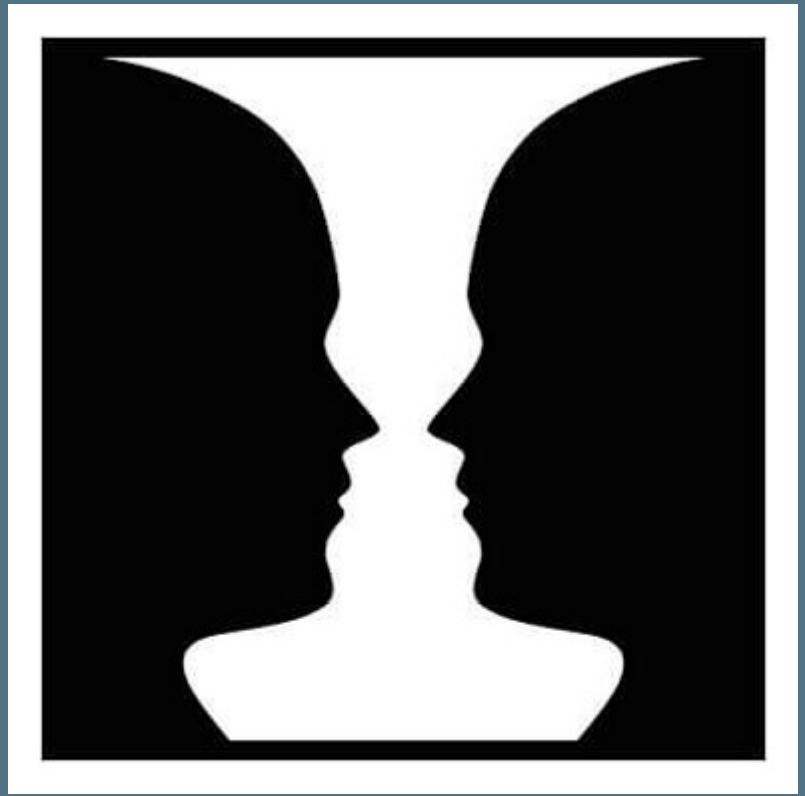
Perception and Cognition

Overview:

- The Perception Paradox
- Psychophysics
- Signal-Detection Theory
- Judging Differences
- Feature Analysis and Visual Search
- Processing Styles
- Attention

The Perception Paradox

- What seems easy for the perceiver is exceedingly difficult for psychologists to understand and explain.
- In order to function so effectively and efficiently, perceptual systems must be extremely complex.
- This week, we'll try to break down some of those complex systems and apply them to design decisions.



Psychophysics

What do we detect in our environment?

- ***Psychophysics*** is the study of the relationship between the physical energy of the environmental stimuli and the psychological experiences that those stimuli produce.
- ***Absolute threshold*** is the minimum amount of energy that can be detected 50% of the time.
- Stimuli that fall below this threshold are usually not detected – these are called ***subliminal stimuli***.
- Stimuli above this threshold are usually detected and called ***supraliminal stimuli***.

