

PSYCO 457

Week 3: Classical Music and the Classical Mind

The Boolean Dream



Classical Characteristics of Mind and Music

Classical Reactions

Synthetic Theories of Classical Music?


Preliminary Discussion

- Seeking comments or questions concerning the main themes of readings to this point in "From Bricks To Brains" and in "Embodied Cognition"





The Boolean Dream

- One characteristic of classical cognitive science is a commitment to **logicism**
 - "There is not only a close analogy between the operations of the mind in general reasoning and its operations in the particular science of Algebra, but there is to a considerable extent an exact agreement in the laws by which the two classes of operations are conducted." (Boole, 1854, p. 6)
 - "It would not be unreasonable to describe Classical Cognitive Science as an extended attempt to apply the methods of proof theory to the modeling of thought" (Fodor & Pylyshyn, 1988, pp. 29-30)



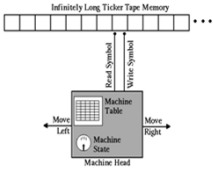
George Boole



Jerry Fodor

The Classical View

- "Cognition is information processing"
- Information processing is the manipulation of symbols or tokens by means of specific rules
- The prototypical classical device is the Turing machine
- A classical theory must have three major ingredients:
 - Symbols
 - Rules
 - Control




Classical Analogy

- We will begin by pursuing a striking analogy between classical cognitive science and classical music in the Austro-German tradition

	Classical Cognitive Science	Classical Music
Formal structures	Logicism	Tonality, sonata-allegro form
Meaningful representations	Rationality	Musical messages
Disembodiment	Mental representations separate from world	Mental compositions separate from world
Central control	What rule to use next?	Conductor and score
Reacted against	By connectionism and embodied approach	By modern music

Musical Logicism

- Musical formalisms obviously exist at the level of formal notes – designation of keys, combinations of notes that sound pleasing together, and so on
- Musical formalism extends far beyond this, to the structure of entire musical pieces. A musical offering is expected to have a particular structure (Copland, 1939), "the planned design that binds an entire composition together"
- Sonata-allegro form – *note importance of tonality*
 - "This juxtaposition of one group of themes denoting power and aggressiveness with another group which is relaxed and more song like in quality is the essence of the exposition section and determines the character of the entire sonata-allegro form."



Aaron Copland

Exposition (A)			Development (B)	Recapitulation (A)		
a	b	c	abc	a	b	c
First theme in tonic key	Second theme in dominant key	Closing theme in dominant key	Free combination of the three themes, and new material, in foreign keys	First theme in tonic key	Second theme in tonic key	Closing theme in tonic key

Table 2-1. The hierarchical structure of sonata-allegro form.

Musical Rationality

- Classical cognitive science is committed to **rationality**: the notion that behavior is a consequence of the contents of mental representations
- Classical music is also content-laden because of its structure
 - “My own belief is that all music has an expressive power, some more and some less, but that all music has a certain meaning behind the notes and that that meaning behind the notes constitutes, after all, what the piece is saying, what the piece is about” (Copland, 1939, p. 12)
 - “It seemed to me that composers knew what they were doing, and that the experiments that had been made had taken place prior to the finished works, just as sketches are made before paintings and rehearsals precede performances” (Cage, 1961, p. 7).



Aaron Copland



John Cage

The Disembodied Mind

- Classical cognitive science employs a sense-think-act cycle, but emphasizes thinking at the expense of sensing and acting
- This disembodies the mind, separating it from the world, which is consistent with its Cartesian roots
- Classical music is similarly disembodied
 - Mozart “carried his compositions around in his head for days before setting them down on paper” (Hildesheimer, 1983): in a letter that he wrote to his father in 1780, Mozart noted that “everything is composed, just not copied out yet.”
 - Copland (1939, p. 22) observes that “a current idea exists that there is something shameful about writing a piece of music at the piano.”
 - Joe Jackson (1999 liner notes for *Symphony No. 1*) recalls that “I had a handful of very simple musical themes in my head and wanted to see if they could be developed and transformed throughout four whole movements.”



