Hot Science Cool Talks

UT Environmental Science Institute

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Our Perceptions of Music: Why Does the Theme from Jaws Sound Like a Big Scary Shark?

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Our Perceptions of Music

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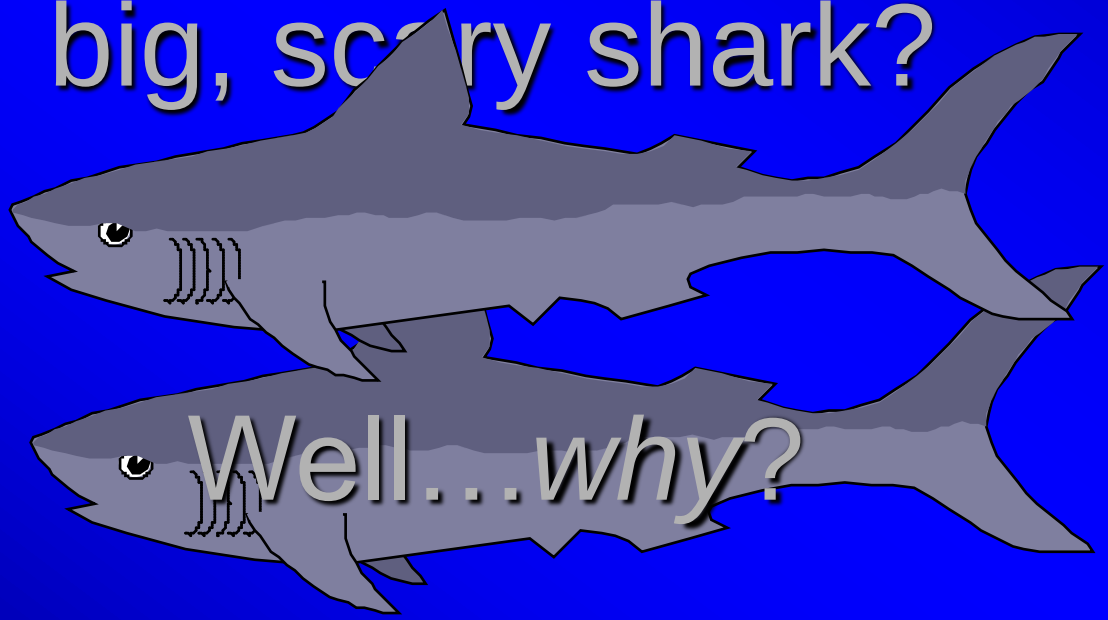
Why does the theme from Jaws sound like a big, scary shark?



Well…*why*?

A Different Context …

Emotion and Meaning in Music

The Stimulus

The Listener

The Context

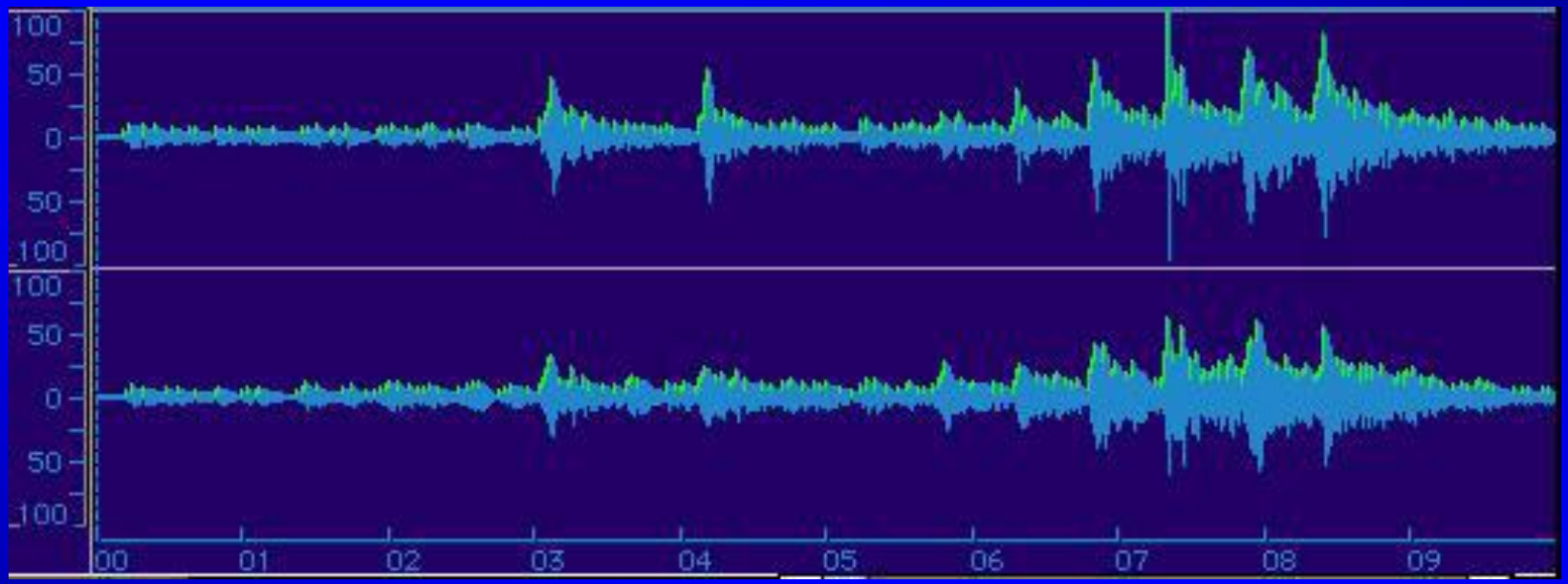
Properties of Musical Sound

Periodic Sound Waves

Described in terms of:

Frequency
Waveform
Amplitude
Duration

Sound is Pressure Waves

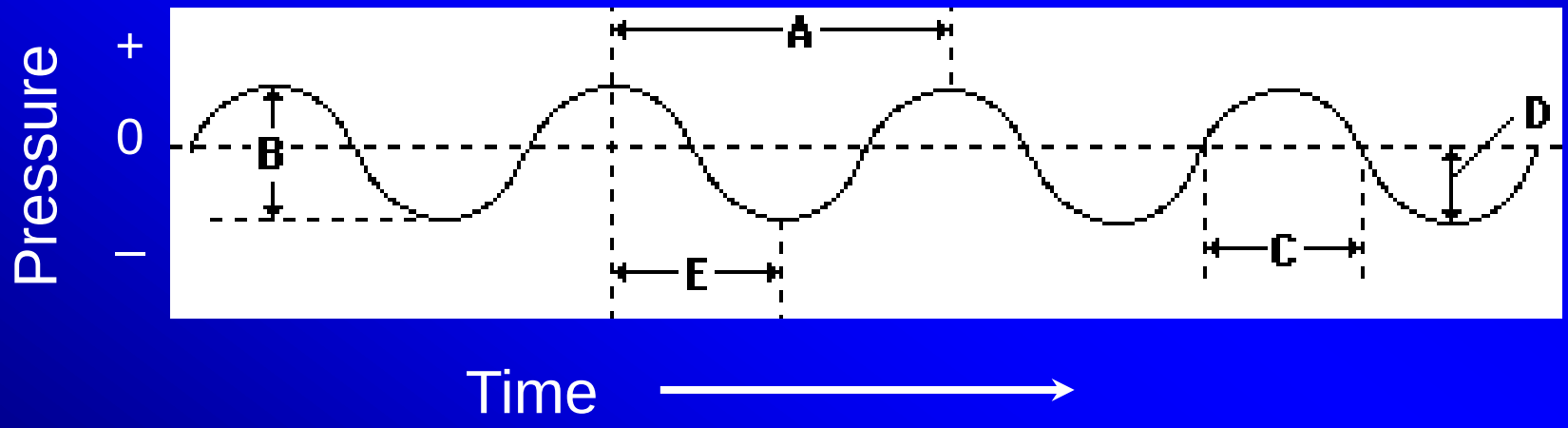


Time

Perceptual Correlates of Physical Properties

Physical		Perceptual
Frequency	⟷	Pitch
Waveform	⟷	Tone Quality
Amplitude	⟷	Loudness
Duration	⟷	Articulation
		Rhythm
		Tempo

