

Music from Brainwaves

Michael O' Bannon
September 7, 2011



Music and EEG in the Last Millenium



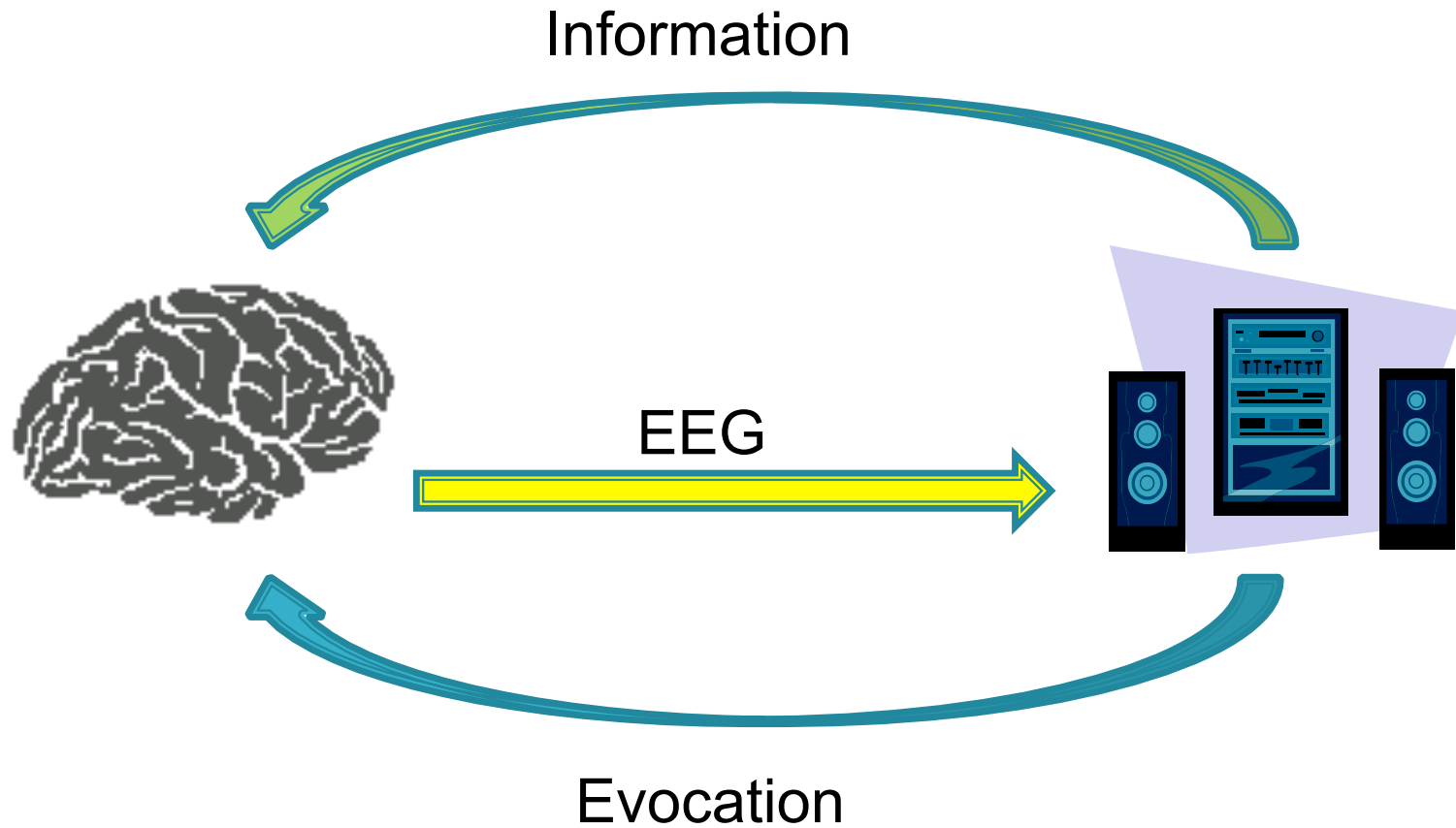
*Portable Gold and
Philosophers' Stones*
David Rosenboom, 1972

