

Metaform and Metaforming

Multiple representations in music

“Is it not strange that sheep’s guts should hale souls out of men’s bodies?”

William Shakespeare *Much Ado About Nothing*

“...all the achievements of human culture - language, art, religion, ethics, science itself - are themselves artifacts (of artifacts of artifacts...) of the same fundamental process that developed the bacteria, the mammals, and Homo Sapiens. There is no Special Creation of language, and neither art nor religion has a literally divine inspiration.”

Daniel Dennett (1995), *Darwin's Dangerous Idea*, p144

Preface

“There is no such thing as a sound Argument from Authority, but authorities can be persuasive, sometimes rightly and sometimes wrongly. I try to sort this all out, and I myself do not understand all the science that is relevant to the theories I discuss, but, then, neither do the scientists (with perhaps a few polymath exceptions). Interdisciplinary work has its risks.”

Daniel Dennett (1995), Preface

Preface

“...why ask an archeologist about the human mind? People are intrigued by various aspects of the mind. What is intelligence? What is consciousness? How can the human mind create art, undertake science and believe in religious ideologies when not a trace of these are found in the chimpanzee, our closest living relative? ...How can archaeologists with their ancient artifacts help answer such questions? Rather than approach an archaeologist, one is likely to turn to a psychologist [...or...] a philosopher [...or...] a neurologist [...or...] a primatologist...artists, athletes and actors - those who use their minds for particularly impressive feats of concentration and imagination. Of course the sensible answer is that we should ask all of these: almost all disciplines can contribute towards an understanding of the human mind.”

Mithen, S. J. (1998). *The Prehistory of the Mind*. p9-10 .

“Our brains have been built by natural selection to assess probability and risk, just as our eyes have been built to assess electromagnetic wavelength. We are equipped to make mental calculations of risk and odds, within the range of improbabilities that would be useful in human life. This means risks of the order of say, being gored by a buffalo if we shoot an arrow at it, being struck by lightning if we shelter under a lone tree in a thunderstorm, or drowning if we try to swim across a river. These acceptable risks are commensurate with our lifetimes of a few decades. If we were biologically capable of living for a million years, and wanted to do so, we should assess risks quite differently. We should make a habit of not crossing roads, for instance, for if you crossed a road every day for half a million years you would undoubtedly be run over.”

Richard Dawkins (1986), *The Blind Watchmaker*, p162

Introduction: Meta**form** or Meta**phor**?

“Some musicologists scoff at theories like Cooke’s, finding counterexamples to every claim. But the exceptions tend to come from fine classical music, which uses interleaved, embedded, and ambiguous lines to challenge simple expectations and engage a sophisticated listener.

Cooke’s particular analyses may be debatable, but his main idea that there are lawful connections between patterns of intervals and patterns of emotion is clearly on the right track.”

Steve Pinker (1997), *How the Mind Works*

Meta**form** and Meta**forming**

Meta**form** or Meta**phor**?

“Something that explains how the whole is more than the sum of the parts. Something that explains why watching a slide go in and out of focus or dragging a filing cabinet up a flight of stairs does not hale souls out of men’s bodies. Perhaps a resonance in the brain between neurons firing in synchrony with a soundwave, and a natural oscillation in the emotion circuits? An unused counterpart in the right hemisphere of the speech areas in the left? Some kind of spandrel or crawl space or short-circuit or coupling that came along as an accident of the way that auditory, emotional, language and motor circuits are packed together in the brain?”

Steve Pinker (1997)

“I wonder whether the ability to see analogies, the ability to express meanings in terms of symbolic resemblances to other things, may have been the crucial software advance that propelled human brain evolution over the threshold into a co-evolutionary spiral.”

Richard Dawkins (1998), *Unweaving the Rainbow*

“If I ever conceive any original idea, it will be because I have been abnormally prone to confuse ideas...and have thus found remote analogies and relations which others have not considered! Others rarely make these confusions, and proceed by precise analysis.”

Kenneth J W Craik (1943), *The Nature of Explanation*

“Innovative behaviours are usually not new units: instead, they are composed of a novel combination of old elements: a different stimulus evokes a standard behaviour, or some new combination of movements is used in response. How is sensory/movement innovation related to intelligence?”

