Chapter 4: The central nervous system
Learning activity suggested answers

Learning Activity 4.1 (p. 173)

1
a What is the central nervous system?
The CNS is a branch/subdivision of the human nervous system comprising the brain and spinal cord.
b What are its main roles in mental processes and behaviour?
Its roles include:
• transmitting messages to and receive messages from the peripheral nervous system (PNS)
• activation and/or coordination of numerous mental processes and behaviours: the brain is responsible for virtually everything we think, feel and do.

2 What are the main functions of the cerebral cortex?
Main functions include information processing activities such as perception, language, learning, memory, thinking and problem-solving, as well as the planning and control of voluntary bodily movements.

3 Where is the cerebral cortex located?
Location may refer to:
• outer layer of the cerebral hemispheres/cerebrum
• encased within skull and just below.

4 Of what does the cerebral cortex mainly consist?
neurons

5 Name the three different categories of cortical areas and briefly describe the functions performed by each of these areas.
• sensory cortex area: receives and processes information from the different senses
• motor cortex area: receives, processes and sends information about voluntary bodily movements
• association cortex area: receives and integrates(combines) sensory, motor and other information and a involved in more complex mental abilities, e.g. - perceiving, planning and problem-solving.

6 Describe the relationship between the size of the cerebral cortex and the mental capabilities of an organism.
Generally, the larger the cortex, the more sophisticated/complex the mental capabilities of an organism.

**Learning Activity 4.2 (p. 175)**

1. a. What is a cerebral hemisphere?
   Description should refer to one of two almost symmetrical ‘halves’ of the cerebral cortex (but not ‘halves’ of the brain).
   
   b. Briefly describe three key characteristics that the cerebral hemispheres have in common.
   Characteristics include:
   - physiology, e.g. similar overall size, shape and structure
   - common functions
   - common anatomical location of many functions for opposite sides of the body
   - specialised functions.

2. Name the deep groove that appears to separate the hemispheres
   longitudinal fissure

3. a. What is the corpus callosum?
   Description should refer to the band/strand/bundle/‘bridge’ of nerve tissue connecting the left and right cerebral hemispheres.
   
   b. Where is the corpus callosum located?
   deep in the brain/towards the bottom of the cerebral hemispheres
   
   c. What key function is performed by the corpus callosum?
   Function should refer to a communication/neural pathway enabling exchange of information/neural messages between the two cerebral hemispheres.

4. Suggest the possible impact on mental processes and behaviour if the corpus callosum were to be cut in two and it was no longer an intact ‘bridge’. Explain your answer.
   Suggestion should demonstrate knowledge of:
   - the function of the corpus callosum
   - the fact that some information exchange is still possible, i.e. the corpus callosum is the main pathway connecting the hemispheres but not the only pathway.

   Note that a more detailed understanding should be expected if students have studied split-brain research.

**Learning Activity 4.3 (p. 178)**

- bending your right arm—elbow area of left cortex
• wriggling the toes on your left foot—toe area of right cortex (may also refer to ankle)
• opening your mouth for the dentist—jaw area of both cortices
• sucking on your thumb—jaw, lips, tongue and swallowing areas of both cortices (may also refer to elbow, wrist etc.)
• winking with your right eye—eye area of left cortex
• clenching your left fist—hand, fingers and thumb areas of right cortex
• kissing—lips, jaw and tongue areas of both cortices
• crossing your legs—hip and knee areas of both cortices (left or right depends on which leg is lifted for the cross over)
• bending your right knee to walk up a step—knee area of the left cortex
• talking—lips, jaw and tongue areas of both cortices

Note: Answers may vary in relation to individual differences of students in executing movements.

Learning Activity 4.4 (p. 178)

Suppose you mapped the primary motor cortex of an orangutan. What would you expect to find with regard to the distribution of body parts in this cortical area? Explain your answer with reference to the proportion of the primary motor cortex likely to be occupied by four different body parts, including the arms and legs.

