EFP Notes

Topics Covered:

Week 1: Introduction to Psychology and Visual Perception (1)

Week 2: Brain Behaviour Relationships (1): How does the Nervous System Operate?

Week 3: Brain Behaviour Relationships (2) and Perception (2)

Week 4: Brain Behaviour Relationships (3) and (4)

Week 5: Brain Behaviour Relationships (5) and Perception (3)

Week 6: How do drugs affect consciousness + Introduction to Cognition and Attention (1)

Week 7: What is Memory + Attention (2)

Week 8: Cognition 3 & 4

Week 9: Memory, Thinking, Language and Intelligence (2) + Lifespan Development (1)

Week 10: Memory, Thinking and Language (3) + Lifespan Development (2)

Week 11: Memory, Thinking and Language (4) + Lifespan Development (3)

Week 12: Memory, Thinking and Language (5) + Lifespan Development (4)

Week 1: Introduction to Psychology and Visual Perception

Introduction to Psychology:

Textbook readings: 3-11

Learning objectives:

- What is psychological science?
- Critical thinking and influences on decision making
- What kind of jobs will we do in 2025?
- Jargon and the language of psychology

What is psychological science?

Psychology involves the study of mental activity and behaviour.

Psychological science: the study, through research, of mind, brain, and behaviour.

Psychology's aim is to:

Understand behaviour (in both humans and animals), and as a secondary goal, to treat behaviours deemed abnormal.

To do this we need to:

- Describe what is known about the behaviour
- Explain why people (or animals) behave that way
- Predict future behaviour of people (or animals) by studying past behaviours, and
- Influence (control) behaviour in some way

Thus psychology is both a discipline and a practice.

Types of Behaviours:

- Observable behaviour: that can be measured
- Unobservable behaviour: thoughts and feelings (mind)

Psychological Science requires Critical Thinking:

Critical thinking is: A systematic way of evaluating information using well-supported evidence to reach reasonable conclusions.

Critical thinking involves:

- Looking for holes in evidence
- Using logic and reasoning to see whether information makes sense
- Considering alternative explanations
- Considering whether information is biased (e.g. by personal or political agendas)

Amiable scepticism: the application of critical thinking to real life situations

NOTE:

- Most of us function as intuitive psychologists, but many of our intuitions and beliefs are wrong
- To improve the accuracy of our own ideas, we need to think critically about them

Major Biases:

- Ignoring evidence (confirmation bias): (Don't believe everything you think)
- Failing to accurately judge source credibility: (Who can you trust?)
- Misunderstanding or not using statistics: (Going with your gut)
- Failure to see our own inadequacies (self-serving bias)

Decision Making:

- Decisions can be influenced by the way a decision is framed
- Many psychologists focus on the processes and capacities of the mind and pay much less attention to the neural underpinnings of these processes

Example:

- A group of shoppers presented with 80% lean meat is more likely to buy it than a group offered meat that is 20% fat
- This shows that people are heavily influenced by differences in how their options are described

What kind of jobs will we do in 2025?

For example:

- Mental image retriever: uploading personal images (dreams/images/perceptions) to computer
- Artificial organ designer: uses own stem cells to grow replacement organs

Visual Perception:

Textbook readings: 173-190

Learning objectives:

- What is perception?
- Perceptual organisation
- Form perception
- Gestalt principles: figure-ground, similarity, proximity, good continuation, closure
- Is visual object recognition viewpoint dependent or viewpoint invariant?

Key words:

Sensation: the detection of physical stimuli and transmission of that information to the brain.

Perception*:* the acquisition and processing of sensory information in order to see/hear/taste/feel objects in the world.

Bottom-up processing: perception based on the physical features of the stimulus

NOTE: All Gestalt Laws (except for illusory contours) are driven by bottom-up processing

Top-down processing: how knowledge, expectations, or past experiences shape the interpretation of sensory information. (Good way to remember: top = mind; top of the body)

That is, context affects perception. What we expect to see (higher level) influences what we perceive (lower level).

Transduction: the process by which sensory stimuli are converted to signals the brain can interpret.

Perception uses previous knowledge to gather and interpret stimuli registered by your senses.

Perception combines visual stimuli (outside world) with previous knowledge (inner world).

It takes 100-200mseconds to recognise something (very quick).