William H Calvin (1996), *How Brains Think*

The Meaning of Metaphor

“You and I, we humans, we mammals, we animals, inhabit a virtual world, constructed from elements that are, at successively higher levels, useful for representing the real world. Of course, we feel as if we are firmly placed in the real world - which is exactly as it should be if our constrained virtual reality software is any good. It is very good, and the only time we notice it at all is on the rare occasions when it gets something wrong. When this happens we experience an illusion or a hallucination...”

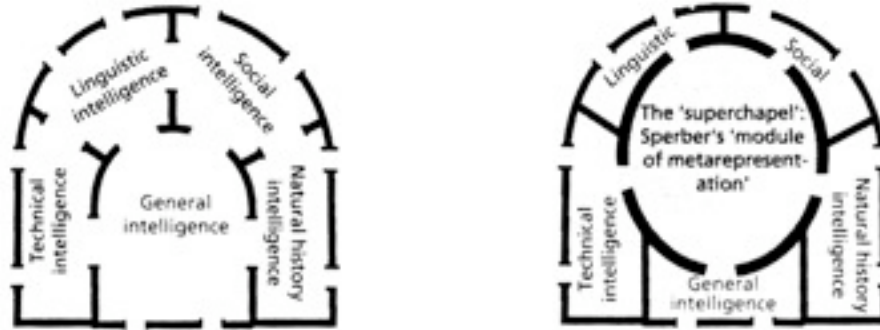
Richard Dawkins (1998)

Steven Mithen (1996), *The Prehistory of the Mind*

The mind as a cathedral

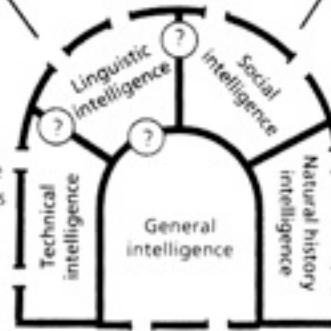
Phase 3: Two possible architectural plans for Phase 3 minds.

These represent minds of people living by hunting and gathering. For those with other lifestyles, it is likely that other types of specialized intelligences will develop, although social and linguistic intelligence are likely to be universal.



Phase 2

Minds with a 'nave' of general intelligence and multiple 'chapels' of specialized intelligences. It remains unclear how that of language is related to the other cognitive domains. As we can assume that all minds of this phase were of people living by hunting and gathering, the three 'chapels' are social, technical and natural history intelligence.



Phase 1

Minds with a 'nave' of general intelligence. The 'doors' represent the passage of information from modules concerned with perception.



Evolutionary time ↑

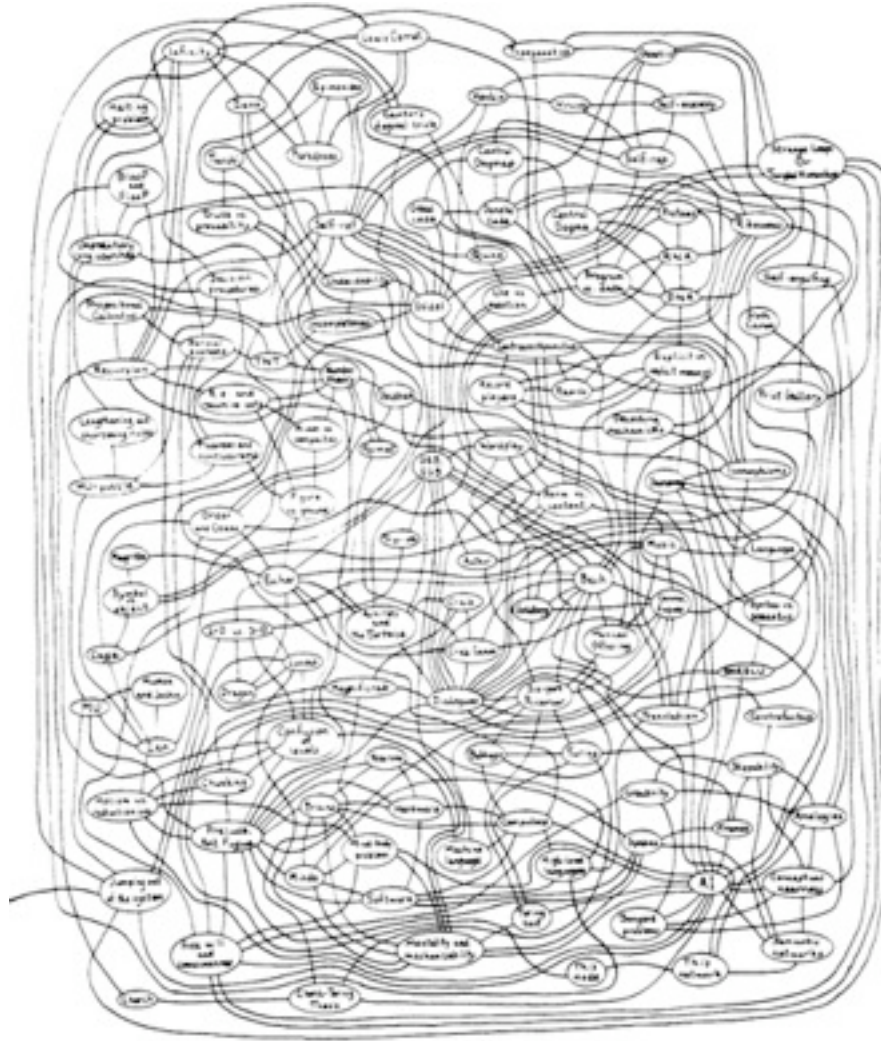
“For me it is the human passion for analogy and metaphor which provides the greatest challenge to Cosmides and Tooby’s (C&T) view of the mind. Simply by being able to invoke the analogy that the mind is like a Swiss army knife, Leda Cosmides appears to be falsifying the claim that is being made.”