Explanation should demonstrate understanding of the degree/proportion of representation on the primary motor cortex for a particular body part reflecting the complexity and precision of the animal’s movements.

In relation to the orangutan, note that the orangutan can and does use all its limbs with equal effectiveness. Therefore, there should be minimal difference in the amount of tissue each limb would occupy in terms of cortical area, e.g. it uses feet and toes in the same way as hands and fingers (such as for eating, climbing and swinging through a canopy).

Additional references:
http://www.seaworld.org/animal-info/info-books/orangutan/physical-characteristics.htm

Learning Activity 4.6 (p. 190)

Refer to Figure 4.27 for answers.

Learning Activity 4.7 (p. 190)

1 Construct a table that summarises the major functions of each lobe.

<table>
<thead>
<tr>
<th>Lobe</th>
<th>Main structures &amp; areas</th>
<th>Functions</th>
</tr>
</thead>
</table>

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VCE Psychology Units 3 & 4
ISBN 978 1 4202 3217 2 | Digital teacher: 978 1 4202 3242 4
### Frontal Lobe
- Primary Motor Cortex
- Broca’s Area
- Association Areas
- Other Areas
- Control of voluntary bodily movements (left controls right side of body and vice versa)
- Speech production (and comprehension)
- Receive information from other lobes for complex mental functions, e.g. decision-making, planning, problem-solving
- Attention, personality, control of emotions, expression of emotional behaviour

### Parietal Lobe
- Primary Somatosensory Cortex
- Association Areas in Right Lobe
- Receive and process sensory information from the skin and body for perception of bodily sensations (left receives and processes information from right side of body and vice versa)
- Integrate information about the body’s limb positions and movements with information about vision transmitted from the primary visual cortex in the occipital lobe and information about sound transmitted from the primary auditory cortex in the temporal lobe; attention, spatial reasoning

### Temporal Lobe
- Primary Auditory Cortex
- Wernicke’s Area
- Hippocampus
- Association Areas
- Receive and process sounds from both ears for auditory perception
- Speech comprehension (and production)
- Memory formation and consolidation
- Receive, process and store all types of long-term memories; link memory and emotion; object identification (‘what’); facial recognition

### Occipital Lobe
- Primary Visual Cortex
- Neurons in Primary and Secondary Cortex
- Association Areas
- Receive and process visual information from the eyes (left receives and processes information from right half of visual field, i.e. left half of eye, and vice versa)
- Feature detection
- Interact with the primary visual cortex in each occipital lobe to select, organise and integrate visual information; interact with association areas in the other lobes to integrate visual information with other information, e.g. memory, language, sounds

2. Draw a half-page diagram of the brain and divide the brain into four lobes.
   a. Within each lobe, write three or four key words to summarise key roles of the lobe.
      See table above for key words.
b Most mental processes and behaviours do not exclusively involve any one of the lobes. Demonstrate interaction between the lobes by using arrows on a diagram of the brain to link the lobes in three different roles.

Examples include:
- object recognition ('what'): occipital and temporal
- spatial perception ('where'): occipital and parietal
- spatial reasoning: occipital, parietal and frontal
- body limb positions and movements: occipital, parietal and temporal.

3 Following a head injury sustained in a car accident, Sofia is unable to feel any sensation of touch or temperature in the area on the left side of her face between her cheeks and her lower jaw. Fortunately, Sofia did not damage her spine.

a Which brain area is likely to be affected?

primary somatosensory cortex

b Explain your answer to part (a).

Explanation should refer to the role of primary somatosensory cortex in receiving and processing sensory information from the skin and body for perception of bodily sensations.

c In which lobe is this area located?

parietal

**Learning Activity 4.9 (p 192)**

1 Explain the meaning of the term hemispheric specialisation (or lateralisation) in relation to the cerebral cortex

Explanation should refer to each of the hemispheres in the cerebral cortex as having specialised/exclusive/dedicated and clearly distinguishable functions, or exerting greater control over a particular function.

