

Music Evolution: The Memory Modulation Theory

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Solving the Mystery of Music

The evolutionary basis for the development of advanced musical capabilities in humans has remained a mystery. Whereas language clearly confers obvious fitness advantages, music has resisted such an easy explanation. Current explanations tend to fall into the categories of either music as a by-product of the evolution of other facilities that do directly confer fitness benefits, or music as a sexual selection fitness indicator (Wallin, Merker & Brown, 2000).

We have found neither of these classes of explanations, nor any other of the previously proposed explanations compelling. Rather, we argue that advanced musical capabilities evolved because they directly confer specific fitness advantages. In particular, we argue that human musical capabilities are precisely those set of specialized mental capabilities that co-evolved with language to enable the sophisticated memory modulation of the receiver of information by the communicator of a message. In other words, music enables individuals and groups that are communicating messages to have a degree of control over how the messages will be retained in the memory of the receiver(s). Particularly in the pre-literate world, such abilities have obvious, direct evolutionary advantages.

Memory Modulation and Music

The consolidation theory of memory (McGaugh, 2000) continues to guide current memory research. The theory suggests that it takes time for long-term memories to consolidate. "Considerable evidence suggests that the slow consolidation of memories serves an adaptive function by enabling endogenous processes activated by an experience to modulate memory strength". In other words, it is optimal for long-term memory processes to be highly selective.

Key facilitators of memory modulation are emotional arousal, repetition, and structure. And these are exactly the essential attributes of music -- making it the ultimate vehicle for fine-tuned memory modulation.

In particular, music enhances the probability of long-term memory of coincident events and communications. It appears that music facilitates long-term memory primarily through the evocation of emotion, and with contributions from repetition and additional structure (Schulkind, Hennis & Brown, 1999)

An Information Theoretic Approach

From an information theory point of view, the generalized issue at hand is precisely how communications modes would co-evolve with increasing intelligence, given specific memory storage architectures.

If the architecture of the human brain had been such that there existed only one type of memory, then a communications capability relying simply on syntactical structures would have been sufficient. However, the durability of memories in the human brain (and other animals) can, as a first approximation, be divided into two categories: short-term and long-term memory. Syntactical structures of language alone offer limited ability for the sender of a message to effectively influence the strength of memory of the receiver.

However, the ability of communicators to directly influence strength of memory in receivers would be of exceedingly high fitness value as intelligence and the sophistication of associated messages increased. Indeed, the encoding of a message in very long-term memory significantly increases the probability that the message will be re-transmitted with high fidelity by the original receiver to others. This cascading of the original message vastly increases the evolutionary value of preferential memory selection by the message sender.

We argue, music is, therefore, just that (expected) mode of communication that co-evolved with language and overall intelligence that enabled finer and finer control of the memory modulation of message receivers by message sender(s). Music has all the right characteristics to fit this critical (and expected) role, and there is no other such communications mode that fills such a role as effectively. Nor do we find any other explanation for the evolution of musicality in humans that is as comprehensive and compelling.

References

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Memory Modulation Theory of Music

Explaining the evolutionary purpose of human musicality and its generalization to the evolution of communications modes among intelligent agents

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The Mystery of Music

The Question . . .

Why did the complex capabilities of musicality evolve in humans???

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The Mystery of Music

. . . and Current Proposed Answers . . .

1. Music is simply a by-product of genuine mental adaptations (fails Occam's razor)
2. Musical capabilities are the result of sexual selection adaptations (no evidence)
3. Music is adaptive by providing for social cohesion (implies group selection)

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Our Answer . . .

Musicality co-evolved with language in humans (and likely in ancestral species) as a direct adaptation by enabling the modulation of memories of message receivers by message senders.

