

2023 VCE Psychology external assessment report

General comments

The 2023 VCE Psychology examination was the first examination based on the *VCE Psychology Study Design 2023–2027*.

All students are strongly encouraged to provide a response to every multiple-choice question, even if the answer is unknown, as marks are not deducted for incorrect answers.

As marking of Section B is completed online using scanned images of the examination, students should make sure to write within the marked boundaries of the examination paper for each question with a blue or black pen, and clearly indicate if a response is continued in the extra space provided at the end of the question-and-answer book. If students continue a response in the extra space, they must number the response clearly.

For short-answer questions and the extended response, students should ensure that they clearly address the requirements of each question, and that the examples they provide are relevant to the question. For questions that assess the application of psychological knowledge to a scenario, it is particularly important that students make clear any relevant references to the scenario in their responses.

Students are encouraged to familiarise themselves with VCAA's [glossary of command terms](#).

Some common strengths found in this year's responses included:

- outlining the three-phase models of classical conditioning and operant conditioning
- using graphing conventions to draw a bar chart
- explaining the bidirectional nature of the gut–brain axis.

Areas for improvement included:

- being sure to provide only the number of responses a question asks for – assessors can only read the set number of responses asked for in the question (e.g. identify one role ...; outline two expected characteristics ...)
- specifying a direction when concluding that two variables are related or that the independent variable has an impact on the dependent variable
- highlighting and understanding the requirements of the question stem such as 'with reference to', 'using your understanding of', 'using the language of' and 'as part of your answer'
- writing answers that are related directly to the context of the question.

Specific information

This report provides sample answers, or an indication of what answers may have been included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

The statistics in this report may be subject to rounding, resulting in a total of more or less than 100 per cent.

Section A – Multiple-choice questions

The table below indicates the percentage of students who chose each option. **Bold text** and grey shading indicate the correct answer.

Question	Correct answer	% A	% B	% C	% D	Comment
1	C	4	55	40	1	This question required students to consider the differences between conscious and unconscious responses more broadly, and spinal reflexes as a particular type of unconscious response. Conscious responses are responses that involve awareness and therefore the brain is dominant. Unconscious responses occur without conscious awareness and include autonomic nervous system-based responses as well as spinal reflex responses. Many students incorrectly identified Option B as the response that best answered the question; however, unconscious responses of the autonomic nervous system, such as heart rate and breathing, require the involvement of both the brain (brain stem) and spinal cord.
2	C	2	7	89	1	
3	B	15	38	34	13	The question asked students to consider the exhaustion stage of Han Selye's General Adaptation Syndrome. Both Options A and C were incorrect, as terminology referred to Lazarus and Folkman's Transactional Model of Stress and Coping: 'appraise', 'perceive' and 'resources to cope'. Option D was incorrect, as it referred to the alarm-reaction sub-stage of 'shock' and also provided an untrue statement about the parasympathetic nervous system.
4	C	10	1	87	2	
5	D	27	2	0	71	Students should understand that the sympathetic and parasympathetic nervous systems are both active in a flight-or-flight-or-freeze response, but variances in dominance are demonstrated depending on the type of response. The sympathetic nervous system becomes dominant during fight-or-flight, while the parasympathetic nervous system becomes dominant during freeze. Option A was incorrect, as the freeze response does not involve the sympathetic nervous system becoming dominant. Furthermore, when standing on the other side of the road, Alex felt angry and wanted to yell at the driver, signifying a 'fight' response.
6	B	0	84	2	13	
7	B	22	39	29	9	Students should understand how both semantic autobiographical knowledge and episodic autobiographical knowledge contribute to the retrieval of autobiographical events. They should also understand the role of autobiographical events in constructing possible imagined futures, such as simulations of possible future events. Option A included reference to when Peta is 'in their next interview', not imagining their next interview. For Option C, there was no indication in the question that that Peta had

Question	Correct answer	% A	% B	% C	% D	Comment
						an existing episodic autobiographical memory of the room the 'next interview' will take place in. Instead, they could have used the episodic autobiographical memory of their 'last' interview room to create a possible imagined future of their next interview room.
8	C	11	8	78	3	
9	A	51	16	2	30	The focus of the new research, after public health campaigns, was to evaluate the impact over time. Option B is incorrect, as only determining the most used strategy every six months will not give a complete understanding of the effectiveness of the public health campaign. Option D is incorrect, as a tally of the number of individuals using a particular strategy each month will not have a standard deviation to calculate.
10	C	1	2	94	2	
11	C	4	1	77	18	Students should recognise that Aboriginal and Torres Strait Islander peoples' ways of knowing are unique, complex and sophisticated systems that are different to Western concepts of learning. Option D is incorrect due to its reference to 'a collection of artefacts', which is not a key feature of Aboriginal and Torres Strait Islander peoples' ways of knowing, and nor is it a unique aspect in comparison to Western approaches. Option C was correct due to its inclusion of several key and unique aspects of the Aboriginal and Torres Strait Islander peoples' ways of knowing: relationships, kinship, Country.
12	D	5	20	3	72	The scenario suggested that the teachers would demonstrate a motor skill and ask the students to perform the same skill in the next lesson. Therefore, Option B was incorrect, as rehearsing the visual image and maintaining it in the short-term memory store would not allow them to perform the skill in the next lesson.
13	A	81	5	9	5	
14	B	13	64	14	9	Students should understand that the cerebellum interacts with the basal ganglia and motor programming areas of the neocortex to encode, store and retrieve implicit long-term memories, such as those associated with habit formation, fine motor movements and simple reflexes. The new motor skill therefore involves both the basal ganglia and the cerebellum. Option C is incorrect, as the hippocampus is involved in the encoding and retrieval of explicit long-term memories, not the implicit memory of a new motor skill.
15	C	3	4	78	15	
16	C	22	17	52	10	Students should understand that research involving people with aphantasia has highlighted the role visual imagery plays both in the retrieval of long-term explicit memories and in episodic future thinking. Autobiographical memory has two components – semantic autobiographical knowledge and episodic autobiographical knowledge. Option C is correct, as the retrieval of autobiographical memory is