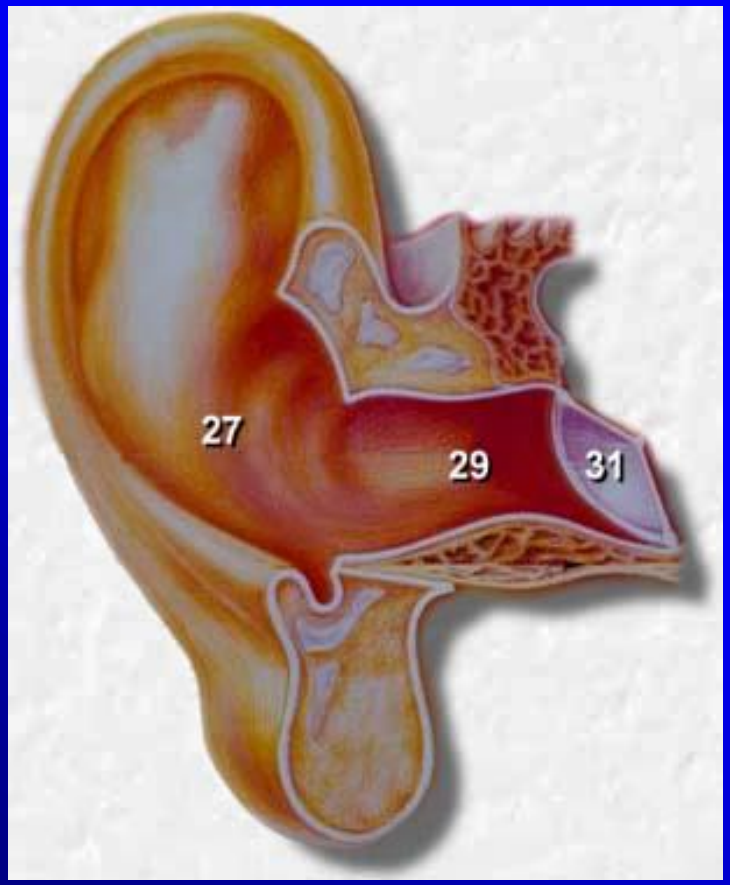
Sound is variations in air pressure produced by physical vibration



Wave Motion Demos

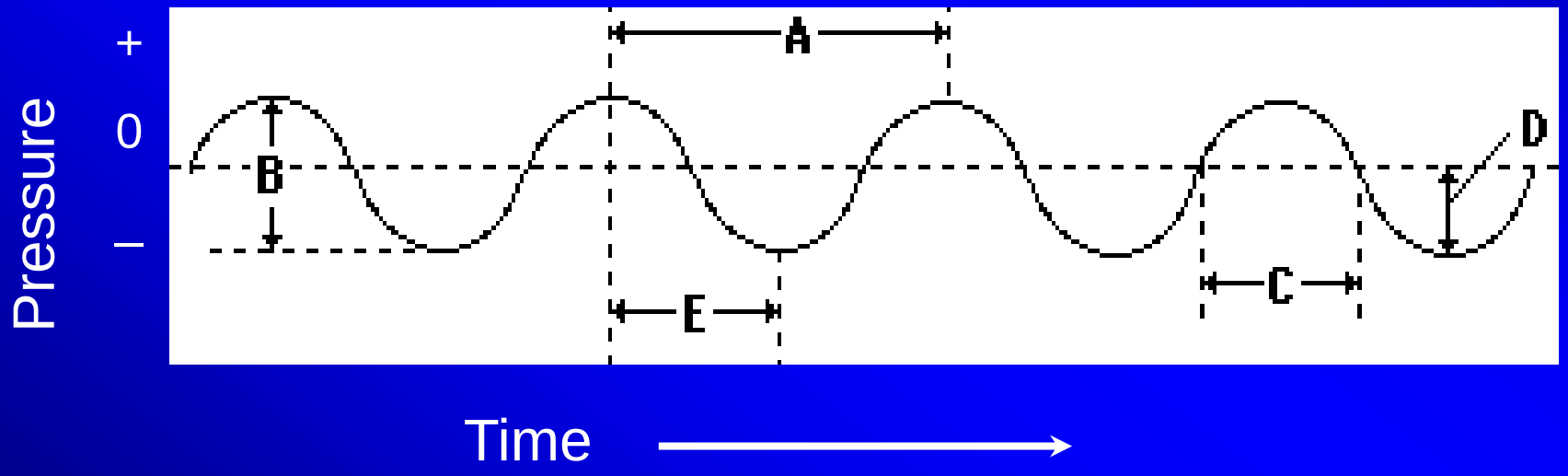
Ears detect pressure changes

Outer ear: pinna, meatus

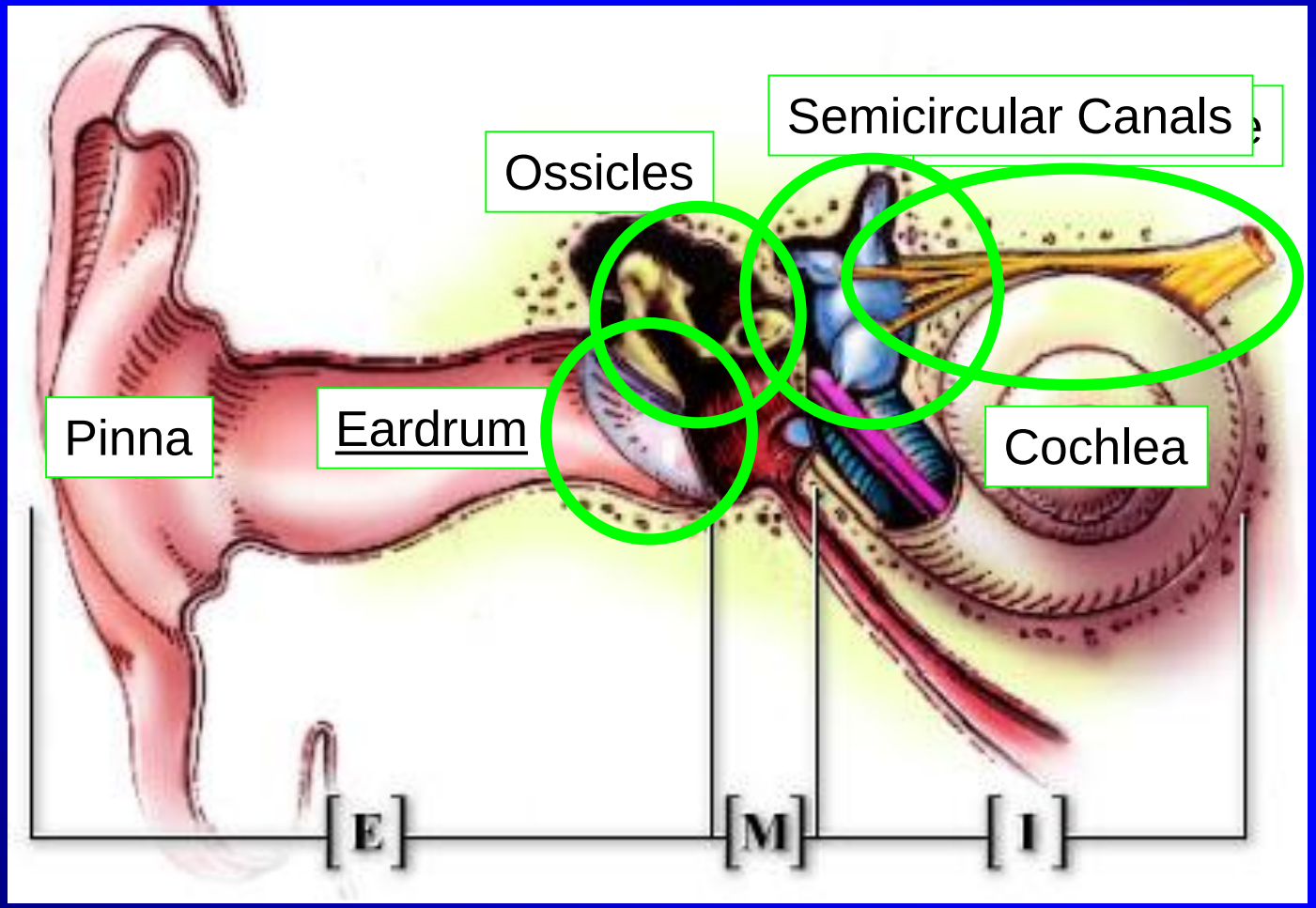


Tympanic membrane

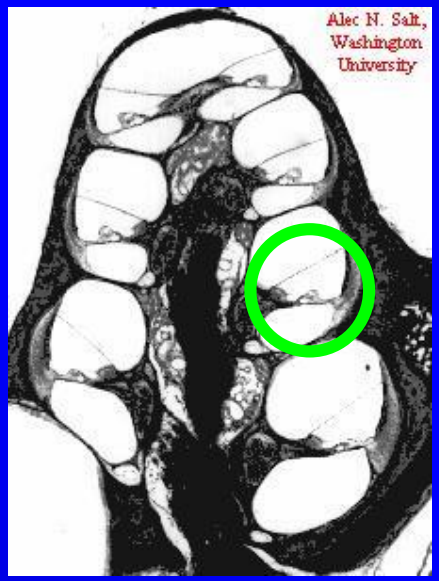
… and analyze the frequency of the changes



