Lesson Ten

Perceptual Processes

Aims

The aims of this lesson are to enable you to

- Define the perceptual set and the effects of motivation, expectation, emotion and culture on perception

- Explore perceptual organization:
    - The Gestalt principles;
    - Gibson's and Gregory's theories of visual perception;
    - Depth cues, monocular and binocular. Types of perceptual constancy, including size constancy and shape constancy.

- Analyse distortion illusions, including the Muller-Lyer illusion and the Ponzo illusion

- Consider ambiguous figures, including the Necker Cube and Rubin's vase

- Say what distortion illusions and ambiguous figures tell us about perception

Context

How do psychologists study cognitive processes? There is a link between our sense and our brain, but how do they communicate with each other. Perception attempts to account for these differences. Researchers use a variety of methods to study perception, and we will see how laboratory experiments can be used effectively to broaden our knowledge.

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Cognitive Psychology

Cognitive psychology is concerned with the ways in which we take in (*perception* and *attention*), store (*memory*), process (*thought* and *problem solving*) and communicate (*language*) information.

Sensation and Perception

Psychologists make an important distinction between sensation and perception.

Sensations are messages carried by the nerves to the brain about events going on in the world. Such messages can reach the body via a number of different sense organs. In particular, we have the sensory receptors of sight, hearing, taste, smell and touch.

These five senses receive a huge amount of information, far more than we can possibly deal with at any one time.

Sense receptors are nerve endings (a collection of specialised cells) or an organ which responds to physical stimuli. Skin, for instance, is just such an organ.

Perception, on the other hand, is the organisation and interpretation of sensation. All those sensory messages are sifted and patterns are deduced. From the chaos of sensation, we get the simplified order of perception.

Vision is perhaps the most important of the senses and our eyes are bombarded with fluctuating waves. This information is recorded by the sight receptor cells in the eyes and these messages are sent to the brain with little or no interpretation. The brain translates the fluctuating light waves into “objects” — for instance, it works out that, about six feet away, there is something recognisable as a table.

But how does the brain do that? How do we distinguish specific things from the mass of patches of dark and light and from the spread of disconnected colours? How do we decide what is an object and what is the background? These are questions which have intrigued psychologists.

The basic argument is whether perception is a result of direct sensory information or whether it is a result of the way in which we interpret that information based on past experience.

In one experiment, the viewer may see two faces or they may see a vase. If you were only taking in the raw sensory data, you would “see” one picture, not a choice of two different figures. This suggests that there is more to visual perception than meets the eye!

So which is the more important component in the perceptual process? Does the incoming sensory information effectively control the perceptions we have in a direct way? Or, to put it another way, does perception occur from the "bottom up"? Or does perception occur from the "top-down"? In other words do we make inferences about the sensory data that we perceive?

Theory One

Perception as a result of top-down information processing — Gregory (1972, 1980)

Gregory (1972) identifies a difference between sensation and perception. In 1966 he described perception as "... a dynamic searching for the best interpretation of the available data... going beyond.... the evidence of our senses". So this view describes perception as an active process whereby sensation relates to the raw data taken in from the environment and the perceptual experience is what your mind does with the raw data.

Gregory (1972) also maintains that relevant past knowledge and experience is of paramount importance in perception. This is called top-down processing, and means that we perceive from the brain downwards by using relevant knowledge and experience to help us perceive objects.

So, according to Gregory, perception is an indirect, active process in which we make use of relevant past knowledge and experience. He pointed out that when we perceive, we make an *inference* — we go beyond the information given. This is part of using relevant past knowledge and experience. Illusions have been widely used to give examples of the way in which we go beyond basic sensory information.

Theory Two

Perception as a result of bottom-up information processing — Gibson (1950, 1966, 1979)

Gibson (1950, 1966, 1979) gives the opposite point of view to Gregory. He sees perception as being a direct process whereby our perceptual experience is based on the qualities of the stimulus itself. Gregory maintained that we ought to look at the way in which perception occurs in real life. He called this approach 'ecological optics'. This means that we live in a world of stimuli which we have to perceive at the same time as we meet each stimulus. For example, if you walk through a field of tall grass, you will be using the visual information to indicate that you are moving forward as the blades of grass part while you walk.