Question	Correct answer	% A	% B	% C	% D	Comment
						dependent on the vividness of mental imagery. Those with aphantasia will have difficulties retrieving autobiographical memory because of this.
17	D	8	14	19	59	Students should understand the similarities and differences between aphantasic participants and Alzheimer's patients in terms of retrieving autobiographical events and in constructing possible imagined futures. Constructing possible imagined futures involves the hippocampus, which is a key area that is damaged in those with Alzheimer's. Option C is incorrect, as people with aphantasia do not have reduced semantic detail, as compared to those with Alzheimer's disease who do.
18	A	29	8	60	3	Repeatability is the closeness of the agreement between the results of successive measurements of the same quantity being measured, carried out under the same conditions of measurement. Option C is incorrect because using a different group of participants would bring about a change to the conditions of measurement therefore allowing the researchers to consider the reproducibility of their experiment.
19	A	64	11	13	11	Option B is incorrect, as the advantage described a method of loci, not an acronym. Option C is incorrect, as the basal ganglia is not the brain area involved when utilising acronyms – the hippocampus and neocortex are involved. Option D is incorrect, as extensive training is not an accurate limitation for acronyms.
20	B	8	89	2	1	
21	B	12	38	25	24	Students should understand that eating and drinking patterns are related to the sleep–wake cycle and are considered to be zeitgebers that have an important influence on sleep hygiene. Option C is incorrect, as temperature changes and exposure to light have an impact on circadian rhythm patterns, not ultradian rhythm patterns. Option D is incorrect, as the timing of the sleep–wake cycle can be both improved and impaired by external factors such as daylight and blue light, temperature, and eating and drinking patterns.
22	B	6	60	30	4	Option C is incorrect, as emotional resilience does not have a relationship with the decreased alertness symptom listed with it. Option B is correct, as people will enter a short daytime nap in NREM Stage 1 and rarely progress to REM sleep in a nap of short duration. This limits their amount of REM sleep and they miss out on the cognitive benefits of REM sleep, hence attention time is shortened.
23	D	9	7	26	57	Option C is incorrect, as long periods of REM sleep at the beginning of a sleep episode are the hallmarks of infants only. Option D is correct, as the DSPS and ASPD both shift the timing of the sleep–wake cycle, but when there is no conflict between this sleep–wake cycle and their

Question	Correct answer	% A	% B	% C	% D	Comment
						lifestyle, they will still experience a full required sleep episode duration.
24	C	46	7	36	10	This question required students to use data from both graphs and apply it to their understanding of NREM and REM sleep cycles across a sleep period for two different age groups. Based on the two graphs, students should have concluded that Option C was the best response, as both ages slept on average for 10 hours, both ages experienced the same amount (and same increase) in REM sleep duration over the course of a sleep episode, and both ages had a decreasing amount of time in NREM sleep duration over the course of a sleep episode; however, six-year-old children experienced a greater amount of NREM sleep throughout the sleep episode. This additional NREM sleep for six-year-olds explains the increase in ultradian rhythm length. As they both sleep on average for 10 hours, there must also be a decreased number of ultradian rhythm cycles.
25	D	8	14	43	35	Option C is incorrect, as this was the independent variable and therefore not a limitation. The investigation was looking into the different sleeping patterns of two-year-old and six-year-old children. Option D presents a plausible limitation of the research in that the sample is not representative of Jessica's aim to investigate the 'sleep episodes of children'. Expanding the sample to include a more diverse range of children would increase the internal (and external) validity of the data.
26	C	3	24	62	11	This question assessed students' understanding of the terms 'time' and 'proportion'. Two- and six-year-olds experience a longer sleep episode duration, but a lower proportion of NREM sleep. Therefore, when considering 14- and 16-year-olds, despite having a greater proportion of NREM sleep, given that their sleep duration is lower, they would not have a greater amount of time in NREM sleep. Hence, Option B is incorrect.
27	D	2	34	11	53	Option B is incorrect, as the use of an electroencephalograph (EEG) can measure sleep quantity. While it cannot be directly observed, the use of brain wave patterns can clearly define sleep onset and therefore measure the sleep quantity.
28	A	59	26	7	8	The focus of this study was the use of theophylline. Therefore, a control group would involve using a salt solution – hence, Option A is correct. Option B is incorrect, as a control group involving light would require a separate group of rats, exposed to full light for two days. The presence of light for one of the two days might have lingering effects and not truly act as a control group that leads to high internal validity.
29	D	6	31	28	35	Option B is incorrect, as REM brain waves already resemble those of a waking state, regardless of the presence of theophylline. Option C is incorrect, as theophylline was described as a central nervous system stimulant and therefore the REM brain waves would have high frequency and low amplitude.

Question	Correct answer	% A	% B	% C	% D	Comment
						Option D is correct, as the stimulating nature of theophylline will decrease the time spent in high-amplitude, low-frequency waves.
30	D	8	26	25	40	A measurement is said to be valid if it measures what it is supposed to be measuring, while the validity of a psychological investigation refers to how well the results among the study participants represent true findings among similar individuals outside of a study. Option B is incorrect, as it represents a different investigation aim. Option C is incorrect, as it represents the repeatability of the study. Option D is correct, as including both a control group and a pre-theophylline measurement on the EEG will increase the ability to form an accurate cause-and-effect relationship.
31	B	16	66	4	14	Students needed to select the conclusion that could be formed from the data provided in the table. The increased mean percentage of high-frequency, low-amplitude (beta) brain waves is evidence of enhanced neurotransmission. Hence, Option B is the response that best answers the question.
32	D	7	12	17	63	
33	A	75	12	11	1	
34	A	79	11	8	1	
35	A	66	7	26	0	Option C, while referring to other people, is not a social protective factor. Changing his thinking patterns around how other people perceive him is a psychological factor. Option A is correct, as connection with other students is a social factor that would enhance his resilience.
36	C	31	6	56	7	Option A is incorrect, as Henry's phobia would be explained by a lack of GABA release, and classical conditioning precipitates the phobia rather than perpetuates it. Option C is correct, as long-term potentiation explains the enhanced synaptic transmission between different neural pathways, and the precipitation by classical conditioning and stigmas to seeking to treatment are all correctly allocated in the biopsychosocial approach.
37	C	4	27	54	15	Option B is incorrect, as Henry's phobia is of rocks; however, the described systematic desensitisation focuses on bridges.
38	C	5	5	70	20	
39	B	1	90	5	4	
40	D	16	2	13	68	

Section B – Short-answer questions

Question 1a.

Marks	0	1	Average
%	26	74	0.8

It is important to note that this question was specifically referring to one physiological response that Lana experienced as 'she stepped out onto stage'. As she would be experiencing high levels of arousal at this point in time, students were able to identify any sympathetic nervous system response.

Some possible physiological responses included:

- sympathetic nervous system activated
- increased heart rate
- increased sweating
- dilated pupils
- decreased salivation
- increased breathing (rate)
- adrenaline released.

Common misconceptions resulted in students providing one psychological response that Lana experienced.

Question 1b.