“...Karmiloff-Smith (K-S) agrees ... that the mind of a young child is a Swiss army knife [... but...] this is just a stage prior to the emergence of the butterfly. For she argues that soon after modularisation has occurred, the modules begin working together. She uses a very awkward term for this: ‘representational redescription’ (RR). But what she means is quite simple. The consequence of RR is that in the mind there arise ‘multiple representations of similar knowledge’ and consequently ‘knowledge becomes applicable beyond the special purpose for which it is normally used and perceptual links across domains can be forged’. In other words, thoughts can arise which combine knowledge which had previously been ‘trapped’ within a specific domain.”

Steven Mithen (1998)

“it may have been the single most important factor enabling the characteristics of representational redescription to evolve. It may well be that music is the most important thing we humans ever did.”

Ian Cross (1999), *Is music the most important thing we ever did?*

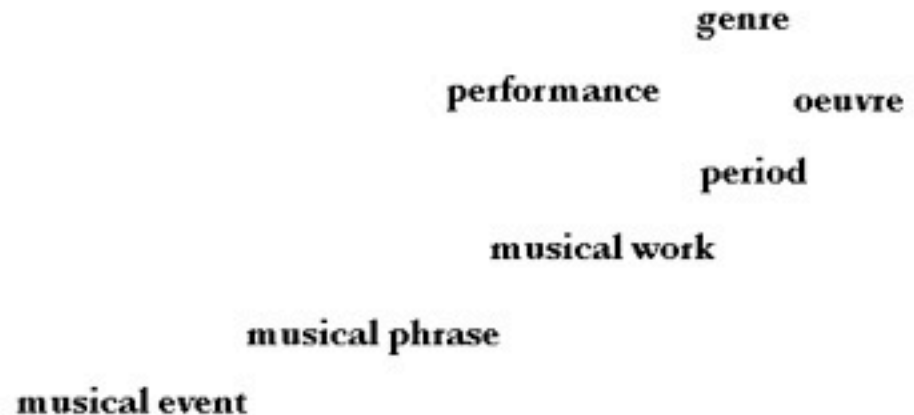


Douglas Hofstadter's Semantic Network from *Godel, Escher, Bach: An Eternal Golden Braid* (1979)



Detail from Hofstadter's semantic network (1979)

1 Musicology



“...not only formalized theory, but also all other thinking or talking about music, consists of metaphors or fictions that become highly dubious or downright bogus if they are regarded as being explanatory in any scientific sense, but that are at the same time indispensable in their descriptive function.”

Nicholas Cook (1990) *Music, Imagination and Culture*

Mozart *F Major Piano Sonata* K332

Measures 1-5 of the first system. Measure 1 is marked with a red '1'. Measure 4 is marked with a red '2a'. The notation shows a treble clef with a key signature of one flat (B-flat) and a 3/4 time signature. The bass clef part features a steady eighth-note accompaniment.