Bottom-up Processing

This means that the stimuli are giving us the information. There is no distinction between sensation and perception. We gather our information from the optic array. This refers to all the information in the environment which strikes the eye and is the pattern of light across time and space. Here are three ways in which we are able to gain information by direct perception:

(i) **optic flow patterns** — the extent to which the point we are aiming for stays still while the patterns of light seem to move away from the focal point. This indicates that movement is a key feature of bottom-up processing.

(ii) **gradient of texture density** — the degree to which light bounces off surfaces to give us an idea of the shape and depth of features of the world around us.

(iii) **affordances** — the relationship between what an object looks like and how we can use it.

So two major theorists have opposite views of perception:

Gregory

Gregory describes perception as involving top-down processing. It is also an indirect, active process which goes beyond sensation.

Gibson

Gibson describes perception as involving bottom-up processing. It is a direct process in which sensation and perception have equal roles to play.

Another way of looking at this is to say that bottom-up processes are data-driven and top-down processing is concept-driven.

Imagine you have been asked to explain this theory to a new psychology student.

1) How would you interpret a keyboard from a) a top-down perspective and b) a bottom-up perspective.

2) Which aspect do you think is more important, or do they carry equal weight?

Theory Three

Perceptual Cycle, Neisser (1976)

Neisser maintains that perception involves both top-down and bottom-up processing. This means that we analyse sensory cues from the stimulus environment to see whether we can make sense of the features it possesses. We make a hypothesis about what the object is and if we find a link with an existing schema, we then looking for more evidence to confirm this idea. This further evidence is based on past experience.

Another theorist who supports an integrated approach is Treisman. She proposed the **feature integration theory** (1988). The idea of this is that we detect sensory features of a stimulus, which have to be integrated into a complete image in order for us to be able to interpret it.

According to her theory, the initial registration of the sensory stimuli is done automatically. This encompasses a wide range of stimuli, not just those to which we are attending.

Activity 1	Look straight ahead of you and notice the colours you see and shapes in your immediate field of vision. Now, still staring ahead, notice what other colours and shapes you are aware of in your peripheral field of vision, that is, anything to the sides.

As I do this myself, I can see my telephone fax machine out of the corner of my eye. I can tell it is my telephone / fax machine because of its general shape and outline, although I cannot perceive the details. I can also see other colours and shapes, and yet in the normal of course of events I do not pay any active attention to these physical aspects. This lends support for perception being based on physical properties of a stimulus, such as lines and angles, colours and shapes.

The second part of her theory concerns how these features are integrated into a whole. This involves serial processing and the coordination and structure of the image. She believes that we build up an image by piecing it together, rather like a jigsaw. This would mean that a more complex picture would take significantly longer to interpret than one with fewer features. If we process information automatically we would expect to be much faster.

For now, have a look at the two diagrams below and see how long it takes you to find the vertical line:

I would expect you to find the one on the left easier and quicker to find. The individual features combine to form an integrated shape which enables the odd one out to stand out from the crowd. In the one on the right, there is much more ambiguity and variety of shape therefore the automatic processes are slowed down and serial processing takes over.

Evidence for this was found in a study of illusory conjunctions, in which participants were flashed a series of mixed colours and shapes (straight red lines and curved green lines). The participants could recognise that they had seen the various shapes and colours, but could not accurately recall which colour belonged to which shape.

In a case study by **Friedman et al (1995),** they examined the effects of a stroke on a person's ability to perceive shapes. This man's cortex was damaged as a result of the stroke, in particular the part for recognizing where items are in space (location). He could name items, and describe them, but he could not say where they were. He had become unable to integrate information. This physiological evidence suggests that the brain comprises several perceptual areas responsible for different aspects of perception and that in order to perceive accurately and effectively, they need to be integrated.

The concept of integration is important. Gestalt theorists, who have been around since the 1920s believe that organisation is the key to successful perception. Gestalt itself means "Organised whole" and they formulated laws of "Pragnanz", or "good fit". The main argument is that we do not analyse information by looking at individual components (in this, they would disagree with Treisman) but analyse information from the point of view of how it fits together. Their adage is "the whole is greater than the sum of its parts", so it is no use expecting to understand your environment by building it block by block, as you will find that it does not provide a satisfactory outcome. Imagine looking at a stream, flowing through a valley, with trees on either side and wild garlic growing beside the path. Obviously, it is entirely possible to perceive this as trees, a stream, flowers, etc but the **quality** of the image lies in its completeness. The experience is more than simply component parts.