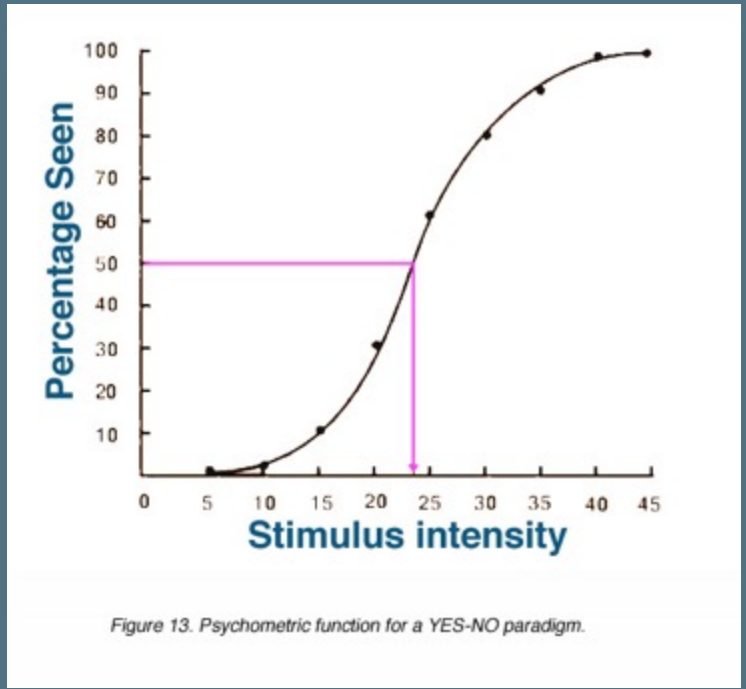
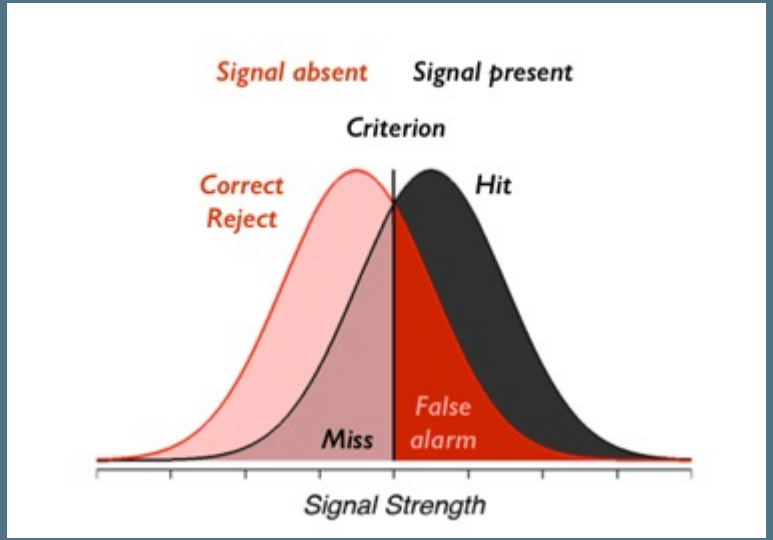


Figure 13. Psychometric function for a YES-NO paradigm.

Signal-Detection Theory

What do we detect in our environment?

- ***Signal-detection theory*** is a mathematical model that describes what determines whether a person perceives a *near-threshold* stimulus.
- Sometimes a person perceives noise (spontaneous random neural firing that is always present) as a perceptual experience.
- Have you ever thought you've seen something out of the corner of your eye? Or missed something seemingly obvious?



Signal-Detection Theory

What do we detect in our environment?

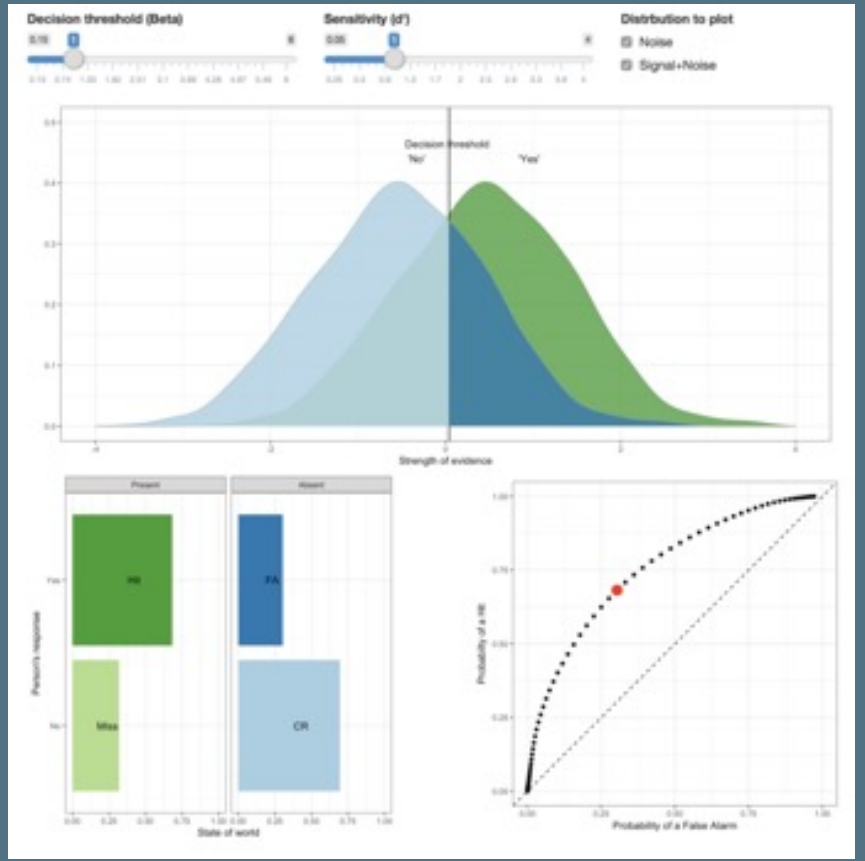
- Whether a person determines a perception is noise depends on ***sensitivity*** - the person's ability to detect a stimulus.
- It also depends upon ***response criterion***, the person's willingness or reluctance to say a stimulus is present.
- If a person expects a stimulus to be present, then their response criterion will be lowered.
- In other words, as expectations of stimuli increase, the amount of stimulus energy required to trigger perception is lowered.