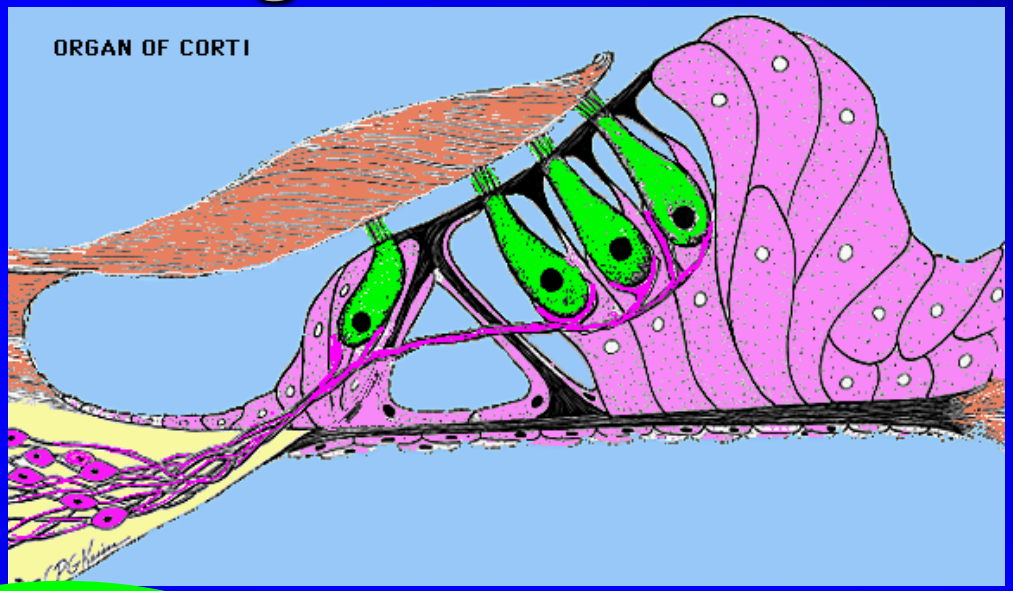
Physiology of the Human Auditory System

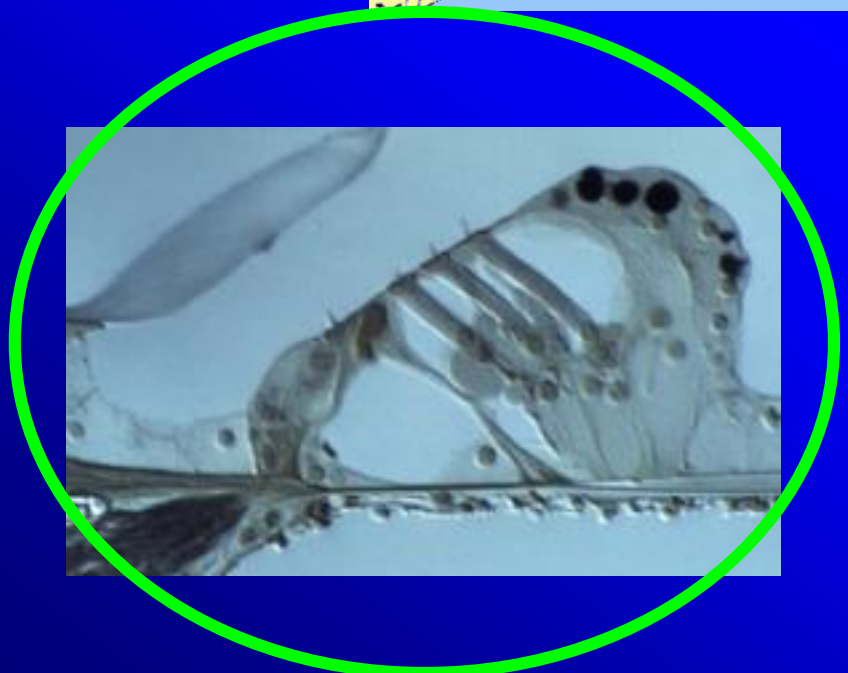


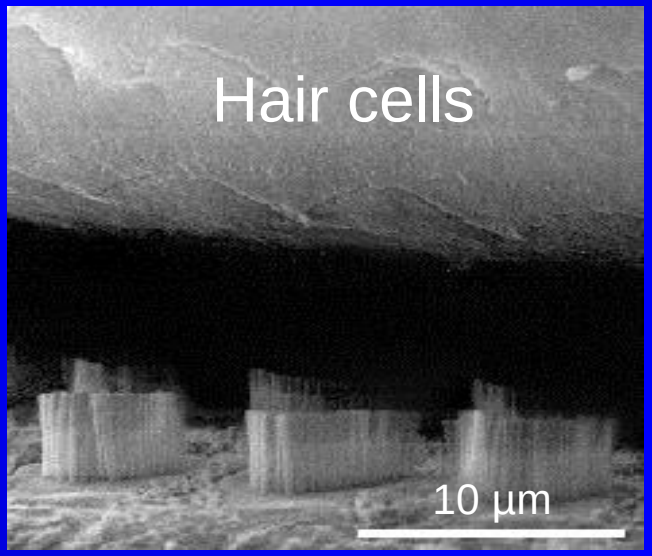
Cochlea



Organ of Corti







Models of the cochlea at work

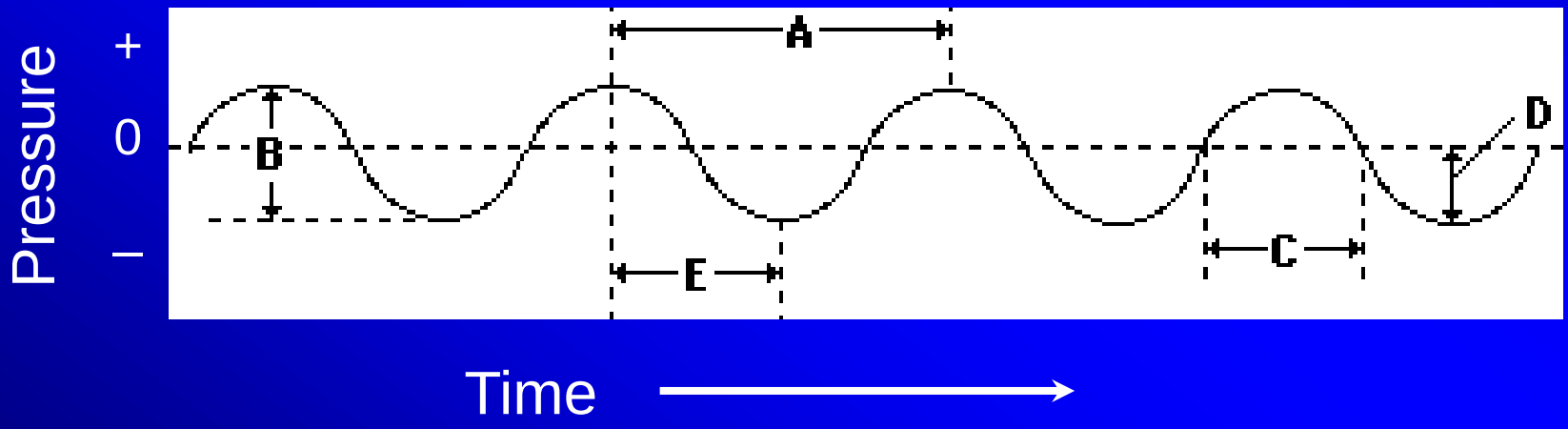
Mechanical cochlea model

The Auditory System:

Detects changes in pressure

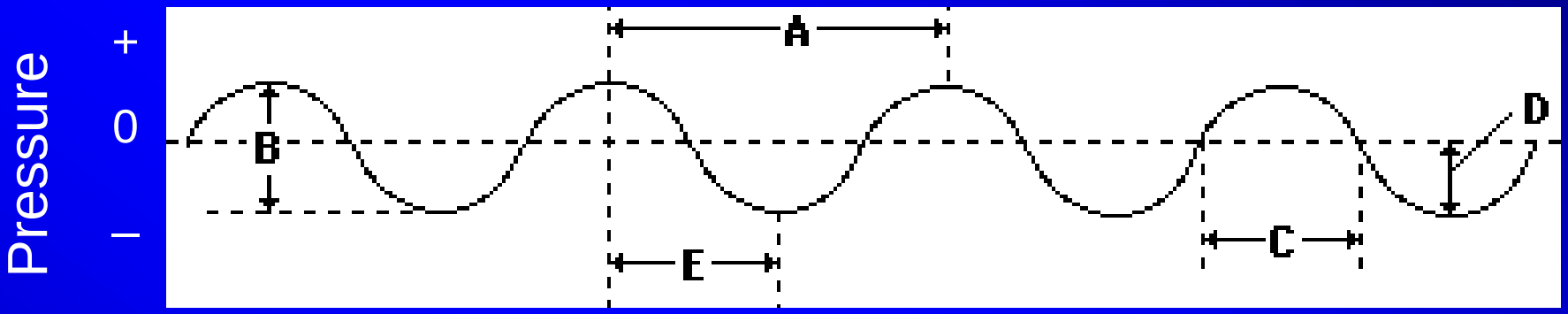
Analyzes the frequency of changes

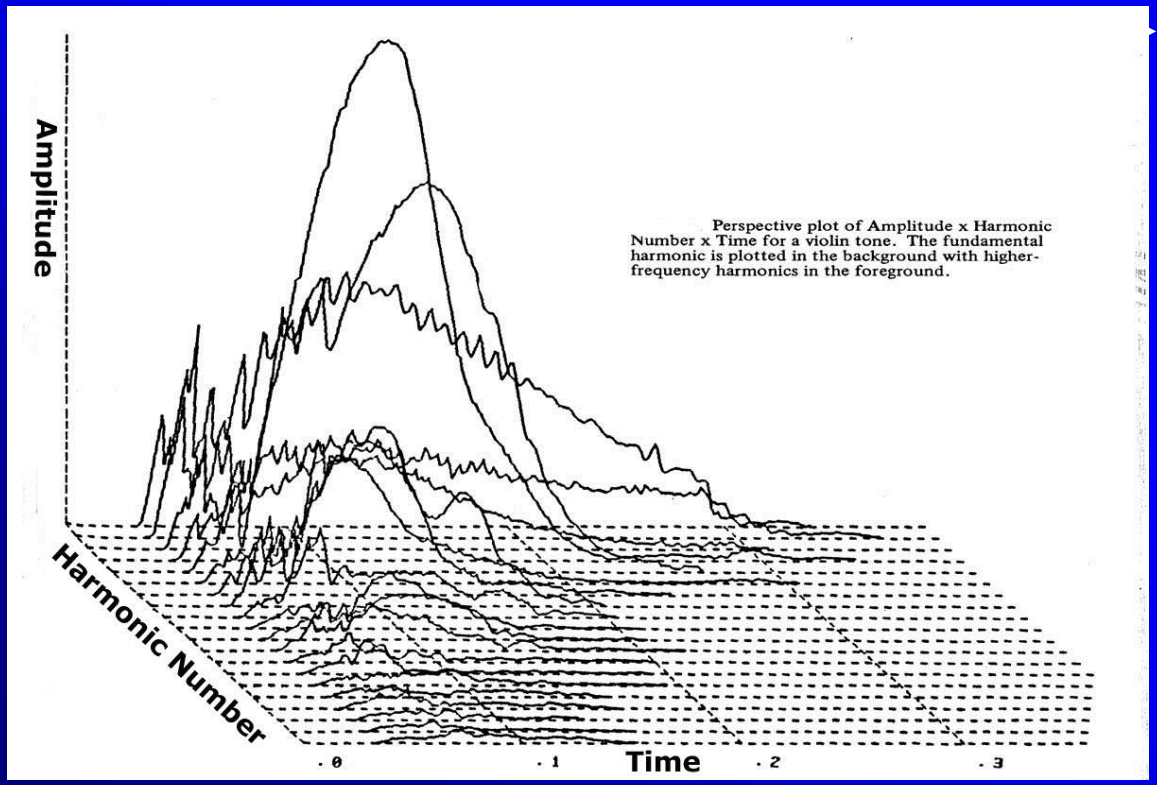
Analyzes the amplitude of changes



Timbre?

