Psychology 2019 v1.4

IA2 high-level annotated sample response

September 2023

Student experiment (20%)

This sample has been compiled by the QCAA to assist and support teachers to match evidence in student responses to the characteristics described in the instrument-specific marking guide (ISMG).

Assessment objectives

This assessment instrument is used to determine student achievement in the following objectives:

2. apply understanding of localisation of function in the brain, visual perception, memory or learning to modify experimental methodologies and process primary data
3. analyse experimental evidence about localisation of function in the brain, visual perception, memory or learning
4. interpret experimental evidence about localisation of function in the brain, visual perception, memory or learning
5. investigate phenomena associated with localisation of function in the brain, visual perception, memory or learning through an experiment
6. evaluate experimental processes and conclusions about localisation of function in the brain, visual perception, memory or learning
7. communicate understandings and experimental findings, arguments and conclusions about localisation of function in the brain, visual perception, memory or learning.

Note: Objective 1 is not assessed in this instrument.

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Queensland Curriculum & Assessment Authority
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Instrument-specific marking guide (ISMG)

Criterion: Research and planning

Assessment objectives

2. apply understanding of localisation of function in the brain, visual perception, memory or learning to modify experimental methodologies and process primary data

5. investigate phenomena associated with localisation of function in the brain, visual perception, memory or learning through an experiment

The student work has the following characteristics:	Marks
• informed application of understanding of localisation of function in the brain, visual perception, memory or learning to modify experimental methodologies demonstrated by – a considered rationale for the experiment – justified modifications to the methodology • effective and efficient investigation of phenomena associated with localisation of function in the brain, visual perception, memory or learning demonstrated by – a specific and relevant research question – a methodology that enables the collection of sufficient, relevant data – considered management of risks and ethical or environmental issues.	5–6
• adequate application of understanding of localisation of function in the brain, visual perception, memory or learning to modify experimental methodologies demonstrated by – a reasonable rationale for the experiment – feasible modifications to the methodology • effective investigation of phenomena associated with localisation of function in the brain, visual perception, memory or learning demonstrated by – a relevant research question – a methodology that enables the collection of relevant data – management of risks and ethical or environmental issues.	3–4
• rudimentary application of understanding of localisation of function in the brain, visual perception, memory or learning to modify experimental methodologies demonstrated by – a vague or irrelevant rationale for the experiment – inappropriate modifications to the methodology • ineffective investigation of phenomena associated with localisation of function in the brain, visual perception, memory or learning demonstrated by – an inappropriate research question – a methodology that causes the collection of insufficient and irrelevant data – inadequate management of risks and ethical or environmental issues.	1–2
• does not satisfy any of the descriptors above.	0

Criterion: Analysis of evidence

Assessment objectives

2. apply understanding of localisation of function in the brain, visual perception, memory or learning to modify experimental methodologies and process primary data
3. analyse experimental evidence about localisation of function in the brain, visual perception, memory or learning
5. investigate phenomena associated with localisation of function in the brain, visual perception, memory or learning through an experiment

The student work has the following characteristics:	Marks
• appropriate application of algorithms, visual and graphical representations of data about localisation of function in the brain, visual perception, memory or learning demonstrated by correct and relevant processing of data • systematic and effective analysis of experimental evidence about localisation of function in the brain, visual perception, memory or learning demonstrated by – thorough identification of relevant trends, patterns or relationships – thorough and appropriate identification of the uncertainty and limitations of evidence • effective and efficient investigation of phenomena associated with localisation of function in the brain, visual perception, memory or learning demonstrated by the collection of sufficient and relevant raw data.	5–6
• adequate application of algorithms, visual and graphical representations of data about localisation of function in the brain, visual perception, memory or learning demonstrated by basic processing of data • effective analysis of experimental evidence about localisation of function in the brain, visual perception, memory or learning demonstrated by – identification of obvious trends, patterns or relationships – basic identification of uncertainty and limitations of evidence • effective investigation of phenomena associated with localisation of function in the brain, visual perception, memory or learning demonstrated by the collection of relevant raw data.	3–4
• rudimentary application of algorithms, visual and graphical representations of data about localisation of function in the brain, visual perception, memory or learning demonstrated by incorrect or irrelevant processing of data • ineffective analysis of experimental evidence about localisation of function in the brain, visual perception, memory or learning demonstrated by – identification of incorrect or irrelevant trends, patterns or relationships – incorrect or insufficient identification of uncertainty and limitations of evidence • ineffective investigation of phenomena associated with localisation of function in the brain, visual perception, memory or learning demonstrated by the collection of insufficient and irrelevant raw data.	1–2
• does not satisfy any of the descriptors above.	0