2 Construct a table that summarises specialised functions of the left and right cerebral hemispheres. Organise the functions under the subheadings ‘cognitive functions’, ‘behavioural functions’, ‘non-verbal functions’, ‘verbal functions’ and ‘analytical functions’. A specific function may be included more than once.

<table>
<thead>
<tr>
<th>Hemisphere</th>
<th>Cognitive functions</th>
<th>Behavioural functions</th>
<th>Non-verbal functions</th>
<th>Verbal functions</th>
<th>Analytical functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>• logical reasoning</td>
<td>• control voluntary</td>
<td>• receive and process</td>
<td>• language/</td>
<td>• identify and</td>
</tr>
<tr>
<td></td>
<td>• verbal and</td>
<td>movements on right</td>
<td>sensations from right</td>
<td>speech production</td>
<td>manipulate elements</td>
</tr>
<tr>
<td></td>
<td>analytical functions</td>
<td>side of body</td>
<td>side of body</td>
<td>and comprehension,</td>
<td>of objects and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>events</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Identify the cerebral hemisphere (left or right) that specialises in these cognitive and behavioural functions:

<table>
<thead>
<tr>
<th></th>
<th>Reading, writing</th>
<th>Sequential tasks</th>
<th>Evaluation</th>
<th>Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>• holistic information processing</td>
<td>• control voluntary movements on left side of body</td>
<td>• receive and process sensations from left side of body</td>
<td>• creativity/creative thinking</td>
</tr>
<tr>
<td></td>
<td>• non-verbal functions</td>
<td></td>
<td></td>
<td>• fantasy/daydreaming</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• spatial thinking</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• visual thinking</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• recognition of faces, patterns, tunes, emotions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• art and music appreciation</td>
</tr>
<tr>
<td>a</td>
<td>appreciating the beauty of a forest: right</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>judging whether a car will fit into a parking space: right</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>kicking a football with the left foot: right</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>listening to someone speak: left</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>applying logic in an argument: left</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>working out if you have enough money for a holiday: left</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>daydreaming about being rich and famous: right</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
h. finding your way around a maze: right
i. speaking on the telephone: left
j. playing golf on a Wii™ or PlayStation®: right
k. playing Scrabble® on an iPad: left
l. playing Angry Birds™ on a smart phone: right
m. working out the meaning of a grin on someone’s face: right
n. arranging a bouquet of flowers: right
o. giving someone the correct change for their purchases: left
p. recognising classmates from an old class photo: right
q. working out when you have to get up in the morning to get to school on time: left.
r. raising your right hand to answer a question in class: left

4 A friend tells you about an internet test that determines hemispheric dominance of the test-taker. The test seems very formal and involves a mixture of verbal and non-verbal tasks. Your friend has performed the test and one of the results indicated that they have no musical ability because of their dominant left hemisphere. List three key arguments that could be used to dispute this result.

Arguments may refer to:
- complexity of ‘musical ability’ and likelihood of comprising specific functions involving both hemispheres
- distinction between ‘musical appreciation’ (right hemisphere) and ‘ability to produce music’ (left hemisphere)
- hemispheric dominance not necessarily meaning presence or absence of a function
- most tasks involving both hemispheres
- validity and reliability of the internet test
- other limitations of internet tests of hemispheric dominance and/or ‘musical ability’.

Learning Activity 4.10 (p. 193)

Explain how accurately the cartoon represents hemispheric specialisation.

Explanation should refer to:
- accuracy of information about specialist functions, i.e. Marcie’s left hemisphere and Franklin’s right hemisphere functions are consistent with research findings
- inaccuracy of ‘left-brain person’/‘right-brain person’, i.e. oversimplified, overgeneralised
- inaccuracy of ‘no-brain person’, i.e. Peppermint Patty’s low level of arousal/inattention/ ASC is more likely attributable to lower level brain structures and function, e.g. reticular activating system (RAS), thalamus and other structures involved in alertness and awareness. Peppermint Patty’s being alive, showing normal waking consciousness and producing speech means that she actually has a functioning brain.
Learning Activity 4.12 (p. 197)

1. Describe the two main functions of the spinal cord in terms of the types of messages that travel up and down its length and the branch of the nervous system to which it connects.
   