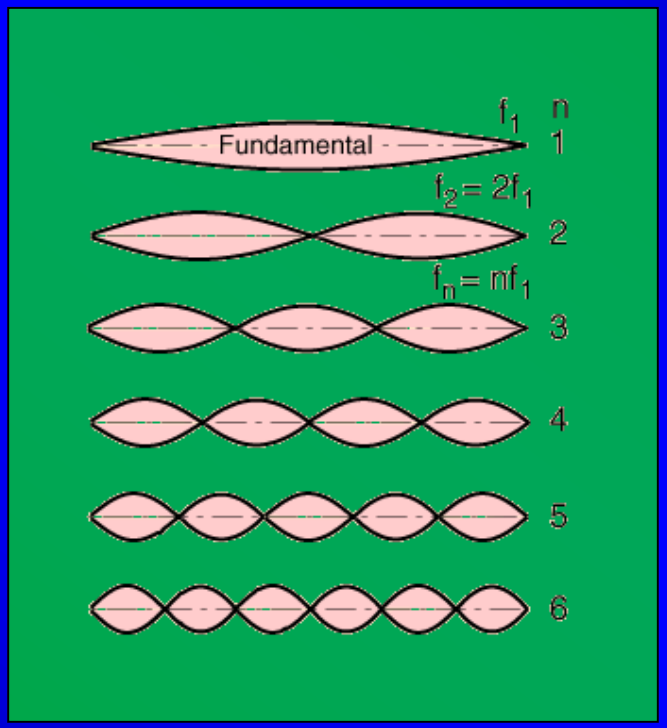
Pure tone sine wave





Complex tone

Harmonics



C 65.4 Hz

C 130.8 Hz

G 196.2 Hz

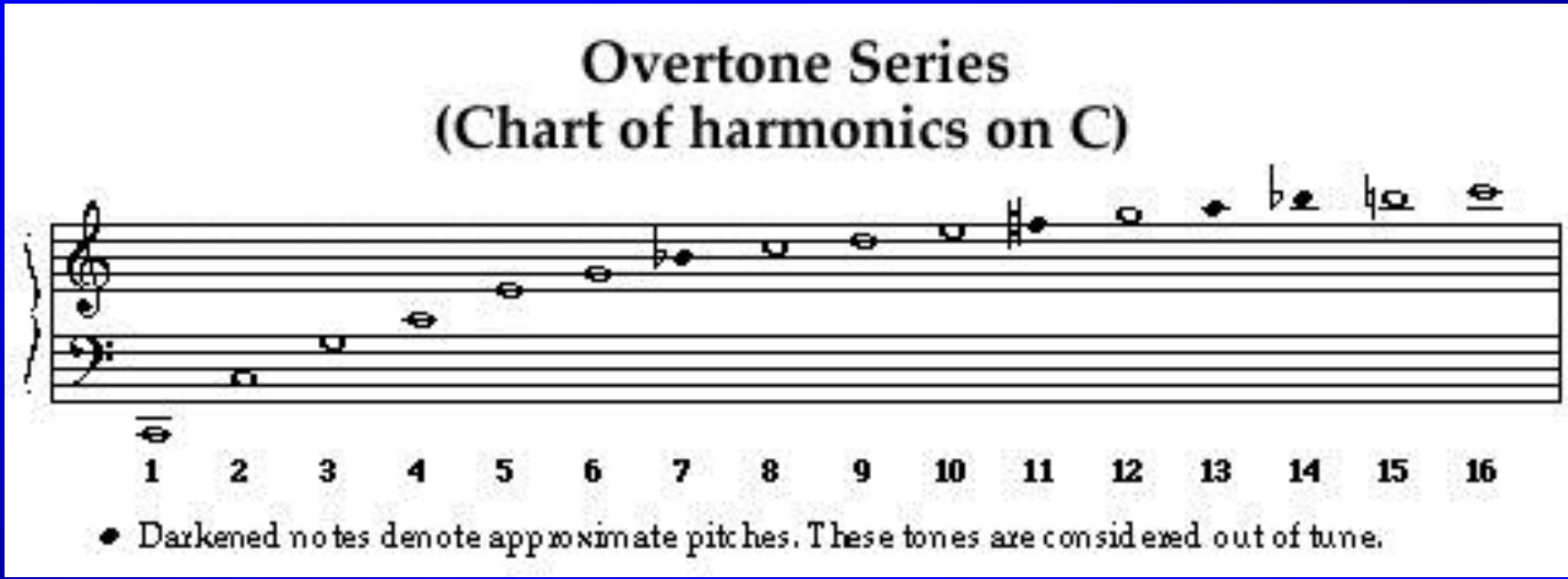
C 261.6 Hz

E 327.0 Hz

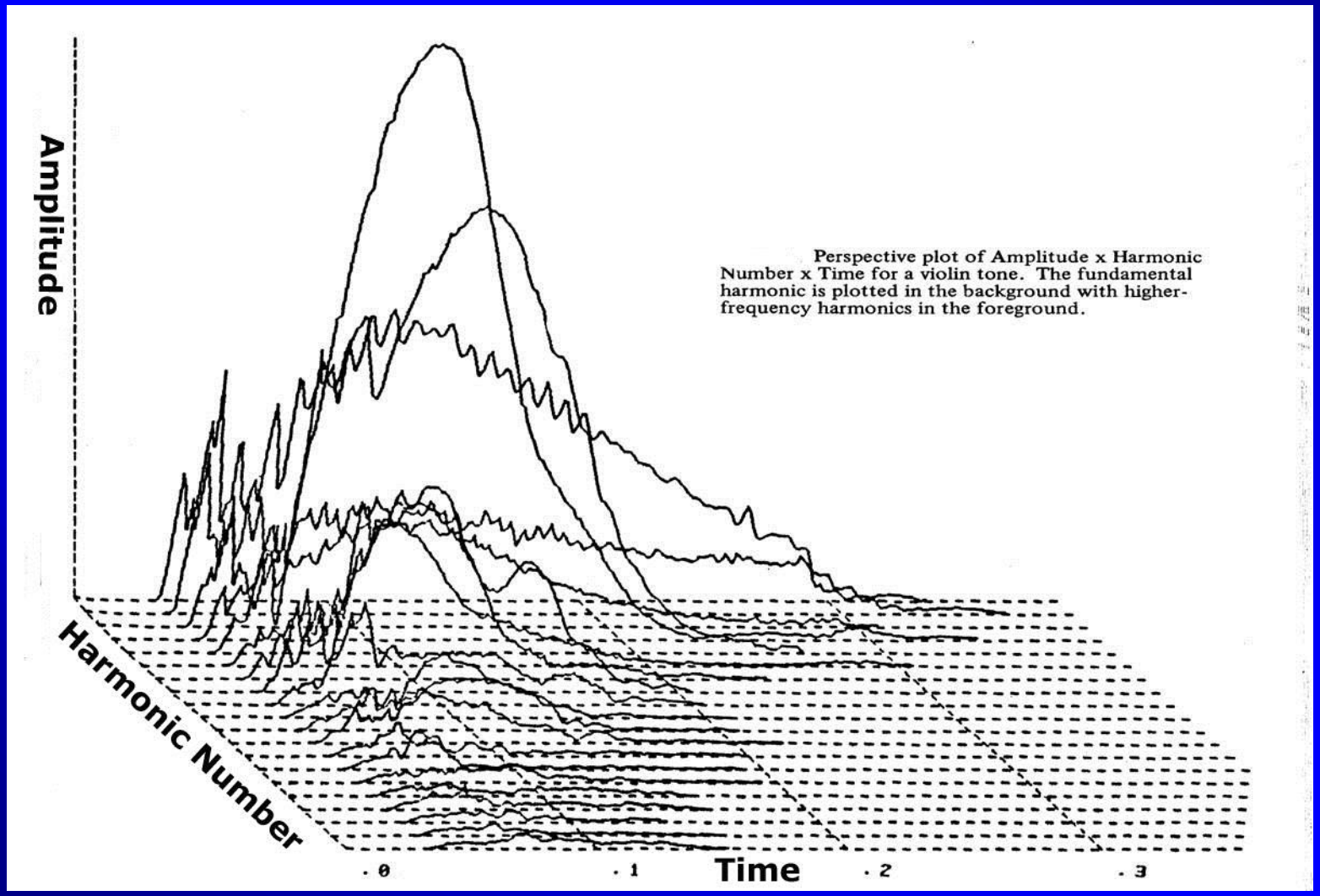
G 392.4 Hz

Vibrating Strings

Harmonic Series



3D Sound Wave



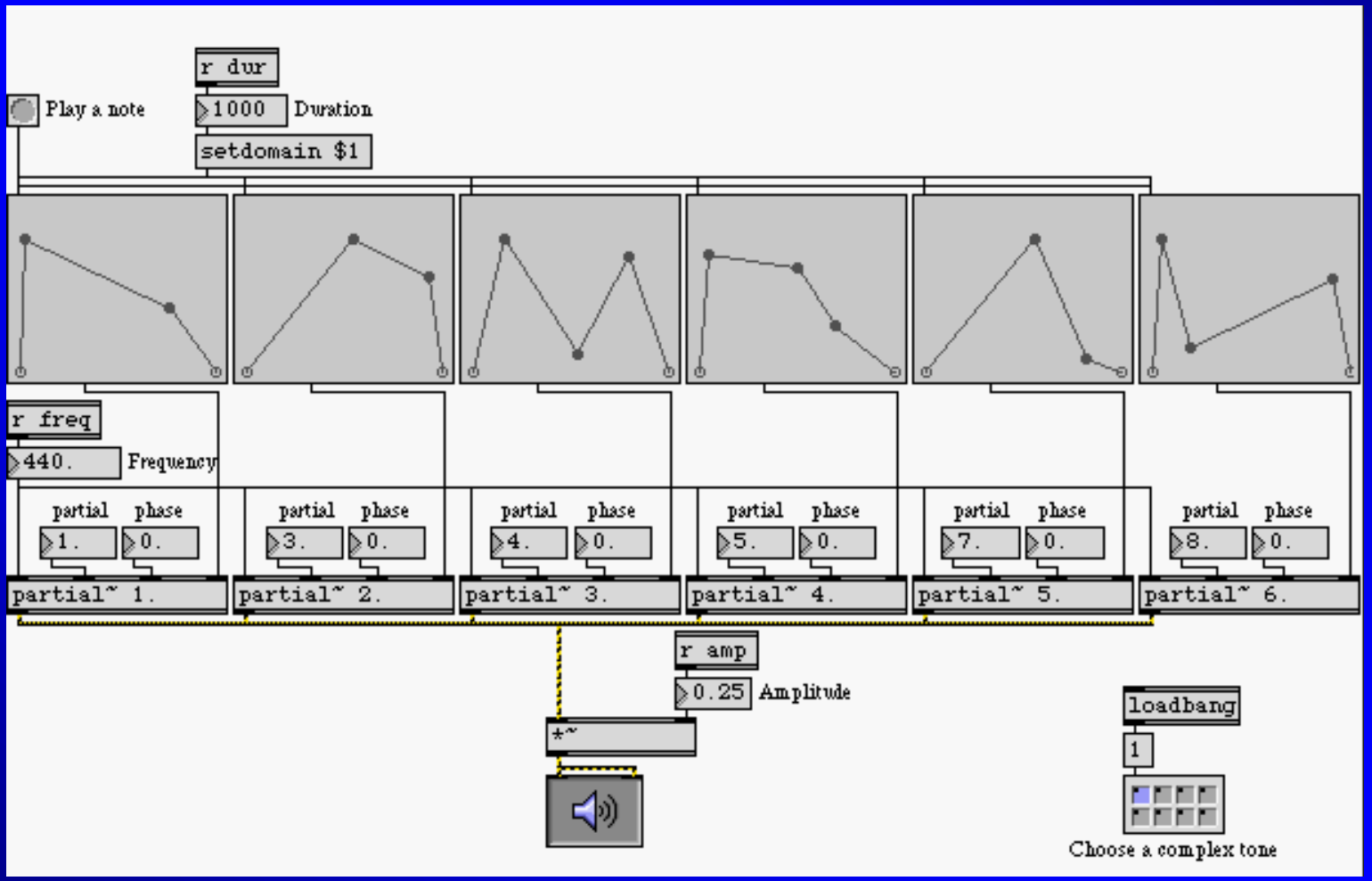
Perspective plot of Amplitude x Harmonic Number x Time for a violin tone. The fundamental harmonic is plotted in the background with higher-frequency harmonics in the foreground.

What do you hear?