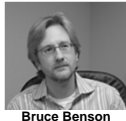
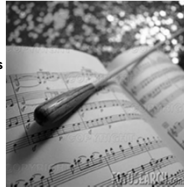
Mozart



Joe Jackson

Central Control

- Classical cognitive science must always be concerned with *the problem of what to do next*
 - “An adequate theory of human cognitive processes must include a description of the control system—the mechanism that determines the sequence in which operations will be performed” (Simon, 1979)
- Classical music employs a form of central control: the composer
 - “The conductor acts as a guide, a solver of problems, a decision maker. His guidance chart is the composer’s score; his job, to animate the score, to make it come alive, to bring it into audible being” (Green & Malko, 1975)
- A classical score also imposes central control
 - “Given the centrality of musical notation in the discourse of classical music, a parallel notion is that of Texttreue: fidelity to the written score (Benson, 2003)



Bruce Benson

Methodological Solipsism and Music

- Disembodiment is a recurrent, tacit theme of classical cognitive science – a consequence of *methodological solipsism*
 - “Methodological solipsism in psychology is the view that psychological states should be construed without reference to anything beyond the boundary of the individual who has those states” (Wilson, 2004)
- Classical music endorses methodological solipsism, in terms of the role of the audience: *A traditional piece is not defined by the audience that listens to it – another form of disembodiment*
 - Composer Arnold Schoenberg believed that the audience was “merely an acoustic necessity – and annoying one at that” (Benson, 2003)
 - Composer Virgil Thompson defined the ideal listener as “a person who applauds vigorously” (Copland, 1939)



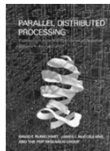
Arnold Schoenberg



Virgil Thompson

Reacting Against Classical Cognitive Science

- Classical cognitive science is a dominant, status quo, view
- However, it has generated movements that are strong reactions against the classical approach
- *Connectionists* are concerned about biological plausibility, and react against the formal basis of logicism
- *Embodied cognitive scientists* are concerned about separating the agent from the world, and react against the tremendous disembodiment of logicism
- For both camps, the Boolean dream is a nightmare!



Reactions Against Classical Music

- Near the beginning of the 20th century, composers reacted against many of the defining characteristics of Austro-German music – paralleling reactions against classical cognitive science
- Modern music begins with the flute solo that opens the *Prélude à 'L'après-midi d'un faune'* composed by Claude Debussy
 - “Debussy had opened the paths of modern music -- the abandonment of traditional tonality, the development of new rhythmic complexity, the recognition of color as an essential, the creation of a quite new form for each work, the exploration of deeper mental processes” (Griffiths, 1994)



Claude Debussy



From Tonality To Dodecaphony

- Tonality is a key structural property of classical music, and is achieved by using particular subsets of the chromatic scale
- Schoenberg invented the 12-tone method to remove tonality from compositions
- The first example of a dodecaphonic composition was Schoenberg's 1923 *Suite for Piano, Op. 25*
- Dodecaphony was later applied to other aspects of music in the serialism of Messaien, Boulez and Stockhausen



Arnold Schoenberg

Piano Keys With Note Name	A	AB	B	C	CB	D	DE	E	F	FB	G	GA
A Major Scale	✓											
A Minor Scale												

Table 2-2. The top row illustrates keys (white and black) on a piano from one A to the A an octave higher. The last two rows provide the subsets of notes that define A-major and A-minor scales; checkmarks are used to indicate which notes are included in a scale.

Reactions to Atonal Structure

- Dodecaphony produced powerful music, but this music was also widely criticized
- It had replaced one kind of structure with a different kind – not a revolutionary change
 - “To me, it was music of the past, passing itself off as music of the present. After all, Arnold Schoenberg was about the same age as my grandfather!” (Glass, 1987)
 - “Faced with complex and lengthy analyses, baffling terminology and a total rejection of common paradigms of musical expression, many critics – not all conservative – found ample ammunition to back up their claims that serial music was a mere intellectual exercise which could not seriously be regarded as music at all” (Grant, 2001)
 - Phillip Glass describes his feelings about serialism: “A wasteland, dominated by these maniacs, these creeps, who were trying to make everyone write this crazy creepy music” (Schwarz, 1996)