Marks	0	1	2	3	Average
%	34	8	30	28	1.5

To gain full marks, students were required to:

- demonstrate a clear understanding of what context-specific effectiveness is
- evaluate the effectiveness of the strategy that was identified as either being a low/poor match OR a high/good match
- provide a congruent justification of the evaluation.

The following is an example of a high-scoring response:

Context-specific effectiveness occurs when the coping strategy used is appropriate to combat the unique demands of the stressor. Although Lana's decision to stay out with friends on the night before her performance was effective in the sense that it distracted her from her worries, she ended up with inadequate sleep. Thus, she has not shown context-specific effectiveness as the coping strategy led to inadequate sleep which may worsen her feelings of anxiety the next day.

Question 1c.

Marks	0	1	2	3	4	Average
%	21	19	14	18	27	2.1

To be awarded full marks, students needed to carefully consider the placement of the annotation as well as the content of the annotation. The following information and annotations were required to achieve full marks:

- an arrow on the leg pointing upwards with an appropriate annotation such as 'sensory receptor sites detect sensation and neural information travels to the spinal cord' OR 'neural information travels via sensory neurons/pathways to the spinal cord from sensory receptor sites'
- on the spinal cord: 'the spinal cord transmits neural information from sensory to motor neurons via interneurons'
- on the muscle of the leg: 'motor neural information is transmitted to muscle of leg, resulting in a flinch'
- somewhere on the diagram: 'this is an example of a spinal reflex' OR 'this response does not require a conscious reaction' OR 'sensory information relayed to brain after the detection of pain / motor response'

A maximum of two marks were awarded if a student provided written information either above, below or to the side of the diagram – provided all of this information was correct. If students simply used one- or two-word labels on the diagram correctly with no annotations, they could achieve one mark only.

A common misconception involved the students' explanations of neural transmission. Students are reminded that while the neural information travels along sensory or motor neurons, motor neurons and sensory neurons do not travel.

Question 2a.

Marks	0	1	Average
%	45	55	0.6

The question required students to identify one role of cortisol in chronic stress. There were many acceptable answers to this question. Some examples include:

- maintaining the body at an increased level of arousal
- enhancing secretion of glucose
- suppressing body systems not immediately needed to confront stressors.

While comments about immunosuppression and increasing susceptibility to illness were accepted on this exam, students should understand the difference between the positive impact cortisol has and the negative consequences of its prolonged release.

Common errors included answers trying to form a link between cortisol release and adrenaline levels. Students are reminded to only include the number of responses ('one role') indicated in the question stem, as assessors cannot continue to read additional responses students have provided and will only assess the first option as the student's answer.

Question 2b.

Marks	0	1	2	3	Average
%	32	43	22	4	1.0

This question required students to make use of their accurate understanding of mindfulness meditation to explain the results of the study. Students needed to include the following to be awarded full marks:

- an illustration of their understanding of mindfulness meditation referring to both the attention and acceptance components of this technique
- a description of the trend in results by referring to at least two time points (3 and 6 months, 3 and 9 months, or 6 and 9 months)
- an explanation of one aspect of the results. Acceptable examples include: cortisol levels continuing to reduce as participants continued to practise the mindfulness meditation technique over time; the reduction of cortisol could be explained by the decrease in stress levels due to mindfulness meditation.

Responses that did not score well focused too much on defining mindfulness meditation without reference to the experiment or the reduction in cortisol levels as shown in the table of results. Common errors also included:

- mistaking mindfulness meditation for breathing retraining
- describing only the attention portion of mindfulness meditation and omitting the idea that thoughts are experienced freely or without judgement
- making a general statement that cortisol levels decrease with time (rather than being specific about the time points)
- misreading the table of results and incorrectly suggesting that cortisol levels reduced another 25% after 9 months (rather than stayed at 25% reduction at 9 months).

The following is an example of a high-scoring response:

Mindfulness meditation refers to a type of meditation where an individual focuses their attention on their breathing in the present moment, fully allowing themselves to experience their thoughts, sensations and feelings in the present moment without judgement. It is a psychological protective factor that enhances wellbeing, as it is a relaxation strategy that is shown to decrease anxiety and racing thoughts, therefore reducing stress levels. As a result, after 6 months and 9 months of training cortisol levels reduced by 25% compared to pre-training levels, as cortisol levels increase during periods of chronic stress and therefore a reduction of cortisol levels indicates that the mindfulness meditation reduces stress as a protective factor for mental wellbeing.

Question 2c.

Marks	0	1	2	Average
%	65	18	18	0.6

The independent variable (IV) is defined in the study design as the variable for which quantities are manipulated (controlled, selected or changed) by the researcher. To gain full marks for this question, students needed to ensure they provided a reason that mindfulness meditation was more appropriate as well as a reason that adequate nutritional intake was not appropriate.

The following are some reasons why mindfulness meditation was a more appropriate IV:

- smaller set of skills in which to train people
- participants were more likely to use it consistently as it was only 30 minutes per day
- fewer baseline variables involved with implementing mindfulness meditation

- increases validity of experiment as there are fewer variables to control
- researchers wanted to study a psychological IV, which is what mindfulness meditation is.

The following are some reasons why adequate nutritional intake was a less appropriate IV:

- more comprehensive training/understanding needed
- participants more likely not to follow through as it is a significant daily lifestyle change
- more baseline variables are involved in measuring impact of diet
- decreases validity of experiment as there are more variables to control
- researchers did not want to study a biological IV, which adequate nutritional intake is.

These two reasons did not need to be congruent, as the command term was not 'distinguish' or 'compare'. Students could only gain full marks by referring to both strategies.

Common errors included suggesting mindfulness meditation was more effective in decreasing cortisol levels or was more directly related to the decrease in cortisol levels, and therefore was a more appropriate IV.

Question 2d.

Marks	0	1	2	Average
%	13	23	64	1.5

There were two parts to this question, signified by two command terms in the question stem.

Accepted limitations of using questionnaires included:

- responses from participants are subjective
- lacks internal validity
- participants give what they think is correct response
- language barriers might decrease accuracy
- lacks repeatability/reproducibility.

Common errors included suggesting that the qualitative nature of the questionnaire was a limitation.

Questionnaires can be qualitative or quantitative. Students should understand that qualitative data is not inherently worse than quantitative data, unless an elaboration as to why is made. In this case, an acceptable response with an elaboration would be 'questionnaires might include qualitative data which is more difficult to summarise and form conclusions from'.

Accepted benefits of testing hair included:

- cortisol levels are an objective measure
- the measurement is not dependent on participant responses, which are prone to bias
- the quantitative nature of cortisol levels makes it easier to graph / see trends / compare time points.