Measures 6-11 of the second system. Measure 6 is marked with a red '2b'. Measure 8 is marked with a red '3'. The treble clef part continues with melodic lines, while the bass clef part provides harmonic support.

Measures 12-15 of the third system. Measure 12 is marked with a red '4a'. The treble clef part features a more active melodic line with some grace notes. The bass clef part continues with a steady accompaniment.

Measures 16-21 of the fourth system. Measure 16 is marked with a red '4b'. The treble clef part has a more complex melodic texture with some sixteenth-note passages. The bass clef part continues with a steady accompaniment.

2 Psychology

(1) Music generative capacity is inherent in all human beings, although it may be developed to a greater or lesser extent.

(2) The capacity to generate any but the most primitive musical sequences is based on the ability to derive sound sequences from higher-order structures or rule systems.

(3) These rule systems have some universal constraints on them (arising from general facts about human cognitive capacity) but incorporate specific constraints picked up from the prevailing musical culture.

(4) Specific instruction is not necessary for skill acquisition, but practice is. Through practice, and possibly through general developmental changes, similar stages in skill acquisition can be observed in the several generative domains.

(5) Many aspects of skill have become partly automated, and not open to conscious introspection. Their nature must therefore be elucidated by observation and analysis of generative behaviour rather than (or in addition to) verbal self-report.

John Sloboda (1988), *Generative Processes in Music*

- Language
- Auditory Scene Analysis
- Emotional Calls
- Habitat Selection
- Motor Control
- Something else (?!)

From Pinker, *ibid*

musical event

ear

rate of nerve cell firing

knowledge structure

change of event

**change of nerve
cell firing rate**

motor action

3 Evolution/Genetics

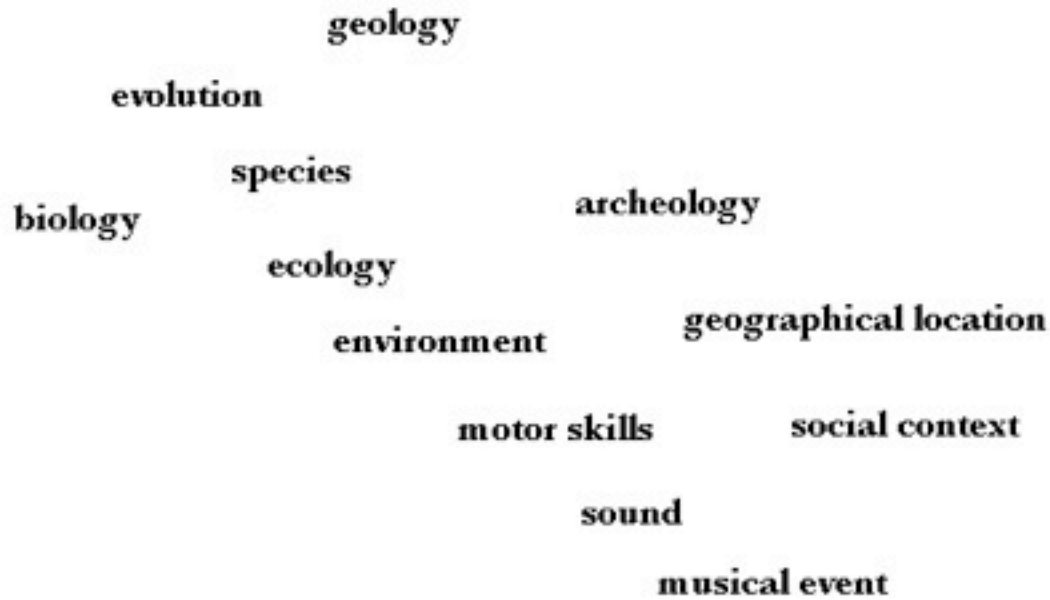
“The idea that birdsong is an auditory drug gains plausibility when you look at how it develops during the individual's lifetime. Typically, a young male songbird teaches himself to sing by practising: matching up fragments of trial song against a 'template' in his brain, a pre-programmed notion of what the song of his species 'ought' to sound like. In some species, such as the American song sparrow, the template is built in, programmed by the genes. In other species, such as the white crowned sparrow or the European chaffinch, it is derived from a 'recording' of another male's song, made early in the young male's life from listening to an adult. Wherever the template comes from, the young male teaches himself how to sing in such a way as to match it.