According to Gestalt psychologists, our desire for completeness overrides the individual features in our environment. If we find a gap in an image which is not consistent with previous experience, our brain ignores it and fills it in. To this extent, Gestalt theory is top-down processing.

Bugelski and Alampay (1961) carried out a study to investigate the way previous experience influences how we perceive things. It also raises an interesting concept, that of "perceptual set". This occurs when our perception of something is so fixed in our minds that, even though we have information to the contrary, were we to analyse it serially, we are not consciously able to perceive it in any other way. Some illusions are based on this premise. An ambiguous figure is one where there is more than one way of interpreting it.

Bugelski and Alampay (1961) Rat-man ambiguous figure

This study was based on the idea that if you present an ambiguous figure to people and ask them to describe what they see, the more they have seen items similar to *one* of the perspectives of the picture then the more likely they are to describe the image closest to their previous experience.

FIGURE 1. The rat-man ambiguous figure used in this study.

When you look at this image, what do you see? A rat, or a man? If you see a rat, it is probably because the salient features that you are responding to are the ears. If you see this as a man, it is more likely that you will have picked up different features from the image, such as the nose or chin, as we would not automatically recognise the image as a man from someone wearing glasses. Or would we?

Bugelski and Alampay wanted to see if they could prime a participant to view the image in a particular way. They designed two series of pictures; one showed animals and the other humans. The human figures were heads only and included a sketch of a baby, an old woman, a young boy, a young girl, an adult man and an adult woman. The animal sketches were outlines of the body.

Activity 2 Why the difference?

The experimenters then gave an excuse for the study, saying they were testing out how recognisable the shapes of animals or humans were. They did not tell the truth, which is an act of deception. As a rule, we do not to use deception in Psychology, but can you think of any reason why they thought this necessary in this study?

Participants were asked to describe the pictures as they were delivered. The instrument used for this was called a tachistoscope, which is like a very fast slide projector. Immediately after their exposure to either animals or humans, the person was shown the ambiguous figure and his or her responses were noted. The researchers altered the number of exposures before the ambiguous figure to investigate the strength of the ‘perceptual set’ if it were to occur.

The participants were all psychology students and contained a balance of men and women. There were 12 groups of people taking part altogether.

The findings were that just one exposure to either the rat or the man, led to the same classification of the ambiguous figure with the primed image in 75% of cases. The figures increased with higher numbers of exposures to between 88% and 97%.

One of the studies was designed to test how easily the perceptual expectation could be broken. Participants who had already viewed one set of slides were shown the alternative set of slides. Interestingly, the more exposures seen the more resistant the person was to perceiving the alternative image.

The researchers thought they may have made a mistake and delivered the pictures too quickly, so they set up a new group which was given a picture of a woman followed by the ambiguous figure. 71% reported seeing a man. Then they had a break, while they had a lecture and then the experiment continued and the experimenter showed them 6 animal pictures followed by the ambiguous figure again. The results this time were only 45% responding with “man”, which is significantly different from the other findings and shows that time delay can have an effect on perceptual set.

When evaluating this study, remember that it was a laboratory study, in which perceptual set was artificially induced. We have to ask the question: does this study have **ecological validity**, which means would you get the same results if we investigated naturally occurring behaviour in the real world? Would people respond the same in a natural setting? Apparently so. In a **cross-cultural study** carried out by Turnbull, it was found that when presented with an ambiguous situation, where the stimuli were unknown to the participants they interpreted the image from their previous perspective, being all they could understand. Buffalo grazing in the distance were perceived as ants, because the tribesmen and women were not used to perusing animals in the distance and their apparent size appeared to be their real size. Animals in the distance look like ants, and so they believed they were looking at ants. Both of these studies are therefore examples of top-down processing having a greater effect than bottom-up processing.

Now you have seen this image, you cannot take part in this experiment as you will be biased to respond in a particular way - This is called **subject bias**. So, choose two willing friends and you can repeat the experiment with them. Replication is an important part of science, as it produces evidence that supports or negates a theory. Your study will not be very scientific, but it will give you practice in communicating with participants and collecting data.

