Psychology 1XX3 Notes – Form Perception I – Mar 12, 2010

Gestalt Principles:

- In the 1920s and 1930s, a group of psychologists in Germany began to study how people perceive the world around them.
- These psychologists were called Gestalt psychologists, and with respect to perception, they firmly believed that "the whole is different than the sum of its parts."
- They believed that people tended to perceive the whole stimulus rather than just putting together a collection of the stimulus' discrete parts. The Gestalt movement was in part a reaction to the structuralist approach in vogue at the time, which suggested that everything could be reduced to basic elements.

- The Gestalt psychologists proposed laws → These laws of organization are called the Gestalt principles, and it's thought that they are innate, or that we acquire them rapidly.

Six Gestalt Principles:

Figure-Ground:

- One of the most fundamental Gestalt principles for form perception is figure-ground, or the ability to determine what aspect of a visual scene is part of the object itself and what is part of the background.
- In the simplest scenario, you would have a small, enclosed region that is completely surrounded by a larger region, which would be the background. The figure would tend to have distinct borders or edges that give it a perceptible form.
- This seemingly simple process can be more difficult if the cues that are used to make these figure-ground decisions aren't clean as is the case with reversible figures. (I.E. the wine glass/two faces kissing image)

Proximity:

- One Gestalt principle that helps with grouping is proximity, which says that elements that are close together in space tend to belong together. For example,
- Field of daisies: The daisies aren't all uniformly spaced apart but tend to have regions where they're clustered close together in some areas and fewer in numbers in other areas. You will naturally see the regions of high daisy density as one group of daisies because of their proximity to each other, rather than grouping together some daisies from one cluster with some from another cluster.

Closure:

- Closure is the Gestalt principle that refers to the fact that if there are gaps in the contours of a shape, we tend to fill in those gaps and perceive a whole object.
- I.E. a telephone pole is in front of a truck, however, we fill in the mixing part of the truck instead of thinking the truck is two parts.

Similarity:

- Another Gestalt principle is similarity or the tendency for us to group together elements that are physically similar.
- Suppose you were driving by a farmer's field that had alternating rows of sunflowers and corn. Even though the distance between rows might be the same as, or even less than, the distance between plants within a row you will tend to group together the vegetation of the same type.

Continuity:

- Continuity is the Gestalt principle that lets us perceive a simple, continuous form rather than a combination of awkward forms.
- For instance, the letter "X" tends to be perceived as two continuous lines, "/" and "\", that cross in the middle, rather than seeing a combination of two “V”s joined in the middle.
- The same idea applies to seeing a vase or flowers. We’re likely to perceive each stem as a continuous line, even though they’re likely to be criss-crossed with other stems.

Common Fate:

- Another Gestalt principle that helps us group elements together is common fate - the idea that things that change in the same way should be grouped together
- For example, we tend to group elements together if they are moving together in the same direction at the same time.
- If we look at a school of fish and see them moving together in the same direction, we will tend to group them together. This tendency is strong enough to lead us to a perception of the group of elements as a kind of object on its own.
- Common fate can also explain why we can suddenly see a camouflaged animal once lt moves, like a moth against the bark of a tree.
- When the moth is still, it’s almost impossible to see where the wings of the moth end and the bark begins. But as soon as the moth moves, there are elements within the moth’s pattern that are moving together in the same direction and at the same time.
- These moving elements with a common fate allow the contour of the moth's shape to be perceived, and suddenly the moth seems to pop out against the tree.

Pattern/Object Recognition:

- What a person expects to see can influence what they do see.

Processes of Object Recognition:

- The preliminary steps in object recognition involve identifying what aspect of the scene is the figure and what is the background.
- Once that is established, the parts of the figure are identified and grouped together into a single object.
- Once you have this single object against a background, how do you go about recognizing what that object is? Recognizing an object is really a combination of two processes:
- The first of these is bottom-up processing, where the features that are present in the stimulus itself guides object recognition.
- For example, you recognize a cow as being a cow because it has four legs, goes "moo", has an udder, a big nose, two long ears on the side of its head, and two big eyes.
- So **bottom-up processing** says you recognize what you see by analyzing the individual features and comparing those features to things with similar features that you have in memory.
- The other process is **top-down processing**, where your own beliefs or expectations are the primary influence for determining what you're seeing.
- We already saw evidence for this type of processing with the ambiguous stimuli, but here are some other examples.

- In this example, the second letters in both words are physically identical. Yet, you still read it as "THE CAT" because you are influenced by the context.