Signal-Detection Theory

What do we detect in our environment?

Test out signal detection theory in the demonstration linked below:

http://designing4people.com/index.php/2017/12/06/interactive-signal-detection-theory-explainer/



Judging Differences

How do we tell the difference between two stimuli?

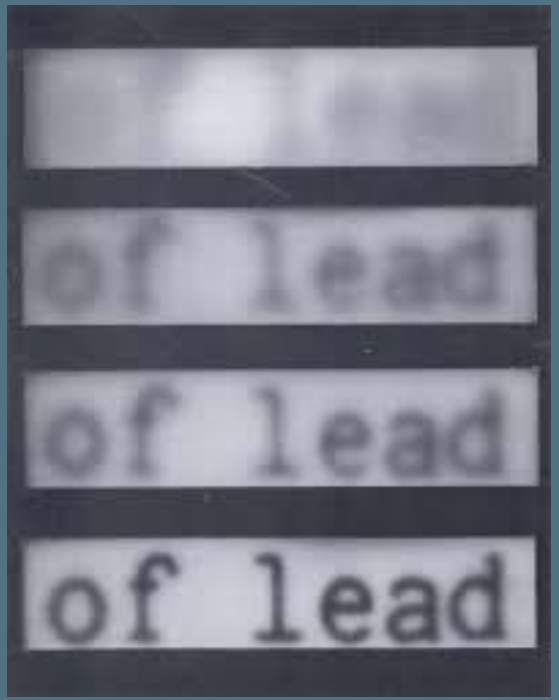
- The minimum detectable difference between two stimuli is the ***just-noticeable difference*** (JND).
- JND depends on the initial magnitude or intensity of the stimuli and on which sense is being stimulated.
- ***Weber's Law*** states that the JND is a fixed proportion (*K*) of the intensity of the stimulus. *K* is different for each of the senses.

Application to User-Centered Design

Why do we care about what we detect?

This image demonstrates a contrast challenge.

Low contrast increases the signal-noise ratio. The "signal" or text, becomes indistinguishable from the background or "noise."