3 Evolution/Genetics

“That, at least, is one way to talk about what happens when a young bird perfects his song. But think of it another way. The song is ultimately designed to have a strong effect on the nervous system of another member of the species, either a prospective mate or a possible territorial rival who needs to be warned off. But the young bird himself is a member of his own species. His brain is a typical brain from that species. A sound that is effective in arousing his own emotions is likely to be as effective in arousing a female of the same species. Instead of speaking of the young male trying to shape his practice song to 'match' a built-in 'template', we could think of him as practicing on himself as a typical member of his species, trying out fragments of song to see whether they excite his own passions, that is, experimenting with his own drug on himself.

“And, to complete the circuit, perhaps it is not too surprising that nightingale song should have acted like a drug on the nervous system of John Keats. He was not a nightingale, but he was a vertebrate, and most drugs that work on humans have a comparable effect upon other vertebrates. Manmade drugs are the products of comparatively crude trial-and-error testing by chemists in the laboratory. Natural selection has had thousands of generations in which to fine-tune its drug technology.”

Richard Dawkins (1998)



"That whales and birds link song sequences together is also not evidence of versatility. The most mindless behaviours are often linked, the completion of one calling forth the next...Indeed, the more complex and 'purposeful' the behaviour is, the further it may be from intelligent behaviour, simply because natural selection has evolved a surefire way of accomplishing it, with little left to chance."

William H Calvin (1996)

4 History, Politics, Economics and Society

“Among the Venda, the feelings which even the same music arouses vary greatly from one individual to another according to their knowledge of, and interest and participation in, the social activities which the music accompanies. The music of initiation affects people according to their age and status in society. Rulers, in particular, seem to be interested more in the social than the musical aspects of the music of the domba initiation school....

4 History, Politics, Economics and Society

“On one occasion, the “musical director” of a school and I were enjoying an exhilarating and technically flawless performance of “domba” by eighty-eight dancers; but the chief of the district was not greatly impressed and said that it would sound better in two months' time. His appreciation of the music was conditioned by the knowledge that at least fifty more novices would join the school during that period: for him, a greater volume of sound would mean more prestige and a larger income from the novices' fee. Furthermore... the volume of sound indicates the amount of support a ruler enjoys so that comparison of the music of two political rivals can lead to a peaceful solution of a dispute.”

John Blacking (1995), *Music, Culture and Experience*

musical event

social context

patronage

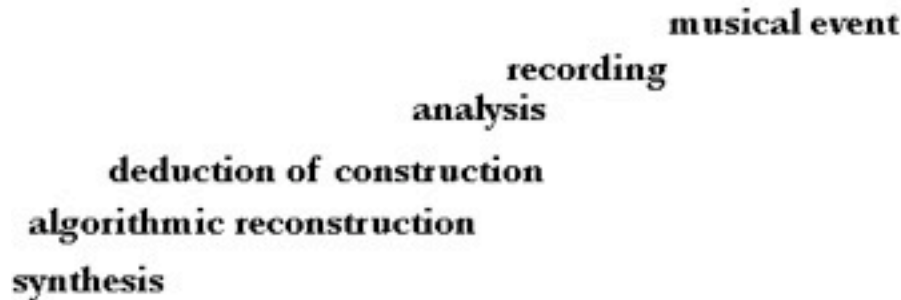
social function

historical period

**political/
economic
power**

5 Physics/Mathematics

“The reason why higher-level subjects can be studied at all is that under special circumstances the stupendously complex behaviour of vast numbers of particles resolves itself into a measure of simplicity and comprehensibility. This is called emergence: high-level simplicity 'emerges' from low-level complexity.



High-level phenomena about which there are comprehensible facts are not simply deducible from lower-level theories are called emergent phenomena. For example, a wall might be strong because its builders feared that their enemies might try to force their way through it. This is a high-level explanation of the wall's strength not deducible from (though not incompatible with) the low-level explanation... The purpose of high-level sciences is to enable us to understand emergent phenomena, of which the most important are, as we shall see, life, thought and computation.”