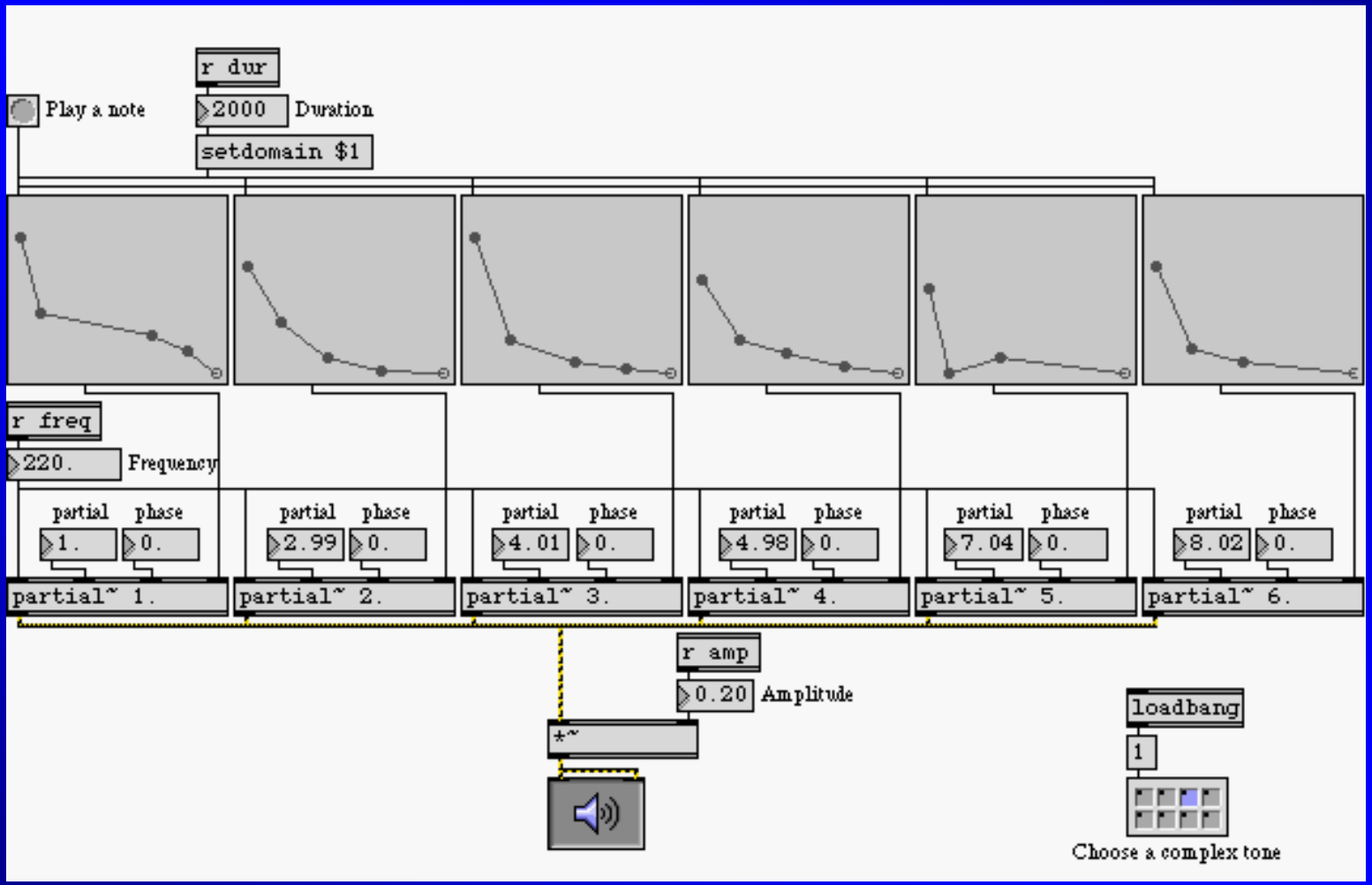
Violin
French horn
Piano
Sine wave

Violin sound

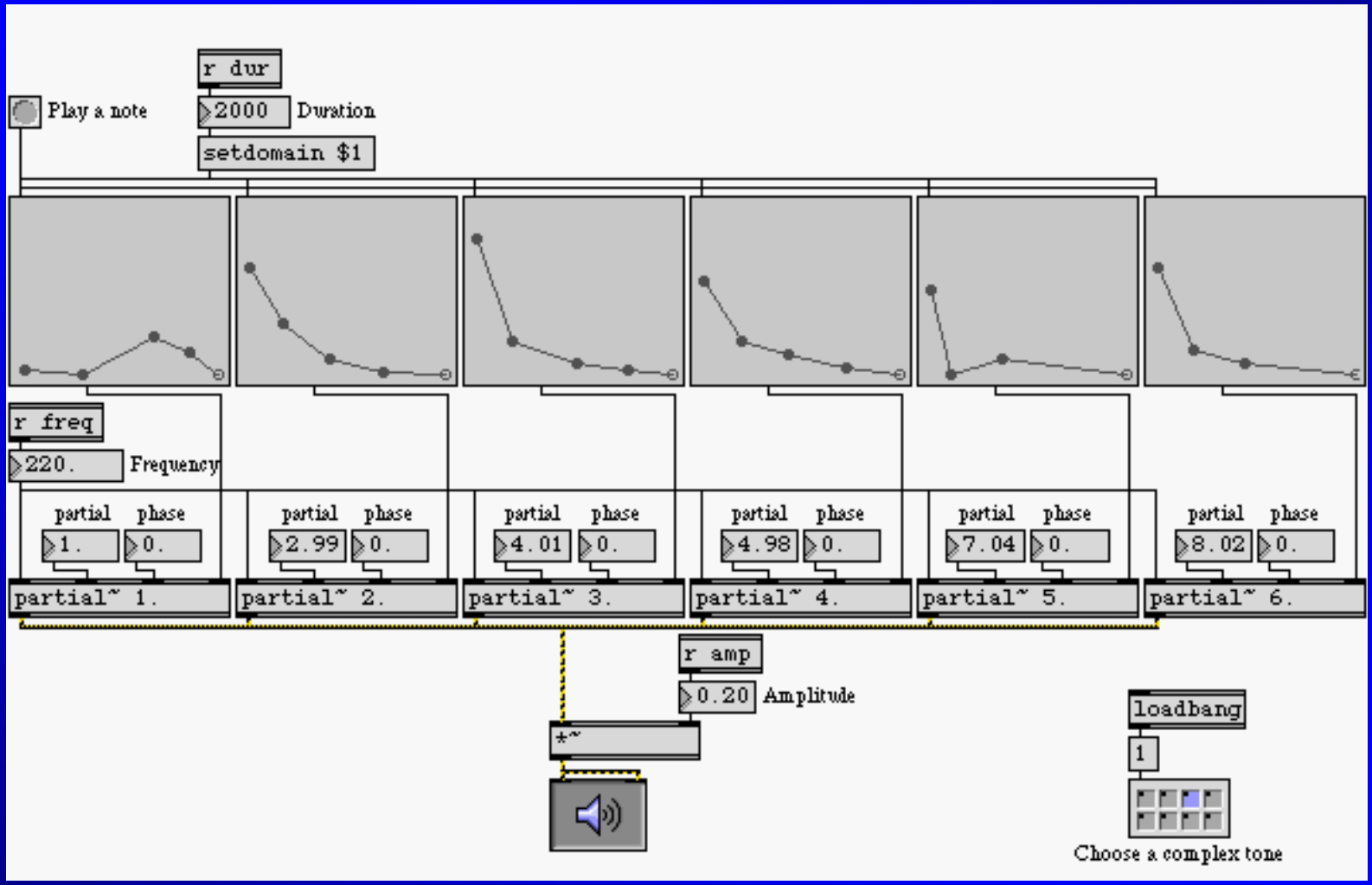
Synthetic Clarinet-like Sound