You need to have a series of black and white pictures of animals and another series depicting men or women, preferably also drawn as cartoons. 4 of each will do. If you cannot draw cartoons, you will have to use photographs or pictures from magazines. Try to keep them the same size and use similar colours, otherwise these factors could become **extraneous variables**, i.e. unwanted influences, on your study.

Activity 3	What other variables should you control?

In the first part of the test, you will show your friend the series of pictures containing animals. You show them the first picture very briefly and ask them to give a short verbal description of what they have seen. At the end of these presentations you show them the ambiguous figure and ask for a description again. Do exactly the same for the human pictures. Then record their answers to the ambiguous figure in both conditions.

Activity 4	What is the point of having the verbal descriptions of the other animals?

If you can do this with a few friends, all the better. You could alter it in some way, either by presenting the ambiguous figure half way through or by timing how long it takes them to call out the name of the ambiguous shape. If you find this an interesting study you could adapt it and use it as basis for your Practical Investigation.

Evidence for the 'Top-Down' Theory: Perceptual Constancies

These refer to our ability to see the world in a stable unchanging way, even though the sensory data coming in from the world is always changing. The perceptual constancies are:

a) Size Constancy

Sense data gives a retinal image of the objects we see as being smaller when they are far away from us, perceptual constancy is maintained by the brain as it scales the perception of the objects up to the correct size on the basis of our previous experience. If you see a friend at the bottom of a street, you assume that your friend is far away, not that he or she has shrunk!

b) Colour Constancy

The tendency to see familiar objects as being of the same colour, regardless of changes in lighting or shadow. If you go into a room at night and you see some apples in a bowl, you don't assume that they have gone black, just that they are in the dark. You have assumed that the colour remains constant, despite the information your eyes are directly receiving.

c) Lightness Constancy

The tendency to see a familiar object as being of the same brightness, regardless of the light and shadow that change its stimulus properties. For example, coal is dark whether in sunlight or in shadow.

d) Location Constancy

The tendency to perceive the place at which a resting object is located as remaining the same, even though the relationship to the observer has changed. For example an apple is still perceived as being in the same place in the fruit bowl, even though you look at it from a different perspective as you walk around the room.

e) Shape Constancy

The tendency to see a familiar object as being of the same shape regardless of the viewing angle. For example a door is still a door shape even though it takes on many different geometric shapes as it opens and closes.

Cultural Differences

Hudson (1960, 1964) investigated cultural factors associated with the interpretation of pictorial depth. See Segall et al.'s **carpentered-world hypothesis** which seeks to explain the differences found.

Visual Illusions

Gregory (1983) describes four types of illusions:

Distortions

Here we make a perceptual mistake. See, for example, the Muller-Lyer illusion below and the Ponzo illusion.

Ambiguous Figures

Here the same stimulus input results in different perceptions through a switch of attention. Take a look at the Rubin Vase and the Necker Cube.

Paradoxical Figures

Here the stimulus leads us to make false assumptions. For an example, see the Penrose impossible objects.

Fictions

Here we see what is not there, there is an absence of data in the stimulus. See, for example, the Kanizsa Triangle. Why do we allow these illusions to play tricks on us?

Several examples of illusions can be found in your textbook and many more examples are easily found on the internet.

Gregory and the Misapplied Constancy Theory

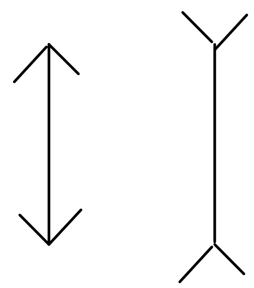
Gregory suggests that we are susceptible to illusions, whereby the sensory stimulus tells us one thing and we perceive it as another, for two reasons:

a) we are using perspective cues derived from our experience of 3D objects to help us perceive the 2D stimulus.

b) we are also misapplying constancy scaling which we normally use to perceive the world around us.

So we attempt to interpret the stimulus figure in a manner which is inappropriate, resulting in the experience of an illusion.

Gregory was particularly concerned with this simple figure which is known as **the Muller-Lyer illusion**:



Which of the two vertical lines is the longer?

Be honest, the one on the right looks longer, doesn't it? But if you measure them carefully, you will see that they are of equal length.

How can this happen with such simple stimuli? Why is our brain so easily fooled? Gregory offers a plausible explanation — the arrow with the ingoing fins (on the left) offers us linear perspective cues which suggest that it could be the outside corner of a building. In this light, the ingoing fins are seen as walls receding away from us so that the shaft is closer to us.