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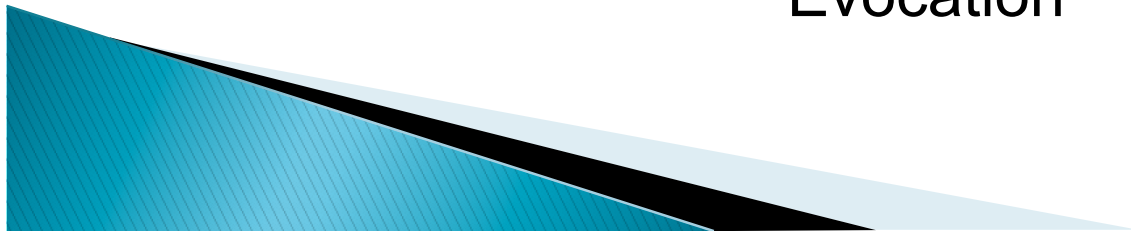
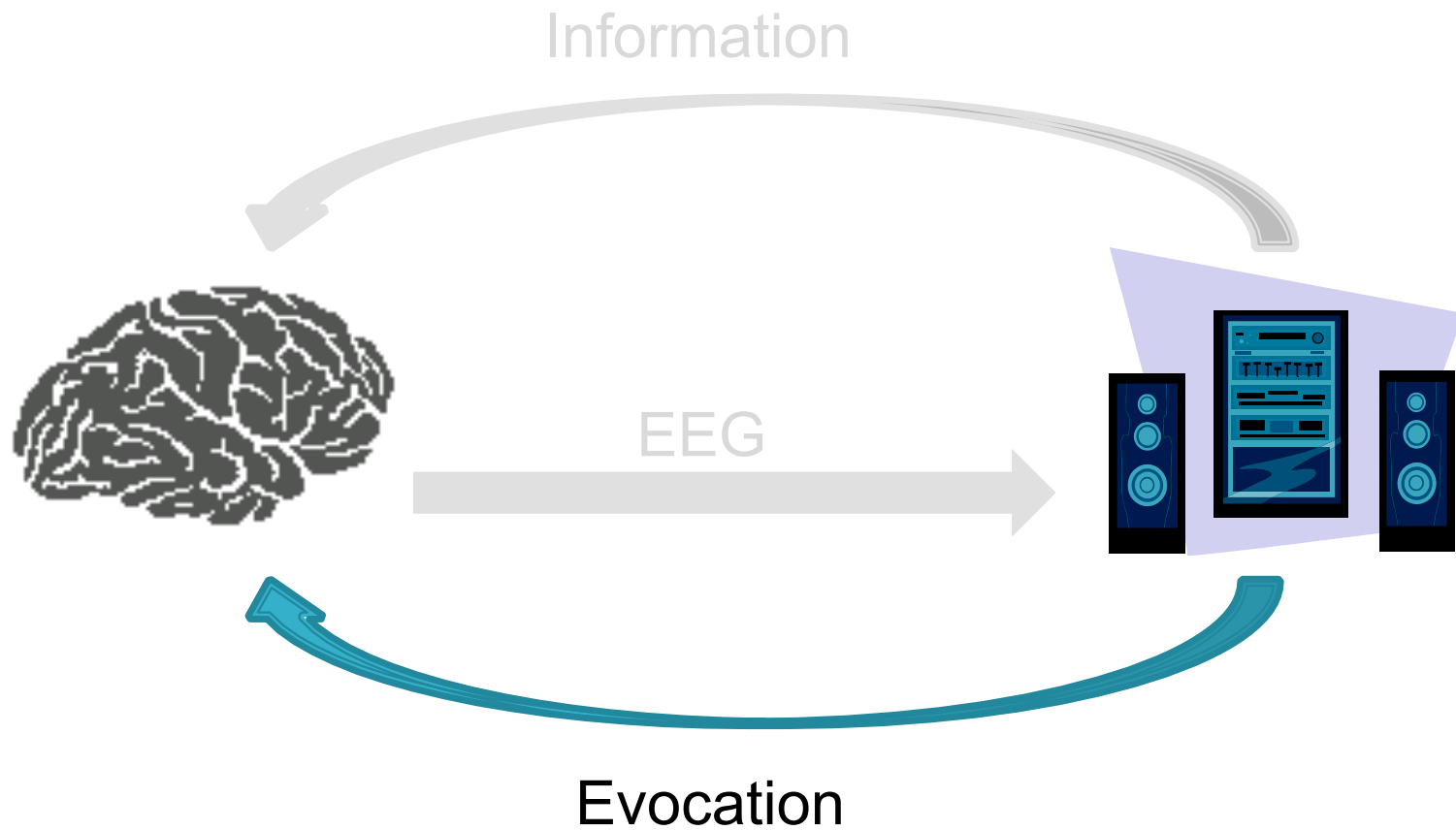
Mike Douglas