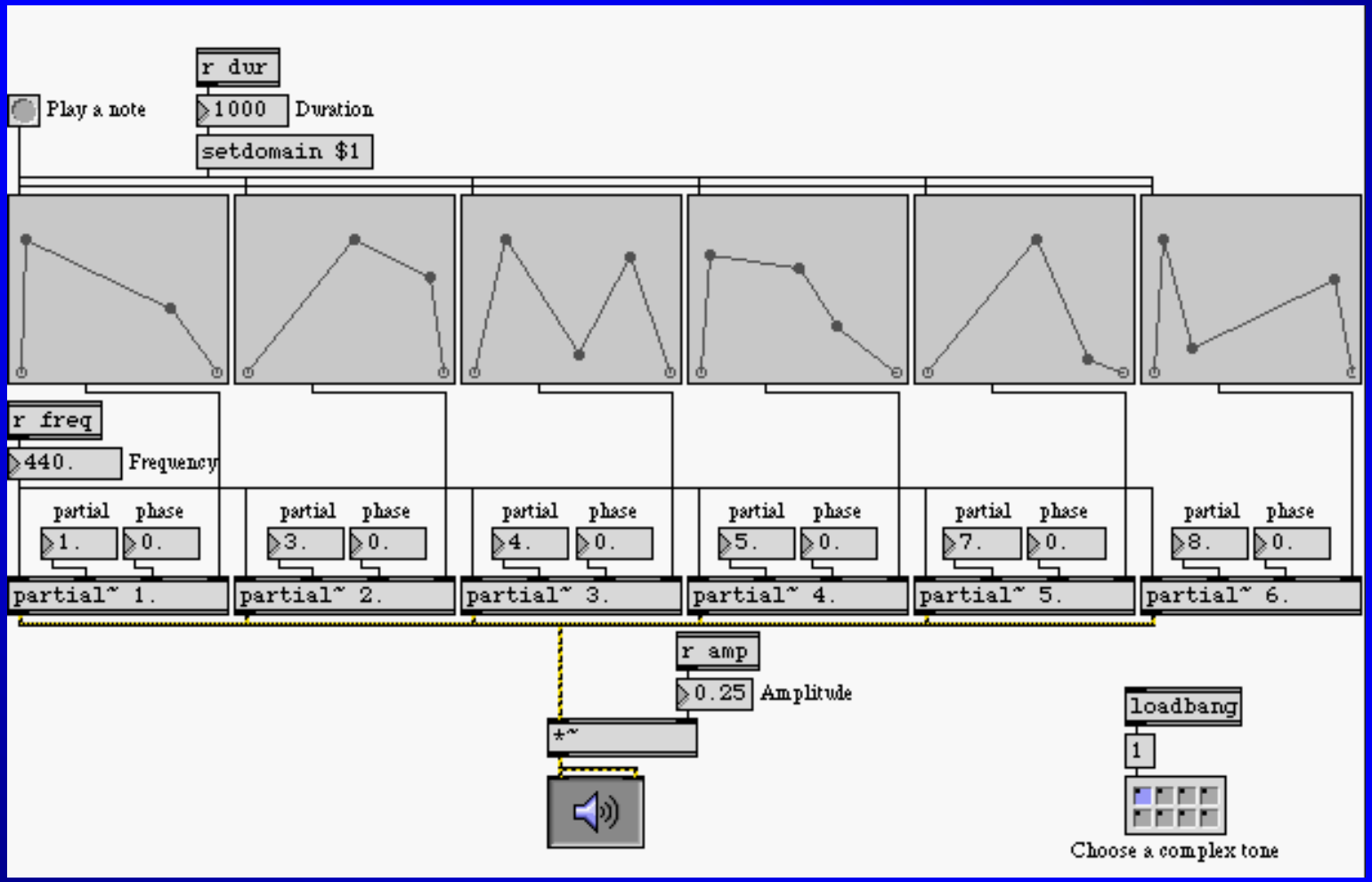
Synthetic Bell-like Sound



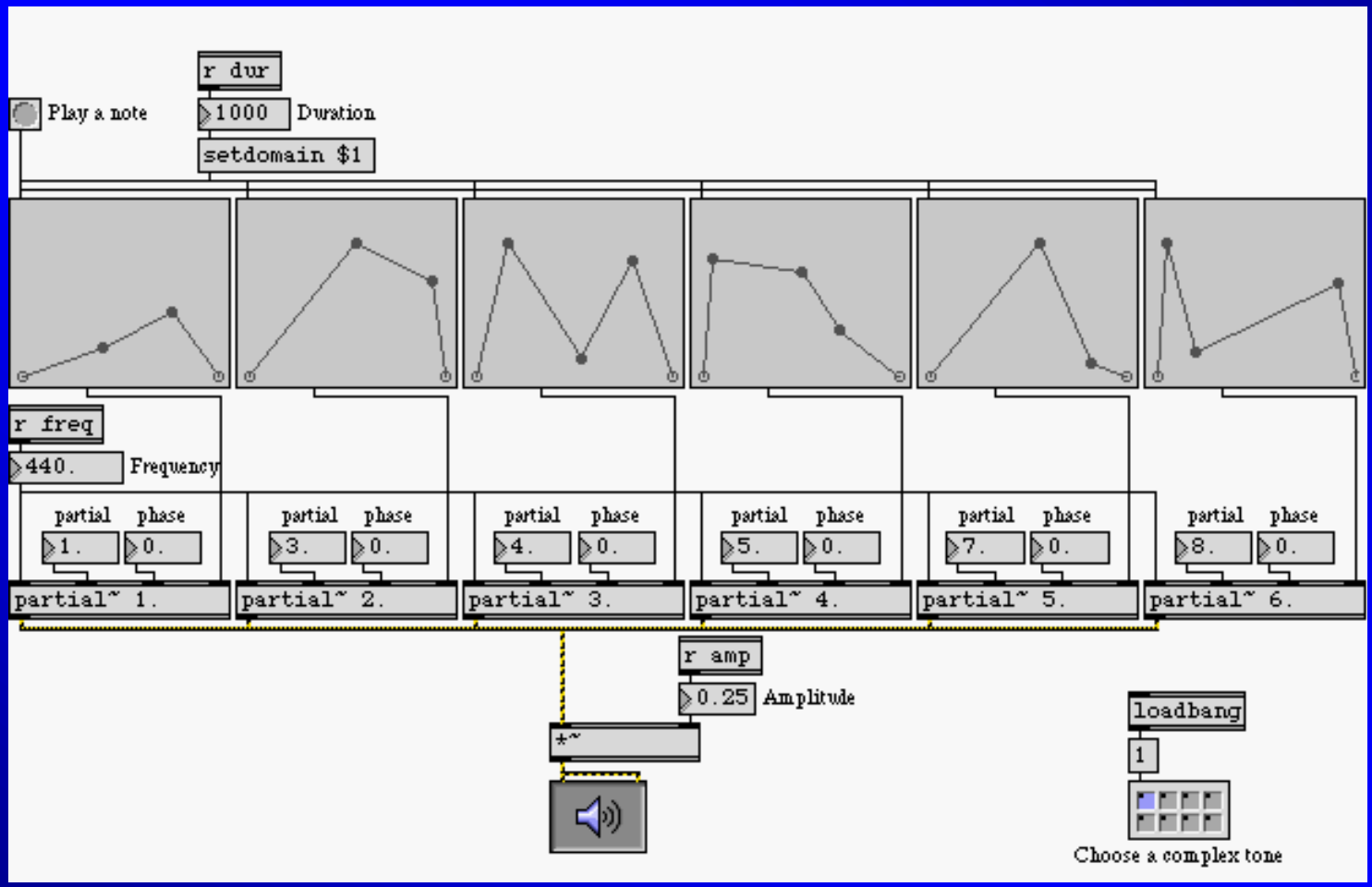
Synthetic Bell-like Sound with Different Fundamental Envelope



