of the same or another symbolic stream... [19]

However, in electroacoustic music, the use of referential or anecdotal sound clearly differentiates electroacoustic from purely acoustic music and implies additional criteria to enable the segmentation and perceptual grouping of memes.

Narmour's implication-realization model and its extension outlined above is one model for the segmentation of sonic material. Another approach, outlined by Stephane Roy (2003) [20], is based on l'analyse du niveau neutre (after Nattiez) and employs a Functional Grid with symbols for forty-five functions classified into four main categories for orientation, stratification, process and rhetoric. The intention of such an approach is to comprehend units pertinent for the analysis of an electroacoustic work. Segmentation may also be aided through the use of computer tools such as the Acousmagraphe from the INA-GRM, which allows the user, having selected a pertinent segment to use an algorithm to retrieve perceptually similar segments, and Max/MSP abstractions for event segmentation by Pandelis Diamantides [21].

Whatever the method of segmentation employed, the most important factor in attributing memetic status is co-equality. Once the meme is identified there are numerous other methods for further classifying sound material from Pierre Schaeffer's typo-morphological approach to sound material outlined in the *Traité des objets musicaux* (1966), the expansion of his work by Delalande (1998), through to Smalley's (1986) classification according to the spectromorphology of sound.

### 3.1 Topic Memes in Electroacoustic Music

In instrumental music topics such as the Sturm und Drang of the Classical period involve the association of a musical meme with a verbal-conceptual meme. In electroacoustic music, topics often involve the association of referential real-world or anecdotal sound materials associated with a verbal-conceptual meme. An example of a topic-meme in electroacoustic music is the identification of homologous environments associated with the 'urban' or 'exotic'. Agawu, describes topics and topical theory in *Playing with Signs*. He writes that,

The pursuit of deeper-level, non-referential process may be conceptualized as a search for an answer to the question 'what is the essence (E) of each individual (T)opic?' Methodologically, we investigate each T, invoking Jauss's notion of a 'generic dominant' to determine its invariable elements. [22]

One of the characteristics of such topic-memes both in instrumental and electroacoustic music is that although it is possible to identify the topic as a replicated pattern of musical meme and verbal-conceptual meme in a stable co-adapted relationship, it is not possible to identify low- (or in Jan's terms, sub-foreground/shallow-middleground) level musical memes that are common to all members of a particular topic-class.

A 'nocturnal-tropical' topic-meme can be identified in: *Sud* by Jean-Claude Risset, *Hot Air* by Jonty Harrison, *Signé Dionysos* by Francis Dhomont, *Tangram* by Robert Normandeau, *Near and Far* by David Lumsdaine, *La Création du Monde* by Bernard Parmegiani, *Associations Libres* by Gilles Gobeil, *Les Couleurs de la Nuit* by François Bayle, and *La Disparition* by Christian Calon. The topic-meme appears in each work at different structural points. The topic-meme is pervasive throughout the works by Bayle and Lumsdaine, whereas in the others it is one topic-meme amongst many other sound elements.

### 3.2 Musico-Operational Memes in Electroacoustic Music

In electroacoustic music a musico-operational meme can be identified as a replicated compositional process occurring at a deeper structural level than the surface low-level memes. A musico-operational meme occurs when compositional devices and ways of handling material are replicated between works even though the material itself may be quite different. Like topic-memes, it is not possible to identify low-level musical memes that are common to all musico-operational memes. Two examples will be given: the first demonstrates two musico-operational memes in abstract works; the second considers musico-operational memes occurring in works that use anecdotal material.

In Denis Smalley's *Windchimes* (1987) and Andrew Lewis's *Time and Fire* (1991) a number of musico-operational memes can be identified. The two illustrated here are taken from the opening and the close of the exposition of each work. The sonograms below (fig.1) are taken from the first two minutes of each work. What they illustrate is a musico-operational meme in which a single opening attack/resonance gesture, followed by a period of silence is gradually developed during the exposition through the extension of the resonance and iterative textures into extended musical phrases. This musico-operational meme, and others throughout the work, such as the harmonic change at the climax of the work, give rise to a shared structural meme in these two works.