A Model of the Brain and Musical Performance



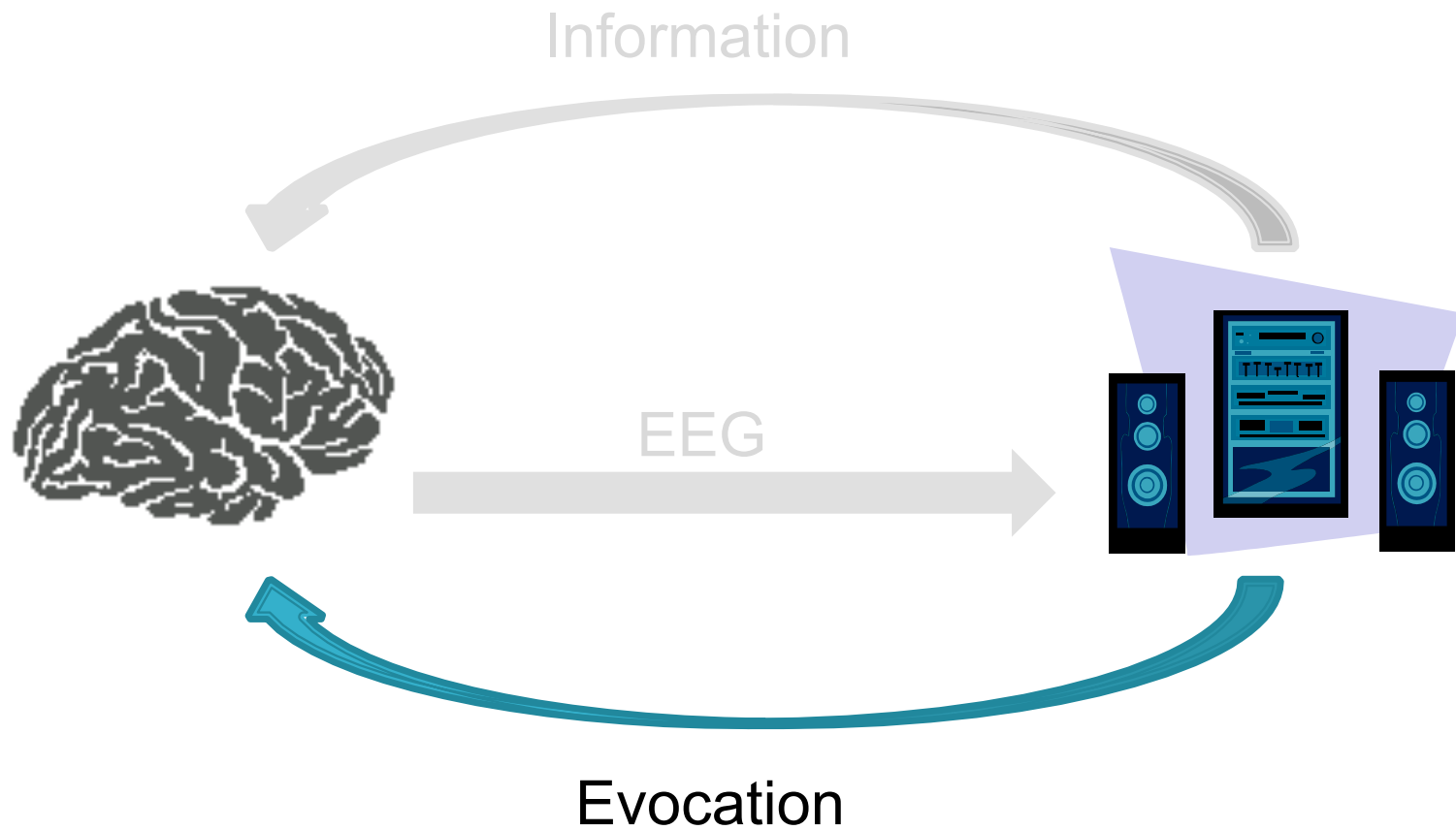
Conventional Performance

Composition shaped by artist introspection and listener response



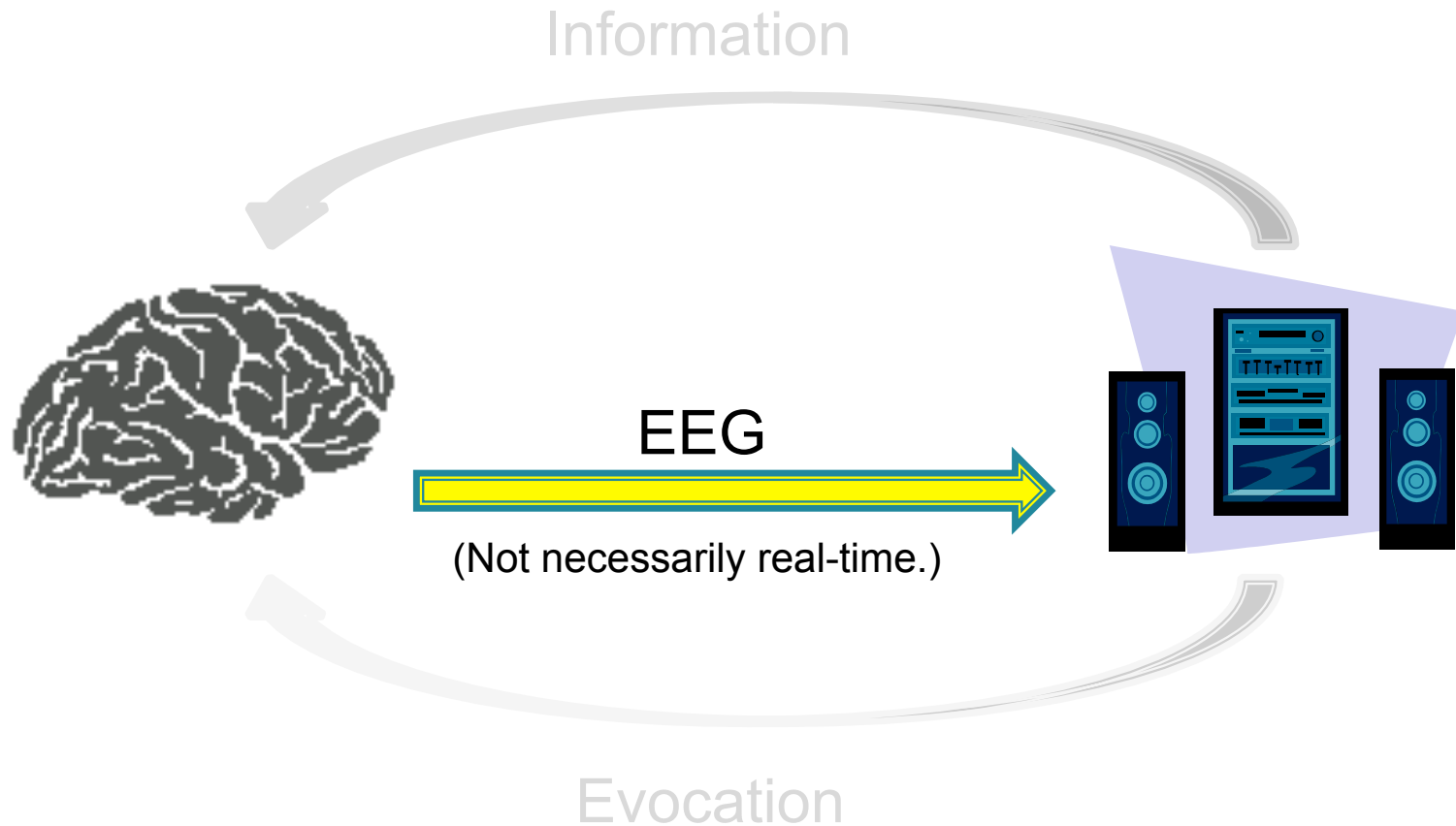
Music Therapy

Sound and music pre-selected for effects on the brain



Sonification

Raw brainwaves transformed to sound spectra and music



Sonification Examples