Question 3

Marks	0	1	2	3	4	Average
%	13	17	17	32	21	2.3

For this question, the only behaviourist approach accepted was classical conditioning. It is important to note that the question did not require students to use the language of classical conditioning, so terms such as 'before conditioning', 'during conditioning' and 'after conditioning' were not needed. They also did not need to use NS, UCS, CS, UCR or CR, although a lot of students did. Students did need to reference the sound of the predator – not just the predator – as this was provided in the question.

In order to achieve full marks, students were required to:

- identify the behaviourist approach as classical conditioning
- state that the sound of the predator elicits no relevant response
- state that the sound of the predator is repeatedly presented before the puff of air to elicit a fear (or avoidance) response
- state that the sound of the predator alone will now produce the fear (or avoidance) response.

Students needed to make specific mention of the repetition and the timing of the sound of the predator occurring before the puff of air in order to gain full marks. It was common to read incorrect responses where students had mistaken the neutral stimulus as the puff of air, or incorrectly referred to the sound of the puff of air as the neutral stimulus.

The following is an example of a high-scoring response:

This scenario discusses classical conditioning as a behaviorist approach to learning, where learning occurs through the repeated association between 2 or more different stimuli to produce a naturally occurring response. Before conditioning, the birds sound of the predator was the NS which produced no response and a puff of air was the UCS which naturally produced the UCR of danger/fear of the puff of air. During conditioning, the NS and UCS were repeatedly associated, with the NS of predator sound presented immediately before the UCS of the puff of air to produce a fear response UCR. After conditioning, due to acquisition occurring, the NS of the predator sound is now the CS which produces the CR of danger/fear to the sound of the predator. The sound of the predator was now able to produce the CR without the UCS being presented after. Since danger/fear now automatically occurred when hearing the sound of the predator, birds were conditioned to avoid the predators due to the feeling of fear.

Question 4a.

Marks	0	1	2	Average
%	31	44	25	1.0

The student could identify the independent variable (IV) as:

- the time they are given the sugar treat (reinforcement) OR
- whether the cows were given a sugar treat (reinforcement) after they urinated in the pen, or at random times.

For the second option listed above, reference must be made to the pen, and to the treat being given after urination or at random times. It must also mention the other group. It is worth noting that a response that said 'giving the cows sugar treats after they urinated in the pen or not' was not enough for this mark, as this implies the IV was giving some cows treats when they urinated and some cows no treats when they urinated.

For the dependent variable, students could have identified any of the following:

- learning
- urinating in the pen
- whether or not they learned to urinate in the pen
- success rate of urinating in the pen
- number of times they urinated in the pen
- time taken to urinate in the pen.

Question 4b.

Marks	0	1	Average
%	28	72	0.7

One mark was awarded if the student could identify one reason why control cows were used. Any of the following reasons were deemed acceptable:

- to establish a clear cause-and-effect relationship between the use of treats in training cows to urinate in a pen
- to determine whether giving the cows treats influenced them learning to urinate in a pen
- to assess the influence of the use of treats in teaching cows where to urinate
- to provide a baseline of whether cows will learn to urinate in a pen without any treats.

Question 4c.

Marks	0	1	2	3	4	Average
%	22	12	12	23	31	2.3

For this response, the students did not need to name the behaviourist approach as operant conditioning. But because the question says 'using the language of the appropriate behaviourist approach', students needed to use the following terms associated with operant conditioning: antecedent, behaviour, consequence and positive reinforcement.

The following was required in order to achieve full marks:

- identifying the antecedent / discriminative stimulus as the cows needing to urinate OR seeing the pen OR the cows being placed outside the pen
- identifying the behaviour as moving into the pen and urinating OR urinating in the pen
- identifying the consequence as receiving a (sugar) treat
- stating that this is positive reinforcement as it as it increases the likelihood of it happening again and thus strengthens the behaviour.

The following is an example of a high-scoring response:

Antecedent – a cow needing to urinate

Behaviour – the cow goes into pen to urinate

Consequence – the cow receives a sugar treat

The sugar treat acts as a positive reinforcement for the test cows urinating in the pen which increases the likelihood of them repeating the behaviour in the future, as they receive a desired stimulus.

Question 5

Marks	0	1	2	3	4	5	Average
%	14	18	27	24	12	5	2.2

Students were required to explain how the use of songlines acts as a mnemonic. Students were required to:

- illustrate an accurate understanding of songlines
- explain one aspect of songlines that enhances encoding
- explain one aspect of songlines that enhances retrieval
- name one brain area involved
- refer to the role of this brain area in memory and link this to songlines.

Students are reminded to take note of the allocated marks as a guide to how much information is required. It was common for students to simply rewrite what had been provided in the stem of the question regarding songlines acting as a strong and vigorous mnemonic, without explaining how songlines achieve this.

Students needed to demonstrate an understanding of the following components of songlines somewhere throughout their response:

- the sung-narrative nature of a songline (song, dance, performance, multimodal, rhythm)
- the connection to Country
- the journey, pathway or navigational route nature of the songline.

High-scoring responses then articulated a clear aspect of the songlines that enhances encoding and another clear aspect that enhances retrieval, such as:

- enhanced encoding – use of songs with a narrative enhances encoding of details; use of vivid characters who are highly memorable; combining location, object, song/rhythm and dance provides multisensory information which enhances memory formation; relating new information to personal experiences / what is already known enhances encoding; repetitive travel along the songline strengthens the memory formed
- enhanced retrieval – locations or use of portable objects serve as retrieval cues; recall of one story/song/dance will trigger retrieval of the next.

Common errors included joining these two separate processes into one singular idea or trying to explain the benefits of songlines from the perspective of the method of loci.

High-scoring responses named the hippocampus as the brain area involved and identified its role in the consolidation of explicit long-term memories or the retrieval of semantic and/or episodic long-term memories. Students could also be awarded marks for naming the amygdala, basal ganglia, cerebellum, or neocortex instead of the hippocampus – and could be awarded a mark for its role, provided it was related to the encoding and retrieval of songlines.

Other errors included:

- providing an incongruent role with the brain area that was listed
- writing 'hypothalamus' instead of hippocampus
- writing that the hippocampus is involved in encoding long-term memory, without specifying explicit or semantic/episodic.