   Functions are:
   
   - receiving sensory information from the body (via the PNS) and transmitting it to the brain
   - receiving information from the brain and relaying it to the body (via the PNS) to control muscles, glands and internal organs.

2. a. Describe the role played by the spinal cord in initiating certain types of reflex responses.
   
   Description should refer to:
   
   reflex arcs i.e.- involuntary reactions that occur automatically in response to certain stimuli. The response to an incoming stimulus is automatically ‘reflected back’ from the spinal cord without any initial input from the brain.
   
   b. Why is this considered to be an ‘adaptive’ or ‘survival’ role?
   
   Explanation should refer to the immediacy of the response enabling a faster reaction time (i.e. a fraction of a second) to a harmful/potentially harmful stimulus before the brain actually processes and interprets the stimulus.
   
   c. Give an example of a reflex response that you believe may not be involved in a spinal reflex arc. Explain your choice of example.
   
   Students’ examples will vary, but they must draw on the text’s spinal arc description to justify their response.

3. Explain why damage to the spinal cord results in loss of brain–body control.
   
   Explanation should refer to the role of nerve tracts with the spinal cord as pathways for transmission of motor information required for control of voluntary movements from the brain to the body.

Learning Activity 4.13 (p. 200)

1. How is aphasia defined?
   
   Definition should refer to aphasia as:
   
   - a language disorder
   - involving speech (comprehension or production), writing or reading
   - produced by injury to brain areas specialised for these functions.

2. Distinguish between fluent and nonfluent aphasia, with reference to examples of speech not used in the text.
   
   - fluent aphasia: difficulties in either auditory verbal comprehension (understanding spoken words) or in the repetition of words, phrases or sentences spoken by others despite being able to speak fluently
- nonfluent aphasia: difficulties in articulating (speaking clearly) despite having relatively good auditory verbal comprehension

Ensure example is not used in the text.

3 Construct a table that compares and contrasts Broca’s aphasia and Wernicke’s aphasia in terms of their specific characteristics. The table should include information about links to specific brain areas, lobes, language problems and patient awareness of problems.

<table>
<thead>
<tr>
<th></th>
<th>Broca’s aphasia</th>
<th>Wernicke’s aphasia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Specific brain areas</strong></td>
<td>usually Broca’s area but damage is always found in left frontal lobe areas</td>
<td>Wernicke’s area but other areas of the left hemisphere that are damaged can also contribute to the condition as can subcortical damage</td>
</tr>
<tr>
<td><strong>Lobes</strong></td>
<td>left frontal</td>
<td>left temporal</td>
</tr>
<tr>
<td><strong>Language problems</strong></td>
<td>• difficulty in speaking, but continue to understand speech</td>
<td>• speech is often fluent and grammatically correct, but what is said is nonsense</td>
</tr>
<tr>
<td></td>
<td>• use very short sentences, typically three or four words, which are mainly verbs and nouns</td>
<td>• considerable difficulty comprehending speech and speaking in a meaningful way</td>
</tr>
<tr>
<td></td>
<td>• small parts of speech are omitted (e.g. to and the)</td>
<td>• speech often has the correct rhythm and general sound of normal speech, but the content is odd, conveys little information and sounds bizarre</td>
</tr>
<tr>
<td></td>
<td>• proper grammatical endings of words are missing (e.g. -ing and -ed)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• confusion when usual order of words is changed, especially if meaning cannot be inferred from individual word meanings alone</td>
<td></td>
</tr>
<tr>
<td><strong>Patient awareness of problems</strong></td>
<td>usually aware of language difficulties and a relatively clear understanding of one’s condition</td>
<td>usually little or no conscious awareness or understanding of one’s condition</td>
</tr>
</tbody>
</table>