Interesting perception example:

There are 2 Suns:

1. The real Sun in outer space, and 8 minutes later
2. The historical Sun that we perceive

This occurs because it take just over 8 minutes for light from the Sun to reach earth.

Visual perception:

A major goal of visual perception is object recognition: identifying objects in the world around you.

But the environment can make this complex, for example:

- Multiple overlapping objects
- Differing distance/orientation
- Category membership (e.g. chairs can come in all sorts of types)

Perceiving form:

Perceptual segregation: the human visual system is designed to impose organisation on the visual environment. (Distinguish between figure and ground)

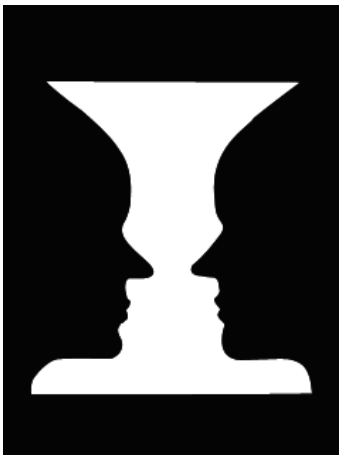
When two areas share a boundary, the figure (important part) has a distinct shape with defined edges, whereas the ground is the area that's left over, forming the background.

Ambiguous Figures:

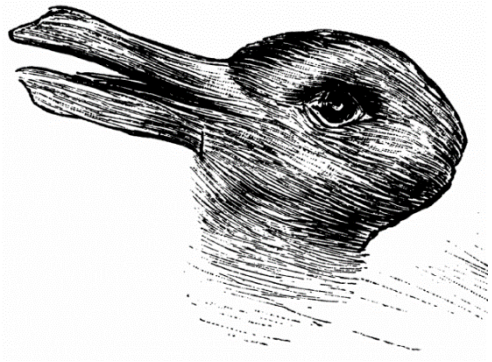
Sometimes an image has an ambiguous figure-ground relationship: the figure and ground reverse periodically

E.g. Faces-vase: can be seen as white vase on a black background, or black faces on a white background

Your perceptual system doesn't allow you to simultaneously perceive the two images at the same time, so imposes a Gestalt organisation (wholes) on the stimulus: one part of it always stands out and the remainder recedes.



Perceptual reversibility: when you can perceive only one organisation at a time, but the selected organisation can change from second to second (e.g. duck-rabbit)

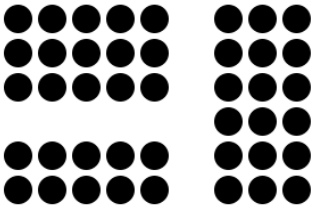


Gestalt Laws:

- Proximity
- Similarity
- Closure
- Common fate
- Good continuation

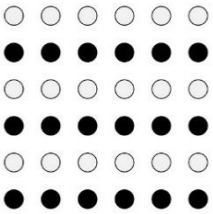
Proximity:

Law of proximity: objects that are near each other (proximal) tend to be grouped together.



Similarity:

Law of similarity: when several similar items are presented together, we tend to perceive the form in a way that groups the similar items together.



Closure:

Law of closure: we group things together if they seem to complete an entity. We can ignore contradictory information and fill in gaps in information.

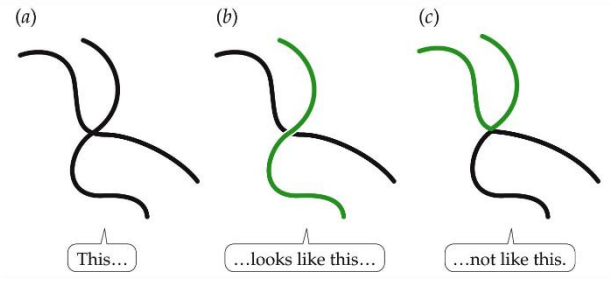
Illusory contours: perceptual phenomenon in which we see edges even though they are not physically present (also applies to 3D images).

Common fate:

Law of common fate: things that appear to move together are grouped together e.g. flock of birds, school of fish

Good continuation:

Law of good continuation: parts of a display are grouped to minimise the number of interruptions to smooth lines or curves.



Viewpoint Invariant:

Biederman (1987) proposed a recognition-by-components theory of object recognition. This theory proposed that object recognition is viewpoint invariant (only hard to recognise an object if one or more geons are hidden from view).