The following is an example of a high-scoring response:

Mnemonics are techniques/methods that consciously aid in memory by enhancing encoding, storage and retrieval of information. Songlines are multimodal performances that are conducted through Country to form a journey, link sites, store immense amount of knowledge and pass down cultural knowledge through generations. It acts as a mnemonic as it allows Aboriginal people to store immense amounts of information through multimodal methods that are holistic in considering the whole person. The performances enhance encoding as it attaches meaning to the information through emotion expressed through song, dance and movements. This emotion consolidates and enhances memory processes as the amygdala encodes this information, associating it to the explicit knowledge shared at these sites. This is used to form emotional memory and assist in the retrieval as well as the landmarks used as retrieval cues. This multimodal oral tradition allows for these practices to share and preserve immense knowledge cultural and important to everyday living skills by enhancing meaning and emotional connection to aid in memory, making it a mnemonic.

Question 6a.

Marks	0	1	2	Average
%	30	36	34	1.1

Students were required to provide two expected sleep–wake cycle characteristics of Hugo’s participants before the experiment began. Hugo conducted his experiment on students in a Year 11 English class and therefore his participants would be between 16 and 18 years of age (late adolescence).

Accepted responses included:

- a sleep episode duration of between 6 and 10 hours
- delayed onset of sleep (by 1–2 hours) or delayed wake time
- irregular sleep pattern across a seven-day week
- mismatch between sleep–wake cycle and school times
- 20% REM and 80% NREM.

Common errors included misquoting data (hours sleep, percentage REM/NREM) or using the table of results in listing the characteristics (e.g., participants will typically use their phone a lot before bed).

Question 6b.

Marks	0	1	2	3	4	Average
%	13	21	28	28	9	2.0

Students were required to:

- provide an overall conclusion on the influence of blue light on sleep quality and quantity
- compare the results on sleep quantity across all three groups (A, B and C)
- compare the results on sleep quality across all three groups (A, B and C)
- illustrate an understanding that sleep quantity was measured in this study by mean duration of sleep episode (hours) and sleep quality was measured in this study by percentage of sleep episode spent in deep sleep.

High-scoring responses began with an overall concluding statement that provided a clear direction. Students could either say that blue light negatively impacted sleep quantity and quality or that the use of night mode improved sleep quantity and quality compared to blue light. Too often, students simply stated that ‘blue light effects sleep quantity and quality’ – this was insufficient to gain a mark.

Comparison statements needed to do more than just list the data from the table. They needed to explicitly compare by using terms such as 'higher', 'lower', 'greater', 'decreased' or 'increased'. Students did not need to quote the data in their response; however, doing this seemed to help students make accurate and complete comparisons across all three groups.

Students need to be exposed to data sets and experiments that include more than two groups and more than one set of collected measurements throughout the year. They should be able to write conclusions, using data to support their claims, from a variety of investigation types. Students who annotated the table of results with 'quantity', 'quality', 'night mode', 'blue light', and 'no phone' against the rows and columns were able to better make sense of the data and provide a more coherent and considered response.

The following is an example of a high-scoring student response:

Hugo may draw [the conclusion] that using 'night mode' on smartphones before bed can lead to an increase in sleep quality (deep sleep) and quantity (hours of sleep) when compared to using the phone without 'night mode', an hour before bed. This is seen by Group A (night mode) experiencing a mean of 7.5 hours of sleep and an 18% in deep sleep when compared to Group B (regular mode) having a lesser mean time of 6.5 hours and 13% deep sleep. Further, those who refrain completely from using their smartphone before bed for an hour likely experience even greater quality and quantity of sleep than Group A, as seen by mean duration of 7.9 hours and 22% in deep sleep which is the greatest quality and quantity of sleep of all groups.

Question 6c.

Marks	0	1	2	Average
%	58	37	6	0.5

Students were required to outline how both an EOG and EMG could confirm the app's accurate tracking of the stages of sleep (NREM and REM). Students needed to relate the expected output of the scan to what stage of sleep the app would show. Answers only needed to reference one of REM sleep or NREM sleep, but needed to have included a mention of the phone app.

For the EOG, students could have mentioned that the app was accurate if:

- when the app suggested the person was in REM sleep, the EOG showed high amounts of electrical activity of the muscles around the eyes
- when the app suggested the person was in NREM sleep, the EOG showed low/no amount of electrical activity of the muscles around the eyes.

For the EMG, the students could have mentioned that the app was accurate if:

- when the app suggested the person was in REM sleep, the EMG showed no amount of electrical activity of the muscles
- when the app suggested the person was in NREM sleep, the EMG showed low/mild amounts of electrical activity of the muscles.

If students provided a more specific reference to NREM stages 1, 2 or 3, then their comments on the EMG needed to be accurate.

Common errors included:

- only providing a generic 'detect, amplify, record, electrical' statement about each device without outlining what the results of the EOG and EMG would show
- providing accurate comments about the EOG and EMG output, but not referencing the phone app and how the electrical output would help confirm the app's accuracy of tracking sleep stages
- including terms such as 'amplitude' and 'frequency' which should be reserved for an EEG only
- confusing either the EOG or EMG with an EEG and discussing brain wave patterns.

Question 6d.

Marks	0	1	2	3	Average
%	14	26	37	23	1.7

This question required students to make use of their accurate understanding of the effect of blue light on sleep. Students needed to include reference to the following ideas to be awarded full marks:

- identify the zeitgeber being studied as blue light
- explain the relationship between the suprachiasmatic nucleus (SCN) and the delayed release of melatonin
- conclude that the effect on sleep would be to delay sleep onset or to decrease the quality/quantity of sleep.

While the pineal gland was not a required part of the answer, the SCN was a critical part of the response. In future, students should ensure that they explain the process of light entering the eyes and being detected by the SCN, which then sends inhibitory messages to the pineal gland to delay the production and release of melatonin. Similarly, they should be able to explain how excitatory messages are sent from the SCN to the pineal gland when no light is detected, which prompts the production and release of melatonin.

Common errors included students suggesting that melatonin is released directly from the SCN in the brain. Other students went to great lengths to discuss how darkness (the absence of light) aided the onset of sleep, which did not answer the question.

Other errors that prevented students from receiving full marks included:

- identifying the zeitgeber as daylight
- mentioning the delayed release of melatonin without reference to the SCN
- outlining the effect of the blue light on wakefulness instead of sleep, as the question asked.

Question 6e.

Marks	0	1	Average
%	43	57	0.6

Students were required to identify why the column of 'Mean duration of phone use throughout the day (hours)' was included in Hugo's results table. To gain a mark, students could have provided a comment such as:

- It was important to check these were similar between the three groups.
- It was another variable that could impact the dependent variable / the results.
- Daytime phone use could also influence night-time melatonin secretion.

A common error included just re-stating what the column of data contained, such as saying 'to see how long the participants used their phones for each day'.

Question 7a.