4 What do studies of people with aphasia indicate about the roles of the different hemispheres in language?

Explanation should refer to:
• specialisation of left hemisphere for speech construction, speech production (especially Broca’s area) and speech comprehension (especially Wernicke’s area) due to impairments associated with aphasia
• right hemisphere having a role in language too, e.g. when the left hemisphere is extremely damaged, the right hemisphere enables overall theme or context of what is said to be understood (i.e. holistic processing), concrete words to be understood, responses to be sung, emotionally charged words and well-learned sayings to be spoken.

5 Olivia has recently suffered serious head injuries as a result of a car accident. Apparent effects of her injury are in her use of speech and her comprehension of speech. While she strings lengthy sentences together, they make little sense. Likewise, she seems to have great difficulty making sense of what others say.
   a Identify the brain area likely to be damaged and therefore the probable cause of Olivia’s speech problems. In which brain lobe is this area located?
      • Wernicke’s area; Wernicke’s aphasia
      • left temporal lobe
   b Explain the role this area plays in people whose brains are not affected by stroke, injury or disease.
      Explanation should refer to Wernicke’s area as:
      • crucial for speech comprehension, i.e. interpreting the sounds of human speech after processing auditory information received from the nearby left auditory cortex
      • involved in speech production (but not as crucial as Broca’s area).

6 Following a stroke, Carlo’s speech consisted of very short sentences that were incoherent. For example, the sentences were often made up of a few nouns and verbs that weren’t linked properly.
   a Identify the brain area that is most likely linked to Carlo’s speech problems. In which brain lobe is this area located?
      • Broca’s area
      • left frontal lobe.
   b Explain the role this area plays in people whose brains are not affected by brain damage.
      Explanation should refer to Broca’s area as:
      • crucial for the production of clear and fluent speech through role in coordinating movements of muscles involved in speech production and supply of this information to the appropriate areas of adjacent motor cortex
      • involved with meaning of words and structure of speech (through interaction with other cortical areas)
      • involved with understanding grammatical structure of a sentence that is heard or read (through interaction with other cortical areas).

Learning Activity 4.14 (p. 204)
1. Explain what spatial neglect is with reference to examples of mental processes and behaviour associated with the disorder.
   - Explanation should refer to spatial neglect as an attentional disorder characterised by behaviour indicating a failure to notice anything either on the left or right side of the body and external environment.
   - Examples should take account of the type and subtype as well as the extent, severity and specific location of underlying brain damage, though failure to notice anything on one side and behaving as if that side does not exist are typical of the disorder in general.
   - Mental processes affected include attention, spatial perception and conscious awareness. Behaviour affected as a result of the impact on these processes may range from indifference towards objects on one side to denial of the very existence of that side of the body.

2. Give an example of a visual scene that may be reported by an individual with spatial neglect while watching a sports event. The person’s spatial neglect is isolated to vision. Your example should identify the event and the position from where the scene is viewed.
   - Students’ examples will vary but responses should clearly relate which hemisphere is affected by neglect (more commonly right hemisphere), what the individual is viewing, where they are seated and how this compares to someone with normal vision.

3. a. Which brain area is most commonly associated with spatial neglect?
   - rear area(s) of the parietal lobe, usually in the right hemisphere

   b. What does your answer to part (a) suggest about the role of this brain area in attention, consciousness and spatial perception?
   - Explanation should emphasise the important roles of rear area(s) of the right parietal lobe and the right hemisphere in attention, consciousness and spatial perception due to impairment or loss associated with damage.

4. In what way does spatial neglect affect conscious experiences of people with the disorder?
   - Given the personal, subjective nature of conscious experience, explanation may refer to:
     - profound affect, if the individual knows that they have the attentional disorder (and considering the role of attention on conscious experience), and/or
     - minimal affect, if the individual believes that there is nothing wrong with how they perceive and act in the world.