Criterion: Interpretation and evaluation

Assessment objectives

4. interpret experimental evidence about localisation of function in the brain, visual perception, memory or learning
6. evaluate experimental processes and conclusions about localisation of function in the brain, visual perception, memory or learning

The student work has the following characteristics:	Marks
• insightful interpretation of experimental evidence about localisation of function in the brain, visual perception, memory or learning demonstrated by justified conclusion/s linked to the research question • critical evaluation of experimental processes about localisation of function in the brain, visual perception, memory or learning demonstrated by – justified discussion of the reliability and validity of the experimental process – suggested improvements and extensions to the experiment that are logically derived from the analysis of evidence.	5–6
• adequate interpretation of experimental evidence about localisation of function in the brain, visual perception, memory or learning demonstrated by reasonable conclusion/s relevant to the research question • basic evaluation of experimental processes about localisation of function in the brain, visual perception, memory or learning demonstrated by – reasonable description of the reliability and validity of the experimental process – suggested improvements and extensions to the experiment that are related to the analysis of evidence.	3–4
• invalid interpretation of experimental evidence about localisation of function in the brain, visual perception, memory or learning demonstrated by identifying inappropriate or irrelevant conclusion/s • superficial evaluation of experimental processes about localisation of function in the brain, visual perception, memory or learning demonstrated by – cursory or simplistic statements about the reliability and validity of the experimental process – ineffective or irrelevant suggestions.	1–2
• does not satisfy any of the descriptors above.	0

Criterion: Communication

Assessment objective

7. communicate understandings and experimental findings, arguments and conclusions about localisation of function in the brain, visual perception, memory or learning

The student work has the following characteristics:	Marks
• effective communication of understandings and experimental findings, arguments and conclusions about localisation of function in the brain, visual perception, memory or learning demonstrated by – fluent and concise use of scientific language and representations – appropriate use of genre conventions – acknowledgment of sources of information through appropriate use of referencing conventions.	2
• adequate communication of understandings and experimental findings, arguments and conclusions about localisation of function in the brain, visual perception, memory or learning demonstrated by – competent use of scientific language and representations – use of basic genre conventions – use of basic referencing conventions.	1
• does not satisfy any of the descriptors above.	0

Task

Context
You have completed the following practicals in class: • use an experimental research design to investigate the effect of learning environment on memory, replicating aspects of the 1998 investigation by Harry Grant et al. (mandatory practical) • modify an experiment investigating memory, such as context-dependent cues on memory (Tulving & Pearlstone 1966) (suggested practical) • modify an experiment investigating memory, such as levels of processing theory — deep processing (semantic) (Elias & Perfetti 1973) (suggested practical).
Task
Modify (i.e. refine, extend or redirect) an experiment in order to address your own related hypothesis or question. You may use a practical performed in class, a related simulation or another practical related to Unit 3 (as negotiated with your teacher) as the basis for your methodology and research question.

Sample response

Criterion	Marks allocated	Result
Research and planning Assessment objectives 2, 5	6	5
Analysis of evidence Assessment objectives 2, 3, 5	6	6
Interpretation and evaluation Assessment objectives 4, 6	6	6
Communication Assessment objective 7	2	2
Total	**20**	**19**

The annotations show the match to the instrument-specific marking guide (ISMG) performance-level descriptors.