Marks	0	1	2	Average
%	12	51	37	1.3

For this response, students needed to identify the subdivision as being the autonomic or sympathetic nervous system. The question also required students to justify their selection, which required a reference to either the heart rate or nightmare, which is scenario specific.

This question was assessing students' understanding of the continuing unconscious role of the sympathetic nervous system even when people are asleep and cannot complete conscious responses. The graph showed the increase in heart rate, due to the presence of the nightmare, several minutes before the participant woke up from sleep. The unconscious nature of this heart rate response is confirmed due to the participant being asleep when this occurs.

Common errors included not justifying their choice with reference to heart rate or nightmare.

Question 7b.

Marks	0	1	2	Average
%	74	6	21	0.5

For this response, an evaluation of the appropriateness of Lazarus and Folkman's Transactional Model of Stress and Coping was required. The student was expected to state that this model has poor explanatory power in that it cannot account for the increase in heart rate. The term 'explanatory power' appears three times in the study design, and while a list of strengths and limitations being taught for each model is advised, the term 'explanatory power' requires an application of these evaluations to each specific scenario.

The students also needed to provide an explanation of why there was poor explanatory power. Any of the following reasons were acceptable:

- because it only explains psychological appraisal/processes, and heart rate is physiological
- because it is a psychological model and not a biological model
- because they are asleep or in an ASC and so cannot complete any conscious appraisals.

Common errors involved the responses reviewing what might occur in primary appraisal and secondary appraisal according to the model, rather than evaluating the appropriateness of the model to explain the increase in heart rate. Students are advised to take time throughout the year to evaluate the explanatory power of all three models to a range of scenarios.

The following is an example of a high-scoring response:

The transactional model of stress and coping has low explanatory power to explain the increase in heart rate during nightmares, as it is a model that describes individual psychological responses and evaluation of stressors, it does not account for physiological responses such as heart rate in a stress response.

Question 7c.

Marks	0	1	2	Average
%	42	28	30	0.9

For this question, students were required to provide two characteristics of a neuromodulator. Any two of the following were acceptable responses:

- released in a slow manner
- long-lasting effects
- binds to neurons a distance away from its release
- far-reaching effects over widespread brain region / many neurons
- modulates brain activity in particular regions
- alters the neural transmission of neurons
- controls the release/synthesis of neurotransmitters
- released outside synapse into neural tissue
- modifies effect of neurotransmitter.

Common errors included students mentioning that neuromodulators could be both inhibitory and excitatory. This was not a characteristic unique to neuromodulators, so this response was not accepted.

Question 7d.

Marks	0	1	2	3	4	5	Average
%	16	12	19	26	20	6	2.4

To be awarded full marks for this question, the following ideas were required:

- First, the student had to make a link between phobias and the neurotransmitter GABA by outlining that people with phobias tend to have a GABA dysfunction or lower levels of GABA.
- Second, students needed to discuss the impact that benzodiazepines have regarding GABA, such as outlining that benzodiazepines are GABA-agonists or that they enhance/mimic the work of the inhibitory neurotransmitter.
- Third, students needed to refer to the resulting impact of the benzodiazepines on the phobic response. Here, students needed to be specific about the reduction in feelings of anxiety/fear or phobic response towards the bedroom.

It was common to read responses that did not refer specifically to the bedroom phobia, which was the focus of this question. Similarly, some students wrote about the use of benzodiazepines with reference to treating the nightmare disorder.

To complete the evaluation component of this question, students also needed to identify one strength and one limitation of the effectiveness of benzodiazepines. Strengths included: it being an effective short-term treatment; or that it can effectively reduce physiological symptoms. Limitations included: it does not treat the cause of the phobia; it will not cure the phobia; it would need to be taken daily; it focuses on physiological symptoms not the psychological cause; it has side effects such as drowsiness/cognitive impairment; or it can become addictive.

The following is an example of a high-scoring response:

Benzodiazepines are short-acting GABA agonists that increase the effectiveness of GABA's inhibitory effects, meaning that it decreases the likelihood of the post synaptic neuron firing an action potential, helping to slow down the CNS. Individuals with a specific phobia, such as of a bedroom, may be experiencing a GABA dysfunction where their brain does not produce and/or receive enough GABA to

regulate brain activity, leading to activation of fight–flight–freeze response that cause increase symptoms of anxiety, thus precipitating the bedroom phobia.

Benzodiazepines can be used to treat people with phobias of bedrooms by administering them prior to bedtime, which will promote feelings of calm and reduce the physiological symptoms of their phobia, allowing them to be calm in the bedroom. However, benzodiazepines are an evidence-based intervention that only deals with the effects of the phobia, not the cause, meaning that by itself, they are not an effective treatment and should instead be paired with other treatments, like systematic desensitisation.

Question 7ei.

Marks	0	1	Average
%	29	71	0.7

This response required students to provide one cognitive effect of sleep deprivation in a person experiencing a nightmare disorder. Any of the following was acceptable for one mark:

- reduced alertness
- reduced ability to focus on a task / attention / concentration
- reduced ability to divide attention
- reduced ability to think clearly
- increased ability to think irrationally
- increased difficulty in decision-making
- reduced spatial orientation
- compromised executive functioning
- difficulty problem-solving
- impaired memory
- impaired learning.

Common errors included students providing a behavioural or emotional effect rather than cognitive.

Question 7eii.

Marks	0	1	2	Average
%	40	41	19	0.8

To gain full marks in this question, students were required to provide a relevant example of catastrophic thinking related to either nightmares or the bedroom or going to sleep. Students also needed to identify the impact of the cognitive effects of sleep deprivation on catastrophic thinking.

The example provided needed to illustrate a thinking style that involves overestimating, exaggerating, or magnifying the situation and predicting the worst possible outcome.

Due to the cognitive effects of sleep deprivation, this catastrophic thinking would be:

- heightened
- more severe
- more likely to occur
- more frequent
- feel more real/rational.

Common errors included providing a generic definition of catastrophic thinking, with no relevant example, or providing an unrelated example of catastrophic thinking that did not connect to nightmares or bedroom

phobias. Furthermore, students who simply stated that sleep deprivation had a negative impact on catastrophic thinking were not awarded this mark.

The following is an example of a high-scoring student response:

The cognitive effects of sleep deprivation may lead to cognitive distortions and irrational thinking which promotes catastrophic thinking – the perception that a stimulus is far more threatening, and disproportionately fear inducing than it truly is, leading to thoughts of worst-case scenarios. For example, someone with sleep deprivation and a phobia of bedrooms may be more prone to fearing that they will experience such a bad nightmare in the bedroom that they will have a heart attack and die.

Question 8a.

Marks	0	1	2	3	Average
%	5	3	24	68	2.6

Many students received full marks for their graph of results.