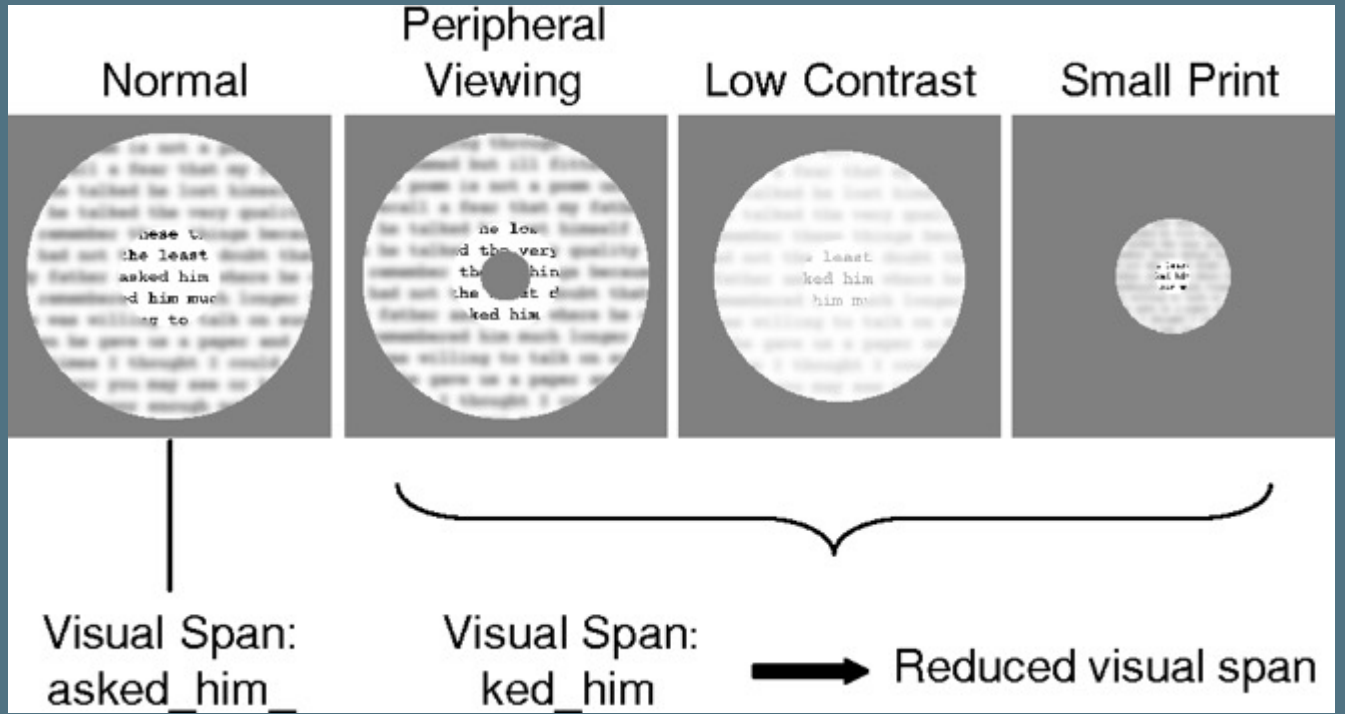


Application to User-Centered Design

Why do we care about what we detect?

This image demonstrates our ability to read text in different conditions.

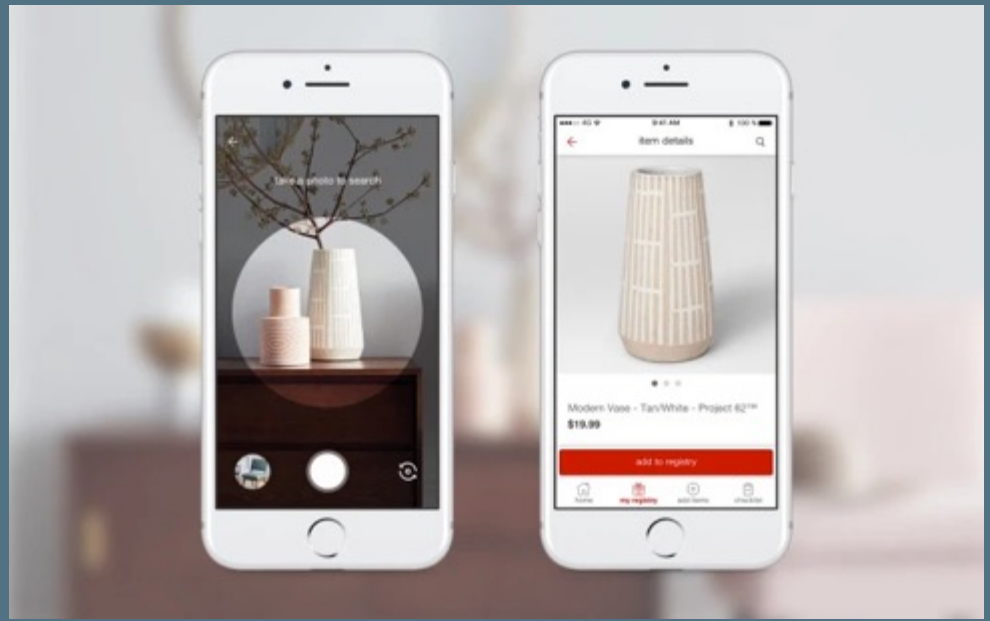
How might you use this information in digital design?



