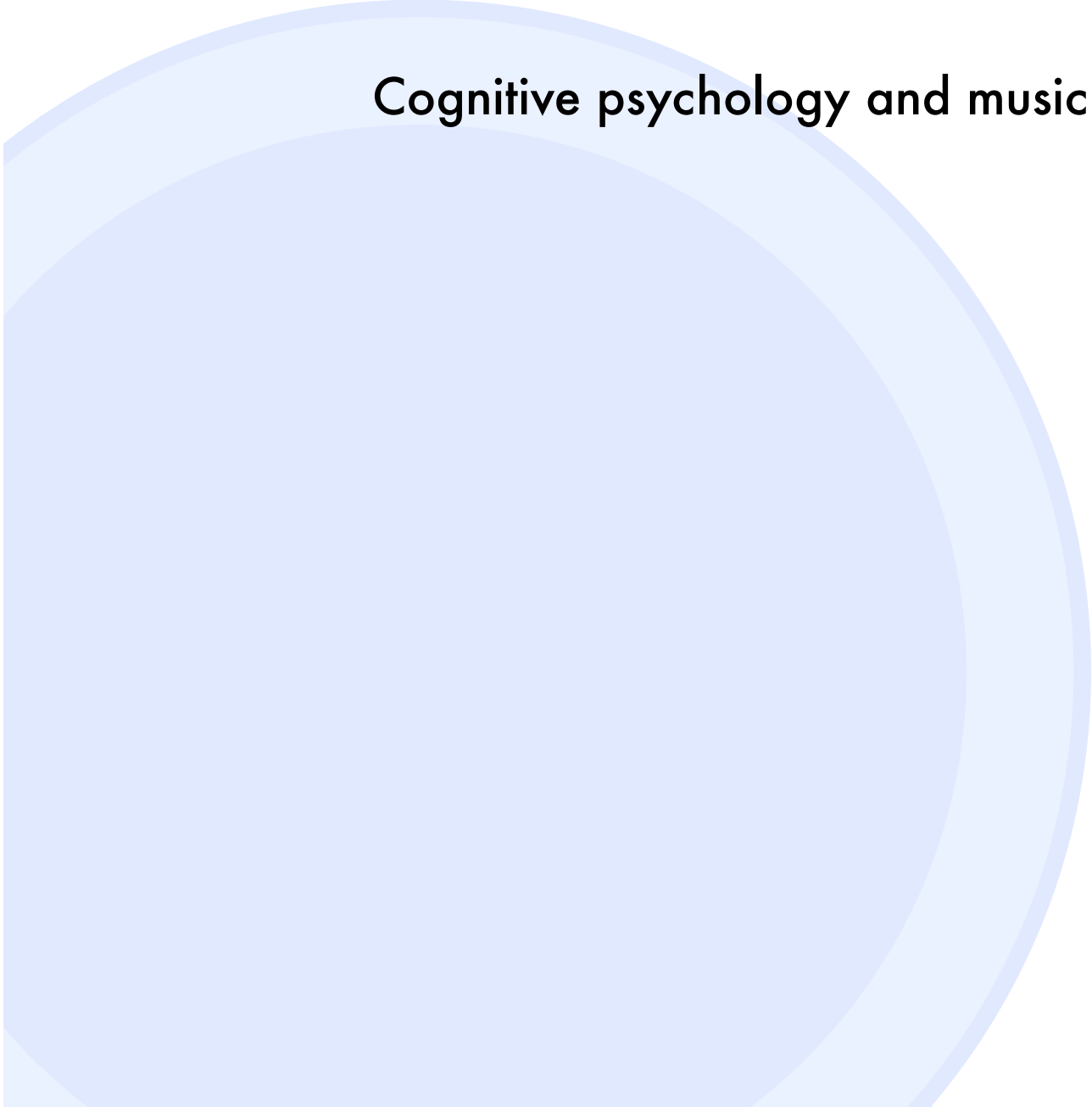




Psychacoustics

8th lesson

Cognitive psychology and music





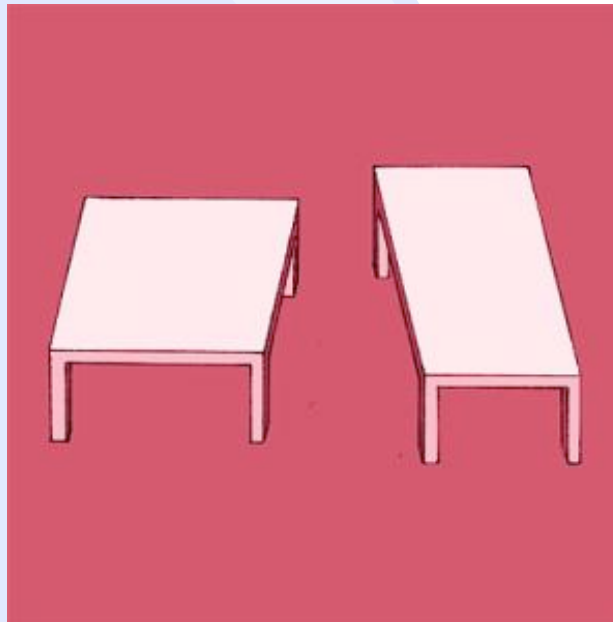
What does cognitive psychology have to do with sounds and music?

Long chain of stimulus processing

- Generation of energy by an external object or event
- Transmission of this energy through the space between the event and the observer
- Recording and processing by the perceptive apparatus of the observer
- Transmission of the signal to the brain and further processing
- ...
- Formation of a representation of the event in the brain



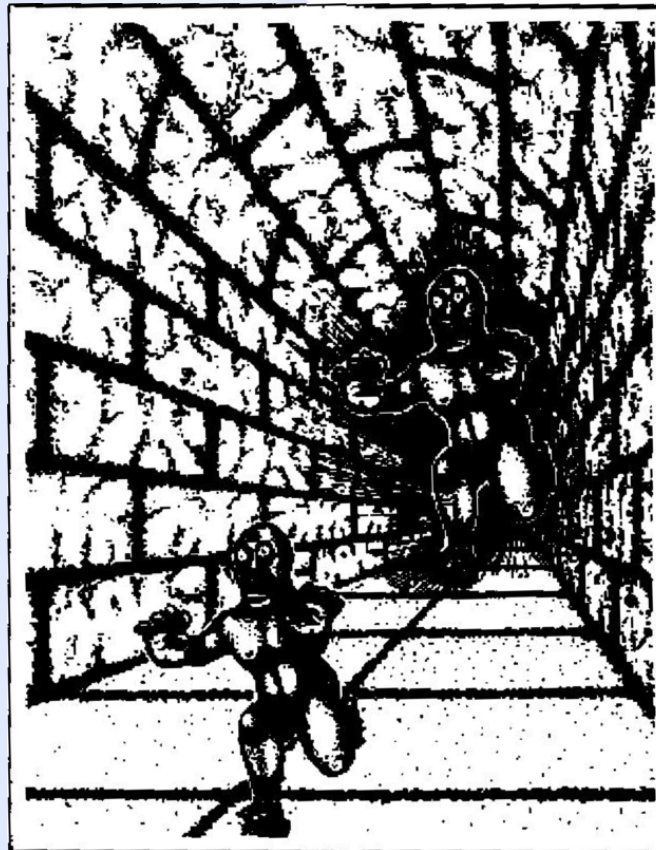
Sensory information has relevance only if the brain can form a representation of the external world from it. During their processing stimuli often have little in common with what is perceived by the observer, as this is the result of further extensive processing in the brain. Regardless of the nature of the mind (eye, ear) - a topic of psychophysics and physiology - cognitive psychologists are interested in exploring the mechanisms of internal representation. The senses must come together to represent the outer world. An evolutionary process has shaped our cognitive processes to be automatic, immediate and efficient. We have few options to consciously influence it.