To be awarded full marks students needed to ensure that they:

- labelled the y-axis as 'mental wellbeing score' and had a 0–4 scale on their axis
- labelled the x-axis as 'traveller type' with 'regular' and 'irregular' bars also labelled
- provided an accurate plot of data in the form of a bar chart.

Common errors included:

- placing the independent variable on the y-axis
- labelling 'regular' and 'irregular' under the columns, but not providing an axis label of 'traveller type'
- providing a histogram where the columns either touched each other or the y-axis
- providing a line graph instead of a bar chart.

Question 8b.

Marks	0	1	2	3	Average
%	21	16	18	45	1.9

This question required students to interpret the meaning of the data in the table provided. High-scoring responses were able to correctly identify that irregular travellers had a higher mental wellbeing while in an unfamiliar environment, compared to regular travellers who had a lower mental wellbeing. Students also needed to reference both scores from the table in the response, given the prompt in the question 'referring to the results of this study'.

Students were not awarded marks if they claimed that the unfamiliar environment had a bigger impact on the regular travellers, given that no pre-data was provided. This was a between-subjects design, not a mixed design that also included an element of time in the collection of data. Students need to ensure that they study a range of data sets throughout the year to allow them to practise forming conclusions for between-subjects, within-subjects, and mixed design experiments.

Common errors included students incorrectly assigning the 1 out of 4 score to the irregular travellers, or interpreting the 1 out of 4 lower score to mean a higher mental wellbeing. Some students also tried to claim the scores collected were associated stress levels, happiness, anxiety, or resilience, none of which were included in the information about the scenario.

Question 8c.

Marks	0	1	2	Average
%	41	25	33	0.9

Students were required to identify the type of data collected and a congruent strength associated with that data type. The questionnaire collected a mental wellbeing score on a four-point scale. Therefore, the data typed could be classified as quantitative, primary, or subjective.

Students are advised to provide only one data type in their response, as including an incorrect aspect in their answers means they will be awarded no marks. Examples included students writing 'quantitative objective data'. Common errors also included students providing the data collection method (questionnaire) rather than data type.

The strength provided needed to be congruent with the data type listed, and no marks were awarded for a strength if the data type was incorrect or left blank. Possible responses included:

- quantitative: easier to summarise the data to identify a trend OR data collected will involve objective interpretation by the researchers
- primary: data collected is tailored for the specific purpose of this investigation OR being collected by the researchers involves less doubt about the quality of the data
- subjective: may provide greater insight into a personal experience of mental wellbeing OR provides insight into an experience that cannot be directly observed.

Question 8di.

Marks	0	1	Average
%	52	48	0.5

Excluding the responses that were completed in less than one minute was controlling for possible extraneous variables. The answer of confounding variables was not accepted, as the data had been eliminated and did not impact the dependent variable.

Question 8dii.

Marks	0	1	Average
%	33	67	0.7

There were many possible responses that students could have provided to be awarded the mark. This response was assessed independently of their answer to Question 8d.i.

For example:

- decreases the internal validity
- data for mental wellbeing scores may be inaccurate
- increases level of uncertainty in mental wellbeing data
- may provide incomplete data
- could confound the results if left in the data set
- outliers could skew the scores.

Common errors included not providing a clear direction of the impact on the data. While some students identified that the accuracy or the validity were the ideas related to the question, they were unable to specify that these would be negatively impacted. Simply saying the inclusion of this data would 'impact the results' or

'significantly impact the accuracy' was not sufficient to be awarded a mark. The impact, in some other cases, could have been positive or beneficial, and therefore students needed to be clear that in this example it was having a negative impact on the data.

Question 8e.

Marks	0	1	2	Average
%	63	34	3	0.4

Students needed to apply the ethical concept of integrity to both administering the questionnaire and reporting the results. Students did well to complete the 'reporting the results' aspect of this question, but most were unable to also relate this to 'administering the questionnaire'.

The study design defines integrity as a commitment to searching for knowledge and understanding, and the honest reporting of all sources of information and results, whether favourable or unfavourable, in ways that permit scrutiny and contribute to public knowledge and understanding.

Many students simply provided this definition in their answer, which enabled them to gain one mark for 'reporting the results', as this is included in the definition. Other accepted responses for applying integrity to 'reporting the results' include:

- commit to reporting the results with honesty
- reporting results whether they are favourable or unfavourable
- reporting results in a way that permits scrutiny
- reporting results that contribute to public knowledge/understanding.

However, to be awarded the mark for 'administering the questionnaire', students needed to make specific mention of how the questionnaire should be developed with a commitment to the search for knowledge/understanding. Students may have also referred to how the questionnaire could meet the concept of integrity if they focused on questions specifically related to the mental wellbeing of travellers.

Students should find opportunities to relate all of the ethical guidelines and concepts to a range of investigation types throughout the year.

Question 9

Marks	0	1	2	3	4	5	6	7	8	9	10	Average
%	9	3	5	7	9	13	16	17	12	7	3	5.3

This was the first year assessing the extended-answer question using the assessment criteria published in the VCE Psychology 2023–2027 Examination specifications. The assessment criteria are:

- identification and explanation of appropriate psychological terminology in novel and unfamiliar contexts
- analysis and discussion of relevant psychological information, ideas and/or concepts and the connections between them
- analysis and evaluation of data, and/or scientific methodologies and methods, and/or models, and/or theories
- construction of evidence-based arguments and/or drawing of conclusions and/or discussion of implications and findings.

For this year's extended-answer question, there were three key aspects to be covered:

- analyse the results of this research study
- consider the role and the impact of gut microbiota on the gut–brain axis
- consider future opportunities for research in this field.

Students are encouraged to respond to each component of the question in order to be awarded higher marks. In responding to the three aspects of the question, the information may not have flowed in order or in neat packages – this is acceptable as each student's response is marked holistically, with assessors checking for aspects of the criteria throughout the whole response. High-scoring responses did tend to write in full sentences and use subheadings to assist the structure of their response.

Students are also advised to still make some attempt at the question, even if they are running out of time and feel like they will not be able to provide a complete response. While some high-quality responses this year omitted any consideration of any future opportunities for research (fourth assessment criterion), these students were still able to achieve a six or seven out of 10 based on the exceptional quality of their response against each of the other assessment criteria.

The following discussion has been divided into sections to demonstrate its relationship to each of the criteria. Throughout this advice, high-scoring responses are provided for reference. These samples are just one of many ways in which students were able to achieve an overall score of 10.