Priming Experiments:

- Another example is with an effect called **priming**. In a priming experiment, the experimenter measures how fast a participant can read a word that is flashed on a screen. If you tell the participant that the next word is an animal, you'll find a priming effect because words like dog or duck will be recognized a lot faster here than words like log or puck.
- This shows that processing of a word is more efficient if the participant is primed to expect a word from a certain category.
- Top-down processing cannot work alone because you need some input from the stimulus itself before your expectations about that stimulus can influence your recognition of it.
- Bottom-up processing cannot explain everything alone either because, as we just saw, expectations certainly do influence our perceptions.
- So it seems most reasonable to think that both of these processes must be involved and that we’re dealing with bi-directional activation, where processing occurs in both directions at once. In this way, the features of the object in combination with our expectations guides object recognition.

Theories of Object Recognition:

Biederman’s Geon Theory:

- Suggests that we have 36 different geons, or simple geometrical forms. stored in memory.
- These would be forms like a cone, a sphere, and a cylinder. According to this theory, using just these 36 geons, its possible to recognize over 150 million different objects.
- So, for example. an ice cream cone is just a cone and a sphere. A garbage can or a glass are just cylinders.
- Problems with the idea that we store 36 geons to recognize everything. There are certain stimuli, like faces or crumpled pieces of paper, for which it is difficult to determine what geons would be used, yet we have no difficulty recognising these stimuli.
- Also, there is evidence that some forms of brain damage lead to very specific deficits. For example, people suffering from these brain injuries may not be able to recognize different types of fruit, but they can name different types of tools.
- If geons were involved in object recognition, you might expect deficits in recognizing all types of objects based on their shapes and not a specific category of objects.
- Keep in mind, however, that it is also possible that geons could be processed at a different level of processing separate from the area of brain damage.

Template Theory:

- Another theory of how we recognize objects is that we store many different templates in memory, and when we come across an object, we compare that object to all the templates in memory.
- If a match is found, then it's a familiar object and the person could name it by activating connections to other language areas in the brain.
- If no match is found, then it's an unfamiliar object and a new template is stored in memory.
- Most psychologists don't find the idea of templates very compelling because we would have to store an incredible number of different templates to recognize all of the different objects that we encounter: Just think of all the different templates you'd need to recognize familiar faces that can appear to us in many different configurations.
- For example, my mother's face has many different facial expressions, hairstyles, lighting conditions, and points of view. I would need countless mother templates, and that's just to recognize one person!

Prototype Theory:

- A theory that overcomes the storage problems of the template theory is the prototype theory, which says that we store the most typical or ideal example of an object.
- This system is much more flexible because you don't need an exact match between the observed object and what is stored in memory. This is how we can easily recognize common objects that we've never seen before, like a new dog or coffee mug.
- However, we also recognize specific individual objects, like our favourite coffee mug or our own dog.
- So it's likely that we have more than one type of representation for each object, like an ideal prototypical dog and also all the dogs that we are personally familiar with.

The Importance of Parallel Processing:

- Much of the neural processing of object information is done in parallel. That is, different brain systems process different components of the visual signal simultaneously.
- At this time, no particular theory can provide a complete explanation for the remarkable success of our ability to recognize objects.

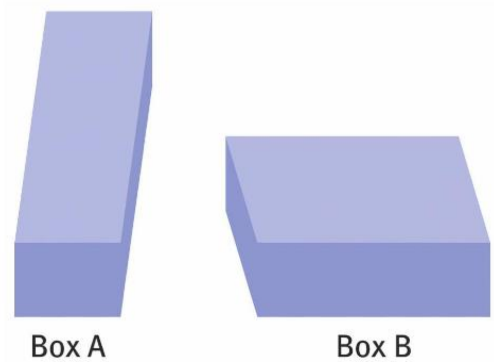
Perceptual Constancies:

- Our world would be an extremely confusing place if we interpreted every perceptual variation in a visual stimulus as belonging to a different stimulus.
- It is probably the rule rather than the exception that a specific object will look somewhat differently every time we look at it; fortunately our perceptual system can handle these variations.
- **Perceptual constancy** refers to our ability to perceive an object as unchanging even though the visual image that the object produces is constantly changing.
- There are several types of perceptual constancies:

5 Types of Perceptual Constancies:

Shape Constancy:

- Shape constancy refers to the fact that we perceive objects to have a constant shape, even though the actual retinal image of the shape would change as your point of view changes or as the object changes position.
- For example, you perceive the shape of your door to be rectangular but it really only produces a rectangular retinal image if you're looking at it straight on and the door is closed.
- As soon as you move, or the door opens, the shape of the retinal image is no longer perfectly rectangular but you still perceive the door as having a constant rectangular shape.
- Here is a visual Illusion that results from our tendency to adjust our perception af the shape of an object to account for our own viewing angle. Even though Box A looks rectangular and Box B looks more square, the two boxes are actually the exact same dimensions.