Key: Research and planning | Analysis of evidence | Interpretation and evaluation | Communication

Note: Colour shadings show the characteristics evident in the response for each criterion.

Communication [2] **acknowledgment of sources of information through appropriate use of referencing conventions** The use of in-text referencing fits the purpose of a scientific report. **Research and planning [5–6]** **a considered rationale for the experiment** The rationale explicitly communicates the experiment's purpose.	**Title:** Increasing the accessibility of information in memory. **Rationale:** Forgetting is the apparent loss or modification of information from an individual's memory. Trace Decay Theory and Displacement Theory propose how information is lost from short-term memory. Trace Decay Theory assumes that memories leave a trace in the brain and that forgetting occurs as a result of the automatic decay or fading of the memory trace (Brown, 1958). On the other hand, displacement theory suggests that forgetting occurs due to the limited capacity (Miller, 1956) of short-term memory (Atkinson & Shiffrin, 1968). According to the information processing model of memory, and described by Feigenbaum (1961), forgetting occurs, not because information has decayed or displaced, but because the information becomes 'inaccessible in a large and growing association network'. Thus there appears to be a distinction between availability and accessibility of information. Prior to the experiment conducted by Tulving and Pearlstone (1966), there were no attempts by researchers to distinguish between availability and accessibility in terms of information recall from memory. To test this phenomenon, they used categorised word lists and recall words in the presence or absence of category names as retrieval cues. They hypothesised that a proportion of words not accessible for recall under the unaided conditions would become accessible as a consequence of experimental presentation of such retrieval cues, thus indicating that sufficient information was available, but was not accessible (Tulving & Pearlstone, 1966). They found that sufficiently

intact memory traces of many words not recalled under the non-cued recall conditions were available in the memory store, but not accessible for retrieval.

The original experimental methodology devised by Tulving and Pearlstone (1966) was modified for the current experiment. The modified experiment aims to refine the methodology in order to determine if the claims made in the findings of the original experiment with regard to the effect of cues on recall, list length and words per category were accurate. These refinements should result in more accurate data about the effect of cues on recall.

Research and planning [5–6]

a considered rationale for the experiment

The rationale explicitly communicates the reasons for modifying the original experiment.

Research question: Does the presence of retrieval cues increase the accessibility of information (recall) within short term memory?

The null hypothesis states that there will be *no difference* in recall between participants presented with cues in the form of category headings on response sheets (cued-recall) and those participants without cues (non-cued recall condition).

a specific and relevant research question

The research question is connected to the rationale and enables effective investigation of the accessibility of information in short-term memory.

The alternative, non-directional hypothesis states that there will be a difference in recall between participants presented with cues in the form of category headings on response sheets (cued-recall condition) and participants not presented with cues (non-cued recall condition).

Modifications to methodology:

Variables

justified modifications to the methodology

The response gives sound reasons for how the modifications to the methodology will refine, extend or redirect the original experiment, and includes strategies for achieving these modifications.

The experimental methodology was refined to test only one independent variable in order to streamline the data analysis. In this case, the two levels of the independent variable were the condition of recall (cued [CR] as the experimental condition or non-cued [NCR] as the control condition). Recall was operationalised by the presence or absence of retrieval cues in the form of category headings on participant response sheets. The dependent variable was refined to the number of words correctly recalled out of 24, as the findings of the original experiment indicated that as list length increased, so did the differences observed between the conditions. The number of words per category was refined to 2, as findings from the original experiment indicated that as the words-within-category increased, recall remained invariant past 24 words.

a methodology that enables the collection of sufficient, relevant data

The methodology shows careful and deliberate thought. It enables collection of adequate data so an informed conclusion to the research question can be drawn.

In order to minimise extraneous variables, the use of standardised word lists, and time limits on viewing and recall were controlled.

Participants

The participants were extended to include a sample selected from 450 students, aged 14-17, attending a high-school in Queensland, Australia, as the findings of the original experiment were limited to students in Toronto, Canada. In order to recruit participants, a convenience sampling method was used. The sample consisted of 22 (males=11, females=11) grade 10 students, aged 14-16 years, and participants were randomly assigned to one of two conditions (i.e. independent groups design) by drawing numbers marked 1 or 2 out of a hat.