5. a. Identify the IV and DV in the experiment conducted by Bisiach and Luzzatti (1978).
   - IV: visual imagery of a well-known landmark/imagining a famous landmark
   - DV: number of landmark details accurately recalled; number of errors in recall

   b. In what way do the researchers’ results suggest that spatial neglect does not involve memory impairment?
   - Explanation should refer to:
the same number of details and a similar number of errors being recalled by both spatial neglect patients and control group participants; and

the fact that this indicates that spatial neglect affects which details are recalled but not the process of recall itself.

**Learning Activity 4.15 (p. 204)**

Explain how accurately the cartoon represents spatial neglect, including its prevalence.

Explanation should acknowledge accuracy of:

- representation, i.e. speaker fails to notice people on one side and behaves as if they do not exist
- prevalence, i.e. speaker ignores left side which is consistent with the most common form of neglect (right parietal damage) as is the sense involved (vision).

**Learning Activity 4.16 (p 208)**

1. What is split-brain surgery and why is it performed?
   - Split-brain surgery is surgically cutting the corpus callosum (and sometimes also other nerves connecting the two hemispheres), thereby disconnecting the two cerebral hemispheres and preventing their direct exchange of information.
   - It is performed in cases of serious/life-threatening epileptic conditions where all available conventional treatments have been ineffective in controlling or minimising seizures.

2. What is a split-brain study and why is it conducted?
   - Split-brain study is a research study involving one or more human or animal participants who have undergone split-brain surgery.
   - It is conducted in order to investigate one or more psychological affects (e.g. consciousness) and/or physiological effects (e.g. epileptic seizures) of split-brain surgery/disconnection of the hemispheres by severing the corpus callosum (and sometimes other connector nerves).

3. Why is each participant required to focus on a dot in the middle of the screen before the picture appears on the screen?
   Explanation should refer to the use of an experimental control procedure enabling visual information/images to be presented to a predetermined visual field (left or right) of each participant, and therefore to one predetermined hemisphere at a time.

4. Describe what happens when a split-brain patient is flashed pictures of objects to the right hemisphere and asked to name them. Your response should identify
   a. which visual field the image is in (i.e. left or right)
   b. on which side of the retina the image will be received (i.e. left or right)
   c. which occipital lobe will process the image (i.e. left or right)
right

d  the expected outcome for a split-brain patient who predominantly processes language in
the left hemisphere and the reason for your answer.
  • Expected outcome: unable to say what they saw/provide a spoken answer.
  • Reason: verbal functions are a left hemisphere specialisation and therefore the
  information cannot be converted into spoken words.

5  What conclusion(s) did Sperry draw about how the hemispheres work in a ‘normal’ brain?
Conclusions should refer to:
  • specialised functions of different hemispheres
  • role of corpus callosum in enabling exchange of information between the hemispheres
    (including how each conclusion was reached on the basis of the results obtained).

6  What do split-brain studies indicate about
a  cognitive processes of the brain?
  Explanation may refer to:
  • specialised cognitive functions of different hemispheres
  • role of corpus callosum in enabling exchange of information between the hemispheres
    for cognitive processing
  • both hemispheres are involved in/contribute to many tasks
  • hemispheres can compensate, to some degree, when they are unable to work
    together as a result of a severed corpus callosum.

b  consciousness?
  Explanation may refer to:
  • in the intact brain, consciousness is the combined result of both hemispheres
  • in the intact brain, the two hemispheres act as an integrated unit rather than
    providing a different conscious experience of the world
  • in the split-brain condition, the separated hemispheres can compensate for the
    absence of the corpus callosum and coordinate their activities (and therefore each
    hemisphere does not provide a different/conflicting conscious experience of the
    world)
  • cross-cueing/implicit transfer.