David Deutsch (1997), *The Fabric of Reality*

[Of a musical performance from the Bolivian campesinos of Northern Potosi, who live in the high Andes and whose culture seems to retain many of the characteristics of pre-Hispanic - Inca - ways of interpreting and experiencing the world:]

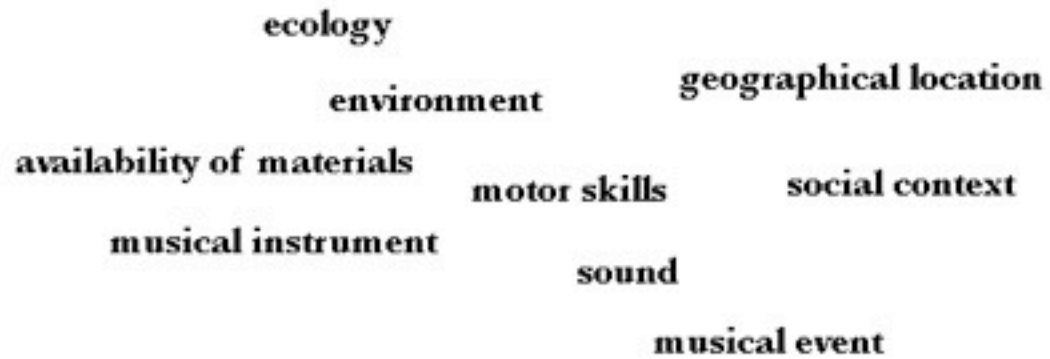
“...the longer duration of the second note, produced on an upstroke, being a result of delaying the fall of the hand for the third note. The inequality in the pattern was a direct consequence of the action embedded in the music, was a consequence of the embodied nature of the music.”

Ian Cross (1999), *AI and music perception in AISB Quarterly*

6 Ecology/Motor Skills

“Playing music is an activity that is comparable in cognitive complexity to speaking a language, and comparable in its demands on motor control to playing a sport like tennis. It has thus been a focus of attention for psychologists interested in issues of motor control...and for those interested primarily in musical cognition... The motor programming perspective adopted in most recent work on motor control has, however, diminished the separation between those two lines of enquiry by emphasising the importance of cognitive structures in the control of movement.”

Eric F Clarke (1988), *Generative principles in music performance*



geology
 evolution
 species
 biology
 ecology
 environment
 archeology
 geographical location
 performance
 genre
 oeuvre
 period
 availability of materials
 motor skills
 social context
 musical work
 musical instrument
 sound
 musical phrase
 musical event
 recording
 analysis
 social context
 patronage
 ear
 social function
 deduction of construction
 algorithmic reconstruction
 historical period
 synthesis
 rate of nerve cell firing
 knowledge structure
 political/
 economic
 power
 change of event
 change of nerve
 cell firing rate
 motor action

7



(meta-metaforms)

'Twas brillig, and the slithy toves
Did gyre and gimble in the wabe:
All mimsy were the borogoves,
And the mome raths outgrabe.

Il brilgue: les toves lubricilleux
Se gyrent en vrillant dans le guave.
Enmimes sont les gougebosqueux
Et le momerade horsgrave.

Es brillig war. Die schlichten Toven
Wirrten und wimmelten in Waben;
Und aller-mumsige Burggoven
Die mohmen Rath' ausgraben.

Lewis Carroll, Frank Warrin and Robert Scott quoted in Hofstadter

“The first sentence [of Crime and Punishment] employs the street name “S. Pereulok” (as transliterated). What is meaning of this? A careful reader of Dostoevsky’s work who know Leningrad (which use to be called “St Petersburg” - or should I say “Petrograd”?)...

[Of course, now, Hofstadter has himself been superceded and “Leningrad” no longer exists!]

...can discover by doing some careful checking of the rest of the geography in the book (which incidentally is also given only by its initials) that the street must be “Stoliarny Pereulok”. Dostoevsky probably wished to tell his story in a realistic way, yet not so realistically that people would take literally the addresses at which crimes and other events were supposed to have occurred. In any case, we have a translation problem; or to be more precise, we have several translation problems, on several different levels.”