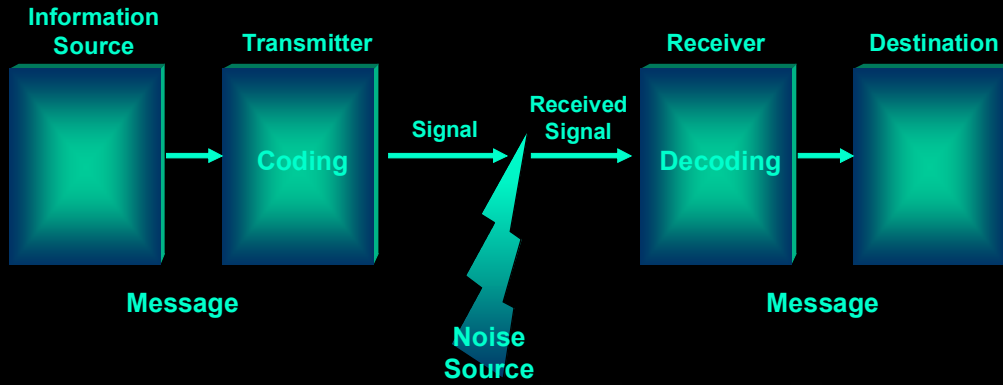
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Shannon's Information Theory

General model of communications in noisy environments



Source: *The Mathematical Theory of Communication* by Shannon & Weaver

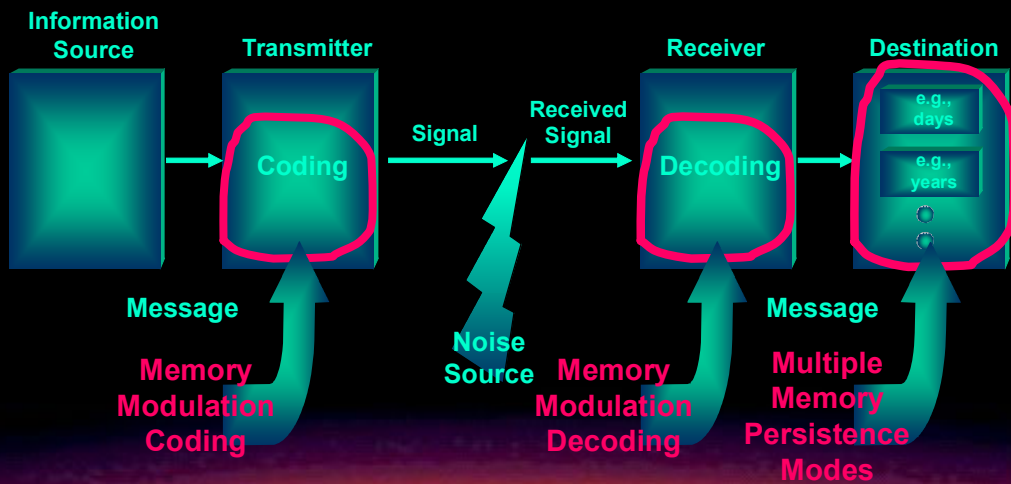
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Extending Shannon's Information Theory