With the right-hand diagram, the situation is reversed. Now the perspective cues (the outgoing fins) suggest that it could be the inside corner of a room, in which case the shaft is the furthest thing away from us. The retinal images produced by the shafts are equal and, according to our sense of size constancy, this means that the line which is further away must actually be longer. It takes a bit of thinking about but it is a plausible argument.

However, it should be noted that a lot of the illusions we have considered do not involve perspective cues. Yet we still experience the illusion. Eysenck (1984) is one psychologist who has challenged Gregory's evidence and the idea that it is always a matter of depth cues and size constancy — for him it may simply be that the apparently longer shaft is part of longer total object and this conditions our perception of it.

Subject Variables

So far we have considered the way properties in the object or sensory stimulus can affect the way it is perceived. But there are also a large number of ways in which variables in the subject can affect perception. We see the same thing in different ways because each of us has a different brain and a different set of prior experiences. Indeed, we could compile a long list of subjective differences affecting perception, which might include the following:

- motivation
- emotion
- perceptual set
- previous experience
- context
- instructions
- reward
- deprivation
- perceptual defence/sensitisation
- level of attention

The importance of each of these factors can usually be appreciated by attention to simple events from everyday life. Most of these factors have an effect on which pieces of sensory information are taken into account. We learn to ignore virtually all of the changes in the environment around us, but these factors help to account for the exceptions — those times when we actually do notice.

Motivation

Motivation is crucial to perception. If you are sitting in your living room for an hour and someone asked you whether there was a pen anywhere to be seen, you would probably not know. But if for some reason you wanted to find a pen, you would sift the visual information reaching you, excluding anything that was clearly not pen-like and you would probably see the pen inside thirty seconds.

Gilchrist and Nesburg (1952) asked a group of subjects to look at a set of pictures and assess how brightly coloured they were. If the subjects had gone without food and drink for four hours, they decided that pictures of food and drink were more brightly coloured than pictures of other things. The motivational state of hunger had had an effect on the way they perceived each picture.

Our Perceptual Set (Expectations)

Expectation is perhaps the most important factor of all in explaining perception. In most cases, we see what we expect to see. A soldier wears camouflage so that he will have a certain degree of similarity with the background against which he is moving. The enemy expects to see a wood and does not pick up the clues that something else is happening.

The importance of expectation is central to the idea of a **perceptual set**, an idea accepted by virtually all the "top down" theorists. **Allport** (1955) defined the perceptual set as follows:

> ... a perceptual bias or predisposition or readiness to perceive particular features of a stimulus.

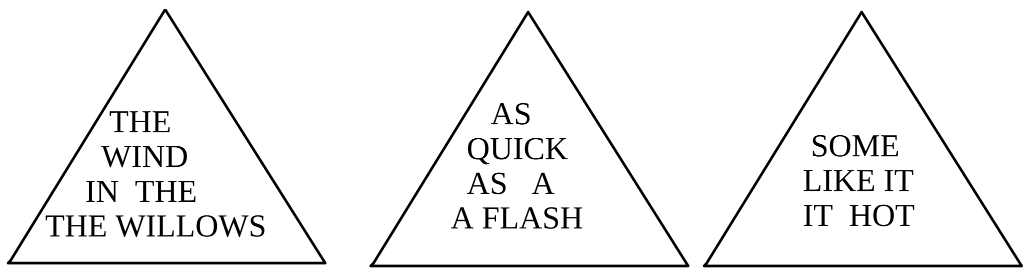
Another word for a perceptual set is a schema, which is defined thus by **Vernon** (1955):

> ... persistent and deep-rooted, well organised classifications of ways of perceiving, thinking and believing

Such sets or schemas are important both in the selection of relevant information or stimuli and in the interpretation of it.

The standard experiment, which you could easily repeat, is one carried out by **Bruner and Minturn** (1955). They showed subjects a set of letters or numbers and asked them to name them out loud. At a certain point, they would be shown an ambiguous figure which might have been either the figure 13 or the letter B. People who had previously been looking at letters announced that it was a B while subjects who had previously been looking at numbers said that it was a 13.

Activity 5 | What is written in the following triangles?



Now check them again, more carefully this time.