Andrew Lewis: *Time and Fire* 0'00 – 2'00



Denis Smalley: *Windchimes* 0'00 – 2'00

(Fig.1)

A second example occurs at the end of the exposition. The sonograms below are taken from 3'00-4'00. In both works the end of the exposition is marked by a strong low frequency attack that cuts off a musical texture that has been building in both spectral density and gestural activity since the beginning of the work. This low frequency attack (occurring in both works at 3'29-3'32) is followed by a low resonance fading to silence and then an extended period of mid-high frequency sustained sounds, occasionally interrupted by attack gestures from the exposition.



Andrew Lewis: *Time and Fire* 3'00 – 4'00





Denis Smalley: *Windchimes* 3'00 – 4'00

(Fig.2)

In this instance, the first halves of the two sonograms look very different, so in terms of meme phenotypes, it is difficult to see any common procedures operating. The second half demonstrates more obvious phenotypic memes. However, in this example higher-order analytical criteria are needed to recognize the operation of the musico-operational meme underlying the quite different surface patterning. This example demonstrates that whilst sonograms (like traditional scores) are useful in the identification of memes they do, on occasion need to be supplemented by other means.

A second example of a musico-operational meme operating within works that predominantly utilise anecdotal sound materials is that of the opening/closing door to articulate musical phrases. This musico-operational meme, in this instance, is also a sonic meme/allele class, and can be found in the works: *Rumeurs (Place de Ransbeck)* (1987), by Robert Normandeau, *Novars* (1988) by Francis Dhomont, *Unsound Objects* (1995), by Jonty Harrison, and *Environs* (1996) by Robert Mackey. In these, and other electroacoustic works, the sound of a door opening into a new spatial location, or the sound of a closing door abruptly cutting off a musical texture has a similar formal function. There is a replicated functional behaviour associated with this sound that assigns it memetic status. In the case of the opening/closing door as a musico-operational meme, a wide variety of door-like sounds might be grouped together into one conceptual meme class and sonic meme/allele-class simply by virtue of their triggering in the listener the concept of 'door opening/closing' and despite what maybe differences in sound spectra. These potential spectral differences may mitigate against the identification of low-level memes common to each of these works. From this brief initial example it can be asserted that for any signifier or sound object to obtain memetic status it needs to manifest a certain morphological unity and continuity (with mutational changes over time). The perceptual similarity, and hence grouping of sound objects has its origins in both gestalt concepts of similarity and an analogy in Dawkins' notion of locus. Dawkins writes that each '*gene is able to occupy only a particular region of chromosome, its locus. At any given locus there may exist...alternative forms of the gene. These alternatives are called alleles [or allelomorphs] of one another...*'[23] Although Dawkins implies that there is competition for survival between these alleles, the perceptual grouping together of variant sound objects is useful for understanding the intertextuality between electroacoustic works.

### 3.3 Low-level Memes in Electroacoustic Music

What the works by Dhomont, Harrison, Normandeau and Mackey also illustrate at a lower level is the formation of a series of mutant memes of an antecedent meme, in this instance from Pierre Henry's *Variations sur une porte et un soupir* (1963), forming a door-meme allele class. Although all of the examples illustrated below are all perceptually derived from the opening of a door and then either the slow, or strong and fast closing of a door, three sonic patterns are replicated: 1) The closing of the door creates a strong attack cut-off (fig.3).



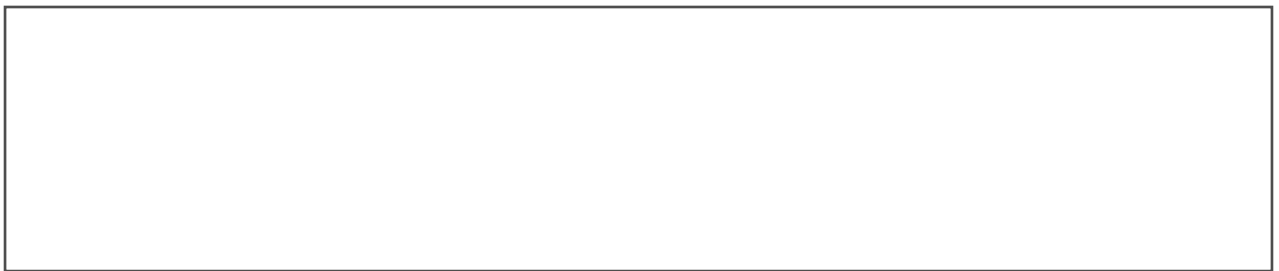
Normandeau: *Rumeurs (Place de Ransbeck)* (1987) – door attack