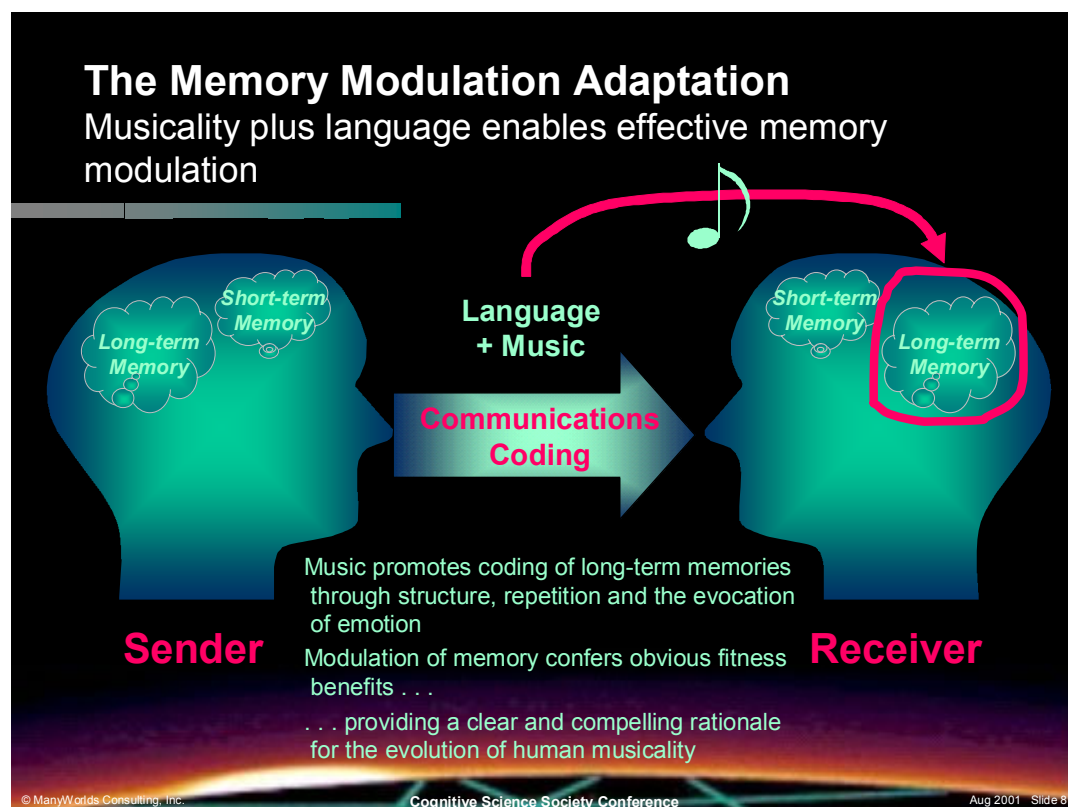
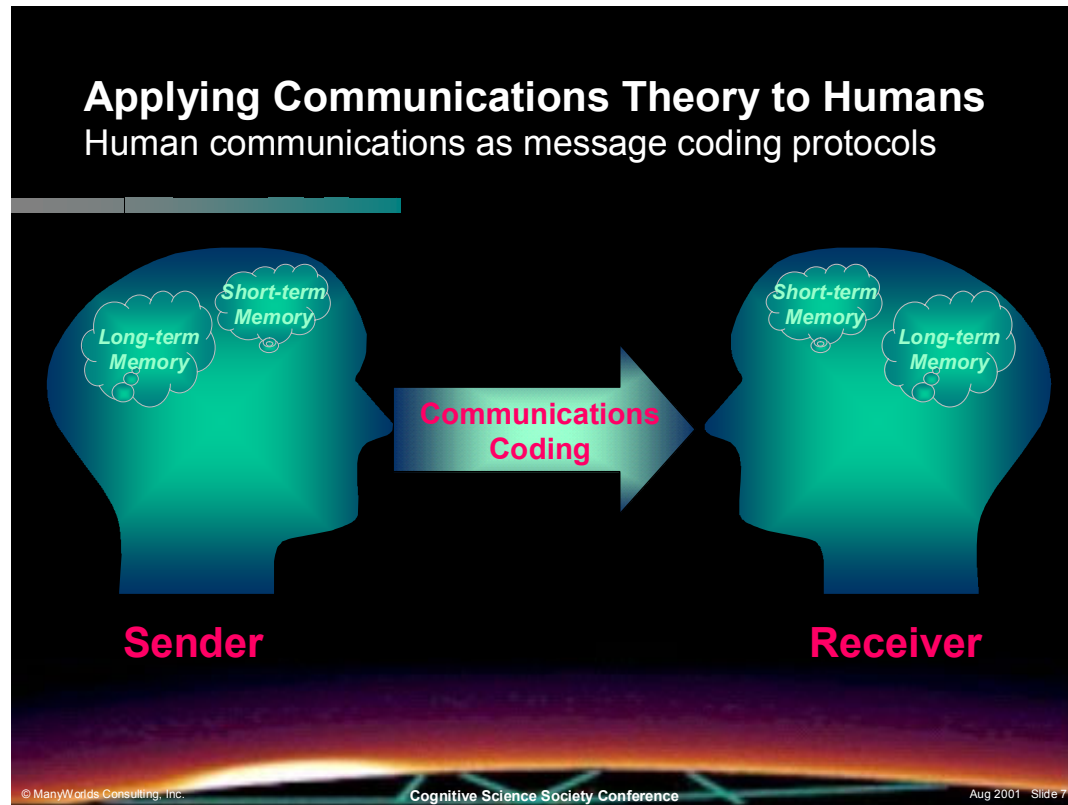
Implications when receiver has multiple memory modes