Douglas Hofstadter (1979)

I II

Examples

I

II

III

geology
 evolution
 biology species archeology genre
 ecology performance oeuvre
 environment geographical location period
 availability of materials motor skills social context musical work
 musical instrument sound musical phrase
 musical event
 recording analysis ear social context patronage
 deduction of construction social function
 algorithmic reconstruction historical period
 synthesis rate of nerve cell firing political/economic power
 change of event knowledge structure
 change of nerve cell firing rate motor action

I

II

III

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8 Some Questions

- What does this mean?
- How does it work?
- What are its problems?
- What does it tell us about music?

psalm

“...not only formalized theory, but also all other thinking or talking about music, consists of metaphors or fictions that become highly dubious or downright bogus if they are regarded as being explanatory in any scientific sense, but that are at the same time indispensable in their descriptive function.”

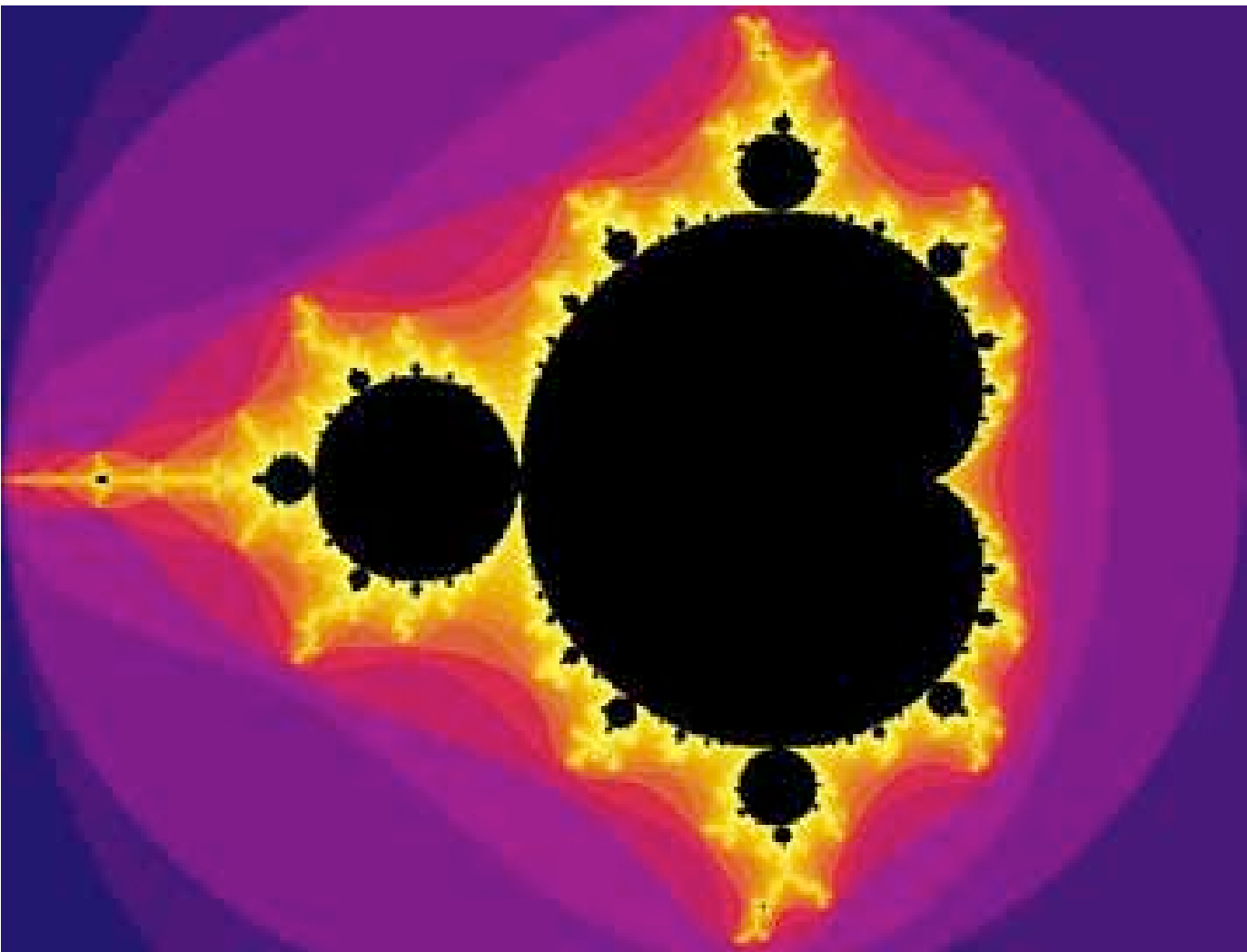
Cook (1990)

“Have you ever seen those pictures produced by computers, the object known as the Mandelbrot set? It's as if you are traveling to some distant world. You turn on your sensing device and see this incredibly complicated configuration, with all sorts of structure to it, and you try to figure out what it is. You might think it is some extraordinary landscape or perhaps some kind of creature with lots of little babies all over the place, babies that are almost but not quite the same as the creature itself.