Feature Analysis and Visual Search

We can recognize an object because we perform ***feature analysis*** – meaning that our sensory systems analyze stimuli into basic features before higher centers of the brain recombine them into a full perceptual experience.

Color, motion, spatial orientation, and patterns of light and darkness are some features analyzed by our visual system (and now our digital systems!).



Feature Analysis and Visual Search

Find the difference in each image.

(A) (B) (C)

Feature Analysis and Visual Search

You probably picked out the target in image A and image B pretty quickly, right?

That's because A was different in orientation and B was different in color. This is a *single feature search*.

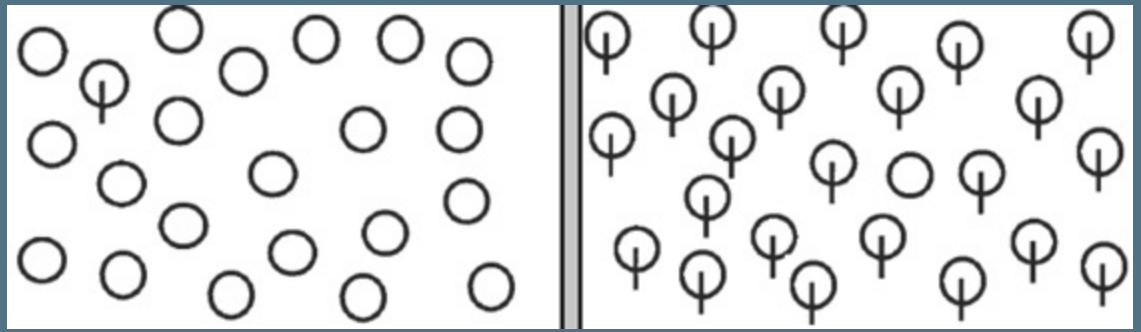
But target C is challenging because it is different in both color and orientation, which makes it a *conjunctive feature search*.

Feature Analysis and Visual Search

This is another example of visual search cueing.

Target A is easy to distinguish. It is defined by a feature that is absent in the others (it has a tail, the other circles do not).

This doesn't hold true in reverse, which makes Target B a bit slower to distinguish (all circles have tails, except for B).