7  Draw a flow chart to briefly summarise Sperry’s experimental design for his split-brain studies.
Flow chart should refer to, in an appropriate sequence:
  • use of an independent-groups experimental research design, with one experimental group
    (i.e. participants with split-brain condition/hemispheric disconnection) and one control
    group (i.e. participants without split-brain condition/hemispheric disconnection)
  • aim, e.g. to identify the effects of hemispheric separation in the human brain, to
    understand how the hemispheres work in the normal human brain by identifying the
    effects of hemispheric separation
• method, e.g. dot point outline of key procedural steps for participants in each group
• results, e.g. very brief summary of typical responses by participants in each group
• conclusions, e.g.
  (1) specialised functions of different hemispheres
  (2) role of corpus callosum in enabling exchange of information between the hemispheres
  (including how each conclusion was reached on the basis of the results obtained).

8 Would Sperry and Gazzaniga split brain studies be ethically permissible today according to guidelines in the National Statement on Ethical Conduct in Human Research? Explain your answer with reference to the guidelines (see pages 77–80).

Explanation should refer to:
• roles and responsibilities of the researchers
• participants’ rights
• ethics committee approval
• demonstrating that all relevant guidelines will be met.

9
a If a doctor injected a sedative drug into the artery leading to your left hemisphere just before a friend visits you in hospital, in what way(s) would you be able to greet your friend?
   non-verbally, e.g. a wave/handshake with the left hand

b What abilities normally used to greet someone would you be unable to use?

Description should refer to loss of left hemisphere specialised/dominant activity, including language functions such as speech production, and control of the right side of their body, e.g. a right-handed handshake may be suppressed by sedation.

**Learning Activity 4.17 (p. 213)**

1 Define the meaning of each of the following ethical principles or practices and explain their relevance in the conduct of psychological research on the brain:

a protection and security of participant confidentiality
   Each participant’s real identity, or clues to their identity, must be protected/must not be revealed and procedures for the safeguarding/security of data obtained from the research must be properly implemented. Results at the individual level are also treated as confidential and should not be traceable to an individual.

b voluntary participation
   Participants must freely choose to participate and must be able to volunteer, e.g. be an adult, have no intellectual disability etc. Participants must not be coerced or feel pressured to volunteer and must not feel victimised for choosing not to participate. Voluntary participation must be based on informed consent.

c informed consent
Participants need to be aware of key aspects of the study and all relevant ramifications of choosing to participate, particularly when the brain research involves medical procedures (e.g. use of neuroimaging). In studies involving the brain, this may include consenting to neuroimaging procedures. Consent must be documented.

d integrity
The researcher needs to show a genuine commitment to the research, principles for conducting research and all relevant ethical principles.

e respect for persons
Research must be designed to ensure that the dignity of participants is respected, that their welfare, rights, beliefs and special needs are attended to. This is especially vital when dealing with participants who are vulnerable, e.g. people with brain damage, children.

f beneficence
The researcher must maximise potential benefits of the research and fully evaluate all aspects to ensure risk of harm or discomfort to participants is minimised, e.g. need to determine if using radioactive neuroimaging is appropriate in their research involving children or whether a different form of brain scanning may be as effective.

g justice
The researcher must ensure a fair distribution of benefits and burdens within the population of research interest, as well as for any individual participant, e.g. not only studying one demographic group when it is equally possible and beneficial to study others.

2 Analyse the ethical acceptability of the proposed study, with reference to each of the ethical principles or practices considered for Question 1. Comment on whether the proposed study is ethically acceptable in relation to each ethical principle. Give reasons for your judgments.

a protection and security of participant confidentiality
Participants have a right to privacy, so any details of their involvement in a study (e.g. proximity of their accommodation to the university) cannot be revealed in a manner that enables any individual to be identified, unless their guardians or spouses’ written consent is obtained.

b voluntary participation
- There should be no pressure to take part in a study. Just because consent has been obtained twice before, does not guarantee automatic participation and the researcher should not assume that this will be the case.
- Prospective participants and their spouses and guardians must not experience negative consequences, if they choose not to be involved in the study.