- ▶ *Mind Your Body*

- Roger Dean, Greg White & David Worrall

- ▶ *Listen (Awakening)*

- Dave Payling

- ▶ *Perceptions in C*

- John Sanderson & Tom Heuzenroeder

- ▶ *Neural Dialogs*

- Guillaume Potard & Greg Schiemer

From *Listening to the Mind Listening*,
Sydney, Australia, 2004



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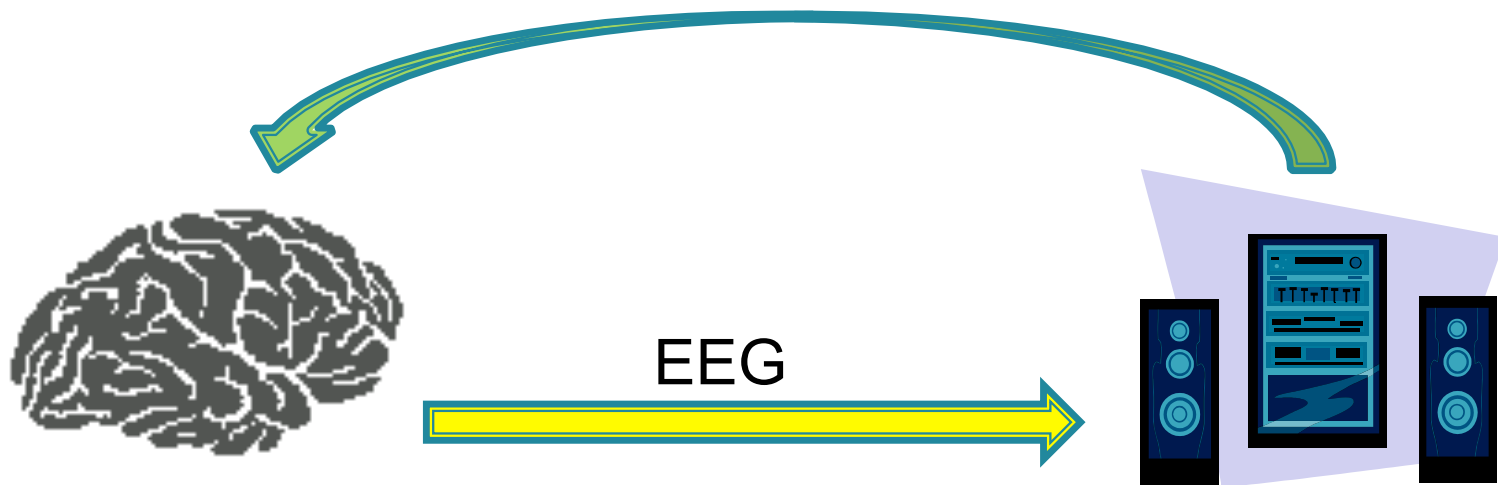