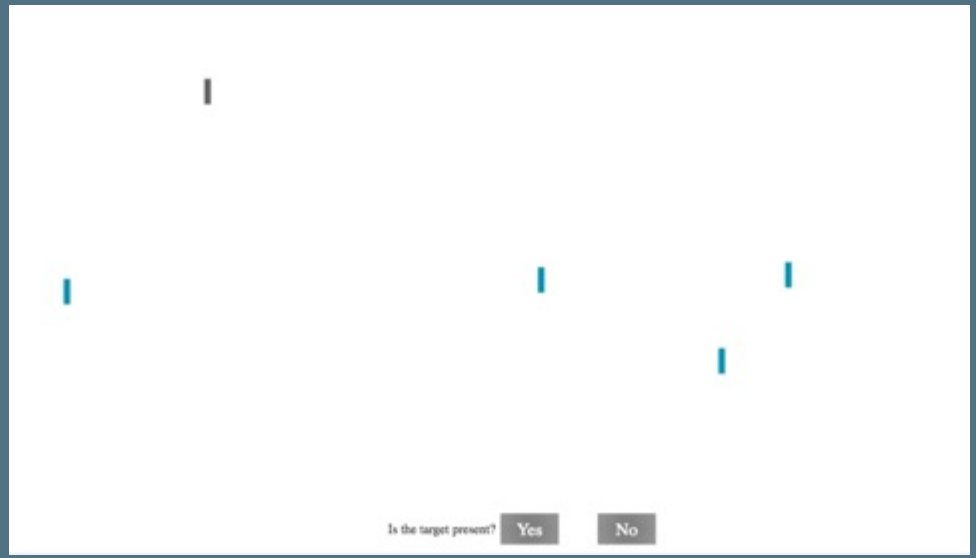


(A) (B)

Feature Analysis and Visual Search

Click on the link below and explore one more demonstration of visual search. Think about how you might use these principles in your own design work.

https://isle.hanover.edu/Ch09Attention/Ch09Search.html



Processing Styles

Perception is a result of ***top-down*** and ***bottom-up*** processing.

Let's talk about bottom-up processing first. This occurs when our entire perception is based on the stimulus itself, like color or shape.

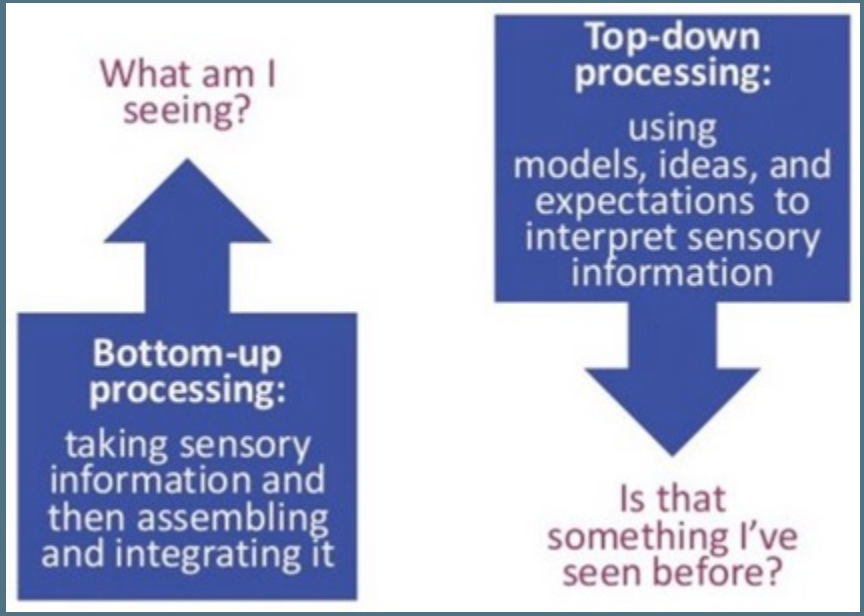
Take this figure, for example. Seen alone, without any context, you simply see a combination of vertical and horizontal lines.

Processing Styles

What happens once we actually detect the stimulus?

Top-down processing is a bit different:

- In top-down processing, our knowledge, motivations, and expectations influence our perception.
- ***Schemas*** are mental representations of our knowledge and expectations.
- Such expectancies are influenced by context, past experiences, and our motivation to perceive something in a certain way.