The example shows that the internal representation of an object can differ greatly from the physical stimulus on the retina. In fact, both table surfaces (parallelograms) are identical (http://www.michaelbach.de/ot/size_shepardTables/index.html). However, the fact that the lines are interpreted as part of a three-dimensional object creates the impression that the tables are different.

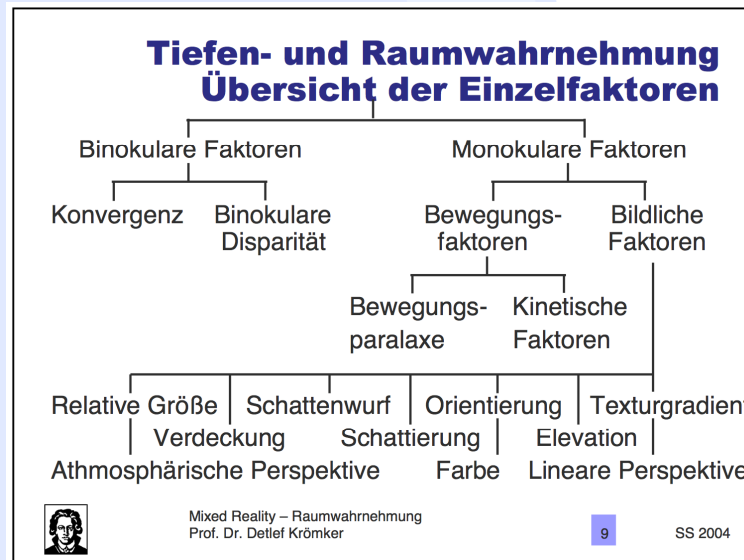
Hermann von Helmholtz (1821-1894) is considered by some to be the greatest perceptual physiologist and psychologist of all time. From him comes the term unconscious inference.

Our brain infers three-dimensional objects based on clues found in the two-dimensional patterns on the retina without any conscious effort.



Such clues include:

- Linear perspective: e.g. converging lines indicate parallelism and depth in 3 dimensions
- Size gradient: elements of a similar pattern become smaller towards the horizon
- Aerial perspective: distant objects appear bright and blue
- Binocular disparity: each of the two eyes gets a slightly different image, from which the brain can draw conclusions about the relative distance of the contained objects
- Motion Parallax: moving the observer shifts the image on the retina. This makes it possible to draw conclusions about distances.