Location Constancy:

- Objects are constantly moving around on our retinas as we move our eyes, heads, and bodies. Despite this constant movement, we perceive the objects around us as stationary and this is called **location constancy**.
- For instance, when we drive in a car, the entire scene is moving very fast on our retinas, but we don't perceive the objects in the scene to be moving.

Size Constancy:

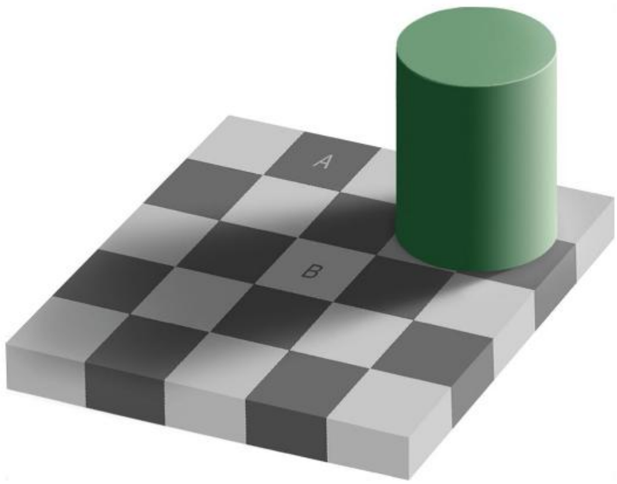
- With **size constancy**, we tend to see the size of objects around us as unchanging, even though as these objects vary in distance from us, the size of the retinal image that they produce an vary quite a bit.
- So as your friend walks away from you, you don't suddenly gasp in horror thinking that he is shrinking before your eyes as your retinal image of his gets smaller and smaller.
- You perceive that he is still the same size but that he is getting farther away from you.

Brightness constancy:

- **Brightness constancy** refers to our ability to know that the brightness of objects around us does not change even though the object may reflect more or less light depending on the ambient lighting conditions.
- We perceive that our favourite coffee mug is the same brightness whether we see it outside on a sunny day, or inside in a dimly lit room.
- Put another way, black still looks black, and white still looks white regardless of whether we are inside under relatively low illumination or outside on a bright

sunny day. Although this is our perception, the black object outside is reflecting more light than the white object inside.

- Here's an illusion that results from our tendency to adjust our perception of the brightness of an object according to the shading
- Within the context of the shading on the checkerboard, you see the two squares as vastly different. But remove the context, and you will see that square A and B are the same.



Colour Constancy:

- Finally, colour constancy has to do with the way that we perceive objects around us to have a constant colour even though the light stimulus that reaches the retina may change with different illumination conditions.
- In the earlier example, I mentioned how you would still recognize your white dog even if she was under a red fluorescent light and looked reddish so long as a range of other colors are available in the background for reference.
- This is an example of colour constancy.

Existing Knowledge:

- How do we account for all of these perceptual constancies? Well, some of it probably depends on our knowledge about objects, which can provide a top-down influence on how we see those objects.
- We know most objects don't change. For instance, we know our friend is a constant size, our coffee mug has a particular level of brightness, our dog is a certain colour, buildings don't move as we drive by them, and doors don't morph into a different shape when we open them.
- But more than that, our visual system has a way of picking up cues in the rest of the scene and using those as clues to perceiving constancy in an object.

Cues in Scene:

- For example, we might use depth cues to both determine that our friend is far away, and shape how we perceive our friend in that context.
- Similarly under the red fluorescent lights, everything will take on a reddish cast, not just our dog. Our brain can use this information from the rest of the scene to fine tune our perception of objects within the scene.
- When you're driving a car and approaching bus that stopped in front of you, you don not see the bus as moving toward you. Again, your brain is integrating the motion of all the elements in the scene. If the bus was moving toward you, everything else in the background would remain stationary.

- When everything in the scene is moving toward you, the brain can use this information to determine that the movement is actually yours and adjust how you perceive the scene accordingly.
- Perceptual constancy occurs because we know that certain properties of objects do not change and our perceptual system automatically factors in other cues in the environment that give us information about the object of interest.