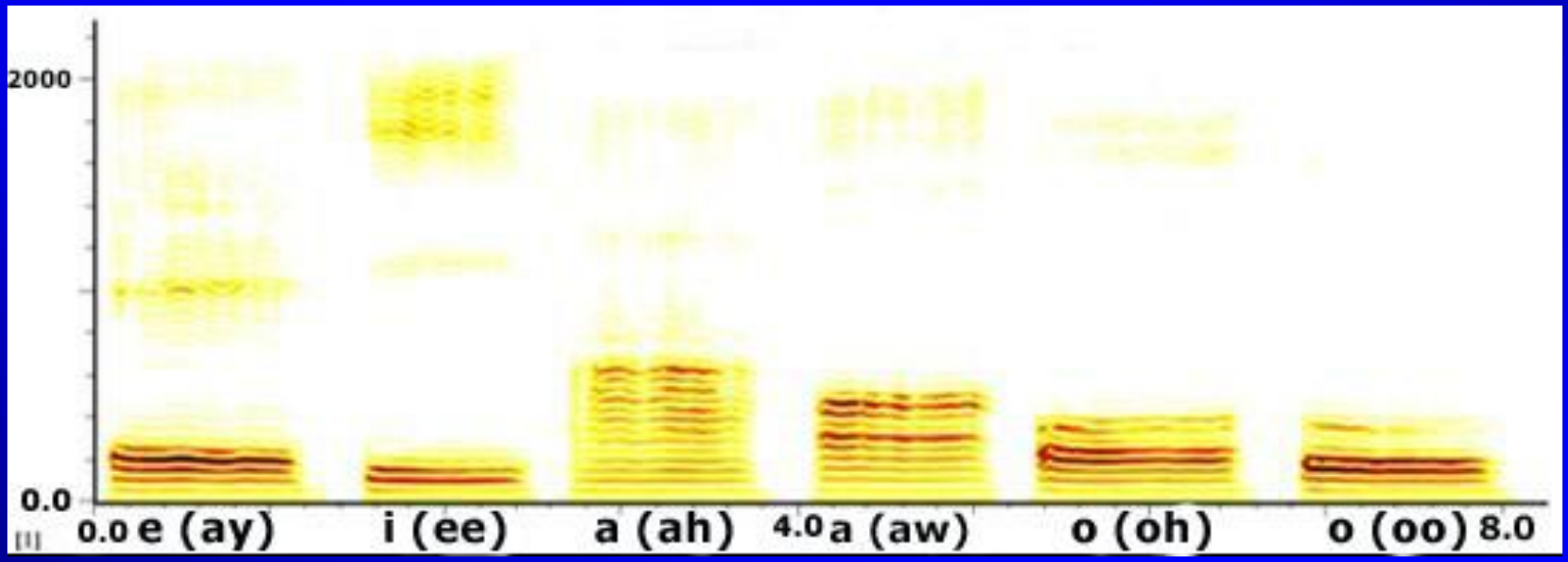
Synthetic Clarinet-Like Sound



Synthetic Clarinet Sound with Different Fundamental Envelope



Sonogram of cardinal vowels

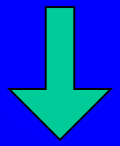


Frequency (Hz)

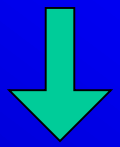
Time (sec)

Probability of perceptual skills determined by

Nature:
Sets parameters (opportunities)

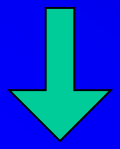


Environment:
Provides experience (probability)

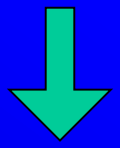


Perception

Sound Spectrum



Pitch Loudness Timbre
Consonance/dissonance …



Preference Enjoyment
Pleasure Emotion …

Aspects of Human Perception

Pattern Recognition - Expectation

Orienting Response - Habituation

Paired Association

Ligeti
Adventures

Haydn
Symphony No. 101 in D

Aspects of Human Perception

Pattern Recognition - Expectation

Orienting Response - Habituation

Paired Association

Holst
Mars, from The Planets

Strauss
Tod und Verklarung

Characteristics of the Stimulus

Intensity

Density

Continuity

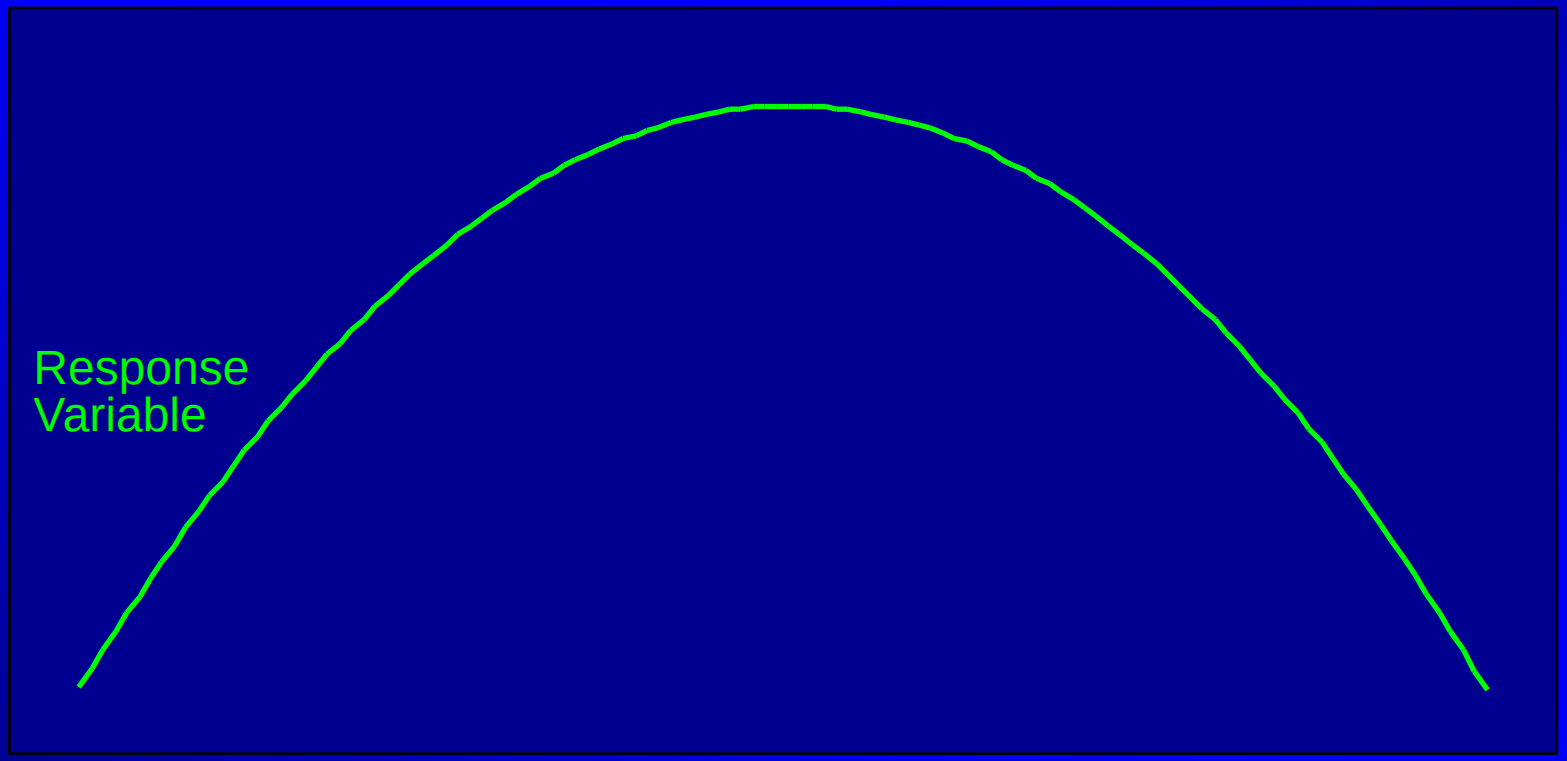
Redundancy

Mantovani
The Nearness of You

Coltrane
Giant Steps

Smashing Pumpkins

Responses to Sound Stimuli



Characteristics of the Listener

Experience (language, time scale)

Familiarity with Stimulus

Paired Associations with Stimulus

Mood State

Raga Mishra Gara 

Raga Mishra Gara 

Randy Newman 

Etta James 

Characteristics of the Listening Context

Solitary - Group

Social Occasion

Societal Conventions

Level of Active Participation

Williams

So why does the theme from Jaws sound like a big scary shark?

Because of the characteristics of ...

The Stimulus

Parameters of sound waves

Organization of sounds in time

The Listener

Innate predispositions

Learned associations

The Context

Social cues and expectations

Observations of the responses of others

Questions?

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Dr. Costa-Giomi wishes to thank Dr. Bruce Pennycook for the recording of stimuli.

Dr. Bob Duke

Robert Duke is the Marlene and Morton Meyerson Centennial Professor of Music and Human Learning, University Distinguished Teaching Professor, and Director of the Center for Music Learning. Widely published in music and education, he has directed national research efforts under the sponsorship of such organizations as the National Piano Foundation and the International Suzuki Institute. His work has been presented at national and international conferences in music education, music therapy, and music psychology, and appears in major research journals and texts. Dr. Duke serves on the editorial boards of the Journal of Research in Music Education, the Bulletin of the Council for Research in Music Education, and Psych musicology. A former studio musician and public school music teacher, he has worked closely with children at-risk, both in the public schools and through the juvenile court system, and he remains an active clinician and researcher in music learning, systematic observation and evaluation, and behavior management, presenting lectures and teaching demonstrations throughout the United States.

Dr. Eugenia Costa-Giomi

Eugenia Costa-Giomi (Ph.D. Ohio State University), teaches research methods in music education, psychology of music, and musical development. Her research focuses on music perception and cognition during childhood, the nonmusical benefits of music instruction, and the relationship between specific abilities and behaviors and musical achievement. She chaired the third International Conference in Music Perception and Cognition with Dr. Pennycook (1996), the 13th Symposium for Research in Music Behavior (1999), the Music Perception Interest Group of the Music Educators National Association (1998), is part of the editorial committees of the Journal of Research in Music Education and Musicae Scientiae, and past member of the editorial board of the Bulletin of the Music College Symposium. She has taught music to children in Argentina, Mexico, Canada, and the United States and was Associate Professor of Music Education at McGill University, Canada (1991-2002).