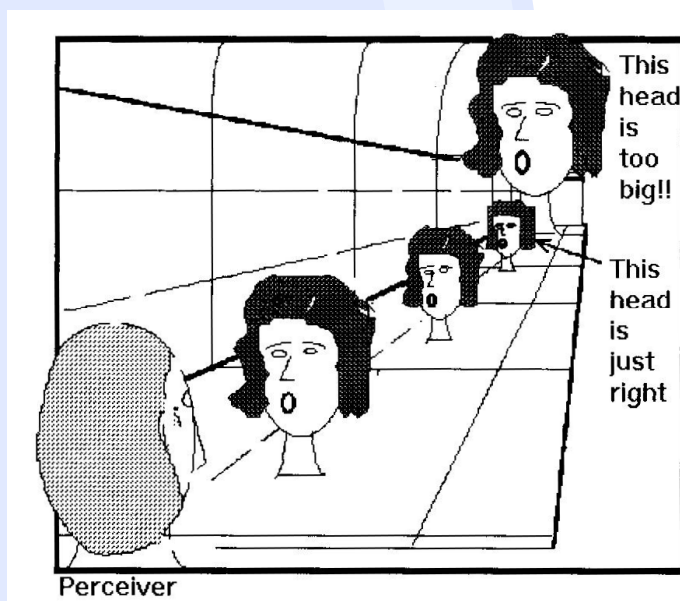


Constancy of Size and Loudness

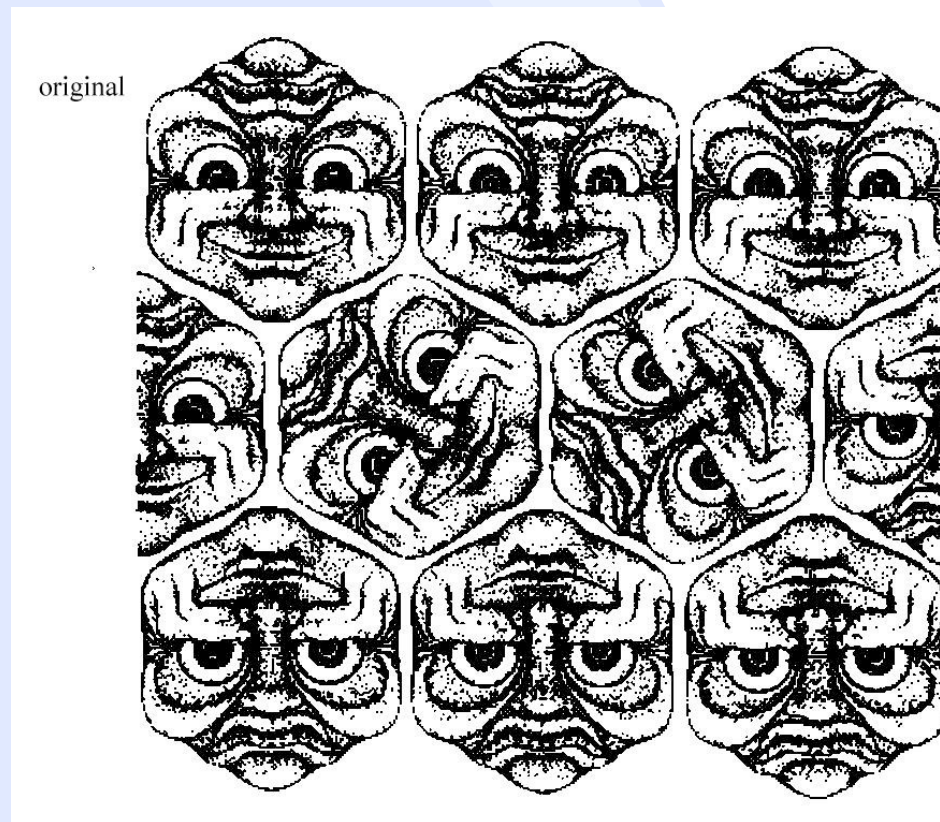
The size of an object on the retina changes with the distance to the observer. Nevertheless, we have developed the ability to perceive the size of an object independently of its distance. We call this phenomenon constancy of size. When listening, we find the phenomenon of volume constancy as an analogy to size constancy.

Example in the sound domain: The difference between quieter and farther away. The energy that an instrument emits is ideally evenly distributed over a spherical surface. As a result, the intensity reaching the listener decreases with the square of the distance. Visual Analogy: Balloon that either flies away or loses size. So we need other clues to decide about the nature of the process:

1. When an instrument plays quietly, the tone changes noticeably
2. Normally a sound is reflected by other objects in the room. This creates reverb, which gives information about the size of the room. When a sound is close, we hear more direct sound and little reverb that hits with a time delay. As the sound fades away, its intensity decreases and reverb increases.



The perception of objects can be confusing if the spatial or temporal order is reversed, as in the case of the double faces of the image, which we interpret in a specific, fixed way (this definition takes place in early childhood). The same applies to reverberated sounds, where we first expect the sound and then virtual copies of the sound. A reversal leads to unexpected results, for example, gun shots in Georg Hajdu's opera *Der Sprung*.



Completion of incomplete information (e.g., blind spot or TV noise experiments). Top-down in addition to bottom-up processes, based on experience. Computers have difficulty to deal with ambiguity for lack of visual knowledge.

