3. Now use the formulae to calculate $U_a$ and $U_b$

Note that $R_a$ is the sum total of ranks for list A and $R_b$ is the sum total of ranks for list B

$$U_a = \frac{N_a \times N_b + N_a \times (N_b +1)}{2} - R_a$$

$$U_b = \frac{N_a \times N_b + N_b \times (N_a +1)}{2} - R_b$$

$$U_a = 10 \times 10 + 10 \times 11 /2 - 75.5$$

$$U_b = 100 + 110/2 - 134.5$$

$$U_a = 79.5$$

$$U_b = 20.5$$

The lowest value of $U_a$ or $U_b$ is the $U$ value taken. In this case the $U$ value is 20.5.

The $U$ value = 20.5, which is less than the critical value of 27 for a one-tailed test (which we will assume in this instance), therefore the results are significant.

Table 2.6 Critical values for a Mann-Whitney U test.

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<td>27</td>
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</table>

Critical values of $U$ for a one-tailed test at 0.05; two-tailed test at 0.1 (Mann-Whitney)

The observed value of $U$ is significant at the given level of significance if it is equal to or less than the table (critical) value above.

In addition to gathering quantitative data, we can also gather qualitative data from research. Case studies are a research method where both qualitative and quantitative data can be gathered.

**Case studies of brain-damaged patients and the use of qualitative data**

Case studies of brain-damaged patients have been critical to cognitive psychology in order to investigate how brain injury affects cognitive functioning. Sometimes we can understand cognitive functions, such as memory, more in their absence, as is the case in brain-damaged patients.
Henry Molaison (HM)

An invaluable case study was that of Henry Molaison who suffered brain injury as a result of a surgical procedure to relieve him from seizures caused by epilepsy.

Henry Molaison, known by thousands of psychology students as ‘HM’, lost his memory on an operating table in a hospital in Hartford, Connecticut, in August 1953. He was 27 years old and had suffered from epileptic seizures for many years. He was operated on by William Scoville, who removed a brain structure within the temporal lobe called the hippocampus. The procedure did reduce his seizures, but left him with severe memory loss.

Henry was quickly referred to two neuropsychologists, Wilder Penfield and Brenda Milner, to assess the extent of his amnesia. The hippocampus was known to be associated with consolidating memories so the removal of this structure was devastating and irreversible.

Having already established themselves by conducting memory research on other case studies of brain-damaged patients, Penfield and Milner realised that Henry was an ideal amnesia case because his injury was specifically localised and his personality and intelligence were virtually intact.

Henry was assessed as having anterograde and retrograde amnesia. His anterograde amnesia resulted in an inability to form any new memories after the operation (he could not store memories for new names, faces, events or information). Despite this, he did learn new skills, although he had no memory of being able to learn them. His retrograde amnesia meant that he lost the ability to retrieve memories from 19 months to 11 years prior to the operation; he was 27 years old at the time of his surgery, so this meant he could only remember partial events after the age of 16 and virtually no events after the age of 25. His retrograde amnesia may not have been due to the surgery, but is likely to have been affected by epilepsy medication and the frequency of his seizures prior to the operation.

During his life, Henry was interviewed many times, and this qualitative information has informed an understanding of which cognitive functions were still intact and which were impaired. Following his death, HM’s brain was gifted to psychological research; it was spliced into over 2000 segments to map the human brain at the Brain Observatory in San Diego.

The use of qualitative data

Unlike quantitative data, which presents data as numbers and statistics, qualitative data presents descriptions of findings in prose. In cognitive psychology, memory research is often reported as quantitative data, but research using case studies of brain-damaged patients is often qualitative in nature, describing what functioning is intact or lost as a result of amnesia and gaining an understanding of the patient’s subjective experiences. Qualitative data provides us with detailed accounts of a person’s experiences, feelings and beliefs. Some argue that this is the essence of psychology, but others argue that it is at the expense of objectivity as qualitative data requires interpretation, which can be biased.
Qualitative research is not straightforward or mechanistic; quantitative research involves working through a step-by-step procedure resulting in data analysis, whereas qualitative research is defined by the nature of the investigation and the choices made by the researcher along the way. It is a process of making meaning from responses given by participants, and as such is open to the individual interpretation of the researcher. As a researcher establishes the themes that emerge from the discourse, they apply meaning to its content and reach subjective conclusions. This does not mean that the emergent themes found are invalid, but it is up to the researcher to explain and justify the emerging conclusions using evidence in the discourse.

Rather than following the hypothetico-deductive model, which proposes a hypothesis and then tests it, qualitative research is an inductive process whereby a research question is proposed and the answer emerges from careful decoding of the information gathered. Information can be gathered using a variety of methods, such as unstructured or semi-structured interviews, questionnaires with open-ended question types, group discussions, speech analysis and a literature review. The non-numerical information gathered is carefully transcribed and notes are taken on the emerging themes or ideas that run through the text. There is no single type of qualitative research, and no single way of conducting qualitative analysis. However, they generally follow a similar format.

Common to all qualitative research is the way it is used to understand how individuals make sense of their own experiences. Qualitative research aims to understand how people perceive their world and make sense of it. This results in rich descriptions based on what people disclose about themselves, the connections they make between events that happen and the meanings they attribute to them, and how they feel.

Qualitative analysis is idiographic; it does not claim any general rules that apply to other people, but only that the results are specific and unique to the individual involved. Although some research can claim that emergent themes are general to others, qualitative research is often based on small sample sizes and built up into a case study.

Once qualitative data has been gathered, transcriptions are made of the discourse and the researcher immerses themselves in the text, making notes on the feelings, beliefs and meanings given to experiences by the participants. Then the researcher reflects on these notes, checks that the notes reflect the content of the transcript and develops from these notes the emerging themes from the transcript. These themes are presented as conclusions with extracts from the transcript to support the interpretation given to them.

**Evaluation**

Qualitative analysis gathers rich descriptions based on meaning, which can often be missed when using quantitative methods. However, it is laborious and difficult to conduct because data analysis and transcription takes a lot of time. It does not follow any particular standardised format and has been criticised for being unscientific and highly subjective. Additionally, many argue that it is largely a descriptive rather than explanatory method. However, qualitative research goes beyond merely describing discourse, it is a process of comprehending the information, synthesising the material and theorising about why the themes exist. A strength of qualitative research is that it is very important when trying to understand some of the important issues in health and clinical psychology, such as how patients experience palliative care, or what caregivers believe could help them as carers for those with long-term illness. These big questions could not be addressed by simply administering a questionnaire which would be unable to address people's deeply held beliefs and feelings.

**Taking it further**

Download the lyrics to the song 'Barbie Girl' by the pop band Aqua. Conduct your own qualitative analysis using the following steps:

1. Read the lyrics through (without singing them!)
2. In the margin of each line, write a summary of the lyrical content, and consider the meaning of the lyrics.
3. Reflect on your notes, synthesise them and consider any overall message being delivered in the song.
4. Drawing together your themes, suggest possible reasons for these themes existing and present them using evidence from the lyrics in the song.

**Types of qualitative methods**

Content analysis (although some dispute this method as being truly qualitative as it quantifies qualitative material).

Discourse analysis

Grounded theory

Interpretive phenomenological analysis
2.3 Studies

Learning outcomes

In this section you will learn about one classic study:

- Baddeley (1966b) on working memory

and three contemporary studies, from which you will need to choose one to learn about:

- Schmolck et al. (2002) on HM and other brain-damaged patients
- Steyvers and Hemmer (2012) on reconstructive memory

The influence of acoustic and semantic similarity on long-term memory for word sequences (Baddeley, 1966b)

Alan Baddeley, a prominent researcher in memory, wanted to test whether long-term memory and short-term memory were different or whether the emergent view of the time that memory existed on a continuum was accurate. However, investigations into short-term and long-term memory employed different research techniques, and Baddeley suggested that it would be impossible to tell whether short-term and long-term memory were different or the same unless the same research techniques were used on both. He set out an investigation to explore the effects of both semantic and acoustic coding in both long-term and short-term memory.

Aim

To investigate the influence of acoustic and semantic word similarity on learning and recall in short-term and long-term memory.

Procedure

A laboratory experiment was designed to test sequential recall of acoustically and semantically similar word lists. Three different experiments were conducted, but here we will focus on experiment three.

Experiment three

Four lists of 10 words were used:

- List A contained 10 acoustically similar words (man, can, cat, map, etc.)
- List B contained 10 acoustically dissimilar words that were matched in terms of frequency of everyday use to List A (pit, few, cow, mat, etc.)
- List C contained 10 semantically similar words (great, large, big, broad, etc.)
- List D contained 10 semantically dissimilar words that were matched in terms of frequency of everyday use to List C (good, huge, deep, late, etc.)

List B and D acted as baseline control groups for List A and C.

The participants were men and women recruited from the Applied Psychology Research Unit subject panel and were assigned one of the four list conditions as an independent groups design.

Each list of 10 words was presented via projector at a rate of one word every three seconds in the correct order. After presentation the participants were required to complete six tasks involving memory for digits. They were then asked to recall the word list in one minute by writing down the
sequence in the correct order. This was repeated over four learning trials. As it was not a test of
learning words, but a test of sequence order, the word list in random order was made visible on a
card in the room. After the four learning trials, the groups were given a 15-minute interference task
involving copying eight digit sequences at their own pace. After the interference task participants
were given a surprise retest on the word list sequence.

Table 2.7 Procedure order.

<table>
<thead>
<tr>
<th>Hearing test</th>
<th>Learning trials</th>
<th>Interference task</th>
<th>Retest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Listening and copying each word presented in random order from the list</td>
<td>Trial 1 Visual presentation of list followed by a 6 eight-digit sequence recall task, followed by recall of the list.</td>
<td>Trial 2 Visual presentation of list followed by a 6 eight-digit sequence recall task, followed by recall of the list.</td>
<td>Trial 4 Visual presentation of list followed by a 6 eight-digit sequence recall task, followed by recall of the list.</td>
</tr>
</tbody>
</table>

Results of experiment three
Recall of the acoustically similar sounding words was worse than the dissimilar sounding words
during the initial phase of learning (trial two in particular). However, recall of the similar and dissimilar
sounding words was not statistically significant. This demonstrates that acoustic encoding was
initially difficult, but did not affect long term memory recall. Participants found the semantically
similar words more difficult to learn than the semantically dissimilar words and recalled significantly
fewer semantically similar words in the retest.

Conclusion
The fact that participants found it more difficult to recall list one in the initial phase of learning
suggests that short-term memory is largely acoustic, therefore acoustically similar sounding words
were more difficult to encode. Later retest recall of list three was impaired compared to all other lists
because they were semantically similar, suggesting that encoding in long-term memory is largely, but
not exclusively, semantic.

Evaluation
Laboratory research, such as this, employs the use of experimental techniques that are not typical
of the way in which we use memory in an everyday context; we do not often learn lists of random
monosyllabic words. Therefore the ability to generalise these findings to everyday contexts is
questioned. However, memory researchers would argue that in order to understand memory we
need to remove the context in which normal memory is used and simplify the nature of the to-be-
learned information in order to isolate the aspects of memory we are concerned with.

This experiment relied heavily on the role of rehearsal during the four learning trials in order for
information to become established in long-term memory. The very concentrated nature of rehearsal
is likely to have exaggerated this memory process with the result found being an artefact of the
experimental procedure. Under normal conditions we would not be expected to use rehearsal in such
a contrived way, so this study lacks mundane realism.

However, the study was scientific in that it was conducted in a controlled laboratory environment
with a standardised procedure. Therefore the study can be regarded as replicable and the reliability
of the results can be established. Due to the highly controlled nature of the experiment, Baddeley
can also establish a cause and effect relationship between the independent variable (semantic or
acoustic word list similarity, and the dependent variable (long-term memory).

Key term
Mundane realism: The extent to which the test used in an experiment represents a realistic activity.
Semantic knowledge in patient HM and other patients with bilateral medial and lateral temporal lobe lesions (Schmolck et al., 2002)

Case studies of brain-damaged patients have been invaluable in understanding the nature and function of human memory. Amnesia patients have been investigated in neuropsychological research to establish which regions of the brain are responsible for which stores and processes involved in encoding new and recollecting previously learned information. It is widely accepted that damage to the temporal lobe of the brain is associated with memory loss, in particular anterograde and retrograde amnesia, but often well-established long-term semantic knowledge is intact.

Aim

Heike Schmolck, Elizabeth Kensinger, Suzanne Corkin and Larry Squire attempted to investigate the effects of specific brain damage on semantic memory using case studies of brain-damaged patients compared to a control group of ‘normal’ participants. Specifically they wanted to test the relationship between semantic test scores and temporal lobe damage and to determine whether Henry Molaison (HM) was unique in the way the brain damage he sustained affected his memory compared to similar damage in other cases.

Key terms

**Encephalitis:** inflammation of the brain causing damage to the structures of the brain.

**Medial:** situated in the middle.

**Anterolateral:** to the front and side of.

**Lateral:** towards the side of.

**Bilateral:** both hemispheres of the brain are involved.

**Figure 2.12** The lobes of the human brain.

Procedure

Participants

Six participants with amnesia were compared to eight ‘normal’ control participants. The control group was matched for age (74 years old), sex (male) and education (12.4 years) to the amnesia patients (apart from one female). The six amnesia patients were divided into groups according to the level of brain damage they suffered. Two patients had brain damage largely restricted to the hippocampus (HF); three patients had suffered encephalitis resulting in large medial temporal lobe and anterolateral temporal cortex damage (MTL+) and Henry Molaison (HM) had medial temporal lobe damage with some lateral temporal lobe damage following surgery to resolve his epilepsy. All patients had suffered bilateral damage to varying degrees. A biography of each patient was compiled.

Apparatus

Nine tests were conducted over three to five different sessions with participants. Seven of these tests were from the Semantic Test Battery and two tests were constructed by the researchers. The tests were all based on line drawings of 24 animals and 24 objects. The 48 line drawings were further categorised into groups of eight domestic land animals, foreign land animals, water animals, birds, electrical household items, non-electrical household items, vehicles and musical instruments.
Tests
The nine tests were designed to measure semantic knowledge related to identifying, sorting or defining the line drawings. A further four semantic tests were conducted on some of the patients and control participants (HM only received test 10 of these additional tests).

Table 2.8 Test conditions.

| Tasks 1–4 | Pointing to or naming a picture | Participants were asked to point to or name a picture when given the name or a description of the object. |
| Task 5 | Semantic features | Participants were asked to answer yes/no questions about the physical and associated features of an object. |
| Tasks 6 & 7 | Category fluency and sorting | Participants were asked to name or sort into categories as many examples within a category or class (living/non-living) of objects without a picture cue. |
| Tasks 8 and 9 | Defining task | Participants were given the name or picture of the 24 less common objects and they were asked to provide a definition. |
| Task 10 | Pyramid and palm tree test | Participants were given a target picture and two test pictures and asked which test picture went with the target picture. For example, a target picture of a saddle was presented with two test pictures of a horse and a goat, and participants were asked to say which test picture went with the target. |
| Task 11 | Object/non-object discrimination task | Participants were asked whether the object presented to them was real or not. |
| Task 12 | Colouring object task | Participants were asked to colour 28 line drawings of objects using appropriate colours from a selection of four coloured pencils. |
| Task 13 | Nouns and verbs test | Participants were given a fill-in-the-gaps exercise designed to test knowledge of regular and irregular verbs and tenses. For example, 'A hoof is hard, in fact most ________ are hard'. |

The percentage of correct responses was scored for all tests other than test 6, 8 and 9, which were recorded and transcribed and were given an accuracy rating of between 0 and 4 by the researchers. These transcripts were also assessed for errors in grammar, expression, confusion and word intrusions. Inter-rater reliability was established for the scoring.

Results

Tasks 1–9
Patients with damage restricted largely to the hippocampus (HF) were able to name, point out and answer questions about objects they were given with considerable accuracy. They were also comparable to the control group when asked to generate examples of a given category or give definitions of objects. Patients with damage to the medial temporal lobe and anterolateral temporal cortex (MTL+), performed less well at naming, pointing out or answering questions about objects. They also had considerable difficulty generating examples in a given category. Notably one MTL+ patient could not generate names of dog breeds despite previously being a dog breeder. They also had difficulty defining objects, often giving less detail which contained more errors; HM performed worst among these patients. Interestingly the MTL+ patients found it most difficult to identify and recall facts about living objects compared to non-living objects in all tasks.

When the participants were ranked in terms of their overall performance on these tasks, their rank appeared to correspond directly with the extent of their brain damage. In particular, damage to the anterolateral temporal cortex seemed to cause impairment in semantic knowledge.
Other semantic tests (test 10–13)
When asked to decide whether an object was real or not two of the MTL+ participants performed well, but one made eight errors. All MTL+ patients scored well on the colouring task. On the Pyramid and palm tree test, the MTL+ patients and HM scored either below the required 90 per cent accuracy or performed below the control group. The MTL+ group were able to produce regular plurals and verbs but performed less well at producing irregular verbs and plurals. In contrast, HM performed well on both tasks, suggesting that the difficulty with irregular items is associated with anterolateral temporal cortex damage.

Conclusions
The MTL+ patient data shows that damage to the anterolateral temporal cortex is consistent with a loss of semantic knowledge that results in a ‘blurring’ or overlap of conceptual knowledge that leads to confusion. This semantic knowledge is associated with the anterolateral region and is not associated with the medial temporal lobe. This is consistent with patients with semantic dementia whose impairment is restricted to the anterolateral temporal cortex and the medial temporal lobe is relatively unaffected. Additionally, MRI scans seem to suggest that the more progressed the disease, the greater the anterolateral damage.

HM – a special case
HM was similar to the MTL+ patients in tests of definitions suggesting that his impairment had a similar physiological basis. However, in many respects his semantic knowledge was in the normal range in other tests. Unique to HM was the large number of grammatical errors he made during these tests. The researchers suggest that his deficit in language production was unlikely to be related to his temporal lobe damage but due to other factors during his childhood. HM suffered from a seizure at age 10, was from low socioeconomic status and his schooling was interrupted. These factors could have contributed to poor language development.

The researchers conclude that the hippocampus is not involved in semantic knowledge because HF patients performed similarly to the control group. HM was less affected than the MTL+ patients, which leads to the conclusion that the anterolateral temporal cortex and not the medial temporal lobe is involved in semantic knowledge. The language impairment displayed by HM was unrelated to his neurological condition and probably due to his upbringing.

WIDER ISSUES AND DEBATES
Nature–nurture
Schmolck et al. believed that HM’s language impairment had developed due to causes other than the neurological impairment caused by his surgery, that it was perhaps due to nurture rather than nature. It is possible that his low socioeconomic status and interrupted education had a negative effect on his language development.

The following transcript was made of HM describing a motorcycle:
‘… well… it can be…uh… a motorcycle is…uh… maybe, … it’s on two wheels… And it could be have ‘cause my father used to ride one at one time…and he stopped himself because the doctor told him not to.’

It seems somewhat questionable whether these errors in grammar and form could be solely attributed to educational disruption and economy. However, the nature–nurture debate will never be resolved in this case because HM’s language was not tested prior to the surgery.
Evaluation

Case studies of brain-damaged patients are rare and therefore small in number. The small sample size involved in this investigation limits the generalisability of the conclusions made. However, findings from semantic dementia, neuroimaging, brain stimulation and unilateral lobectomy all support the finding that the anterolateral and, in particular, the lateral temporal cortex is involved in semantic knowledge, strongly reinforcing the conclusion of this study.

Exam tip

It is easy to criticise research for its shortcomings without understanding the reason for such problems or trying to understand whether the problem is actually well founded. Answers in psychology are rarely agreed on, so it is important to discuss evaluation from alternative points of view rather than taking a single-sided or definitive approach. To be able to evaluate effectively and demonstrate a mature and considered approach to evaluation, it is worth considering these questions:

Is the criticism justified?
Is there any further support for or against the criticism being levelled at the research?
Does the criticism demonstrate the view of certain psychologists or groups of people? If so, could an alternative view be considered?

The special case of HM reported in this investigation was seen as a product of upbringing and events prior to his surgery for epilepsy. However, it could be argued that the individual differences found in this investigation demonstrate individual variation in neurology which may account for the differences between them. It is often the case that retrospective research, such as this study, cannot establish causal relationships between the injury sustained and the resulting impairments tested. The brain is adaptable and can compensate for injury. The findings of tests may reflect the ability of the brain to adapt to injury rather than the injury itself. However, prospective research is not possible as it would involve predicting those individuals who are likely to sustain such brain damage.

Also the stimuli that are common to many cognitive investigations used to test semantic knowledge, such as the line drawings used, lack mundane realism and may not tap into semantic knowledge as it is used in everyday life. Such research may be said to lack ecological validity, as the findings cannot be generalised to everyday use of semantic memory.

WIDER ISSUES AND DEBATES

Ethical issues

Doctor Scoville, the surgeon responsible for HM’s surgery, was vilified for his reckless approach. However, the case of HM was fundamental to our understanding that memory is a distinct cognitive process, independent of language and thought. Damage to his hippocampus and temporal lobes enabled neuroscience to establish a location for memory in the brain. This is arguably the most important advance in our understanding of memory functioning and HM was the most researched individual in the field of neuroscience.
Reconstruction from memory in naturalistic environments (Steyvers and Hemmer, 2012)

Mark Steyvers and Pernille Hemmer investigated the interaction between episodic and semantic memory, and the reconstructive nature of memory recall. Previous research into reconstructive memory suggested that prior knowledge stored in semantic memory had a detrimental effect on recall, often resulting in false memories of an object or event. However, Steyvers and Hemmer argued that research focused on the fallibility of memory often derived its findings from laboratory-based investigations designed to deliberately induce these errors in recall. For example, asking participants to recall objects in a photograph of an office with no books or computer in the picture would deliberately induce a false memory for such items. Removing such highly probable items would only result in a high likelihood of such items being expected and subsequently falsely remembered. Rather than seeing the recall of books or a computer as a typical everyday error in recall, Steyvers and Hemmer argued that it is only an error because of the experimental manipulation of the environment (withholding objects from the image), and that this was not representative of naturalistic environments.

Therefore, rather than accepting that memory is prone to error, as much previous research concluded, they felt that these errors in recall could provide important insights into the nature and function of memory, and that memory should be studied in a more naturalistic way where environments were not manipulated to elicit certain responses.

Aim

The aim of the research was to investigate the interaction between episodic and prior knowledge in naturalistic environments. They wanted to see how prior knowledge (semantic memory) was used to reconstruct memory for photographs of normal everyday settings (episodic recall), such as hotel, kitchen, and office.

Procedure

Initial testing

An important element of the investigation was to first assess prior knowledge, and therefore expectations, about the naturalistic scenes they would show participants. A random sample of 22 participants was recruited from an experimental participant pool at the University of California, Irvine. To assess prior expectations, one group of participants was required to list objects that they would expect to find in five naturalistic scenes (office, kitchen, hotel, urban, and dining). Participants were required to enter their responses on a computer for at least one minute per scene. The frequency of objects named was recorded as a measure of prior expectation.

A separate group of 25 participants was shown 25 images of the five scenes; office, kitchen, urban, hotel and dining (there were five images of each scene), and asked to name all the objects they could see as a measure of perception. This initial testing was an important control to ensure that objects were not overlooked because they were not perceptible in the image.

The frequency of objects named in the expectation test and then identified in the perception test was recorded. The top ten most frequently recalled objects were analysed along with low frequency recall objects. Expectation of high frequency objects tended to be associated with iconic objects from each scene, such as television in a hotel room (22/22 participants), a table in a dining room (19/22 participants), and a computer in an office (20/22 participants). This prior testing suggested that people have good prior knowledge of each scene that seems largely representative of each naturalistic environment.
The experimental memory condition

Using the same experimental pool, 49 participants who had not taken part in either the expectation or perception test were randomly selected. Ten of the stimulus images from the prior tests were chosen to be used in the experiment (two from each scene that elicited the most objects named in the perception test). From these, two sets of five images, one from each scene, were formed. Participants only viewed one set of five images to avoid carry-over effects from viewing more than one image from the same scene type.

Participants were shown the five images for either 2 or 10 seconds to control for exposure duration. There were four possible trial time orderings, and participants were randomly allocated to one of these time orderings.

So, for example, one participant might see:

Set 1
The kitchen scene for 10 seconds
The hotel scene for 10 seconds
The urban scene for 10 seconds
The dining scene for 2 seconds
The office scene for 2 seconds

Exposure duration was manipulated to alter the extent to which participants used prior knowledge in episodic memory retrieval. It was thought that recall from short exposure duration of 2 seconds would rely more heavily on prior knowledge, as the event would have had little opportunity to be encoded as an episodic memory. It was also thought that the correct recall of objects not consistent with a scene (e.g. a microwave in an office) could only be recalled from episodic memory, and recall of objects that were missing from the image (e.g. a table cloth missing from the dining scene) could only be recalled using semantic memory/prior knowledge. The trials were randomised and participants were asked to carry out free recall of objects they remembered from each scene in their own time.

The researchers noted down all objects that were recalled by participants and the order in which they were remembered. Responses were normalised to remove plurals (‘chairs’ was treated as ‘chair’) and additional descriptive content (‘silver car’ was treated as ‘car’).

Results

Analysis of errors:
Recall of objects that were also listed in the perception test was recorded as accurate.

Table 2.10 Average recall rate.

<table>
<thead>
<tr>
<th></th>
<th>2 second exposure duration</th>
<th>10 second exposure duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean number of objects recalled during free recall</td>
<td>7.75</td>
<td>10.05</td>
</tr>
</tbody>
</table>

Steyvers and Hemmer used the initial analysis of high and low probability of recall rates for objects based on expectation to analyse the results. It was found that incorrect recall of highly probable objects was 9 per cent and incorrect recall of low probability objects was 18 per cent.

These error rates ran in contrast to previous research that suggested that error rates were high for high probability objects. However, this low error rate for high probability objects is unsurprising as they were likely to be present in the unmanipulated naturalistic scenes. This suggests that when participants are presented with scenes that are representative of naturalistic contexts and unmanipulated by experimental control, memory of such scenes is quite accurate. Where scenes do not represent real-life context accurately, such as a dining scene without a table cloth, the error rate increased to 19 per cent.

Key term

Free recall: recall of stimulus material in any order and without memory cues.
The effect of prior knowledge:
The effect of prior knowledge (semantic memory) was assessed by comparing the correct number of objects guessed in the expectation test, to those objects actually recalled in the two experimental conditions (2- and 10-second duration exposure). The cumulative accuracy of object guesses based on the expectation test was over 55 per cent from semantic memory under initial testing, and the actual recall in both conditions was much higher, over 80 per cent, suggesting that episodic memory played a significant role in recall.

Unsurprisingly, they found that longer duration improved recall overall; with short exposure to the picture, seven objects were correctly recalled on average compared with nine objects recalled with longer exposure to the picture.

Conclusions
It seems that in recall of naturalistic scenes, prior knowledge drawn from semantic memory can contribute to accurate recall in episodic memory tasks, when such scenes are unmanipulated. We draw on general knowledge as good guesses of what is expected to be seen in such contexts. Prior knowledge contributes greatly to recall of naturalistic environments, but this is not at the expense of accuracy; in fact we are more likely to notice novel items more readily than previous research might suggest.

Adopting a naturalistic approach to the study of memory has highlighted that prior research tends to be unrepresentative of everyday event recall; removing high probability objects from a familiar context will induce false memory and give a misleading view of memory as unreliable. When using untampered naturalistic contexts, guesses can be effective because of the high probability of the objects being present. This guessing frees up cognitive resources to be better spent focusing on novel and unexpected objects in a scene. In this sense, both recall of inconsistent and consistent objects is benefitted using a more ecologically valid approach.

Evaluation
Steyvers and Hemmer are strong advocates for increased ecological validity in memory research to be able to generalise findings to everyday use of memory. But they acknowledge that their research is not as naturalistic as it could have been. Using photographs rather than exposing participants to real environments, and using laboratory rather than real conditions. As such, this research goes some way to trying to establish greater ecological validity in the field of memory research, but does so without compromising generalisability and operationalisation of concepts.

Important controls were used in this investigation. A control during the memory experiment was that the participants only viewed one image from each of the five scenes rather than multiple images of each scene. This was to prevent interference from a previously viewed scene of a similar nature affecting subsequent recall. Time orderings were manipulated using a Latin square design, and participants were randomly allocated to one of the time ordering sequences.

This research has important implications for the way in which eyewitness testimony is viewed in the justice system. It suggests that contrary to previous research, prior knowledge from semantic memory can enhance recall of episodic events and even allow greater cognitive effort to be spent on recognising unexpected features of a context. This implies that eyewitnesses are effective when recalling from familiar contexts and effective at encoding novel features.
Sebastián and Hernández-Gil’s (2012) study of the developmental pattern of digit span

Working at the University of Madrid, Mariá Victoria Sebastián and Laura Hernández-Gil examined the developmental pattern of digit span in the Spanish population to test the phonological loop component of working memory (Baddeley and Hitch, 1974). They set out to investigate the capacity of the phonological loop to understand whether it would differ in a Spanish population across different ages. Anglo-Saxon research concluded that digit span increased with age, so Sebastián and Hernández-Gil wanted to see whether the same developmental trend occurred in a different culture to assess whether Anglo-Saxon findings could be generalised using the same digit span procedure.

Aims

To investigate the development of the phonological loop in children between the ages of 5 and 17 years using digit span as a measure of phonological capacity. They also wanted to compare the findings to their previous research of adult, aged and dementia patients.

Procedure

A sample of 570 volunteer (or volunteered) participants were taken from schools in Madrid. All participants were native Spanish and impairments in hearing, reading and writing ability were controlled. Participants were divided into five different age groups and the average digit span was recorded for each age and age group. Tested individually, participants were read increasing sequences of digits to recall in the correct order. The digits were read out at a rate of one per second and the digit list increased one digit per sequence. The digit span for participants was recorded as the maximum digit recalled in the correct order without error.

Results

Table 2.12 Mean average (and standard deviation) digit span for each age and age group.

<table>
<thead>
<tr>
<th>Age groups mean (SD) digit span</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preschool (5 years)</td>
</tr>
<tr>
<td>Primary school (6–8 years)</td>
</tr>
<tr>
<td>Primary school (9–11 years)</td>
</tr>
<tr>
<td>Secondary school (12–14 years)</td>
</tr>
<tr>
<td>Secondary school (15–17 years)</td>
</tr>
</tbody>
</table>

Table 2.11 Example of digit span measure.

<table>
<thead>
<tr>
<th>Read out digits</th>
<th>Recall of digits in sequential order</th>
<th>Digit span</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 5 9 4 5</td>
<td>2 5 9 4 5</td>
<td>Correct</td>
</tr>
<tr>
<td>3 7 8 1 6 9</td>
<td>3 7 8 1 6 9</td>
<td>Correct</td>
</tr>
<tr>
<td>9 0 1 5 2 6 8</td>
<td>9 0 1 5 2 6 8</td>
<td>Correct Maximum digit span of 7</td>
</tr>
<tr>
<td>4 3 7 5 9 2 1 5</td>
<td>4 3 7 - 9 2 7 2</td>
<td>Errors and omission</td>
</tr>
</tbody>
</table>

The table shows clearly a developmental trend of increasing digit span with age. Children aged 5 years have a very low digit span that rises steadily until around 11 years old where it slows. The digit span between 15 and 17 years remains fairly stable.

Comparing the findings to previous research

Comparing the findings of this study to previous related research conducted by Sebastián and Hernández-Gil, they found that elderly participants had a significantly higher digit span compared to the 5-year-olds in this study, but it was not significantly different from other age groups. Patients with advanced dementia (AD) showed a similar profile (mean digit span 4.2). However, patients with frontal variant frontotemporal dementia (fvFTD) had a digit span that was significantly similar to the younger age group. Comparing the elderly group to the dementia patients showed no significant difference, suggesting that impoverished digit span was a consequence of ageing rather than dementias.

Key terms

Frontal variant frontotemporal dementia: A degenerative neurological disease that affects the frontal lobes of the brain.

Advanced dementia: The later stages of dementia where symptoms are more profound.
Consistent with Anglo-Saxon research, this investigation showed a continued increase in digit span over time in the Spanish population. However, the overall capacity of digit span was far lower in the Spanish population compared to the digit span of seven found in Anglo-Saxon studies. This decrease in phonological capacity could be accounted for by the nature of the Spanish language. Digits in Spanish tend to be two or more syllables (e.g. uno, cuatro, cinco, ocho), compared to the monosyllabic Anglo-Saxon numerals (e.g. one, two, three, four). This word (or digit) length effect means that it takes more time to sub-vocally repeat and rehearse Spanish words, taking up more space in the phonological loop, resulting in a lower digit span.

To further support the word length effect as an explanation for the difference in digit span, differences at each age was examined. As sub-vocal rehearsal does not appear until the age of 7–8 years, there should be no difference in digit span as a result of word length effect until after this age. This was found to be true as, before the age of 7 years, differences between Spanish and Anglo-Saxon counterparts were not found. At age 9 years, there is a noticeable difference in digit span, suggesting that word length effect occurs once sub-vocalisation appears in phonological development. However, unlike previous research, this study speculates that digit span in the Spanish population increases beyond the age of 15 years.

**Conclusions**

Digit span was found to increase with age; the starting point of this development occurs when children are able to sub-vocalise at around 7 years. Digit span in the Spanish population is significantly shorter than Anglo-Saxon culture, probably due to the word length effect associated with digits. Comparing the findings to research into patients with degenerative neurological disease and the aged population, it is possible to speculate from this research that poor digit span is a result of ageing rather than dementias.

**Evaluation**

Digit span experiments are measures of the phonological loop proposed by Baddeley and Hitch (1972). However, we rarely use verbal memory to memorise lists of digit in everyday life, other than when trying to rehearse a telephone number. Everyday verbal memory is used to hold sequences of words in order to comprehend sentences, master new languages or aid reading of complex information. Therefore it is open to question whether or not digit span experiments reflect everyday use of verbal memory. However, digit span tests have been reliably linked to performance in reading ability and intelligence, suggesting they are a good general measure of verbal memory. Digits, rather than word sequences or sentences, are also considered to be a culture-free and meaning-free way of measuring pure verbal memory. However, based on the cultural differences found, digits may not be the best culture-free determinant of verbal memory capacity.

Cultural differences in digit span have been reported by other researchers. Ellis and Hennelley (1980) reported poorer digit span in Welsh-speaking children compared to English children, largely because Welsh words for digits take longer to pronounce than English digit words. Longer digit spans have been reported in Chinese because the words for digits are short (Stigler et al., 1986). This research supports the finding that language and the phonological loop are interrelated.

A large sample size was tested in this study, allowing the findings to be considered reliable and generalisable to the Spanish population as a whole. The sample size gathered was important for this research because comparisons were made across different cultures. The study also excluded participants with any hearing, reading or language impairments, known to diminish digit span, which could have affected the results.
2.4 Key questions
Learning outcomes

In this section you will learn about one key issue of relevance in today’s society. You will need to be able to:

- describe the key issue and its importance to today’s society
- apply concepts, theories and research used in cognitive psychology to explain the key issue.

This section will describe an example of the key issue of how our knowledge of working memory can be used to inform the treatment of dyslexia as a reading disorder. However, you can choose your own key issue and relate it to theories, concepts and research used in the cognitive approach.

Can knowledge of working memory inform treatments for dyslexia?

Dyslexia is a reading disorder associated with poor or inefficient working memory. Children with dyslexia find it difficult to hold enough information in working memory to be able to blend sounds to form a word and find associating letters to sounds problematic. This results in slower reading and writing ability. They have particular phonological deficits too, meaning that they code phonology inefficiently in the brain, causing problems with short-term verbal memory such as difficulties with non-word repetition, rapid naming and learning a new language. Ultimately, the memory problems associated with dyslexia mean that skills associated with reading, writing, spelling and grammar are impaired.

These difficulties are often detected during preschool and early years education, and a number of classroom strategies have been identified in order to help students with dyslexia.

Interventions based on working memory

There are currently two main interventions used to help children with dyslexia in schools. One is a classroom-based approach that aims to alter the teaching and learning environment to better suit children with working memory problems. These classroom strategies are easy to implement by educators and can be used with all children to aid learning. The second is direct intervention to help children with literacy difficulties to improve their working memory. There are several types of direct intervention programmes, but all aim to help children practise and develop working memory using specific or a variety of tasks targeted at increasing processing speed and strategies for remembering.

Classroom strategies approach

Strategies used in the classroom to help children with dyslexia include:

- clearly stating lesson aims
- using checklists
- simplifying instructions
- highlighting or colour coding information
- using audio and visual materials
- avoiding asking a child to read out loud.

By simplifying and breaking down classroom tasks it avoids overloading the limited working memory capacity associated with dyslexia. Because dyslexia is also associated with slower processing speeds, avoiding lengthy periods of teacher talking and using alternative delivery methods can work better to prevent phonological loop overload.

Taking it further

Consider whether the introduction of PowerPoint® into the classroom has been of benefit to children with dyslexia. Make a list of the arguments for and against using PowerPoint® with children with a literacy impairment.
Cognitive psychology

2.4

Spelling can be difficult for a child with dyslexia because they find it hard to associate a letter sound with the printed letter. Phonics is a literacy strategy that uses phonological rules to learn letter sounds and encourages sound blending. Mathematics can also be difficult for a child with dyslexia because they are required to take different steps to solve a mathematical problem, which can overload working memory. Each arithmetic step can be written down or verbally discussed to ensure that it is broken into stages.

Direct intervention programmes

Different intervention strategies have been designed to help children with literacy difficulties in schools by directly targeting memory skills. Some of these interventions are computer based and target a range of working memory skills, such as Cogmed, or target specific memory skills, such as the N-Back programme (Klingberg et al., 2005; Jaeggi et al., 2011). These programmes have been shown to enhance working memory with long-lasting cognitive gains and academic improvement in both Maths and English.

Are interventions effective?

In a review of dyslexia interventions, Snowling and Hulme (2011) commented that for dyslexia interventions to work there should be targeted training in phonological awareness, letter-sound recognition, and practice in reading and writing. However, children present different literacy difficulties, so it impossible to implement a ‘one fits all’ strategy. They also highlight that there is currently a delay in diagnosing literacy difficulties, which can sometimes be mistaken for attention problems, making early intervention difficult.

Dyslexia, like many learning impairments, can cause social and emotional difficulties, such as a loss of self-esteem and confidence. These aspects of the condition are not treated in intervention programmes per se, but should be addressed as much as memory enhancement techniques because they may not naturally recover with working memory improvements.

In conclusion, the evidence so far suggests that there are cognitive benefits shown from both classroom-based and direct intervention strategies, particularly early interventions; however the long-term gains and transferability of these benefits to daily tasks and activities is questionable.
2.5 Practical investigation

Learning objectives

In this section you will have to design and conduct a practical investigation using a laboratory experiment in an area relevant to the topics covered in cognitive psychology. In conducting the practical research exercise, you must:

- design and conduct a laboratory experiment to gather quantitative data on a topic in cognitive psychology
- make design decisions in your planning
- collect and present the data you have gathered using appropriate tables, graphs, descriptive statistics and a non-parametric tests of difference, and draw conclusions from your data
- consider the strengths and weaknesses of your experiment and suggest possible improvements that could be made
- use typical reporting conventions to document your procedure, results and discussion.

There are many laboratory experiments in cognitive psychology that you could replicate or modify. In this section you will follow an example of a laboratory experiment used to investigate the influence of acoustic similarity on short-term memory recall. Although you may choose a different area of cognitive psychology to investigate, this section will provide a worked through example of how to go about designing, conducting and discussing a practical investigation.

Before you begin planning your practical investigation, you should review the methodology section in this topic to familiarise yourself with key terms and concepts concerning laboratory experiments.

Aim

All research begins with an aim that is typically based on current theory or research into an area. The aim of this experiment is to investigate the effect of acoustic similarity on short-term memory. This is based on the theory that the short-term store uses acoustic encoding, so similar sounding words and letters are more difficult to sub-vocalise and encode, resulting in poor recall performance. It is important that you read around the topic before you plan your practical investigation to establish a rationale for your own aim.

Hypotheses

Your practical investigation should have an experimental hypothesis and a null hypothesis. Once you have read around the topic you are interested in, you will need to decide whether your experimental hypothesis is directional or non-directional. If prior research and theory indicates the likely direction in which your results will go, you must use a directional hypothesis, but if there are conflicting theories and research, it may be more prudent to use a non-directional hypothesis.

Before a clear hypothesis can be written, the independent and dependent variables should be defined and operationalised. This practical investigation is looking to see if acoustically similar or dissimilar sounding words (the independent variable) will have an effect on recall (the dependent variable).

WIDER ISSUES AND DEBATES

Psychology as a science

Science follows the hypothetico-deductive method. This means that in order to be scientific (objective, reliable and empirical) we must first propose a testable hypothesis and then conduct an experiment to gather empirical data that will support or refute this hypothesis. In this experiment, a clear hypothesis has been predicted and measures taken to collect data that can be used to test this hypothesis.
2.5

Key terms

Order effects: the effect of practice or fatigue due to taking part in both conditions of the study.

Demand characteristics: participant behaviour altered because they may guess the study aim.

Homogenous: equal or similar.

Randomly allocated: randomly dividing the participants into each condition by, for example, picking their names out of a hat.

Counterbalancing: alternating the conditions of the study for each participant in a repeated measures design.

Randomisation: randomising the conditions of the study for each participant in a repeated measures design.

Experimental hypothesis

The experimental hypothesis for this practical investigation will be directional because prior theory and research indicates the direction of difference that is likely to be found between recall of acoustically similar and dissimilar sounding words, that is, more acoustically dissimilar sounding words will be recalled than acoustically similar sounding words.

Null hypothesis

Remember that your practical should also have a null hypothesis. For this practical investigation the null hypothesis is that there will be no difference in the number of acoustically similar and dissimilar sounding words, and any difference found will be due to chance.

Experimental design

When choosing an experimental design, it is worth considering the strengths and weaknesses of each. An independent groups design is a good design to select if you want to avoid order effects and demand characteristics, but it can mean that the individual differences between participants in each group may affect your results. A repeated measures design avoids individual differences, but has the problem of order effects and demand characteristics.

In this experiment the aim is to examine encoding in short-term memory which, unless affected by age, illness or a learning impairment, is relatively similar between participants. If the sample you select is fairly homogenous, individual differences should not be a significant problem. However, order effects are likely to be a problem if participants are asked to repeat the memory test, particularly immediately after one another, and they may guess the aim of the study if you are involved in both conditions of the experiment.

On balance, an independent groups design should work to avoid order effects and demand characteristics, and you can be reasonably assured that the individual differences in memory between participants is not going to impact on your results. However, to evenly distribute any individual differences in short-term memory span, participants can be randomly allocated to each condition of the experiment.

If you chose to use a repeated measures design for your experiment, it is worth considering using counterbalancing or randomisation of conditions.

Sampling

Selecting a sampling method involves considering your target population and using a sampling technique that draws out a representative sample of people. This means that you can confidently generalise your findings back to the target population. For this experiment, the target population is very large as it can involve any individual with a reasonably intact and unimpaired short-term memory. This means that it would be difficult and time-consuming to use a random or stratified sampling technique, so either a volunteer or opportunity sample would be more efficient.

The volunteer sampling technique encourages participants with a particular compliant nature. This would be a problem for social psychological research, but as cognitive processing is relatively unaffected by personality type and an independent groups design is being used, the volunteer sampling technique is probably more ethical than an opportunity sample. No one is being directly asked and put under pressure to participate.

Twenty participants will be selected from the first twenty who respond to an advert placed in a sixth-form common room, excluding anyone with short-term memory impairment.
Operationalisation means that you need to make your independent variable and dependent variable specifically defined. The independent variable in this experiment is whether the words presented to participants are acoustically similar or dissimilar in sound. This will be operationalised by presenting one group of participants with ten monosyllabic words that rhyme (acoustically similar) or ten monosyllabic words that do not rhyme (acoustically dissimilar). The dependent variable will be the total number of accurately recalled words from the original list in a free recall memory test. It is very important that you operationally define both your independent and dependent variables.

WIDER ISSUES AND DEBATES

Psychology as a science
Operationalisation is very important to establish objectivity and reliability in psychological research. In this experiment operationalisation has been achieved by defining the type of words each group of participants will receive, and exactly what will be measured as an outcome. With good control over extraneous variables, it is possible to establish a cause and effect relationship between the IV and the DV in this experiment.

Controls

Situational variables
Because you are conducting a laboratory experiment, the environment will be reasonably well controlled already. However, it is worth considering any situational variables that are likely to have an effect on participants. In this experiment it would be important to control for any noise or interruptions that might affect learning and recall, so participants will be tested individually and a sign will be placed on the door to prevent interruptions. To prevent conferring, and therefore the potential for demand characteristics, all participants will be placed in a room, called out individually to do the memory test, and will be told not to return. The procedure will also be standardised to prevent experimenter effects occurring.

Participant variables
Although cognition is reasonably similar in the majority of people, individual differences are not likely to have a huge impact on your investigation. However, it is worth considering significant individual differences such as age and learning impairments. Once you have identified potential individual differences between your participants, you will need to either control them or eliminate them. In this practical investigation individual differences in short-term memory will be controlled by equally distributing them using random allocation of participants to the conditions of the experiment. However, a short questionnaire will be conducted prior to the experiment to check for any short-term memory problems by asking participants about their educational needs. There will, of course, be participant variables that are not controlled for, such as motivation. However, the experiment will be conducted in the morning to prevent any possible effects of fatigue that might occur later in the day.

Developing a procedure
A procedure should be a schedule of what happens, where, when and how. This ties into how you will control for extraneous variables and it is important that the procedure stays the same for all participants. In this experiment, participants will be read a set of standardised instructions by the researcher and asked to sit at a desk directly in front of a whiteboard and projector. To prevent

Example standardised instructions
Thank you for volunteering to take part in this memory experiment.
You will see a set of ten words appear one at a time on the whiteboard in front of you. Each word will appear for 3 seconds and you will need to learn as many as you can. Immediately after the tenth word, you will see a blank screen, this is a cue for you to write as many words as you can remember on the piece of paper in front of you. You may write them down in any order and you will have 1 minute to remember all the words that you can.
If you wish to take part, please sign the consent form in front of you. If you do not wish to take part, please let me know now. If you wish to leave the experiment, you are free to do so at any point. This is not a test of intelligence.
Do you have any questions you would like to ask before we begin?
Cognitive psychology

 demande characteristics, the participants will be told what they will be required to do, but not why they are doing it or what other participants will be doing. The words will be presented one at a time for a duration of 3 seconds per word. Participants will be given a pen and paper to recall in any order the words they have learned immediately after the words have been presented. They will be given 1 minute to recall the word list. This standardised procedure will mean that all participants will be treated in exactly the same way, and will minimise any experimenter effects.

Apparatus

Any research into memory typically involves participants learning something, whether it is a list of words, letters or digits, a set of images, or a simulated event. Your apparatus will depend on your aim, but it is worth considering the nature of the apparatus you ask participants to remember. A word list may seem fairly straightforward, but you need to remember that some words are easier to remember or more memorable than other words. It may be worth considering using a list of high frequency words, words of similar syllable length (particularly for short-term memory research) or using letters or digits instead.

This practical investigation uses monosyllabic words to ensure that each word takes up an equal amount of short-term storage capacity. The words have also been selected for being high frequency, so that each list is equal in familiarity and difficulty.

Table 2.13 Apparatus: word lists.

<table>
<thead>
<tr>
<th>Acoustically similar sounding words</th>
<th>Acoustically dissimilar sounding words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat</td>
<td>Pan</td>
</tr>
<tr>
<td>Mat</td>
<td>Ten</td>
</tr>
<tr>
<td>Hat</td>
<td>Mill</td>
</tr>
<tr>
<td>Lot</td>
<td>Hit</td>
</tr>
<tr>
<td>Hot</td>
<td>Gun</td>
</tr>
<tr>
<td>Dot</td>
<td>Dog</td>
</tr>
<tr>
<td>Cot</td>
<td>Get</td>
</tr>
<tr>
<td>Den</td>
<td>Hot</td>
</tr>
<tr>
<td>Pen</td>
<td>Bun</td>
</tr>
<tr>
<td>Hen</td>
<td>Pit</td>
</tr>
</tbody>
</table>

Ethical issues

Before undertaking any psychological research it is essential you consider the ethical implications of your research. Both the British Psychological Society (BPS) and British Education Research Association (BERA) guidelines should be consulted and adhered to as closely as possible, even for a small A-level practical investigation. Any research can make participants feel pressured, intimidated, embarrassed or concerned. It is important that ethical issues are given careful thought before proceeding with your experiment. If you are unsure whether your experiment will present any ethical issues, you may wish to conduct a pilot study on family and friends first and ask them how they felt during the experiment.

Valid consent

In this experiment, participants have been asked to volunteer for an experiment into short-term memory. This is clearly stated on the recruitment advertisement. However, participants will not be entirely aware of the full aim of the experiment until after they have completed the memory test. This means that, although consent to take part has been given, fully informed consent has not been achieved because the true nature of the experiment has been partially withheld. When deciding on whether to gain fully informed consent for your own experiment, it is worth considering whether knowledge of the aim will affect the performance of participants and whether the participants are likely to refuse to take part if they did know the full aim. It might be prudent to ask other people whether they would object to taking part in your experiment; if they would not mind, you may assume presumptive consent. Where possible, fully informed consent should be gained or otherwise fully justified, and no offer of incentives should be given for taking part in the investigation.

Example advert for a psychology experiment

We are looking for volunteers for a psychology experiment on memory. You will be asked to learn a list of words to remember and recall; this will measure your short-term memory. This is an experiment for my A-level practical investigation, which may be used in my exam.

The study will take place in the psychology classroom on Monday morning. You will be required for most of the morning, but the actual memory test will take only 2 minutes. You will be tested...
Because the participants being recruited for this experiment are under the age of 18 years, it is necessary to gain consent from a parent or guardian of the child. In this experiment, details of parents/carers were gained from the volunteers and a consent form was sent out to parents with information about the experiment. You will also need to consider whom consent needs to be gained from if your participants are considered to be children. You should provide an information sheet for both parents/guardians and participants setting out the nature of your experiment.

**Right to withdraw**

In any psychological investigation, it is very important to offer participants a right to withdraw. This means that they can elect to leave the study before, during or after the experiment has taken place. If they withdraw from the study after it has happened, the participant’s results should be destroyed. In this experiment, participants were offered a right to withdraw in the recruitment advertisement, the standardised instructions and debrief.

**Example debrief**

Thank you for taking part in this psychology experiment into memory.

You were given a list of ten words to learn and recall. The words you were given either rhymed or did not rhyme. This was to test whether dissimilar sounding words were more easily recalled from short-term memory than similar sounding words. Psychological theory predicts that, because we use rehearsal to hold information in short-term memory, we will be better at rehearsing dissimilar sounding words. Similar sounding words will be more difficult to rehearse because they can be confused.

Your memory test score was X out of ten, which is in normal range for this type of experiment.

This result will only be used for my A-level practical investigation. Your result will be anonymised and the data destroyed after the exam. If you feel uncomfortable with this, you may withdraw your results.

Do you have any questions?

Thank you for your time.

**Risk**

It is important to consider whether your participants will be protected from harm. Harm can be physical or psychological. Under no circumstances should you physically harm your participants, and you will have to think very carefully about whether they will suffer any psychological harm, even modest harm such as embarrassment or stress. In this experiment participants are reminded of their right to withdraw, the results were anonymised, and they were told that the test is not a measure of intelligence. It is also important that participants are given an opportunity to ask any questions they may have arising from the research. This can help alleviate any anxiety before the test and any embarrassment caused by the test.
Analysing the results

Gather together the results from the participants and present them in a raw data table, like the one in Table 2.14.

<table>
<thead>
<tr>
<th>Participant number</th>
<th>Total number of similar sounding words recalled</th>
<th>Participant number</th>
<th>Total number of dissimilar sounding words recalled</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
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<td>8</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>4</td>
<td>20</td>
<td>9</td>
</tr>
</tbody>
</table>

This raw data indicates that the highest number of words was recalled when the words presented were acoustically dissimilar and the lowest number recalled was from the acoustically similar list. The raw data seems to support the experimental hypothesis. However, raw data can be difficult to interpret and represents individual scores. To help interpret the findings, descriptive statistics can be useful to present a summary of the average score achieved in a data set. Measures of central tendency, such as mean, median and mode, and measures of dispersion, such as range and standard deviation, should be presented in a summary table, as shown in Table 2.15.

<table>
<thead>
<tr>
<th></th>
<th>Acoustically similar sounding words</th>
<th>Acoustically dissimilar sounding words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median of words recalled</td>
<td>5</td>
<td>8.5</td>
</tr>
<tr>
<td>Mode of words recalled</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>Mean number of words recalled</td>
<td>5.5</td>
<td>8.1</td>
</tr>
<tr>
<td>Range of words recalled</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>2</td>
<td>1.6</td>
</tr>
</tbody>
</table>

The mode score for acoustically similar sounding words were 3, 4, 5 and 7, so is not a useful modal score to present. However, overall, the measures of central tendency suggest that more acoustically dissimilar words were recalled than similar sounding words. The measures of dispersion suggest that there was greater spread of results for the acoustically similar sounding words than the dissimilar sounding words, but this was only slightly greater. It perhaps suggests that some participants found it slightly easier or more difficult to recall the words than others within the acoustically similar word group.

Maths tip

All tables should be clearly labelled and titled to make it clear to the reader what the table represents and what the figures in the table mean.
The mean of words recalled seems to reflect the typical score achieved by participants in both conditions of the experiment, so this statistic can be graphically represented in a bar chart.

![Figure 2.13 A bar graph to show the mean recall of acoustically similar and dissimilar sounding words.](image)

**Drawing conclusions**

From the data gathered and presented, it is important that you can draw conclusions from your findings. This can involve going beyond the findings and relating your data to the concepts under investigation. This practical investigation found that participants recalled fewer acoustically similar sounding words compared to acoustically dissimilar sounding words. The typical recall score achieved by participants given acoustically similar sounding words was, on average, three words fewer than for dissimilar sounding words. However, the distribution of scores suggests that there was a large degree of individual variation in recall for both groups, which was marginally greater for the acoustically similar words group. This demonstrates that some individuals found word recall easier and some more difficult than others.

**Inferential test of significance**

To determine whether the findings of the practical investigation are statistically significant, or just due to chance, you will have to run your data through an inferential test. For your practical investigation you will need to gather quantitative data that is at ordinal level or above, and therefore conduct either a Mann-Whitney U or Wilcoxon non-parametric test of difference. If you have used an independent groups design you will use a Mann-Whitney test, or if you have used a repeated measures design you will use a Wilcoxon test.

This practical investigation used an independent groups design, so a Mann-Whitney U test was run on the data:

**Mann-Whitney U test formulae**

\[
U_a = n_a n_b + \frac{n_a (n_a + 1)}{2} - Z_a
\]

\[
U_b = n_a n_b + \frac{n_b (n_b + 1)}{2} - Z_b
\]

(U is the smaller of \(U_a\) and \(U_b\))
Table 2.16 Scores for each group: words recalled.

<table>
<thead>
<tr>
<th>Total number of similar sounding words recalled</th>
<th>Rank</th>
<th>Total number of dissimilar sounding words recalled</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td></td>
<td>Group B</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3.5</td>
<td>9</td>
<td>16.5</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>1.5</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>16.5</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>19.5</td>
<td>10</td>
<td>19.5</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>9</td>
<td>16.5</td>
</tr>
<tr>
<td>8</td>
<td>13</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>10</td>
<td>19.5</td>
</tr>
<tr>
<td>4</td>
<td>3.5</td>
<td>9</td>
<td>16.5</td>
</tr>
<tr>
<td>Sum total of points</td>
<td>89.5</td>
<td>Sum total of points</td>
<td>138.5</td>
</tr>
</tbody>
</table>

The sum of the ranks for group A and group B should be used in the following formulae:

\[ U_a = N_a \times N_b + N_a \times \left( N_a + 1 \right) / 2 - R_a \]
\[ U_b = N_a \times N_b + N_b \times \left( N_b + 1 \right) / 2 - R_b \]

\[ U_a = 10 \times 10 + 10 \times 11 / 2 - 89.5 \]
\[ U_b = 10 \times 10 + 10 \times 11 / 2 - 138.5 \]

\[ U_a = 65.5 \]
\[ U_b = 16.5 \]

This should be compared to a table of critical values for a Mann-Whitney U test.

Table 2.17 Critical values of U for a one-tailed test at 0.05; two-tailed test at 0.1 for a Mann-Whitney U test.

<table>
<thead>
<tr>
<th>n</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
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<tbody>
<tr>
<td>1</td>
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<td>-</td>
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<tr>
<td>2</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
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<td>1</td>
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<tr>
<td>3</td>
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<td>1</td>
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<td>2</td>
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<td>4</td>
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<tr>
<td>4</td>
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<td>0</td>
<td>1</td>
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<td>7</td>
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<tr>
<td>5</td>
<td>-</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>14</td>
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<tr>
<td>7</td>
<td>-</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>11</td>
<td>13</td>
<td>15</td>
<td>17</td>
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<td>3</td>
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<td>13</td>
<td>15</td>
<td>18</td>
<td>20</td>
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<tr>
<td>9</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
<td>18</td>
<td>21</td>
<td>24</td>
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<tr>
<td>10</td>
<td>-</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>11</td>
<td>14</td>
<td>17</td>
<td>20</td>
<td>24</td>
<td>27</td>
</tr>
</tbody>
</table>

The observed value of U is significant at the given level of significance if it is equal to or less than the table (critical) value above.

The calculated (observed) Mann-Whitney U-value is 16.5. This is less than the table (critical) value at \( p \leq 0.05 \) of 27, with \( N = 10, 10 \). Therefore, the result is significant at \( p \leq 0.05 \) for a one-tailed test. Therefore the experimental hypothesis can be supported. In fact the calculated (observed) value is less than the critical value for a one-tailed test at \( p \leq 0.01 \), meaning that the result is highly significant and therefore the difference between the recall of the groups is unlikely to be due to chance. This means that the likelihood of making a type 1 error is reduced and the experimental hypothesis can be supported with confidence.
Making a statistical statement
Following your statistical test, it is important to make a statistical statement and support or reject your hypotheses. Your statistical statement should include the following information:

- the statistical test used
- the observed/calculated value
- whether a one- or two-tailed test was used
- the level of probability
- the number of participants
- the critical value used
- whether the calculated value was greater than/equal to/less than the critical value
- whether the result is significant or not
- which hypothesis it supported.

Discussion
A discussion section of a report will include a summary of the findings and how these relate to the wider concepts, theory and prior research related to the study. It will also include the strengths and weaknesses of the practical investigation and suggestions for possible improvements and new directions for the research.

In this practical investigation it can be concluded that there was a significant difference between recall of acoustically similar sounding and dissimilar sounding words; acoustically dissimilar sounding words were significantly less well recalled. This finding is consistent with theory which suggests that encoding in the short-term store is primarily acoustic, making similar sounding words difficult to sub-vocalise (rehearse) and maintain compared to dissimilar sounding material. This is also consistent with research conducted by Sperling (1963) who found that participants had difficulty remembering acoustically similar letters (B, D, T) compared to acoustically dissimilar sounding letters (F, L, M, X).

Critical evaluation
It is important to consider both the strengths and weaknesses of the practical investigation. For this, you will be better placed to judge the successes and failures with regard to your own procedure and outcomes. However, a number of general questions should be asked.

- Is the study ethical?
- Can you generalise the findings to others/different cultures/different eras?
- Is the study reliable?
- Is the study carried out in a natural or artificial environment?
- Is the task ordinary?
- Are the findings useful in real life?
- Is the research valid?
- Is there any conflicting evidence from other research?

Is the task ordinary?
This is a common question asked of much cognitive research conducted in laboratories using series of stimulus lists of words, letters and digits, seemingly unrelated to memory tasks that occur in ordinary everyday life. It is true that we are often required to draw on our memory for shopping
lists, telephone numbers or random sequences. However, this is not a typical activity for memory to undertake and often takes a degree of conscious processing and effort. For this reason, the task used in this practical investigation may be criticised for not reflecting an ordinary use of memory.

However, the task was intended to investigate encoding in the short-term store in a way that actually measured short-term memory in its most pure form, unaffected by the meaningfulness of everyday material. In order to study memory this practical investigation had to remove the social context in which memory normally operates in order to remove variables that could potentially confound the research. This can be more easily understood by comparing psychology to biology as a subject. No one would criticise a biologist for collecting blood in a test tube to determine its blood group, yet a test tube is not a natural state for blood to exist. In order for the blood to be tested, it needs to be collected from the body and isolated from contamination. This experiment performed the same function to test encoding in short-term memory.

**Suggestions for improvement**

In addition to considering the strengths and weaknesses of your practical investigation, you should also refer to how your study could be improved. To do this effectively you will need to consider the weaknesses of your research and how these weaknesses could be overcome. Suggestions for improvement can be ambitious, but should not be impractical or impossible to achieve.

In this practical investigation the nature of the word lists were withheld from participants, resulting in a lack of valid consent being gained. This is a potential ethical weakness of the study that could have been improved by fully informing participants of the aim of the research. A pilot study could have been conducted where participants were told that they would receive either a similar sounding word list or a dissimilar sounding word list, and participants could have been asked later whether this knowledge affected their performance. This is a useful suggestion to improve the ethical problem with the practical investigation that is not impractical and would not ruin the research.

**Writing up the report**

Psychological investigations are written following a set of conventions for report writing as shown below.

**Conventions of report writing**

Abstract: a summary of the background theory/research, aims, hypotheses, method, results and discussion. This is a short paragraph overview of the entire report.

Introduction: an overview of related theories and research in the topic area. The introduction provides a rationale for the current investigation that links prior research to the study aims and hypotheses.

Method: a detailed account of the participants, sampling method, apparatus, procedure, controls and ethical issues.

Results: a detailed account of the data gathered and its analysis using descriptive and inferential statistics.

Discussion: conclusions drawn from the results analysis, reference to prior research, strengths, weaknesses and possible improvements for future research.

To complete your practical investigation, it is necessary and useful to follow these conventions when writing up your report.
2.6 Issues and debates

Learning outcomes

In this section you will learn about issues and debates relevant to cognitive psychology. You should have already noticed that issues and debates have been mentioned throughout this topic. This section will draw together the main themes and ideas related to the cognitive approach as a whole. You will learn about:

- Ethical (including socially sensitive research), methodological and practical issues associated with cognitive research
- Reductionism as it applies to cognitive research and theory
- Different ways of explaining behaviour using alternative theories in cognitive psychology
- Whether or not cognitive psychology can be considered scientific
- The role of nature and nurture in cognitive systems and research
- How the cognitive approach and research has developed over time
- The use of cognitive psychological knowledge in society

Issues of social control

Psychology is largely concerned with how knowledge can be applied to the real world, and as such can have important applications in many areas of life, such as health, education and crime. However, we need to exercise care when applying knowledge in real life to ensure that it is not unwittingly directing the behaviour of others or encouraging social injustice. Using psychological knowledge can impact adversely on others, even if the application reflects dominant thinking at the time, this thinking may change practise or opinion. Memory research has been very influential in directing legal practise. Criminology is the application of memory research, used by police interviewers and the courts. One such theory has dominated legal practise for many years; that is the belief that eyewitnesses may not be reliable because their memory is reconstructive and prone to distortion. This has driven legal policy and police practise in an attempt to improve the reliability of testimony or ensure that eyewitnesses are not the only form of evidence used in court. This knowledge has effectively been used as a form of social control, dictating who can testify and under what conditions they can give accurate testimony.

Ethical issues associated with cognitive research

Experimental research

Cognitive psychology is largely based on experimental research into ‘normal’ participants with average memory ability. Although the full nature of experimental aims may be withheld from participants, to avoid the possibility of demand characteristics, most research gains participant consent and rarely involves deliberately violating the protection of participants by causing distress or anxiety. Some research may use deception by misguiding participants as to the true nature of the experiment, but will offer participants the right to withdraw from the research at any stage. In fact, most experimental research adheres very closely to the BPS ethical guidelines for research with human participants.

More recent experimental research into memory has adopted more naturalistic methodology, such as the field experiment. This research can involve staging realistic events for people to witness and
asking them to recall the event later on. These experiments may not ask participants for their initial consent to take part, but do gain consent after the staged incident and provide a full debrief after the memory test has concluded.

**Case studies of brain-damaged patients**

In case studies of brain-damaged patients, such as HM, participant confidentiality is maintained by ensuring that they are given pseudonyms to anonymise their identities. Research using individuals with brain damage is often criticised for violating a right to privacy; case studies of brain-damaged patients are rare and unique, which can result in them being over studied and their normal life impinged on by rigorous and intensive experimentation. This may be true of some cases where researchers may become overzealous in their research. However, Henry Molaison was reported to have enjoyed being tested and saw memory experiments as fun and challenging activities; this is perhaps because he had no recollection of any prior testing.

**Socially sensitive research**

Memory loss is a sensitive area for both the amnesia patient and the families concerned. Amnesia is a life-altering impairment that can cause an individual extreme distress because their intelligence remains virtually intact, leading to confusion and frustration about their loss of memory. However, this research is important for both psychological understanding and to benefit amnesia patient recovery.

**Methodological and practical issues associated with cognitive research**

Cognitive research often involves the use of laboratory experiments using tasks that lack mundane realism. The ecological validity of this research has often been debated, particularly when the findings are used to explain everyday memory or are applied to everyday contexts. However, laboratory experiments are often necessary to study memory in a vacuum that is devoid of variables that could affect the findings of the research, for example, the use of trigrams may not reflect ordinary information that we need to remember, but trigrams are necessary to study memory without the inference of meaning that we often associate with words or images. Ecological validity is often lost at the expense of internal validity.

**Reductionism**

Historically, the cognitive approach has tended to separate different cognitive functions, such as perception and memory, to make these cognitive processes easier to research and understand. Breaking up these areas of cognition into these separate parts can be considered to be reductionist as clearly what we remember is based on what we perceive in the first place, and to some extent perception is affected by previously stored knowledge. Bartlett recognised this in his theory of reconstructive memory, which can be considered as less reductionist than the other models of memory described in cognitive psychology. The multi-store model of memory can be considered as reductionist because it artificially fragments the short-term and long-term memory stores without discussing the interconnections between each store. Similarly, Baddeley and Hitch divided the short-term memory into slave systems for the purposes of studying working memory.

It has become increasingly acknowledged that in order to better understand memory and other cognitive processes we need to acknowledge the interplay between systems and stores. Research using brain imaging has helped us to appreciate the interrelatedness of different parts of the brain when we perform cognitive functions, and amnesia patients have helped us understand that loss of functionality may not be a direct consequence of damage to a particular region of the brain, but an interaction between different regions.
Comparing explanations

Comparing explanations of memory can be done on many levels; such as the type of research used to support the explanation, the role of nature or nurture within the explanation, or whether its emphasis is on structure or function. As an example, the explanations of memory described in this section can be compared in terms of whether they emphasize the nature of memory as a series of structures or the way that memory is processed. The multi-store model views memory as a series of stores; the sensory store, the short-term store and the long-term store, so can be considered a structural model of memory because the focus of the explanation is on the architecture of the memory system. Similarly, Baddeley and Hitch also focus their explanation of working memory on what components of short-term memory exist. Although both theories of memory acknowledge the type of processes involved in the transfer and manipulation of information, this is second to describing how memory is represented as a structural system.

In direct contrast to these structural models is Bartlett’s reconstructive memory. This explanation of memory does not attempt to describe the structure of memory, instead focusing on memory as a process or function. Reconstructive memory is a functional model of memory because it explains how stored knowledge affects perception and remembering as an active process of construction.

Psychology as a science

The cognitive approach is one of the most scientific perspectives in psychology because it largely adopts the scientific method. The dominant research method used is the laboratory experiment, which means that controls are used to establish causality between the independent and dependent variables, and research has replicability. Studies within this approach employ the hypothetico-deductive experimental method, which investigates predictions in an objective way and, unlike the inductive method, ensures that hypotheses can be refuted or supported.

The use of case studies of brain-damaged patients can be very scientific because they use highly controlled experiments and brain-imaging techniques, however, these cases are rare and often the damage is unique to the individual, resulting in a lack of generalisability.

However, the cognitive approach can study concepts that are largely theoretical with no empirical evidence to support them, such as the working memory’s central executive.

Nature–nurture

The cognitive approach emphasizes the role of both nature and nurture within its explanations of cognitive functioning. Using the computer metaphor, the cognitive approach assumes that we are born with the hardware to have the capacity to perform certain functions, such as remembering. The approach also assumes that the experiences we have during our lives change what we remember and how we process information in the same way that a programmer alters the software of a computer. How our experiences affect cognition represents the role of nurture.

Reconstructive memory describes how we all represent knowledge as schema; these are universal mental constructs (nature) hardwired into our memory, but the contents of which are affected by how we are raised and what we experience as we develop (nurture).

The case of HM is a useful example when considering the nature–nurture debate because his unique characteristics make it unclear which elements of his impairment are due to the surgery that caused his brain damage and which to the lack of schooling and seizures he experienced when growing up. Clearly the loss of his hippocampus (nature) resulted in severe amnesia, but perhaps his underperformance on certain tests could be a result of nurture.
How psychological knowledge has developed over time

The study of memory can be traced back many years, and each time that a new explanation is put forward, psychology develops a new understanding. The multi-store model was one of the first coherent theories of memory, and although now largely regarded as simplistic, it has been useful in understanding what memory might look like and has contributed to a better understanding of memory today. The multi-store model directly informed the development of Baddeley and Hitch’s working memory and Tulving’s semantic and episodic long-term memory. Similarly, within the working memory theory, a reformulation was done to fine-tune the explanation by adding the episodic buffer to explain the interrelationship between short-term and long-term memory.

More recently there has been a resurgence of interest in reconstructive memory that has led to a wealth of studies conducted into eyewitness memory which continues to debate whether we can rely on such testimony in our courts.

The use of psychological knowledge within society

The most important use of cognitive psychology is its application of explanations and research in society. A general understanding of how memory works can be used in everyday contexts, such as using mnemonics to aid revision or chunking bits of information together to remember a telephone number. Understanding how memory works can also help in the treatment of learning impairments such as dyslexia; teachers can simplify and shorten instructions and information so that working memory is not overloaded. As there is no cure for memory loss, cognitive therapies, such as cognitive stimulation, have been used with dementia patients to practise memory tasks (remembering the date, people in a group) and reduce their confusion.

One of the most significant contributions of memory has been to our understanding whether eyewitness testimony can be relied on. There has been considerable research examining the factors affecting reliability of memory, such as whether age, anxiety or post-event information can affect our ability to accurately recall an incident and identify a perpetrator. This academic research led to the Devlin Report (1976) which called into question eyewitness reliability following a number of cases of false imprisonment based on witness identification. This has led to recent changes in the Police and Criminal Evidence Act Codes of Practice in the way eyewitnesses are asked to identify a perpetrator from a line-up.
Summary

Knowledge check

Content

In the content section you are required to describe, evaluate and apply your knowledge of four theories of memory.

To check your evaluation skills, refer to the introduction section of this book and review ‘how to evaluate a theory’. Remember that you may be asked to consider issues of validity, reliability, credibility, generalisability, objectivity and subjectivity in your evaluation of theories.

Can you describe Atkinson and Shiffrin’s (1968) multi-store model of memory and understand the difference between each store in terms of their capacity, duration, encoding and forgetting?

Are you able to apply the concepts used in the multi-store model of memory to explain how we remember and why we forget?

Can you evaluate the multi-store model of memory in terms of strengths and weaknesses?

Are you confident that you can describe the components of the working memory model (Baddeley and Hitch, 1974)?

Are you able to apply working memory concepts to explain dual task performance?

Can you evaluate the working memory model in terms of strengths and weaknesses?

Can you identify and distinguish between the episodic and semantic long-term memory stores?

Are you able to evaluate Tulving’s (1972) distinction between the types of long-term memory in terms of strengths and weaknesses?

Can you describe Bartlett’s (1932) theory of reconstructive memory?

Are you confident that you can apply your knowledge of schemas to understanding everyday memory and how memory can be affected by stored knowledge?

Can you evaluate reconstructive memory in terms of strengths and weaknesses?

Can you explain individual differences in memory in terms of processing speed, autobiographical memory and schemas?

Can you describe at least one developmental difference in memory by age (see studies section for Sebastián and Hernández-Gil, 2012), dyslexia and Alzheimer’s.

Methods

Are you able to describe how laboratory and field experiments are designed and conducted?

Can you identify and write independent and dependent variables and fully operationalise each?

Can you identify and write operationalised experimental (directional and non-directional) and null hypotheses?

Are you able to identify, describe and evaluate experimental designs (repeated measures, independent groups and matched pairs), explain order effects and how problems with each design could be controlled (counterbalancing and randomisation)?
Are you able to identify and explain extraneous variables (situational and participant) and understand the impact of confounding variables?

Can you identify and explain experimenter effects and demand characteristics and consider how these could be controlled?

Can you explain what is meant by the concepts of objectivity, reliability and validity, and understand the impact and control of these concepts within the scientific process?

For quantitative data, can you identify, calculate and understand the analysis and interpretation of measures of central tendency (mean, median and mode), measures of dispersion (range and standard deviation), and percentages? Can you draw, interpret and select appropriate table and graphical representations of quantitative data (frequency table, bar graph and histogram)?

Do you understand the purpose of inferential tests, and the concept of probability?

Can you select an appropriate non-parametric test of difference (Mann-Whitney and Wilcoxon)?

Do you understand levels of significance ($p \leq 0.1$, $p \leq 0.05$, $p \leq 0.01$) and are you able to use these to interpret the results of an inferential test?

Can you compare observed and critical values on a critical values table to check whether results are significant?

Are you able to select an appropriate one- or two-tailed test according to the hypothesis and use this to interpret significance using a critical values table?

Can you explain what is meant by type I and type II errors and how the results of a statistical test may be vulnerable to these errors according to the level of significance adopted?

Can you describe, identify, draw and interpret normal and skewed distribution?

Are you able to describe the case of Henry Molaison (HM) as a case study of a brain-damaged patient, including how this case demonstrates individual differences in memory and the evaluations done of this case?

Do you understand what is meant by qualitative data, how qualitative data is conducted and interpreted and its strengths and weaknesses?

Studies

In the studies section you are required to describe, evaluate and apply your knowledge of one classic and one contemporary study of memory.

To check your evaluation skills, refer to the introduction section of this book and review ‘how to evaluate a study. Remember that you may be asked to consider issues of validity, reliability, credibility, generalisability, objectivity and subjectivity in your evaluation of studies.

Can you describe the classic study by Baddeley (1966b): The influence of acoustic and semantic similarity on long-term memory for word sequences, in terms of its aim(s), method, procedure, results and conclusions?

Are you able to evaluate Baddeley’s (1966b) study in terms of strengths and weaknesses?
Are you able to identify and describe the aims, method, procedure, results and conclusions of a contemporary study from the following list and evaluate the study in terms of strengths and weaknesses?

- Steyvers and Hemmer (2012) Reconstruction from memory in naturalistic environments.

Key question
Are you able to identify and describe a key question in cognitive psychology that is relevant to today’s society?
Can you explain this key question using concepts, theories and research that you have studied in cognitive psychology?

Practical investigation
Have you designed and conducted a laboratory experiment to investigate an area of cognitive psychology?
Can you explain how you went about planning and designing your laboratory experiment, justifying your decision making for your choice of design, sampling, operationalisation and hypothesis construction?
Can you explain your control issues for experimenter effects and demand characteristics, and ethical considerations you had?
Can you describe and analyse (using measures of central tendency and dispersion) the quantitative data that you gathered for your laboratory experiment and how you presented your data (table and graphical representation)?
Are you able to explain, justify and interpret the non-parametric test of difference that you used on your data?
Are you able to draw conclusions from your descriptive data and inferential test (including critical and observed values, and level of significance)?
Remember that you may be asked to consider issues of validity, reliability, credibility, generalisability, objectivity and subjectivity in your evaluation of your practical investigation.
Can you explain the strengths and weaknesses of your laboratory experiment and suggest possible improvements that could have been made?
Are you able to write up the procedure, results and discussion sections of your laboratory experiment in a report style?

Issues and debates (A level only)
Remember that issues and debates are synoptic. This means you may be asked to make connections by comparing issues and debates across topics in psychology or comment on issues and debates within unseen material.
Can you identify ethical issues associated with theory and research within the cognitive approach?
Can you comment on the practical and methodological issues in the design and implementation of research within the cognitive approach?

Can you explain how theories, research and concepts within the cognitive approach might be considered reductionist?

Can you compare theories and research within cognitive psychology to show different ways of explaining and understanding memory?

Are you able to discuss whether theories, concepts, research and methodology within cognitive psychology are scientific?

Are you able to discuss the nature-nurture debate in the context of cognitive psychology, in terms of which parts emphasise the role or nature and nurture or the interaction between them?

Do you understand how cognitive psychology has developed over time?

Do you understand what is meant by social control and how research within cognitive psychology may be used to control behaviour?

Can you show how the theories, concepts and research within cognitive psychology can be used in a practical way in society?

Are you able to understand what is meant by socially sensitive research and explain how research in cognitive psychology might be considered to be socially sensitive?

References