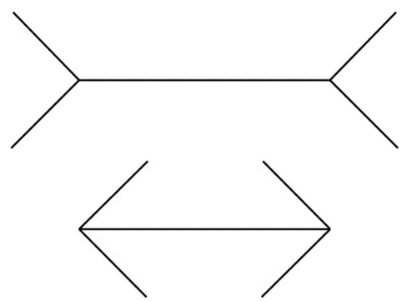
Visual Illusions:

- Although our brain is tuned to recognize a variety of objects in different situations, sometimes it makes mistakes.
- The reason these illusions occur is because our perceptual strategies, which work most of the time, are used in these particular situations where, in fact, they don't belong. We think we see one thing when, in reality what we're looking at is something quite different.
- Many of our perceptual constancies can be overcome by simply by removing the relevant contextual information.
- For example, if we place our dog with the reddish cast in a scene in which no other objects have a reddish cast then we would fail to recognize the dog as our own.

Three Types of Illusions:

The Muller-Lyer Illusion:

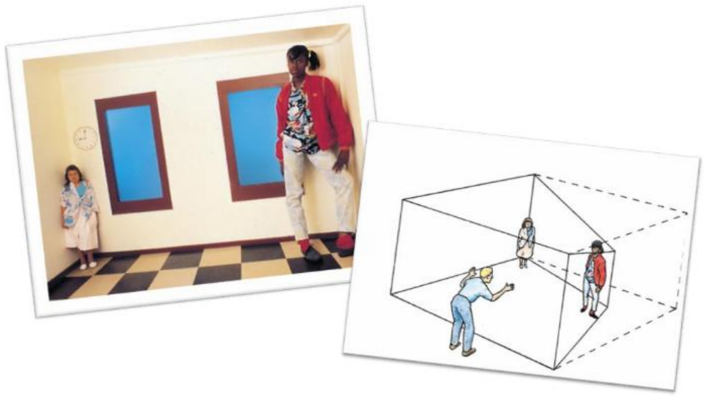
- This is the Muller-Lyer illusion.
- Which of these two horizontal lines do you think is longer?



- Most people will swear that the line on the top is longer than the line on the bottom, when in fact both lines are exactly the same length.
- One explanation of this illusion is that it is an example of misapplying size constancy and inaccurately interpreting depth.
- The angled lines on top of the vertical lines each look like a corner, but the one on the left looks like a corner that is pointed toward you, whereas the one on the right looks like a corner that is receding away from you.
- Since the two lines give the exact same retinal image but the one on the left is assumed to be closer to you than the one on the right, the closer one is perceived as shorter.
- What If you were accustomed to an environment that was relatively free of right angles? Interestingly, people from cultures who live in round huts and aren't surrounded by right angles are much less susceptible to the Muller-Lyer illusion, and they're more likely to say that the two lines are of the same length.
- This provides some support for the explanation of the Muller illusion is at least partly due to cultural and experience dependent processes.

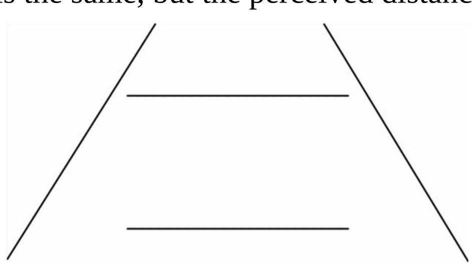
The Ames Room:

- The Ames room is a specially constructed room that looks like a normal rectangular room, except that it's actually trapezoidal in shape: one corner is actually much farther away from your point of view than the other corner.
- So lf you have two people of equal height standing in each corner; the one standing in the farther corner looks much smaller than the person standing closer to you.
- But since you believe and perceive the room to be a normal rectangular room of normal height, you interpret the scene as though each person is the same distance from you.
- When your brain applies the compensatory computations that normally lead to size constancy, it can be tricked by the cues normally used for distance constancy. If you perceive the distance to be the same between you and the two ends of the room, then the two people will be perceived as different sizes.



The Ponzo Illusion:

- A final visual illusion that is the result of conflicting site constancy and depth cues is the Ponzo illusion, seen here.
- If you were asked which of these two horizontal lines is longer; what would you say? Most people say that the top horizontal line is longer than the bottom line, when in fact they are the same length.
- The illusion likely occurs because the two vertical lines are converging, which gives a sense of depth, like train tracks running off in the distance.
- You tend to perceive the top of the lines, where they have converged the most, as farther away than the bottom of the lines where they're further apart.
- So again, you're using depth cues to gauge site, and because the top horizontal line is perceived as being farther away you will see that line as longer than the bottom line which looks like its closer to you.
- Again, retinal site is the same, but the perceived distance differs



- What do these visual illusions tell us about our perceptual system? Among other things, they show us how our experiences and culture can influence how we perceive events in our world. But more than that, they show us that perception is an active process, in which perception is shaped by our prior experiences - and not just by the scene immediately in front of us.