Central assumption of recognition-by-components theory is that objects are composed of 'geons' (geometric ions) e.g. cylinders, blocks, spheres, arcs, wedges

According to Biederman, all the objects in the world can be broken down into about 36 different geons.

Geon-based information about objects is stored in long-term memory, thus according to Biederman, object recognition relies on geon identification.

Recognition-by-components theory has been criticised for being a rather blunt instrument: can discriminate dog from cat, but not *your* cat from other cats.

Viewpoint Dependent:

Tarr and Bulthoff (1995, 1998) argue that object recognition is viewpoint dependent: changes in viewpoint will affect the speed/accuracy of recognition.

They propose that we observed most common objects from several different perspectives: we store these views of the objects in long term memory. (Object recognition is more efficient when our view of the object corresponds with that of the stored representation)

Viewpoint dependent vs invariant:

Measuring the time taken to identify objects from several different viewpoints can test the validity of the viewpoint dependent and viewpoint invariant theories.

Tarr and Bulthoff (1995) study:

Tarr and Bulthoff trained participants to recognise novel objects from certain viewpoints.

Conclusion:

- It was easier to recognise objects that match stored representations.
- The greater the original stored image was rotated, the longer it takes to recognise it.

Gauthier and Tarr (2002) Greeble study:

Used artificial objects called 'greebles' which belong to various families: participants spent 7 hours learning to identify the greebles.

During the study, participants were presented with 2 greebles in rapid succession and asked to determine whether the second greeble was the same as the first. The second greeble was presented at the same orientation or 75 degree rotation.

Conclusion:

- Object recognition was faster when the orientation of the matching greebles was identical then when the orientations were different.

NOTE: Recognition latency is the amount of time it takes to recognise an object.

This data suggests that object recognition is viewpoint dependent, and this does not change as people become more practiced.

Summary:

Perception: the acquisition and processing of sensory information in order to see/hear/taste/feel objects in the world

Perception is influenced by both bottom up (stimulus driven) and top down (prior knowledge/expectations) processing.

Impossible to perceive two figures simultaneously, so in ambiguous figures we perceive Gestalts (wholes). Object perception obeys Gestalt laws for Proximity, Similarity, Closure, Common fate and Good continuation.

Some argue that object recognition is equally efficient across different viewpoints (viewpoint invariant/independent) whilst others hold that object recognition is more efficient from certain, well-practiced angles (viewpoint dependent).

Biederman's (1987) recognition-by-components theory proposes that objects are composed of geons, and recognition is viewpoint invariant.

Week 2: How Does the Nervous System Operate?

Textbook readings: 75-89

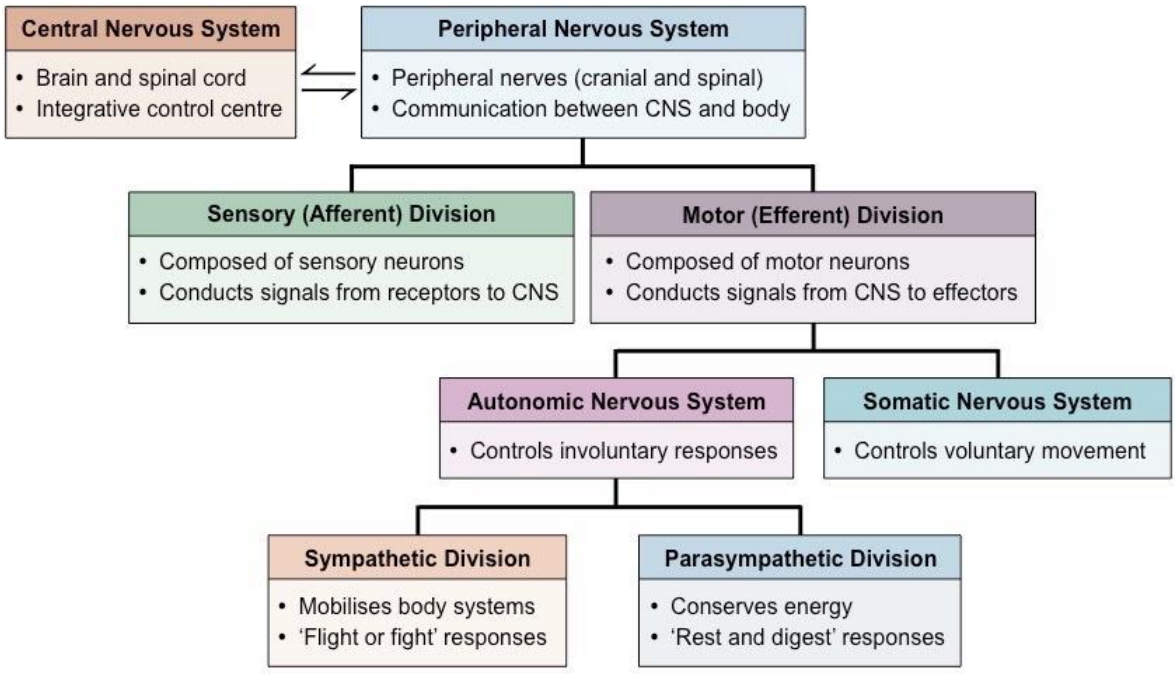
Learning objectives:

- The nervous system has two basic divisions
- Neurons are specialised for communication
- The resting membrane potential is negatively charged
- Action potentials cause neural communication
- Neurotransmitters bind to receptors across the synapse
- Neurotransmitters influence mental activity and behaviour
- Clinical case example: Multiple Sclerosis

Two basic divisions of the nervous system:

Central Nervous System (CNS): brain and spinal cord

Peripheral nervous system (PNS): all nerve cells in the body that are not part of the CNS.



Neurons are specialised for communication:

Nerve cells are powered by electrical impulses and communication with other nerve cells through chemical signals.

NOTE: Within a nerve = electrical; between nerves = chemical (i.e. neurotransmitters)

3 basic phases:

1. Reception: chemical signals are received from neighbouring neurons.
2. Integration: incoming signals are assessed.
3. Transmission: signals are passed on to other receiving neurons.

Types of Neurons:

1. Sensory neurons: detect information from the physical world and pass that information to the brain (sensory receptor to CNS)
2. Motor neurons: direct muscles to contract or relax, thereby producing movement (CNS to muscles or glands)
3. Interneurons: communicate within local or short-distance circuits (connect neuron to neuron)

NOTE: Neurons structure reflects its function:

Sensory neurons: long dendrite and short axon

Motor neurons: long axon and short dendrites

Interneurons: many different shapes

Sensory Receptors:

1. Mechanoreceptors – respond to mechanical stimuli such as tension (stretching), pressure, or displacement/distortion (bending)
2. Thermoreceptors – respond to changes in temperature (heat and cold)
3. Nociceptors – respond to injuries or painful somatic or visceral (based on feelings or emotions) stimuli
4. Photoreceptors – respond to electromagnetic radiation, typically wavelengths of visible light in humans
5. Chemoreceptors – respond to chemical stimuli

Senses: Vision, audition (hearing), olfaction (smell), gustation (taste), somatosensation (touch and pain)

NOTE: *Somatosensory nerves* provide information from the skin and muscles.

The resting membrane potential is negatively charged:

Resting membrane potential: the difference between the electric charge inside and outside of the cell. This difference occurs because the ratio of negative to positive ions is greater inside the neuron than outside it. (Typically -70 millivolts)