Research and planning [3–4]

management of risks and ethical or environmental issues

Ethical issues have been managed. However, the response does not show careful or deliberate identification and planning.

Analysis of evidence [5–6]

collection of sufficient and relevant raw data

The raw data is adequate for forming a conclusion and has direct bearing upon the research question.

Safety and Ethical considerations

During the planning of the methodology for this experiment, ethical issues (e.g. the need for informed consent) were identified and managed.

Raw data

Raw data for the total number of words correctly recalled was presented in a table to show the entire dataset.

Table 1. Raw data for the CR and NCR conditions.

NCR	CR
16	12
11	18
14	19
16	20
18	20
19	20
19	21
20	22
20	22
21	23
22	24

Analysis of evidence [5–6]

correct and relevant processing of data

Raw data is manipulated accurately to provide evidence that is applicable to the research question.

Communication [2]

appropriate use of genre conventions

The response follows scientific conventions of the construction of tables.

Processed data

The most appropriate measure of central tendency chosen was the mean and the standard deviation as the measure of dispersion, as the data was in intervals and there were no obvious outliers identified from the raw data. 95% confidence intervals were calculated for use with error bars, to estimate the interval that we were 95% confident contained the population mean. These statistics are displayed in Table 2 and Figure 1.

Table 2. Mean and standard deviation scores for number of words correctly recalled in non-cued recall (NCR) and cued recall (CR) conditions.

Condition	Mean number of words correctly recalled ($\bar{x}$)	Standard deviation of words correctly recalled (s)
Non-cued recall (NCR)	18	3
Cued recall (CR)	20	3

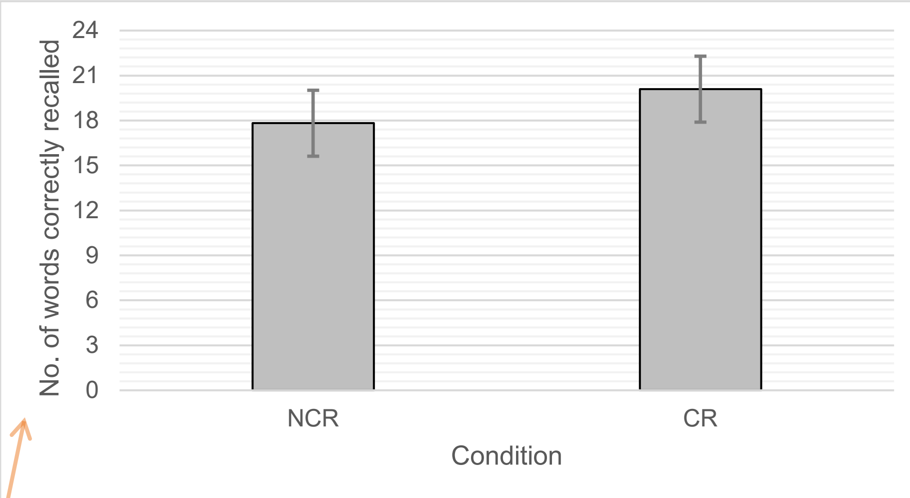

Figure 1. Mean and 95% confidence intervals for number of words correctly recalled in non-cued recall (NCR) and cued recall (CR) conditions.

fluent and concise use of scientific language and representations

The response represents data clearly so that the trends, patterns and relationships can be easily identified.

Analysis of evidence [5–6]

thorough identification of relevant trends, patterns or relationships

The identified trends, patterns and relationships are not superficial and allow a justified conclusion to

The results show that the mean score for the NCR group (18) was lower than the mean score for the CR group (20). The standard deviations show relatively high dispersions of scores around the mean for both groups. *Figure 1* represents the 95% confidence intervals as error bars. These error bars show a range of scores in which there is a 95% chance of finding the population mean. Since these error bars are overlapping, this suggests that the results fall within the same range for both conditions. This suggests that both samples might be sampling from the same population.

the research question to be drawn. **Analysis of evidence [5–6]** **correct and relevant processing of data** Raw data is manipulated accurately, providing evidence that responds to the research question.	**Statistical test** A two-sample t-test (unpaired) was chosen as the most appropriate parametric technique to analyse the data as: the experiment sought to determine a causal relationship between the presence of cues and recall; the experiment used interval measurement to collect discrete data; the research design used independent groups and it was assumed that the raw data was approximately normally distributed. Despite the small sample size (N = 11) potentially violating the t-test's assumption of normally distributed data, it was decided that the t-test was an appropriate inferential test. This is because of the reasons above in favour of the t-test, and the unpaired t-test's robustness to violations of its assumption of normality (Sawilowsky & Blair, 1992) meaning that modest violations do not greatly change the chance of making errors when using the test.
Interpretation and evaluation [5–6] **justified conclusion/s linked to the research question** The response uses sound reasons and evidence to support a conclusion that directly responds to the research question.	As Tulving and Pearlstone (1966) did not report an effect size, a two-tailed test was chosen to limit the chance of Type I errors. A p value of $p \leq .05$ was selected as the margin of error. The calculated result is p = .12. This means that the result is statistically non-significant. As the statistical test found a statistically non-significant result, the null hypothesis is accepted.
Analysis of evidence [5–6] **thorough and appropriate identification of the uncertainty and limitations of evidence** The response suitably identifies uncertainty and limitations of the data in a way that is not superficial or partial. The response examines the uncertainty to determine if the evidence that will be used to draw a conclusion to the research question is reliable and valid.	**Limitations of the evidence and reliability and validity of the experimental process:** Large standard deviations, overlapping 95% confidence intervals, and a non-significant statistical test are all examples of the uncertainty and limitations observed from an analysis of the evidence. These can be explained by a lack of reliability and validity in the experimental process. Large standard deviations (NCR 3, CR 3) were observed for each condition. Large standard deviations indicate that data points are widely dispersed around the mean which suggests that extraneous variables are not fully controlled, therefore making the data less reliable. Figure 1 presents error bars as overlapping. The overlapping error bars suggest that the dispersion of the data is so great that there may not be a true difference between the means for the two conditions (18 NCR, 20 CR). This was supported by the results of the statistical test.
Interpretation and evaluation [5–6] **justified discussion of the reliability and validity of the experimental process** The response uses sound reasoning and evidence from the	Data that is widely dispersed can indicate an unreliable experimental methodology. Although experimenters sought to control extraneous variables, it is likely that the uncertainty observed in the data was due to natural participant variability. To attempt to control for this, experimenters used random allocation of participants to conditions, however the use of convenience sampling, a relatively small sample size (N = 11), and an independent groups design, most likely caused the dispersion (lack of reliability) in the data. A further consideration should be the effect of the refinements made to the original experiment's methodology. Although the list length (24), and words per category (2) were refined to represent those most likely to

identification of uncertainties and limitations to support the consideration of the reliability and validity of the experimental process. **Analysis of evidence [5–6]** **thorough and appropriate identification of the uncertainty and limitations of evidence** The uncertainty of the evidence has been quantified so that a decision can be made about the application of the evidence to the research question. **Interpretation and evaluation [5–6]** **justified discussion of the reliability and validity of the experimental process** The response uses sound reasoning and evidence from the identification of uncertainties and limitations to support the consideration of the reliability and validity of the experimental process. **justified conclusion/s linked to the research question** The response uses sound reasons and evidence to support a conclusion that directly responds to the research question. **suggested improvements and extensions to the experiment that are logically derived from the analysis of evidence** The response uses the analysis of the evidence to inform the suggested improvements and extensions to the experiment.	illicit a result based on the findings of Tulving and Pearlstone (1966), the original lists used were not accessible to the experimenters. Thus, the creation of new lists may have affected the reliability of the experimental methodology, resulting in unreliable data. Moreover, the two-sample t-test (unpaired) obtained a result that was statistically non-significant. This result is contrary to that of Tulving and Pearlstone (1966). There is a 5% probability (5% due to $p \leq .05$) that a Type II error occurred (failure to identify a result as significant in the sample when it exists in the population). This assumption could be made as the experiment would be deemed to have low power as it used a small sample (N = 11), had a high dispersion of data (3 NCR, 3 CR), and used an independent groups design (leading to greater potential for natural participant variability). This type of error is less problematic than making a type I error, which was lessened as a two-tailed test was used. Finally, in terms of validity, the population validity would be deemed to be low due to the use of a small (N = 11), and unrepresentative sample (grade 10 students aged between 14 and 17 years). Furthermore, the ecological validity would also be considered low as the experiment was conducted in a laboratory with highly controlled variables. Therefore, the ability to generalise the results to a real world context in which cues are used is problematic. **Conclusion:** In answer to the research question, 'Does the presence of retrieval cues increase the accessibility of information within short term memory?' the null hypothesis was accepted ($p = .12$), indicating that the results of the experiment showed no difference in recall between participants presented with cues in the form of category headings on response sheets (cued-recall) and those participants without cues (non-cued recall condition). However, the experimental result should be concluded with caution due to the uncertainty and limitations identified in the data, most likely caused by a lack of reliability and validity in the experimental process. **Suggested improvements and extensions:** By analysing the evidence obtained in the experiment, it was clear that the experimental processes lacked reliability (sample and test), population validity and ecological validity. The following improvements and extensions are suggested to increase the reliability and validity of the experimental process in future experiments. To improve the reliability of the sample, a refinement might be to increase the sample size (> 30) to ensure that individual data points (i.e. participants) contribute less to the overall final result (i.e. less noticeable dispersion). A further improvement would be to use a matched participants design, with participants completing a pre-test for memory ability, paired, and then allocated to either the control or experimental group. This measure further decreases the chance of natural participant variability affecting the results. An additional measure would be to use random or stratified-random sampling techniques, as they increase the representativeness of the sample to population. This measure would also help to improve the population validity.

	To improve the reliability of the test, a refinement could be to use a known test (e.g. one that is deemed to be reliable by other researchers), or complete reliability checks on the created test, for example doing a test-retest method. This method could provide experimenters with data about the reliability of their test before using it as a measure in the experiment. An extension to the experiment that would increase population validity would be to test the phenomenon on a more diverse population group, for example using a random-stratified sample of children, adolescents, adults, and the elderly. This would allow experimenters to discover if the effect of cues on recall was age or life stage dependent. Lastly, to improve ecological validity the experiment could be extended to assess the effect of cues on recall using a quasi-experimental design, whereby actual student learning is assessed in a revision or recall setting.
Communication [2] **fluent and concise use of scientific language and representations** The response is easily understood, avoids unnecessary repetition and meets the required length. **acknowledgment of sources of information through appropriate use of referencing conventions** The use of a referencing system fits the purpose of a scientific report.	**Word count:** 1972 **References** Brown, J. (1958). Some tests of the decay theory of immediate memory, *Quarterly Journal of Experimental Psychology*, 10, 12-21. Feigenbaum, E. A. (1961). The simulation of verbal learning behaviour, *Proceedings of the Joint Computer Conference*, 19, 121 – 132. Miller, G. (1956). The magical number seven, plus or minus: Some limits on our capacity for processing information, *The Psychological Review*, 63, 81-97. Sawilowsky, S. & Blair, R. C. (1992). A more realistic look at the robustness and type II error properties of the *t* test to departures from population normality, *Psychological Bulletin,* 111, 352-360. Social Science Statistics. (2017). *Mann-Whitney U Test Calculator*. Retrieved from http://www.socscistatistics.com/tests/mannwhitney/default2.aspx Tulving, E., & Pearlstone, Z. (1966). Availability Versus Accessibility of Information in Memory of Words, *Journal of Verbal Learning and Verbal Behaviour*, 5, 381-391.