c informed consent
- Informed consent for involvement in psychological research on the brain must be given by the participant’s spouse or legal guardian (or a person with medical power of attorney on behalf of an intellectually disabled adult).
- Their responsibility to assess consent must take into consideration information supplied about the purpose, methods, demands, risks, inconveniences, discomforts
and possible outcomes of the research, including the likelihood and form of publication of research results.

d  integrity
  • The researcher needs to show a genuine commitment to the research because of its potential value in advancing our understanding of the brain, not just rely on the convenience of potential participants being nearby and new equipment to try out as the basis for their justification to conduct research.
  • The researcher must demonstrate a genuine and consistent commitment to ethical principles and guidelines generally and specifically relevant to the EEG study.

e  respect for persons
  • Research must be designed to ensure that the dignity of participants is respected, that their welfare, rights, beliefs and special needs are attended to. Participants for this study may have mobility or comprehension issues, dependent on the sort of brain damage they have sustained and relevant provisions must be made.

f  beneficence
  • The researcher must maximise potential benefits of their study and fully evaluate it in terms of risks to participants, including assessments relating to the consequences and the likelihood of risk occurring, how the research design has considered and managed these risks, and informing of spouses and legal guardians etc. of the risks, e.g. need to determine if the newly developed electrodes that are renowned for their exceptional sensitivity have been shown to present minimal risk to humans.

g  justice
  • The researcher must ensure a fair distribution of benefits and burdens within the population of research interest, as well as for any individual participant, e.g. not only studying one demographic group when it is equally possible and beneficial to study others. Justice requires close scrutiny in relation to this specific study given previous use of the sample.

Learning Activity 4.18 (p. 214)

1 Construct a hypothesis for this experiment.
   Example:
   A specific area of primary motor cortex in the left frontal lobe will be active whenever a voluntary movement of the right foot is made in response to a light stimulus, and a corresponding area of cortex in the right frontal lobe will be active whenever a voluntary movement of the left foot is made.

2 What is the operationalised independent variable?
   colour of a light stimulus / blue or yellow light

3 What is the operationalised dependent variable?
   raising left or right foot

4 Explain why the psychologist flashed the lights randomly.
This was done to control potential extraneous variables relating to participant expectations if the lights were presented in a predictable sequence.

5 What is a limitation of this study?

Limitations include:

• whether the participant is naturally a left- or right-footer is unknown but relevant
• use of a convenience sample involving one participant with a brain disorder when interested in the normal population.

6 To what extent can the results be generalised? Explain with reference to external validity.

Explanation should refer to limitations of the study and therefore the results and generalisations from the results e.g. – lacks external validity. Note that use of one participant for a study of this type is not necessarily a limitation (unless they have a brain disorder and there has been no pre-testing for hemispheric dominance in relation to voluntary foot movement).

7 Explain the meaning of participant confidentiality, voluntary participation and informed consent in relation to this experiment.

• participant confidentiality: the participant has a right to privacy and the maintenance of privacy, so any details of their involvement in the study (e.g. test results or personal information) cannot be revealed in a manner that enables him to be identified, unless his written consent is obtained.

• voluntary participation: the researcher must ensure that the participant voluntarily consented to be involved in the study and signed a document to this effect. He must not have been pressured to participate or felt pressured to participate because he is already a medical patient of the researcher and had already consented to an fMRI procedure to assess his epilepsy. The researcher must also have ensured that there would have been no adverse consequence if he chose not to be involved in the study, e.g. no longer a patient, loss of patient rights.

• informed consent: wherever appropriate, the participant must be informed of the nature and purpose of the research. Such informed consent must be appropriately documented for example, by completion of a consent form that takes account of the participant’s level of comprehension and includes information about the purpose, methods, demands, risks, inconveniences, discomforts and possible outcomes of the research, including the likelihood and form of publication of research results.