“Very elaborate and impressive! Yet just from seeing the equations, nobody had the remotest conception that they would produce patterns of this nature. Now these landscapes aren't conjured up out of someone's imagination; everyone sees the same pattern. You're exploring something with a computer, but it's not dissimilar from exploring something with experimental apparatus.”

Roger Penrose, interview in *Omni* (June 1986), quoted in Penrose Tiles to Trapdoor Ciphers, Martin Gardner, 1989

Metaform and Metaforming



Number Theory: The Mandelbrot Set

- The study of pattern and proof in numbers
- A wide variety of study, one reason for which is the investigation of the study of proofs.
- This is one reason for the existence of so-called wondrous numbers

Meta**form** and Meta**forming**

Number Theory: Wondrous Numbers

$$x = \mathbf{13}$$

$$x \text{ is odd so } x = 3x + 1 = \mathbf{40}$$

$$40 \text{ is even so } x = 40/2 = \mathbf{20}$$

$$20 \text{ is even so } x = 20/2 = \mathbf{10}$$

$$10 \text{ is even so } x = 10/2 = \mathbf{5}$$

$$5 \text{ is odd so } x = 3x + 1 = \mathbf{16}$$

$$16 \text{ is even so } x = x/2 = \mathbf{8}$$

$$8 \text{ is even so } x = x/2 = \mathbf{4}$$

$$4 \text{ is even so } x = x/2 = \mathbf{2}$$

$$2 \text{ is even so } x = x/2 = \mathbf{1}$$

If x is odd then $x = 3x + 1$
else $x = x/2$

formulator

So the following sequence is produced:

13, 40, 20, 10, 5, 16, 8, 4, 2, 1

Similarly, starting with 15 this sequence is produced:

15, 46, 23, 70, 35, 106, 53, 160, 80, 40, 20, 10, 5, 16, 8, 4, 2, 1



psy

Problems and The Problem ('cheats' and the 'mistakes')

```
If WondrousX = 1 Or WondrousX = 0 Then WondrousX = Int((127 - 1 + 1) * Rnd + 1)
If WondrousX Mod 2 = 0 Then      'NotePitch is even
    WondrousX = WondrousX / 2
Else
    WondrousX = (WondrousX * 3) + 1
End If
'Convert X into MIDI range
NotePitch = WondrousX Mod 127
'Display result
Pattern(1) = NotePitch
```

- In some early version, in an attempt to get around a particularly annoying loop, I had outlawed some values (I believe 36 was a particular culprit). I immediately forgot about this, and later discovered that (after the first performance, these options had been incorrectly left out.
- The use of MIDI means all values have to be 'squeezed' into a range of 0-127. This is surely rather a gross distortion.
- I limit, in any case, the input value to the range 2-127

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Number Theory or Music?



“Recall how Gardner had described how ‘one typically encounters complexes of intelligences functioning together smoothly, even seamlessly, in order to execute intricate human activities.’ Gardner had suggested that the wisest of human beings are those who are most able at building connections across domains - or mappings - as exemplified in the use of analogy and metaphor.”

Steven Mithen (1997)

“In other words, music propels the development, and propelled the evolution, of mind by enabling consequence-free representational redescription across domains.”

Ian Cross (1999)

*My heart aches, and a drowsy numbness pains
My sense, as though of hemlock I had drunk,
Or emptied some dull opiate to the drains
One minute past, and Lethe-wards had sunk;
'Tis not through envy of thy happy lot,
But being too happy in thy happiness -
That thou, light-winged Dryad of the trees
In some melodious plot
Of beechen green, and shadows numberless
Singest of summer in full-throated ease.*

Keats, *Ode to a Nightingale*, 1820

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