Arnold Schoenberg



Anton Webern

Removing The Composer's Control

- Modern music also moved to remove the central control of the composer
- John Cage frequently relied on chance operations to compose
 - “When silence, generally speaking, is not in evidence, the will of the composer is. Inherent silence is equivalent to denial of the will” (Cage, 1961)
- These operations worked because of careful choice of “building blocks”, and because of the audience
 - “In the *Music of Changes* the effect of the chance operations on the structure (making very apparent its anachronistic character) was balanced by a control of the materials” (Cage, 1961)
 - “Most people think that when they hear a piece of music, they're not doing anything but something is being done to them. Now this is not true, and we must arrange our music, we must arrange our art, we must arrange everything, I believe, so that people realize that they themselves are doing it.”



Minimalism and Emergence

- Minimalist music shared Cage's search for emergence, and his reliance on an active audience, but did not use chance operations
- Minimalists used simple, repetitive sound segments to induce auditory illusions
 - “The mind is mesmerized by repetition, put into such a state that small motifs can leap out of the music with a distinctness quite unrelated to their acoustic dominance” (Griffiths, 1994)
- Early minimalist discoveries were made from tape compositions such as Reich's *It's Gonna Rain*
 - “In the process of trying to line up two identical tape loops in some particular relationship, I discovered that the most interesting music of all was made by simply lining the loops up in unison, and letting them slowly shift out of phase with each other” (Reich, 2002)



La Monte Young



A Minimalist Score

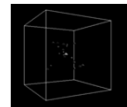
- Terry Riley's *In C* moved minimalist music into the traditional format of a musical score – note the return to tonality!
- However, *In C* did not rely upon central control
- Instead, the musicians interacted with the score stigmergically
 - Riley notes “one of the joys of *In C* is the interaction of the players in polyrhythmic combinations that spontaneously arise between patterns. Some quite fantastic shapes will arise and disintegrate as the group moves through the piece.”



Terry Riley

Swarm Music

- Another example of musical stigmergy is Blackwell's *Swarm Music*
- Computer generated swarms of particles – each a musical event – move to positions in space that produce sounds
 - “The swarming behavior of these particles leads to melodies that are not structured according to familiar musical rules, but are nevertheless neither random nor unpleasant” (Blackwell & Young, 2004)
- Positions can be affected by other sounds, such as those produced by accompanying musicians
 - Jazz singer Kathleen Willison “was surprised to find in the first improvisation that *Swarm Music* seemed to be imitating her: ‘(the swarm) hit the same note at the same time – the harmonies worked’. However, there was some tension; ‘at times I would have liked it to slow down...it has a mind of its own...give it some space’”.
- Musicians affect the swarms, which feedback to the musicians



Tim Blackwell

Stigmergy via reacTable

- Another modern example of musical stigmergy is the [reacTable](#)
- It is a visual, tactile interface in which sound-producing or sound-mediating objects are placed on a table
- More than one musician can interact with the reacTable at the same time
- The table is the environment that serves to control and coordinate the actions of the musicians



Björk with reacTable

A Gradual Process

- Other minimalist practices emphasized emergence in more traditional scores
- Steve Reich composed minimalist music by phase-shifting instruments directly in the score
- These phase shifts were extremely gradual, and thus transparent to the listener
 - “I am interested in perceptible processes. I want to be able to hear the process happening throughout the sounding music” (Reich, 2002)
- This approach produced emergent phenomena that depended upon the active contributions of his audience
 - “Even when all the cards are on the table and everyone hears what is gradually happening in a musical process, there are still enough mysteries to satisfy all. These mysteries are the impersonal, unintended, psychoacoustic by-products of the intended process” (Reich, 2002)



Steve Reich



Music for Six Pianos



Modern Music

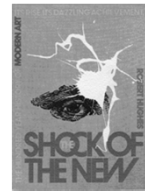
- Modern music arose as a reaction against the traditional structures of Austro-German classical music
 - “Is it not our duty”, he [Debussy] asked, “to find a symphonic means to express our time, one that evokes the progress, the daring and the victories of modern days? The century of the aeroplane deserves its music!” (Griffiths, 1994)
- Modern music abandons tonality, musical logicism, central control of conductor and score, and disembodiment from performers and audience
- It breaks the analogy between classical music and mind – minimalism, for instance, seems very much like the synthetic psychology we are studying
 - “Minimalism was marked by a spirit of discovery: the discovery of models in extra-European music [...], and the discovery of how extended musical structures could be created out of rudimentary ideas” (Griffiths, 1994)