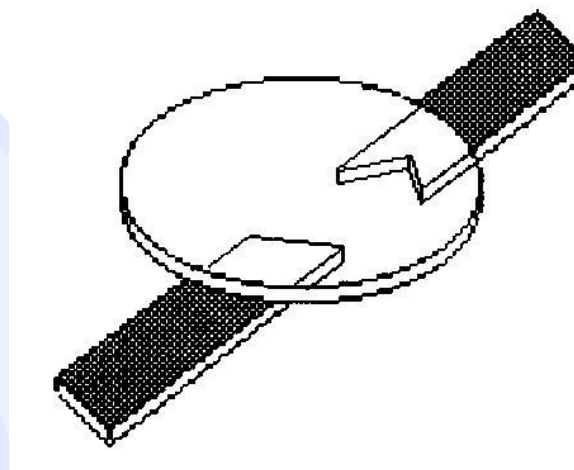
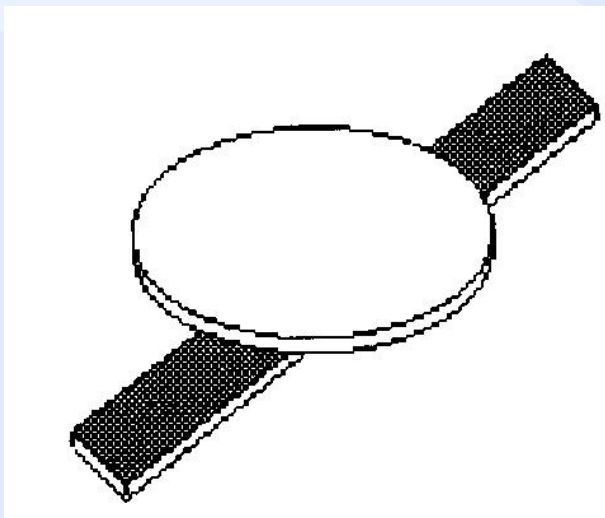


Bev Doolittle: Pintos on a Snowy Background

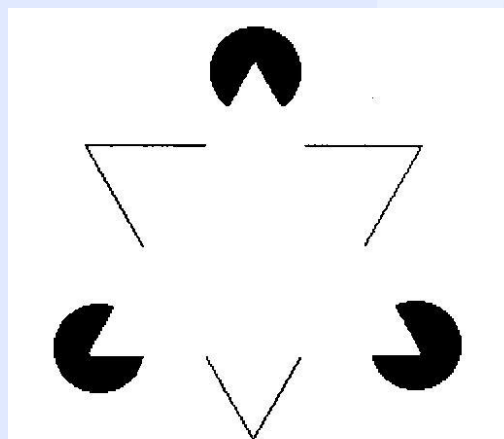


Completion

In the example on the left, as with any reason, the elongated object continues under the round disk. Even babies make such assumptions and are surprised if they do not apply.



A similar phenomenon is the subjective contour. It is difficult not to see that white triangle, though it does not actually exist.





Gestalt Laws of Grouping

According to Max Wertheimer, the co-founder of Gestalt psychology, the brain uses the principles of Gestalt grouping of sensory stimuli to shape objects, especially if the incoming information is incomplete.

The principles include:

Symmetry (symmetry): a

Similarity: b

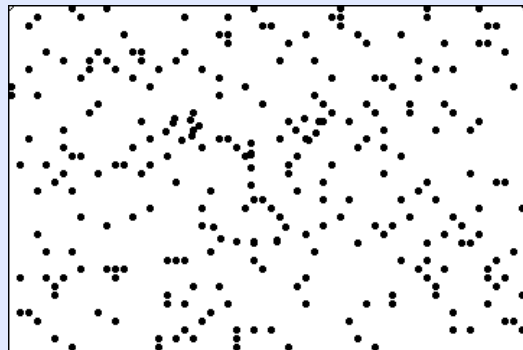
Proximity: c

Closure: d

Continuity (good continuity): e

Common fate: f

(f)