Conventional Biofeedback

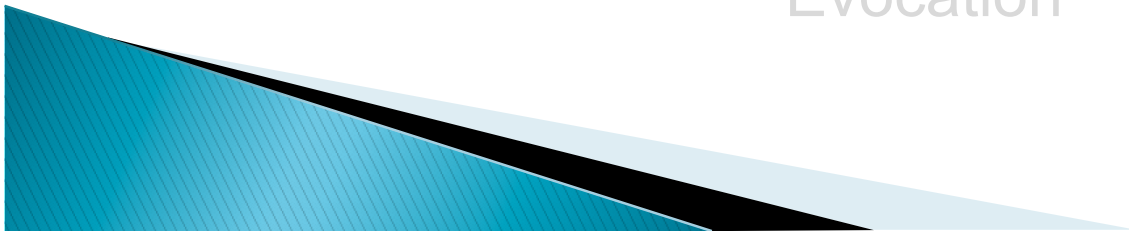
Focus on information for self-control

Minimal attention to evocative effects of sound

Information

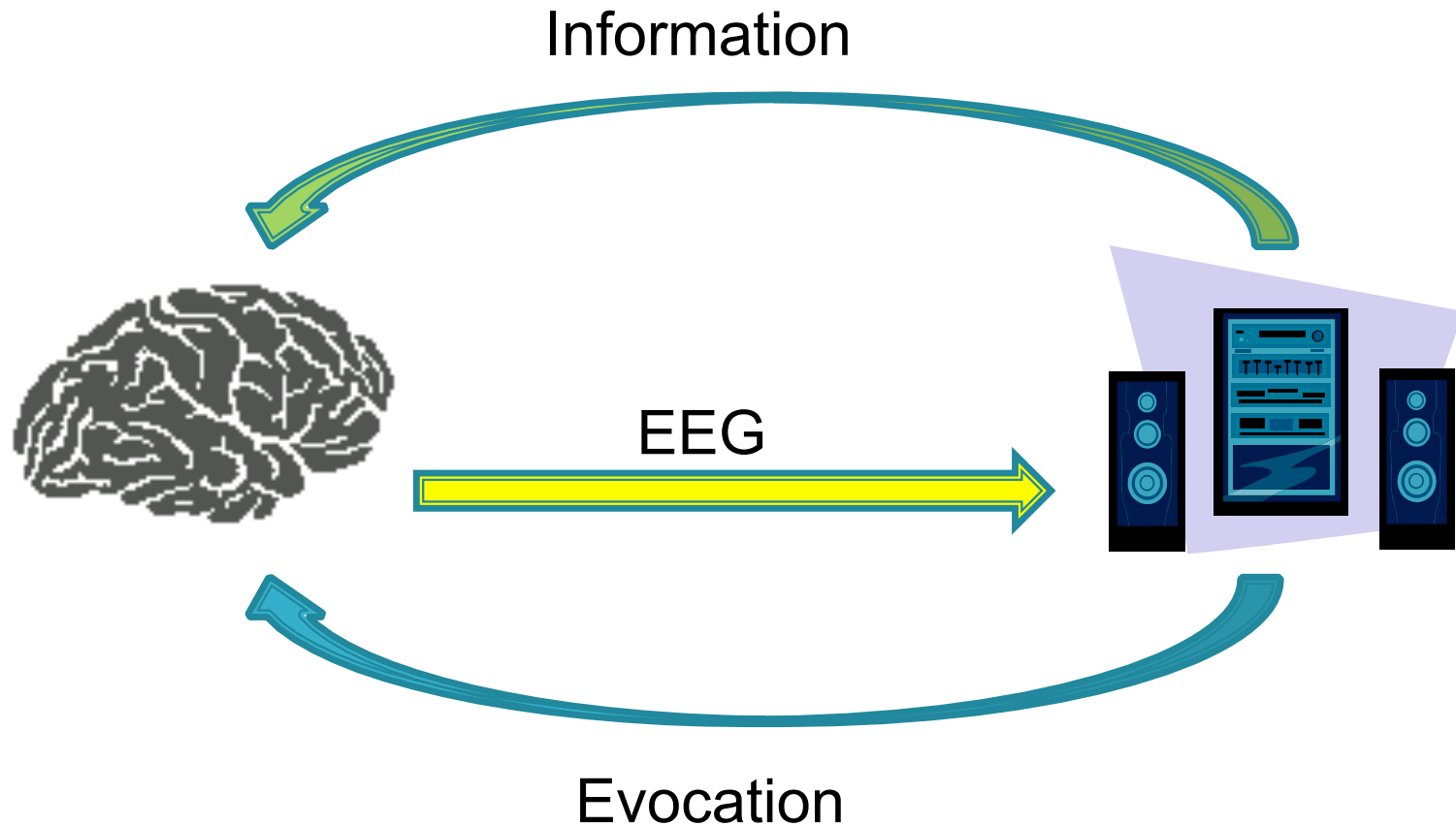


Evocation

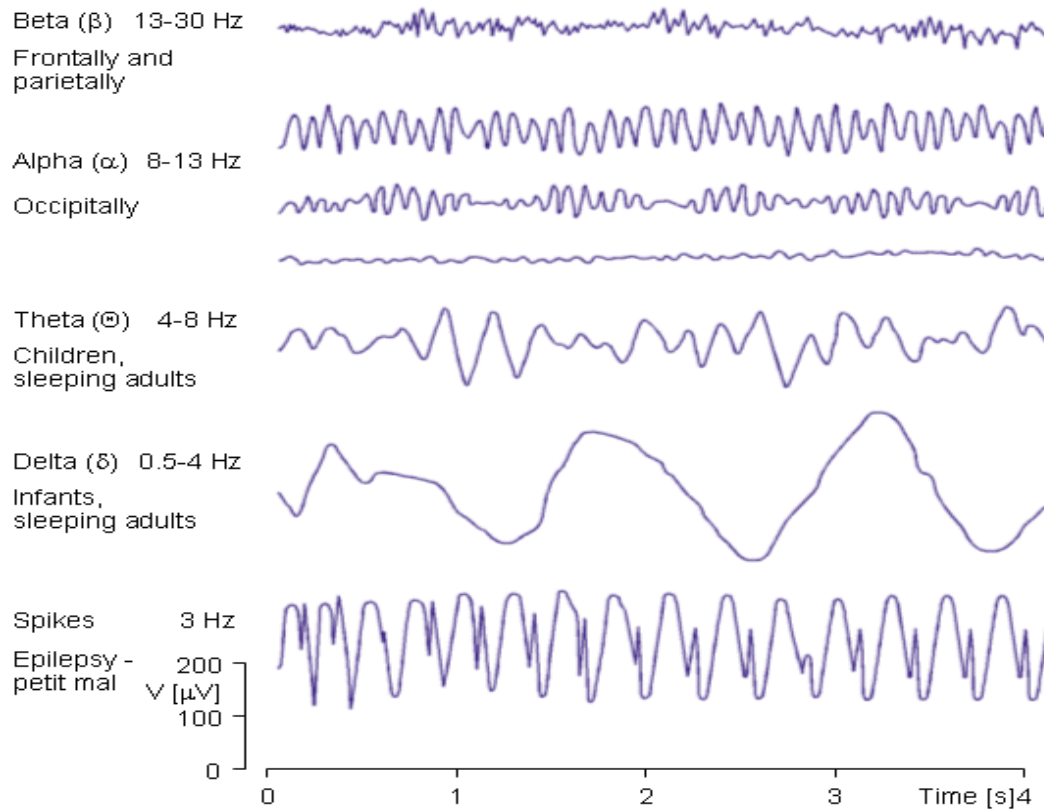


Intentional Composition and Biofeedback

Real time control of evocative stimuli via EEG