Processing Styles

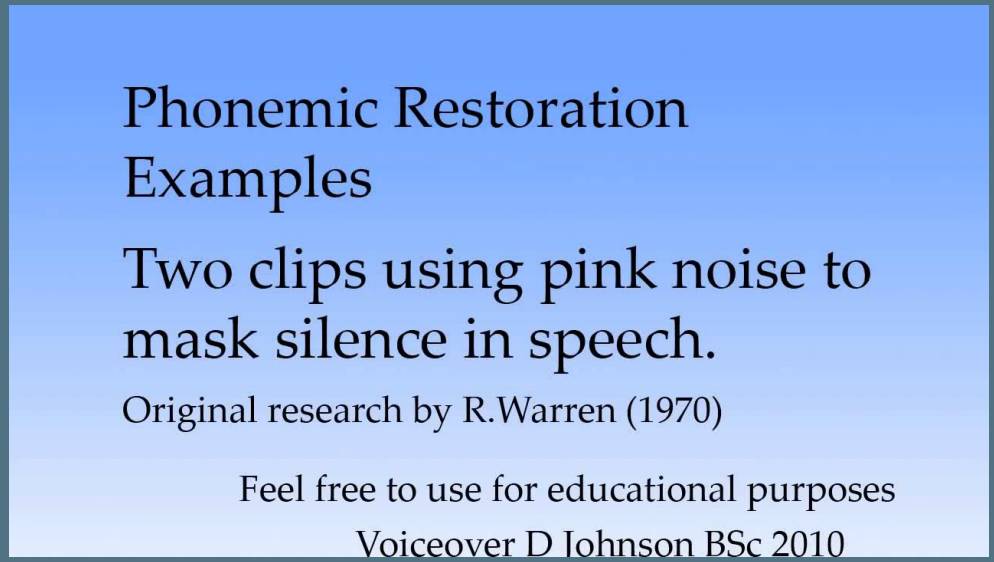
Top-Down Processing

In this example, context changes the way we perceive the earlier figure. That's the role of top-down processing!

Processing Styles

Top-Down Processing

Context can also affect our auditory experience.



Alternate Link: 2-minute phenomic restoration effect video

Attention

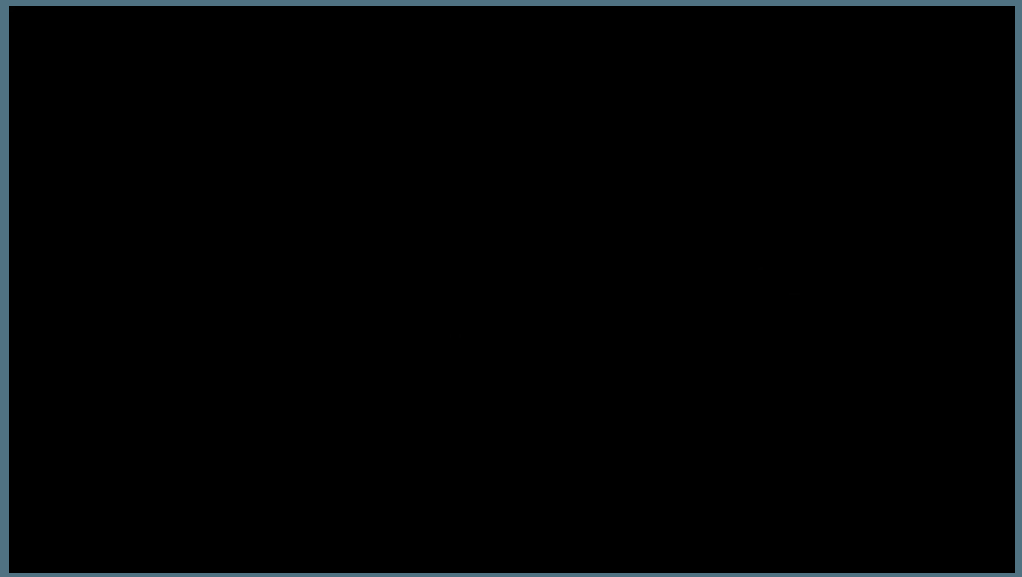
What about competing stimuli?

- Attention is the process of directing and focusing certain psychological resources, usually by voluntary control.
- Attention can enhance perception, performance, and mental experience.
- Directing attention can improve mental processing, but requires effort and has limited resources – that is, you can't pay attention to something forever.

Attention

What about competing stimuli?

- ***Selective attention*** is the tendency to focus on some stimuli in the environment while ignoring others. Ever tried to tune someone out at a party?
- Attention can be voluntarily guided by motivation and a knowledge of which sources of information are critical to a task.
- Check out this short video and test your selective attention!



Alternate link: Monkey Business Illusion on YouTube.

What about competing stimuli?