Perhaps that was too easy. The very fact that you were being asked to read such easy, familiar phrases probably alerted you to the fact that there was some kind of "trap" and, sure enough, when you examine the phrases carefully, you discover that a word has been repeated in each case. But the casual reader would be very unlikely to notice these mistakes. We expect a certain phrase and it is very easy to fail to notice discrepancies.

It is only in the context of a psychological test that we appreciate that there is something extra to look out for and we adjust our expectations accordingly.

The Order of Experience

Previous experience forms the basis for the many perceptual sets that we carry round with us and use to make sense of the world, but it can be a very inaccurate guide. **First impressions** are of critical importance. If our first impression confirms a particular idea or creates one perceptual set, we tend to ignore later impressions to the contrary. Thus the order in which information reaches us can be crucial.

Jones (1968) asked subjects to watch while a "student" tried to solve a series of 30 multiple choice problems. Each time the student got 15 out of 30 right but the order of success was deliberately varied. In front of some viewers, the student started well, creating an initial impression that he was very good (although he didn't do so well later on). In front of others, the "student" started badly and did a lot better later.
Then the viewers were asked to estimate the total number of questions that the student had got right. Viewers in the first group estimated that he had scored 20 out of 30 while those in the second group typically guessed that 12 out of 30 questions had been correctly answered. We can see that first impressions had had a disproportionate effect on the viewer's perception of the student's abilities.

The Context of Perception

The experiments that we have mentioned by Jones, Gilchrist and others also demonstrate the importance of context. Indeed, **context** and expectation are two sides of the same coin. The context is a set of situational cues which help us to determine (subconsciously) which information to select, how to interpret it and which perceptual set is appropriate.

One aspect of context is the **instructions** we have been given. If we have been told to look out for a man in a blue coat walking along the road, we are more likely to notice him than if we have been asked to keep an eye on the weather. If Jones, in the experiment above, had asked the subjects to count the number of correct answers, no doubt they would all have got the correct answer of 15 out of 30.

This is closely linked to the question of **reward** and **deprivation**. If someone if offering you a reward, you are more likely to perceive things in the way that you think that the rewarder wants you to perceive them, even if perception becomes totally distorted as a result. Deprivation or the threat of sanctions can have an even more pronounced effect on perception. In George Orwell's book *1984*, Winston Smith, the hero, is tortured by O'Brien in the Ministry of Love. O'Brien holds up four fingers but persuades Winston that he can really see five, largely because the latter is afraid of further electric shocks.

Emotion and Perceptual Defence

Perceptual defence is the idea that things which are threatening or which cause us anxiety are more difficult to perceive at a conscious level.

Logic suggests that this ought to be true as well. There is some experimental evidence to support the idea of perceptual defence, notably from **McGinnies** (1949). He presented subjects (looking into a tachistoscope) with words just below the threshold of consciousness to see how long it took the subjects to identify and name those words. Eleven of the words were neutral (e.g. "glass", "broom" and "apple") and seven were threatening taboo words (e.g. "rape, bitch, whore"). It took the subjects a lot longer to name these words than the neutral ones and they were less likely to name them correctly. It was as if they didn't want to hear those words and so they didn't. From this, McGinnies coined the idea of perceptual defence.

But McGinnies' work has not been accepted uncritically. Some have suggested that the experiment may simply show that people are less happy about articulating certain words (just as many dislike swearing) and reluctant, even when they think they know what the word is, to make a guess that could be embarrassingly wrong. Others have shown, statistically, that the taboo words would have been less familiar than the neutral words, so there are a number of commonplace reasons why the results were bound to be as they were.

The idea of perceptual defence (as it is formulated by McGinnies) is also at odds with one of the basic functions of perception — survival. If something is threatening or unpleasant, its importance to the subject is increased not decreased, as it may be that some emergency evasive action is required. If we hear someone using threatening language, even if it is at a distance, we will focus on that and cut out other neutral stimuli in order to measure the threat accurately.

All of these factors (constancies, visual illusion and subject factors) tend to support the idea of perception as a "top down" process. In other words, we do not base our perceptions primarily on the retinal images we perceive (and so see the world in a fairly direct way, like a camera), rather we use the sensory information on our retina to make judgments or hypotheses about what the world is like.

Now read *AQA (B) Psychology for AS,* pp. 254-285.