For the **first criterion**, 'identification and explanation of appropriate psychological terminology in novel and unfamiliar contexts', students were required to use and explain the psychological terminology outlined in the question, such as stress, gut–brain axis, gut microbiota and psychobiotic diet. High-scoring responses for this criterion also incorporated additional relevant terms relating to the question, such as central nervous system, enteric nervous system, vagus nerve, neurotransmitters, neuromodulators, microorganisms, enterotype or dysbiosis.

The following is an example of a high-scoring response incorporating this first criterion:

The gut-brain axis (GBA) is a bi-directional link between the enteric and central nervous systems, connected via the vagus nerve. The GBA describes the interactions between the brain and the gut and how they influence each other. The communication of the GBA consists of a majority of neural messages being sent from the gut to the brain (~90%) which previous studies have shown to influence a person's perception and experience of stress.

The study conducted by the Clinical Research Ethics Committee (CREC) also examines the interactions of the GBA, exploring how a healthy gut microbiota impacts the brain's perception of stress, however the GBA also describes how the experience of stress can impact the gut.

The CREC's research study evaluated this impact by testing the effects of a psychobiotic diet on the participant's perception of stress. This described diet contains fermented and prebiotic foods, which are high in diverse microbiota and contain healthy types that promote a healthier gut microbiome (overall population of microbiota in the gut).

Students who were able to correctly use the terms provided in the question were awarded marks for a mid-scoring response, while students who did not use all of the terms in the question, or incorrectly used these terms, were awarded marks for a low-scoring response in relation to this criterion.

For the **second criterion**, 'analysis and discussion of relevant psychological information, ideas and/or concepts and the connections between them', the student was required to discuss the bidirectional role of the gut–brain axis and the role of gut microbiota, to explain the link between them and how it impacts stress, and to consider the role and the impact of gut microbiota on the gut–brain axis.

In their analysis and discussion of relevant psychological information, high-scoring responses elaborated on the following concepts:

- an understanding of the bidirectional communication link between central nervous system and enteric nervous system (gut) via the vagus nerve
- a description of the enteric nervous system as a large network of (inter, sensory and motor) neurons embedded throughout layers of gut tissues in the gastrointestinal tract
- an explanation that being stressed and anxious leads to an upset stomach, and disruption to the gut leads to a change in our mood and emotions and impacts our behaviour
- an explanation that chronic stress and high levels of cortisol can disturb the balance of gut microbiota, and microbiota can lead to susceptibility to stress and resilience.

The following is an example of a high-scoring response incorporating this second criterion:

During the experience of stress, the prolonged release of cortisol – the primary stress hormone – can cause damage and disruption to the digestive system which in turn may impact the experience of stress in the brain. This impact on the gut can be seen through the gut microbiota, which are the trillions of organisms, viruses and fungi that exist within the gut and influence the GBA. Studies have shown that gut microbiota are directly linked to the production of important neurotransmitters and neuromodulators, such as dopamine, GABA and serotonin (90% of which is produced in the gut). This means that the diversity of gut microbiota can positively impact the GBA and subsequent brain chemistry and perception of stress.

Students who were able to relate the diet types to stress level reduction were awarded marks for a mid-scoring response, while students who were able to quote the results for Conditions A and B were awarded marks for a low-scoring response in relation to this criterion.

It is important to note that responses were marked holistically, and the highest-scoring students combined the first two criteria together. It was not a requirement to address each criterion separately.

For the **third criterion**, ‘analysis and evaluation of data, and/or scientific methodologies and methods, and/or models, and/or theories’, students were required to use the data in relation to the results and overall wellbeing with a link to the gut–brain axis and microbiota.

High-scoring responses demonstrated some of the following concepts:

- after four weeks, the participants following the psychobiotic diet scored higher on perceived stress reduction than those on a normal diet
- 32% reduction for the psychobiotic diet compared to 17% reduction in perceived stress for those not following the psychobiotic diet
- the psychobiotic diet will improve health/diversity of gut microbiota.

The following is an example of a high-scoring response incorporating this third criterion:

The CREC’s study displays results that support the understanding of the positive impacts of a healthy gut microbiome, as condition A (the psychobiotic diet) had displayed a 32% decreased in perceived stress levels, whereas condition B (no diet) had only a reduction of 17% in perceived levels of stress. These results show that diets high in fermented and prebiotic foods that promote a healthy and great diversity within the gut microbiota have a clear, positive impact in reducing perceived stress levels, further supporting previous studies in how good gut diversity impacts the GBA.

Students who were able to describe the gut–brain axis and what microbiota are, without including any link between them, were awarded marks for a mid-scoring response, while students who were able to outline one of the gut–brain axis or microbiota were awarded marks for a low-scoring response in relation to this criterion.

For the **fourth criterion**, ‘construction of evidence-based arguments and/or drawing of conclusions and/or discussion of implications and findings’, the student was required to consider future opportunities for further research in the field. The student relates future research ideas with reference to their theoretical

understanding of gut–brain axis and gut microbiota and describes changes to one aspect of the study that would allow further understanding to be developed.

High-scoring responses demonstrated some of the following concepts relating to future research:

- changing the independent variable: germ-free rats/mice, effect of antibiotics, faecal transplants, use of psychobiotics, stress exposure in life (bidirectional nature)
- changing the dependent variable: social behaviour, depression, anxiety, cognition, cortisol levels (objective), microbiota diversity/health (bidirectional nature)
- changing the sample: mice/rats, ‘unhealthy’ human participants (depression, anxiety)
- changing methodology: case studies, correlational study, literature review.

The following is an example of a high-scoring response incorporating this fourth criterion:

These results leave future opportunities for future research in investigating the effects of a psychobiotic diet in the physiological experience and changes of stress, such as investigating how a healthy psychobiotic diet may influence cortisol levels. Because cortisol is the primary stress hormone that influences the suppression of the immune system and significant health problems when prolonged exposure to cortisol occurs.

As the research conducted by the CREC show that diversity-promoting diets already influence perceived levels of stress (psychological), then further research could take this a step further by examining how those diets potentially reduce the physiological harm of chronic stress.

Overall, the GBA describes the bidirectional link between the gut and the brain and how they influence one another. The study conducted by CREC examined how diet impacts stress perception, through the food that promotes gut microbiota diversity, and found that a psychobiotic diet does positively impact the perception of stress. This leaves opportunities for future studies to investigate how this change in perception occurs and what effects psychobiotic diets have on biological functioning of the stress response, such as cortisol levels.

Students who were able to identify one change to the experiment that could be used for future research, without providing any explanation, were awarded marks for a mid-scoring response, while students who suggested simply repeating the same experiment again were awarded marks for a low-scoring response in relation to this criterion.