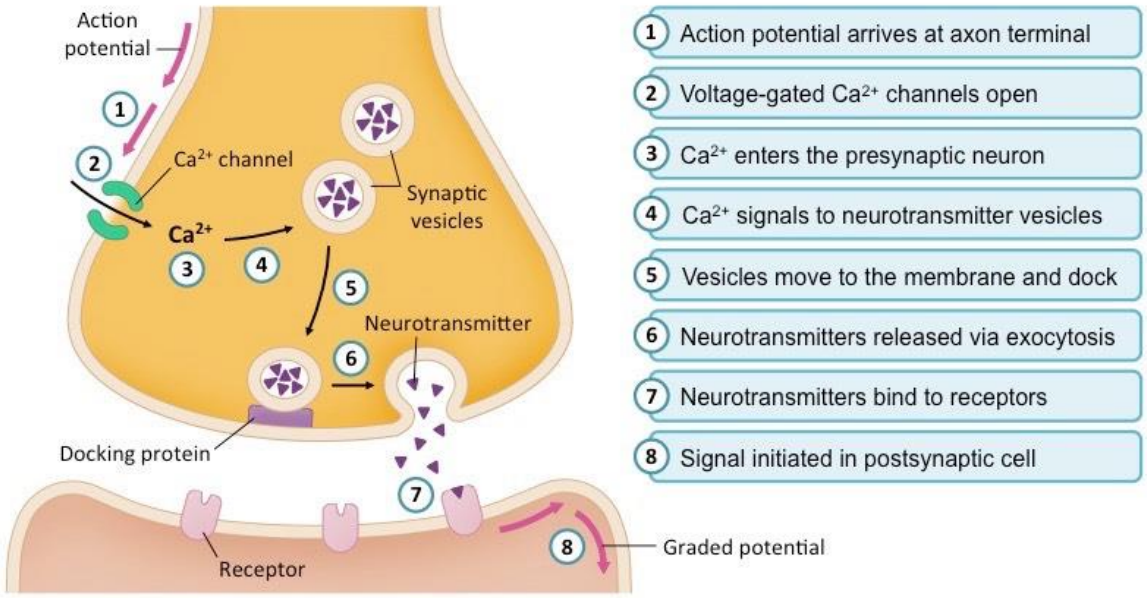
Polarised: when a neuron has more negative ions inside it than outside

Polarisation: creates the electrical energy necessary to power the firing of the neuron

Action potentials:

Action potential (neural firing): the electrical signal that passes along the axon and subsequently causes the release of chemicals from the terminal buttons.

Transmission of a signal:



NOTE 1: The neuron is covered with a semipermeable membrane. The membrane regulates the concentration of ions (via ion channels e.g. sodium-potassium pump) in or out of a neuron, which is the basis of the neuron's electrical activity.

NOTE 2: 3 major events that terminate a neurotransmitter's influence in a synapse:

1. Reuptake: occurs when the neurotransmitter is taken back into the presynaptic terminal buttons.
2. Enzyme deactivation: occurs when an enzyme destroys the neurotransmitter in the synapse.
3. Autoreception: occurs when an excess is detected when a neurotransmitter binds with receptors on the postsynaptic neuron, causing the presynaptic neuron to stop releasing the neurotransmitter.

NOTE 3: Common neurotransmitter examples and their major functions:

Acetylcholine: Motor control over muscles; learning, memory, sleeping, and dreaming; energy

Dopamine: Reward and motivation, motor control over voluntary movement

Endorphins: Pain reduction, reward

Transmission of signals:

Signals are conducted/transmitted within neurons by electrical charges that are created by the movement of salts (sodium, potassium, chloride) from the inside to the outside of the neuron or vice versa.

Communication between neurons is transmitted chemically using neurotransmitters.

Neurotransmitters: chemical substances that transmit signals from one neuron to another

Receptors: specialised protein molecules on the post-synaptic ending; neurotransmitters bind to these molecules after passing across the synapse

NOTE 1:

All-or-none principle: when a neuron fires, it fires with the same potency each time; a neuron either fires or not; it cannot partially fire, although the frequency of firing can vary.

NOTE 2: the binding of a neurotransmitter with a receptor produces an excitatory or inhibitory signal.

Excitatory signals:

- Depolarise the cell membrane (i.e. decrease polarisation by decreasing the negative charge inside the cell).
- Through depolarisation, these signals increase the likelihood that the neuron will fire

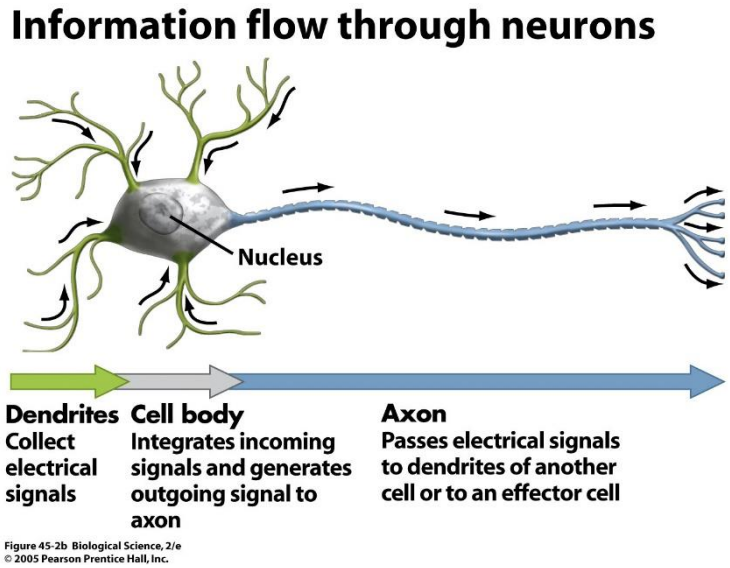
Inhibitory signals:

- Hyperpolarise the cell (i.e. increase the polarisation by increasing the negative charge inside the cell).
- Through hyperpolarisation, these signals decrease the likelihood that the neuron will fire.

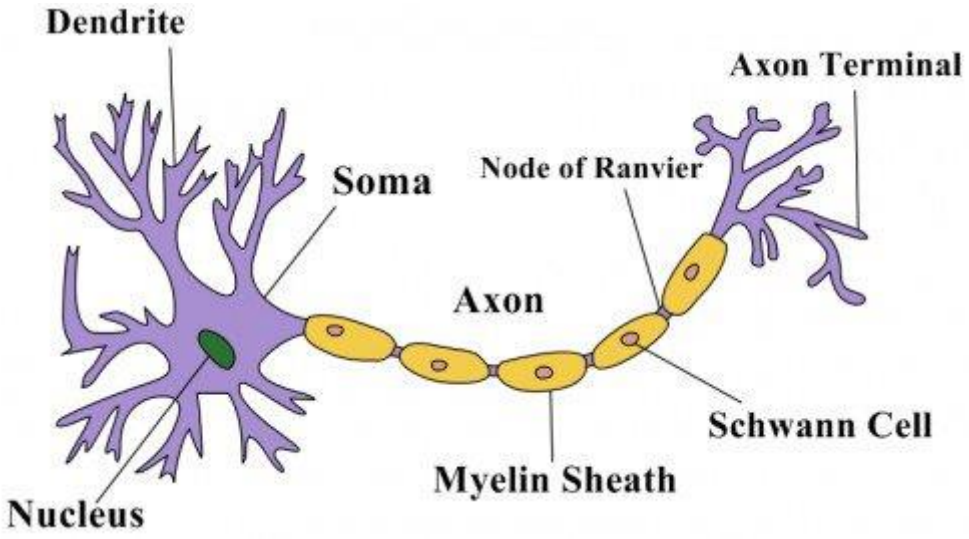
The area that neurons meet is called the synapse or synaptic cleft:

Pre-synaptic ending (where neurotransmitters are made) – end of axon

Post-synaptic ending (has neuroreceptors in the membrane) – at dendrites



Structure of Neuron:



Dendrite: detects chemical signals from neighbouring neurons

Cell body (soma): collects and integrates information

Axon: transmits electrical impulses

Terminal buttons: fat/round ends of an axon

Myelin sheath: encases and insulates axons, increasing the speed of signal transmission; composed of glial cells

Nodes of Ranvier: spaces between glial cells

Manipulating Neurotransmission:

Agonists:

Drugs that increase the actions of neurotransmitters.

Agonists can block the reuptake of neurotransmitters.

Agonists can work by making the post-synaptic receptors that detect the neurotransmitter more sensitive, or increasing the number of post-synaptic receptors so more of the neurotransmitter can be absorbed. (E.g. heroin, opioids).

Antagonists:

Drugs that inhibit the actions of neurotransmitters.

Antagonists help destroy neurotransmitters in the synapse.

Antagonists trick the post-synaptic receptors into thinking they are the neurotransmitter, so that the neurotransmitter itself can't bind and the signal stops. (E.g. naloxone: used to reverse heroin overdose)

SSRIs:

Selective Serotonin Reuptake Inhibitors (SSRIs) are sometimes used to manage depression.

SSRIs work by stopping the neurotransmitter Serotonin from being absorbed back into the pre-synaptic neuron so it stays in the synaptic cleft longer. This maintains high serotonin levels in the brain, hence elevating mood.

Case example: Multiple Sclerosis

MS is an autoimmune disease (the body's immune system attacks its own tissues).

MS destroys myelin, causing signals to be transmitted slower.

Symptoms include fatigue, problems with balance, and pain.

Age of onset typically 20-40, average 30.