- Sometimes our attention can be so focused that it results in inattentional blindness, a failure to detect or identify normally noticeable stimuli.
- Try an attention blindness demonstration here: https://isle.hanover.edu/Ch09Attention/Ch09AttnBlink.html

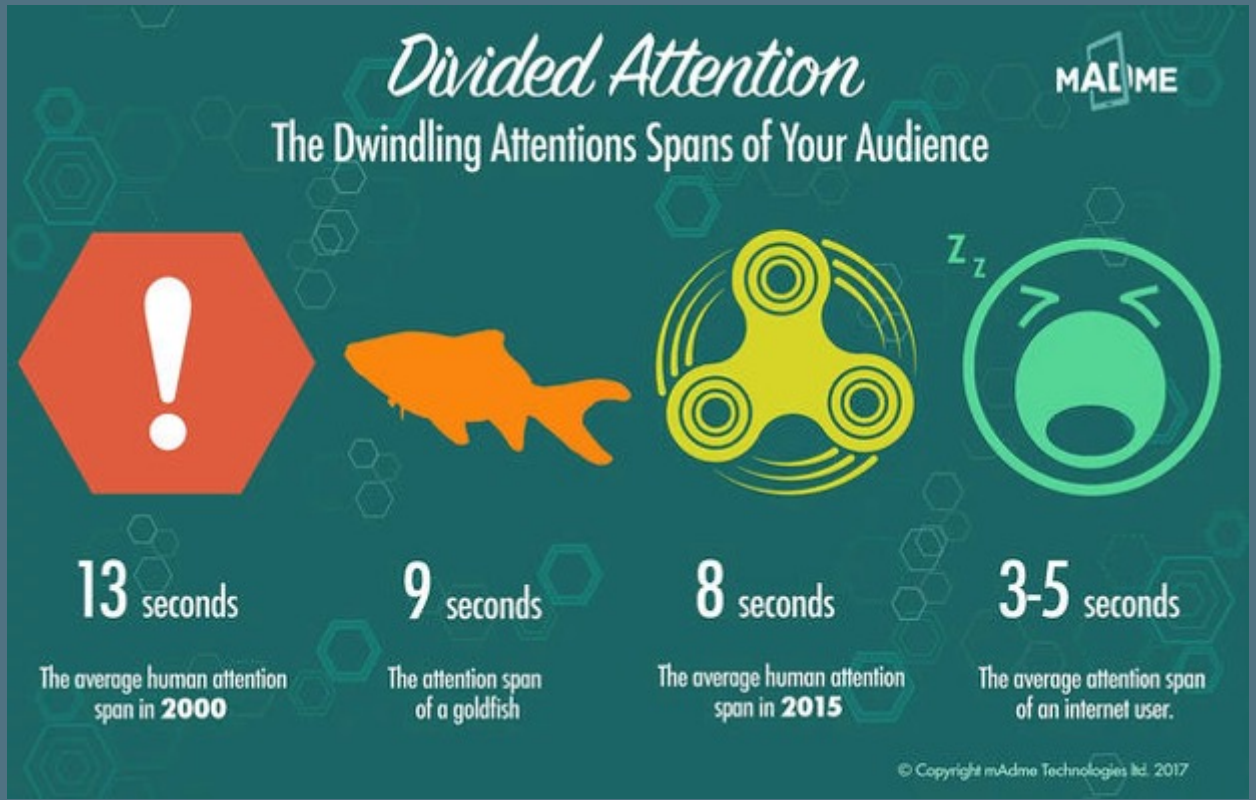
Attention

What about competing stimuli?

- Although attention resources are limited, people can sometimes divide their attention between two tasks.
- It is easier to divide attention between two practiced or automatic tasks. It's much easier to tie your shoe and chew gum than it is to take notes in class while online shopping.
- Attention can also be divided when different sensory systems are utilized to accomplish each task, like when you're listening to a lecture and using both hands to type.

Application to User-Centered Design

How can attention research be applied in design?



Application to User-Centered Design

How can attention research be applied in design?

- Research on divided attention is being applied to alleviate potential dangers associated with driving and cell phone use.