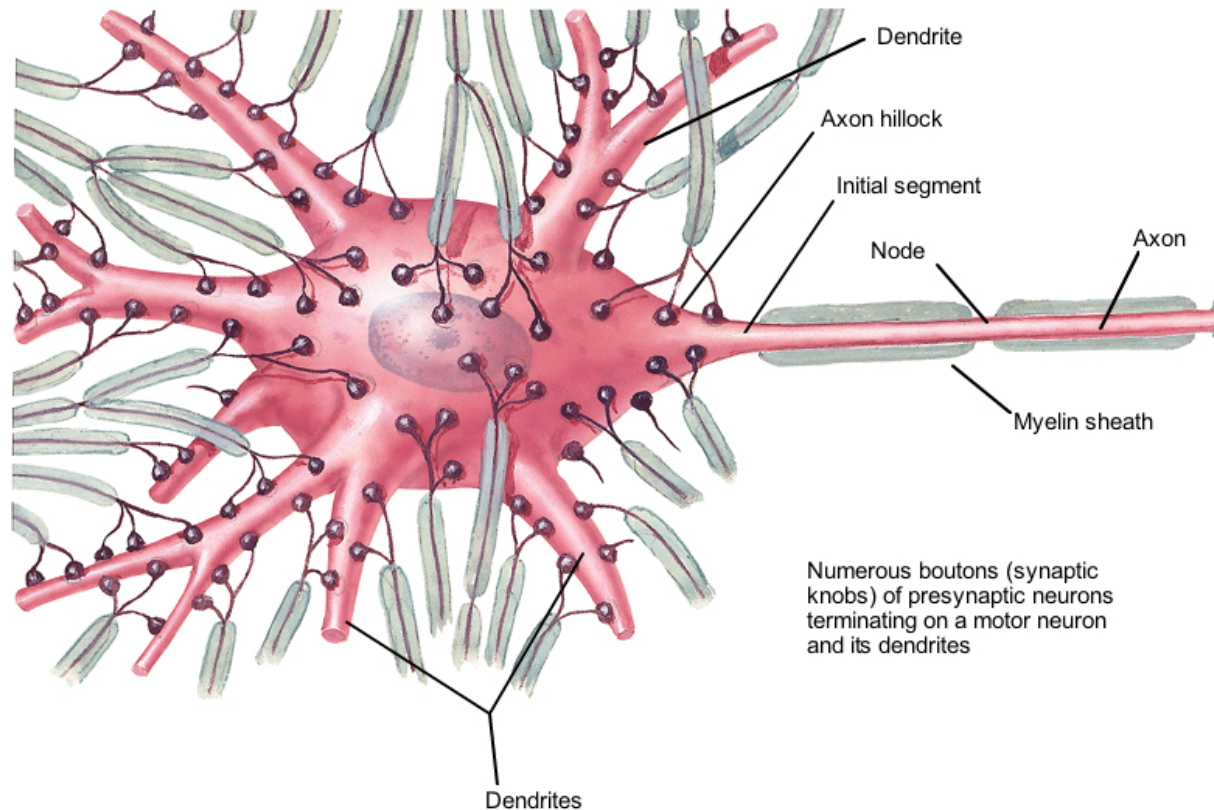
EEG by Frequency Band



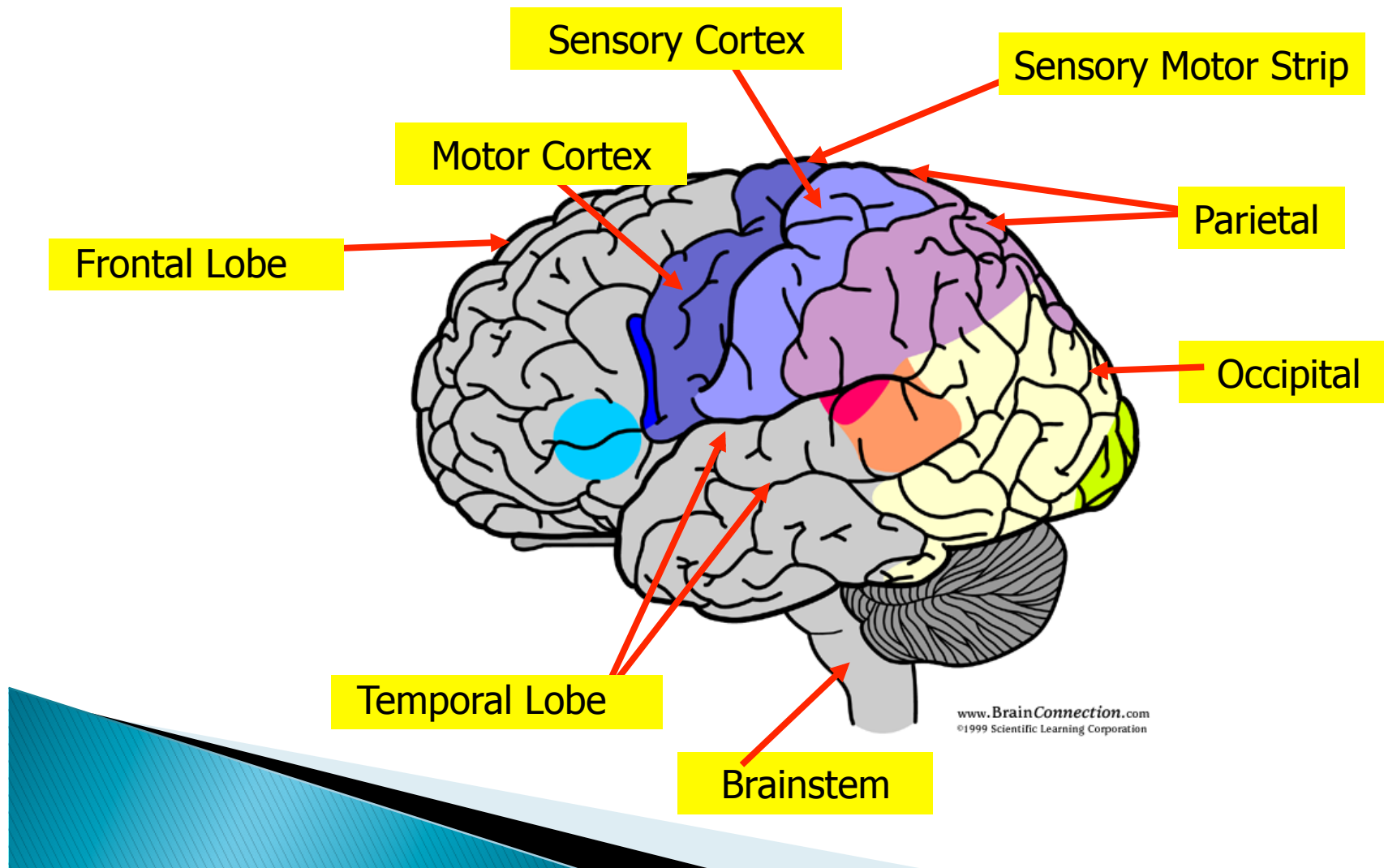
32+	Gamma
16-32	Beta
13-15	SMR
8-12	Alpha
4 - 7	Theta
1 - 3	Delta