Paul Griffiths

Implications for Theories

- One possibility is that the nature of theories of complex cognitive processes related to music (composition, performance, perception) might reflect the kind of music being studied
- Perhaps modern (embodied, connectionist, synthetic) theories will work for modern music
- Perhaps classical theories are required for more traditional classical music
- However, one shock of the new music – in addition to its novel sound – is that many of its characteristics can be found in traditional classical music, if one cares to look for them
- If so, classical theories may not be required for classical music!



Structural Evolution

- Classical music's logicism is reflected in its reliance on standard structures
- However, it is important to realize that these structures have continually been evolving as composers experiment with new ideas
- Our notion of the symphony is the end of a long line of changes
 - 17th century symphony was just overture before a play
 - Early 18th century modern form developed by Carl Philip Emmanuel Bach
 - Late 18th century this form modified by Handel and Mozart
 - 19th century perfection by Beethoven
- Indeed, the conventions for scales and orchestral tunings that we are familiar with are extremely recent
 - Equal temperament not possible until appropriate tuning forks available in 1834
 - Such tuning for piano not possible until 1917
 - A above middle C set at 440 Hz – in 1936!



C.P.E. Bach



Ludwig von Beethoven

Classical Embodiment

- The disembodiment of classical composition may be more of an affectation than a real position
- Composers may depend crucially on external aids for creating and evaluating their compositions
 - “It is also enlightening that Mozart refused to compose without a keyboard near him, for the traditional view is that he was able to compose everything in his head!” (Benson, 2003)
- Even the composition of traditional classical music may leak from the composer's mind into the world
 - “Musical history recounts many instances of composers making adjustments in their scores after having heard how they sound” (Copland, 1952)



Aaron Copland

From Hot To Cool – or Not?

- Marshall McLuhan used audience participation to distinguish hot from cool media
 - “Any hot medium allows of less participation than a cool one, as a lecture makes for less participation than a seminar, and a book for less than dialogue” (McLuhan, 1964)
- Modern music was so much cooler than classical music that it seemed improvised rather than composed
 - “The larger part of classical composition is closed to improvisation and, as its antithesis, it is likely that it will always remain closed” (Bailey, 1992)
- But improvisation is likely characteristic of more traditional classical music
 - “Composers are dependent on the ‘languages’ available to them and usually those languages are relatively well defined. What we call ‘innovation’ comes either from pushing the boundaries or from mixing elements of one language with another” (Benson, 2003)



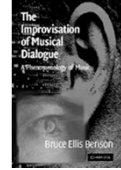
Marshall McLuhan



Derek Bailey

Filling in the Gaps

- Why might even traditional classical music be cool, in McLuhan’s sense?
- Musical scores are merely skeletal guides to a piece
 - “Musical notation, as it exists today, is not an exact transcription of a composer’s thought. It cannot be, for it is too vague; it allows for too great a leeway in individual matters of taste and choice” (Copland, 1939)
- Conductors and performers are forced to be cool, in an attempt to fill in the gaps that every composer must leave in their compositions – requiring a degree of improvisation
 - “One way of thinking about a musical work is that it provides a world in which music making can take place. Performers, listeners, and even composers in effect dwell within the world it creates. And their way of dwelling is best characterized as ‘improvisation’” (Benson, 2003)



Hastings Lake Ponderings

- Ideas like decentralized control, emergence from musical agents, and stigmergy can be plausibly be applied to a complex psychological phenomenon like the composition of modern classical music
- Similar notions also appear to apply to more traditional classical music
- Is it not also plausible that these ideas can also be applied to more mundane aspects of cognition?
- If this is the case, then what new kinds of theories are needed in cognitive science?
- And what new kinds of methods are required to permit these theories to flourish?
- Next week, we will explore *synthetic methods* as a potential answer to these questions