Dhomont: *Novars* (1988) - door attack with fading creaks



Harrison: *Unsound Objects* (1995) - door attack with fading creaks



Mackey: *Environs* (1996) – door attack

(fig.3)

2) The repeated attack of the door forms a series of rhythmic attack patterns (fig.4)



Henry: *Variations sur une porte et un soupir* (1963) – repeated door/squeak attacks



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Normandeu: *Rumeurs (Place de Ransbeck)* (1987) – repeated door attack



|

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Dhomont: *Novars* (1988) – repeated attack door

(fig.4)

3) The final mutant meme removes the attack of the door leaving merely the creaking/squeaking sound. In both the Henry and the Normandeu examples this pattern is subjected to rapid repetition (fig.5).



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Henry: *Variations sur une porte et un soupir* (1963) – repeated door squeaking



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Normandeu: *Rumeurs (Place de Ransbeck)* (1987) – repeated door squeaking

(fig.5)

#### **4. Composing with Memes**

Once a composer becomes consciously aware of the various memes within a given dialect or idiom it is possible to use and manipulate these intentionally within a composition. One such example is in my own *Five Panels no.3* (2008) in which I consciously use a number of musical memes normally associated with differing dialects. One particular meme comprises the use of 'glitch' sound materials combined with a (filtered) mid-frequency quasi-tonal melodic line or drone. Co-equals of this meme occur in *audio avant avant (après edit)* by des Cailloux et du Carbone, *northern* by Taylor Deupree, *Formations* by Mileece, *arid* by Sogar, *closed circuits* by motion, and *Family Tree* by Off the Sky. The sonograms below (fig.6) each present twelve seconds of music:



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des Cailloux et du Carbone – avant avant (après edit) - 0'00-0'12



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Deupree: northern - 0'00-0'12



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Off the Sky: Family tree - 0'00-0'12



|

|

Motion: Closed Circuits - 0'00-0'12



Mileece: Formations (track 1) - 0'00-0'12



Sogar: Arid – (2'54-3'06)



Adkins: Five Panels (no.1) – (4'55-5'08)

(fig.6)

The sonograms, though useful, are not the sole means of demonstrating coindexation and segmentation due to the difficulty in illustrating differences in timbre. In the first five examples the interruption of sustained tones by high spiking glitches is clearly evident. This similarity of sonic patterning regarding interruption of gesture, register and the similarity of structural positioning (they all occur at the beginning of the tracks) allows for the assigning of memetic status. The latter two examples illustrate this same patterning but in a sonic texture in which this is one of a number of sonic layers.

Tracing the development of the glitch memes in these works not only enable us to analyse each of these tracks individually but also to demonstrate the evolution of dialects as the meme is propagated throughout the musical infosphere. The memes in these works are, like the above example of the sound of a door, a series of mutants of an antecedent meme forming a glitch-meme allele-class. The origins and main protagonists of early 'glitch' music are well documented (Cascone, 2000). Early glitch artists such as Oval, Bretschneider, Gert-van Prins, Alva Noto used what Moradi calls 'pure-glitch sounds'. These are defined by Moradi as unpremeditated digital artefacts created through the failure of hardware and software through deliberate misuse or experimentation. Moradi also identifies '*glitch-alike sounds, where 'glitch artists synthesise glitches... or produce and create the environment that is required to invoke a glitch and anticipate one to happen...'*' [24] Through tracing various 'glitch' memes in music since their inception with Yasunao Tone and Oval's work in the late 1980s and early 1990s we are able to trace these memes from their origins in a post-techno dialect into Fennesz's *nu-gaze*, the glitch-house of *des Cailloux et du Carbone*, the ambient experimentalism of Taylor Deupree, through to Bjork's *Vespertine*. Jan maintains that this is a part of the evolution of music - that composers, '*replicate small units of the musical continuum either remembered from musico-aural experience or viewed as musico-graphical symbols on paper, navigating the straits between the siren voices of memorability and the rocks of plagiarism.*' [25]

## 5. Conclusion

In this paper, I have briefly outlined the application of memetic theory and analysis to electroacoustic music and provided examples of how this method of analysis could illustrate not only how individual works can be discussed but how memetics can also elucidate larger issues related to musical culture and its evolution. To paraphrase Paolozzi, if all of our musical culture is one big collage then the meme is fundamental in our understanding of how it all fits together.







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