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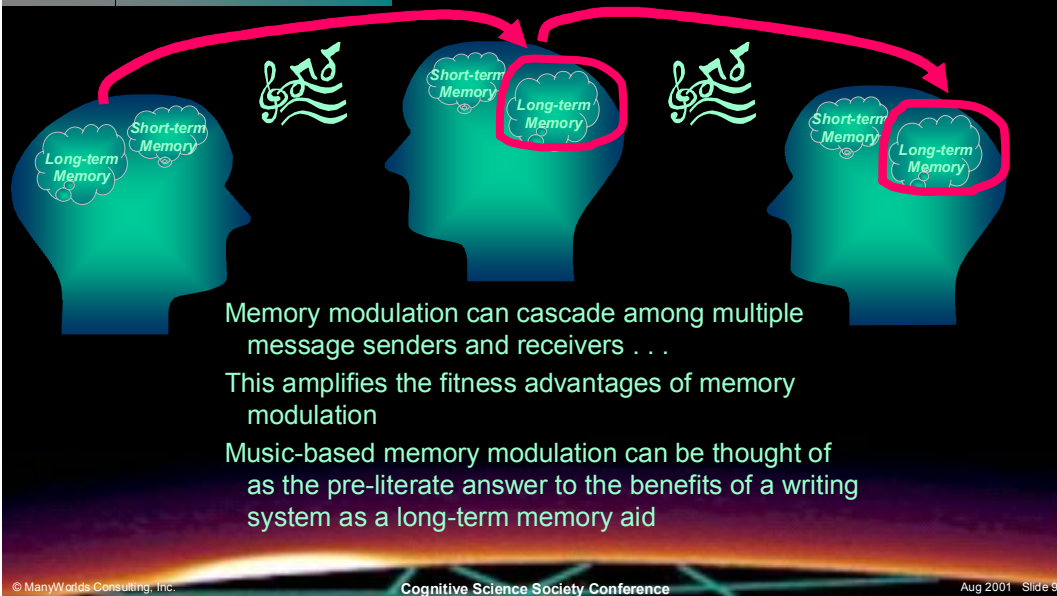
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The Memory Modulation Adaptation

Memory modulation through a series of senders & receivers

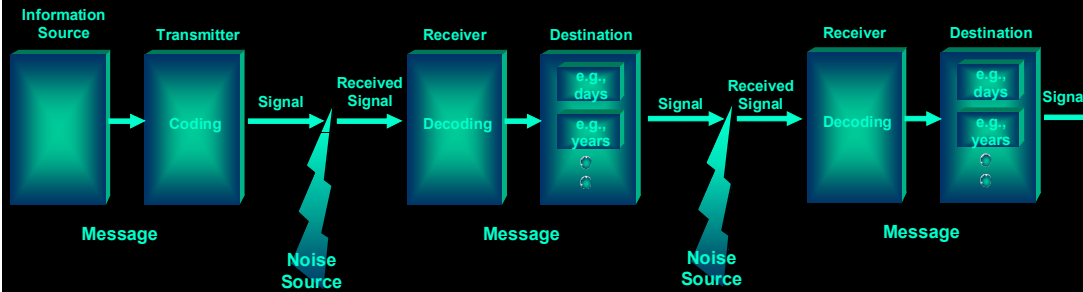


The Mystery of Music Solved

Human musicality is just that message coding approach that evolved to effectively enable memory modulation in human communications.

In fact, in generalizing the human situation to any environment in which evolving intelligent agents communicate and have a memory “budget”, it is virtually guaranteed that a memory modulation communications mode would evolve. We label the set of such acoustic-based modes in humans “music”.

Extending Shannon's Information Theory II



Any intelligent agent will necessarily have a memory "budget".

The agent will have built-in mechanisms to maximize the longer-term storage of "signal" rather than "noise"

As plasticity of behavior, and communications among the agents evolves, modes of modulating memory are guaranteed to evolve.

This should be verifiable through artificial life simulations

A Call for Further Research

The Memory Modulation Theory of Music provides a clear, direct explanation for the evolution of musicality in humans. It synthesizes insights from information and evolutionary theories.

Unlike alternatives, the theory provides testable predictions. For example, it predicts that memory modulation communications modes will evolve only in agents (e.g., animals) that have sufficient behavioral plasticity, a relatively long life span (so long-term memories can confer sufficient benefits), and that the modulation of memory should be particularly acute in the young (who have the longest to benefit from the beneficial long-term memories). These predictions apply to humans, to other animals, and to artificial agents that fit the criteria. We encourage the testing of these predictions in a rigorous manner.