Source of EEG in Cortical Neurons

Synaptic Morphology Schematic of Synaptic Endings



EEG Localization in the Cortex



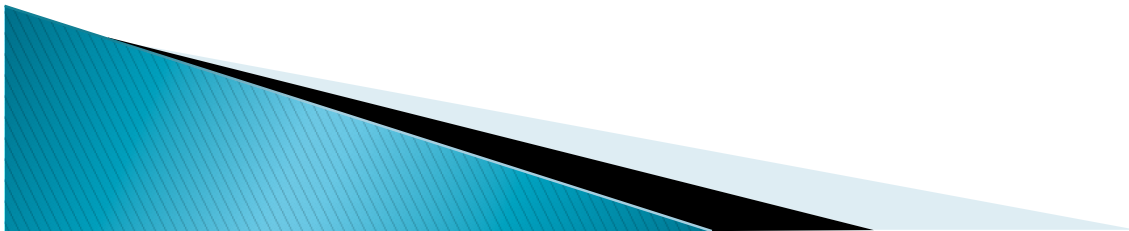
Current Hardware and Software

- Biofeedback input device
 - J&J C+, Brainmaster
- Biofeedback signal processor
 - BioExplorer, BioEra
- MIDI router
 - MIDI Yoke, LoopBE30
- Music programming environment
 - MAX 5.1
- Sound generator / processor
 - Nord G2, Dave Smith Evolver
 - Massive (.vst)
 - Drum machine
 - Eventide Eclipse



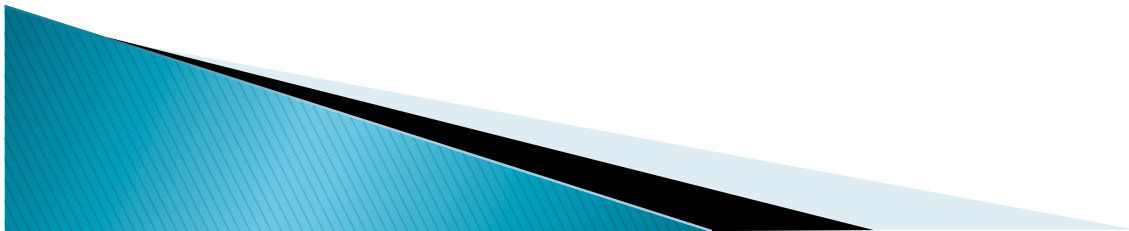
Current Hardware and Software

- Biofeedback input device
 - Neurosky Mindset / Bluetooth
- Biofeedback signal processor
 - Mindset internal μ Processor
- Music programming environment
 - MAX 5.1 / embedded JS and Python
- Sound generator
 - MAX 5.1 / msp



Misconceptions re: EEG Control

- Mapping of intention to EEG
- Specificity of response selection
- Temporal granularity
- Contamination by external noise
- Sensitivity to artifact



Future Possibilities

- ▶ Instruments and sounds tailored to the individual listener
- ▶ Soundscapes, sounds, and melodies composed for specific effects
- ▶ Real-time composition based on a listener's brain state
- ▶ Enhanced control of states of consciousness
- ▶ Improved music composition and performance skills
- ▶ Jamming with your own neurophysiology