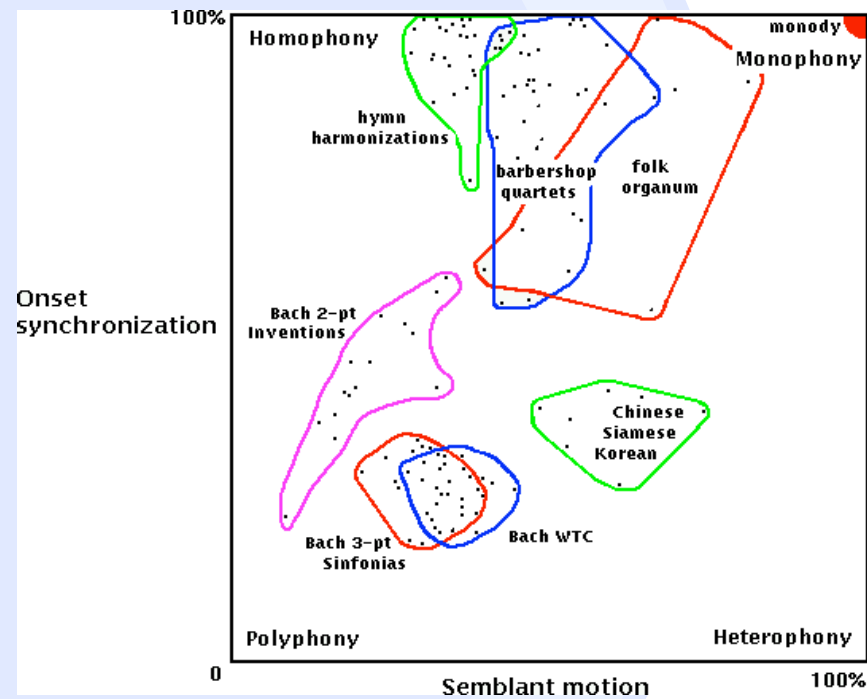
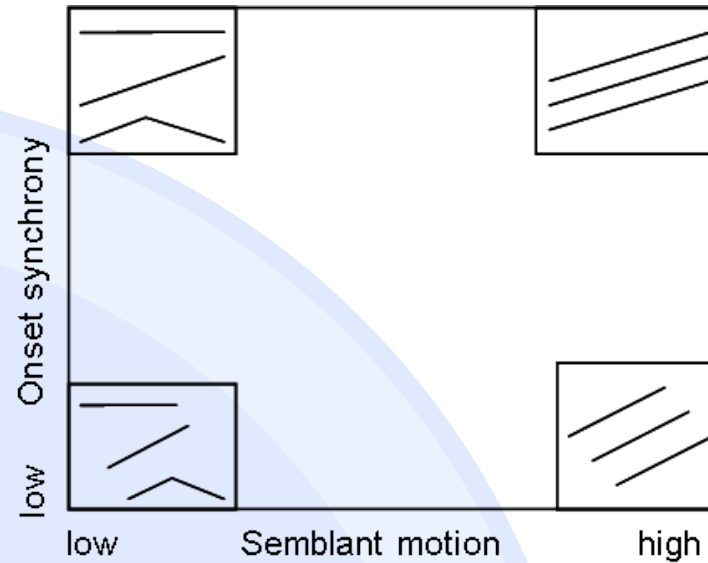




- **Melody:** A time-ordered sequence of pitches
 - Models of melody take into account the following principles:
 - Implication / Realization Model (Eugene Narmour, first interval: implication, second interval: realization)
 - Gap fill
 - Contour
 - Texture Space determines the behavior of melodies in respect to each other (David Huron). The two parameters are:
 - Onset Synchrony (synchronicity of voices)
 - Semblant motion (similarity of movement)



Texture space



Einfluss von Kontur: