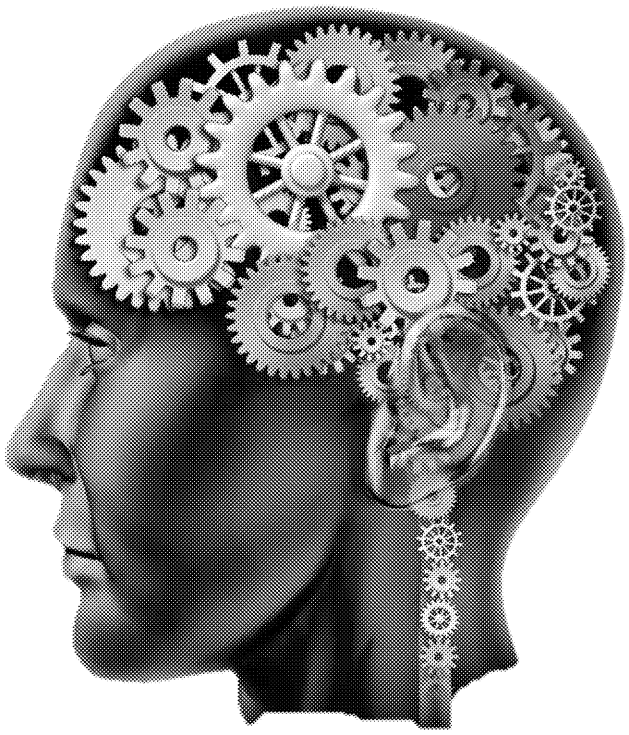
Zig Zag Education

Psychology AS and Level | Edexcel | 8PS0/9PS0

2015 specification
First exams in 2017 (2016 for AS)



Course Companion for Edexcel Psychology

Topic 2: Cognitive Psychology

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POD 7389

Contents

Teacher's Introduction

This course companion is designed to support the AS and A Level Edexcel Psycho
Psychology unit. Within the companion, cognitive psychology has been divided i
covering a single bullet point of the specification. These chapters follow the ord
knowledge of the topic can be built on and developed as the companion progres

The course companion provides a detailed set of notes on the specification conte
class by your students. Opportunities to put their learning into practice are foun
form of tasks and questions.

Tasks have been created to strengthen students' learning by providing ways to te
information they have covered. You may notice 'Try it!' boxes where memory pr
can be carried out by the students. This allows them to gain a better understanc
how it was researched.

You may also come across 'Think!' or 'Consider' boxes during chapters. These bo
students to look beyond the information in front of them and consider wider imp
relate to one another, the significance of findings and how the findings relate to
points that could be raised are provided for these boxes.

At the end of each chapter, there will be two sets of questions to reinforce your students' learning. The first set is 'Check your understanding' questions which focus on testing students' knowledge of the content they have learnt through the companion. Following these is 'Exam-style' questions which test the ability to translate this information into exam-style answers. Model answers have been provided for all questions, and also for tasks when appropriate.

A
w
in
s
a

At the end of the entire set of five chapters, there is a set of four A Level exam-st
taking both the AS and A Level courses. Each question corresponds to each of th
order, i.e. A Level question 1 is based on: 'Chapter 1: The working memory mode
'Chapter 2: The multi-store model of memory' and so on. These questions are m
The mark schemes are provided at the end of the answers section of the resourc

Chapter 1: The Working Memory

Overview

In this chapter we will learn about Baddeley and Hitch's (1974) working memory model. We will study the crucial components of this model: the central executive, phonological loop, visuospatial sketch pad and the necessary addition of the episodic buffer. We will examine how information is encoded in this model and what the capacity is for storage for these components. We will look at the evidence for these components and the strengths and weaknesses of the model as a whole.

Learning outcomes

After studying this chapter you should b

- ❑ Describe the working memory mod components
- ❑ Explain why the episodic buffer is a the model
- ❑ Describe coding and capacity in this
- ❑ Describe and evaluate the evidence
- ❑ Discuss the strengths and weakne

Key Terms

Articulatory process	Rehearses auditory information (inner voice) to prevent d
Central executive	Determines how resources, including attention, are alloca systems
Episodic buffer	Temporarily stores information and integrates informatio
Phonological loop	Encodes auditory information
Phonological store	Holds the auditory information (inner ear)
Visuospatial sketch pad	Encodes visual information
Word-length effect	People find it easier to remember shorter words than lon
Working memory	The capacity to hold and manipulate information in our s

Scene-Setting Questions

- Why is driving and texting a bad idea?
- Can we really multitask?
- In your head, do the sum 18 + 14 + 32; discuss how you did it.

A brief introduction to cognitive psychology

Cognitive psychology is interested in the study of cognitive processes such as me attention, language and problem-solving. Cognitive psychologists are interested because they affect our behaviour. We can learn more about why we behave in processes that we cannot directly observe.

Some of the questions that cognitive psychologists are interested in include:

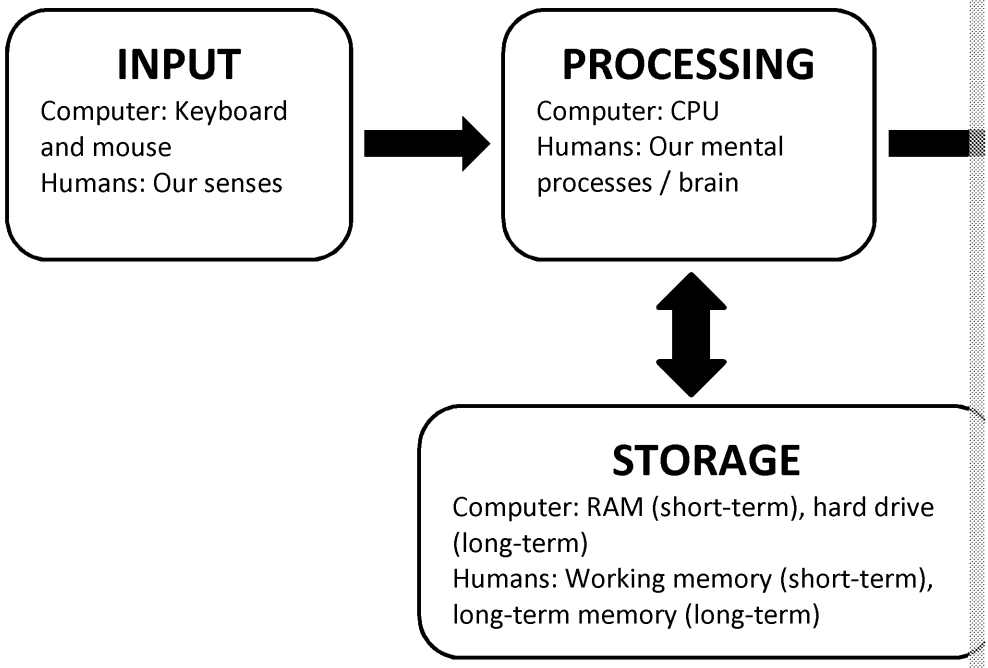
- Why do we forget?
- How do we solve problems?
- How is information stored in the brain?
- Why is our memory not accurate?
- How do we make decisions?
- How can we create human-like intelligence in a machine?
- What happens when we try divide our attention between two tasks?

'Cognition' is an umbrella term for the processes of the mind, and these include categorising information, planning, imagining and many others. It would not be children's cognitive skills and way of thinking would be different from those of a cognitive abilities improve, and the cognitive processes that underlie them beco

Developmental theorists such as Piaget examined how children's cognitive skills
what ways.

Information processing: the computer analogy
Cognitive psychologists have compared human information processing to the wa

The diagram below shows how the components of computer can be likened to o



Cognitive psychologists are especially interested in our mental processes. Two in
input but not produce the same output. Processes such as attention, perception
our output. Processing occurs in systematic ways, and cognitive psychologists ar
processes work so that it might be possible to predict the exact output if provide

However, this analogy is not foolproof. For example, computers are much faster
human mind. Additionally, computers use serial processing, which means that e
next one begins. In contrast, humans use parallel processing. In parallel process
at the same time.

What is working memory?

Tasks to try:
- Write down the directions to go from your house to your school/college.
- Use mental arithmetic to solve the sum 93 x 12.
- Work out how many doors there are in your house.

*A strategy: start by visualising walking through your front door and walk thro
layout of your house, counting the doors as you go.*

What do these tasks have in common? They all use working memory.

Working memory is the capacity to hold and manipulate information in our short-
memory, which allows you to carry out more complicated cognitive processes.
For instance, in the mental arithmetic example, you might solve it by doing:

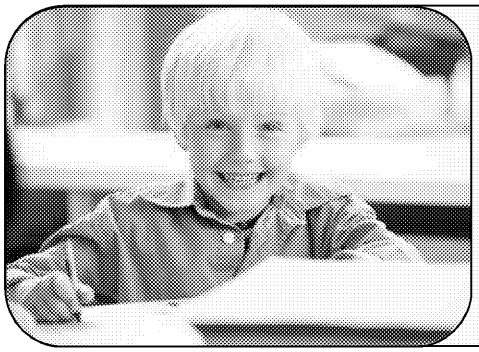
93 x 10 = 930
↓
93 x 2 = 186
↓
930 + 186 = 1116

You must hold the number 930 in your memory while you work out 93 x 2, in orc
then carry out the addition sum.

What led to the idea of working memory?
Baddeley and Hitch (1974) had participants take part in a dual-processing task w
involved participants completing reasoning tasks at the same time as rehearsing
strings. Participants were successfully able to do both tasks without a drop in ac
This led to the suggestion of more than a simple storage of information system.

Individual differences in working memory
Not everyone has equal abilities in their working memory, and lower abilities in w
memory have been associated with worse performance on attention and memor

Unsworth (2007) suggested that in a free recall task individuals with a low workin
memory might search through a larger number of items, which is slower and less
accurate than high working memory.



Real-life application: working memory
Attempts to train working memory in ch
unsuccessful, but adapting teaching app
appropriate method of helping these ch
with working memory problems forget w
so fail to complete it. This could be ren
brief to reduce working memory load, a
instructions.

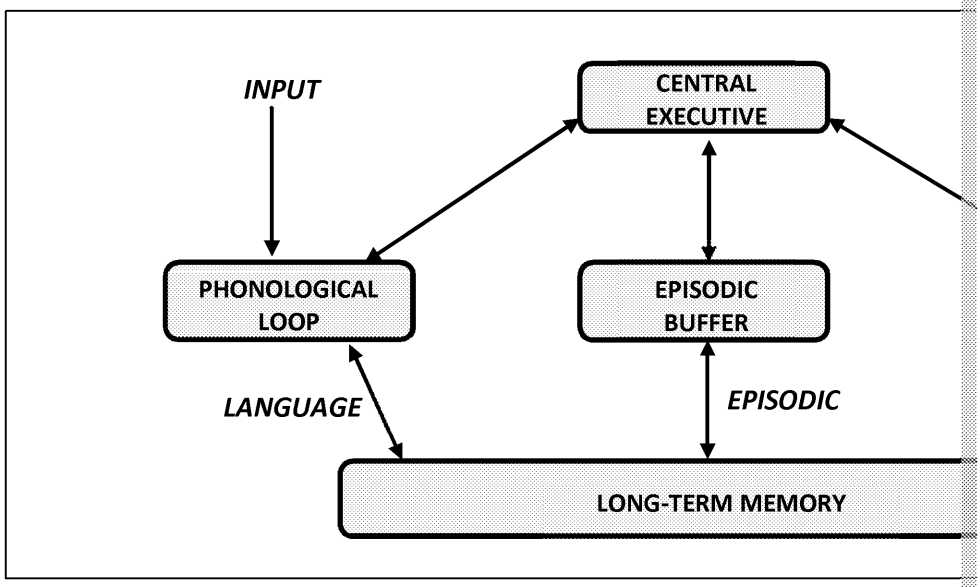
Components of the working memory model

All of the components in the working memory model have a limited capacity, wh
compete for resources. Two assumptions follow on from this model:

1) If two tasks are using the same components, their performance will be impa
performed alone).

2) If two tasks are using different components, their performance will be unaff

The model



The working memory model is proposed instead of short-term memory. Rather
memory argues that short-term memory is split up into a number of different co
with long-term memory.

The most important component of the model is the central executive, which help
other systems. The phonological loop is involved in holding and rehearsing spee
sketch pad stores and processes visual and spatial information.

The episodic buffer is a newer addition to the model, which was added to accoun
information. The episodic buffer is an area involved in the integration of senses a
where other components appear to be storing more information than their limite

Next we look at these components in more detail, and evidence for these will be
chapter.

Central executive

The central executive resembles the function of attention and it allocates 'resour
as the most important component of the model, the central executive controls th
has a very limited capacity, which means it cannot do too many tasks at once.

What is the central executive for?

The central executive is involved in many important functions:

- Switching between multiple tasks
- Focusing attention
- Planning
- Reasoning
- Problem-solving
- Linking to long-term memory

Limited capacity

The central executive, while being a very important component, has a limited capacity. This is one reason why we cannot successfully complete many different tasks at the same time.

Evaluation

Would we be likely to do these two tasks together in real life?

Were both tasks using a central unit or was the visuospatial sketch pad involved?

Hunt (1980) investigated the capacity o participants complete a psychomotor ta involving spatial problems at the same t when completing both tasks at the sam when performing either task alone. He using the capacity of a central unit (the competition reduced performance.

Dysexecutive syndrome

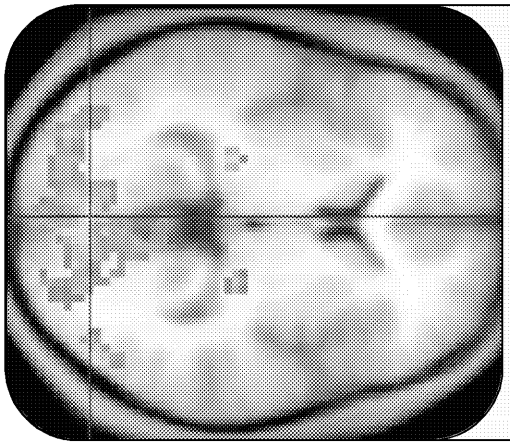
Dysexecutive syndrome is a term for the collection of symptoms as result of brai together and are all related to central executive functions. Individuals with dysex difficulties in planning, maintaining attention and in inhibiting responses as a res deficit. They tend to have damage to the frontal lobes, suggesting that the centr of the brain.

A neural basis?

Mottaghy (2006) reviewed studies that used the technique of repetitive transcranial magnetic stimulation (rTMS), which used magnetic pulses to disrupt activity of the dorsolateral prefrontal cortex. This had the effect of impairing complex cognitive tasks, suggesting that the basis for central executive functions lies in the prefrontal cortex.

More evidence of the central executive

Bunge et al. (2000) used fMRI to investigate brain activity of patients doing dual tasks. Participants were asked to evaluate whether sentences were correct of each sentence. They found that brain activity was of greater intensity in the p condition compared to when performing these tasks separately. This suggests th greater attentional demands, requiring more activity in the prefrontal cortex tha



Functional magnetic resonance imag

fMRI works because when parts of ou blood is directed to the region. Chan measured, which are shown as differ depending on the strength of activati One disadvantage of this technique is to perform multiple roles and it can b results of activation.

One of the key advantages of fMRI ov does not use radiation, which makes

Evaluation of the central executive

It has been suggested that the central executive is actually a 'catch-all' term for p that are not well understood. More current research is now getting closer to und behind the central executive.

Not a single unit

Some critics argue against the central executive being a single unit but suggest th different components.

Miyake et al. (2000) argued that it could be separated into three processes:

Inhibition function	Shifting function	
ability to go against automatic responses	ability to shift between several tasks	us

Collette et al. (2005) used PET scans to examine brain activity of participants doi functions. They found that each activity was associated with a different area of t they are distinct functions.

Eslinger and Damasio (1985) identified a patient EVF who performed well on tas decision-making skills. This suggests that only part of his central executive was d

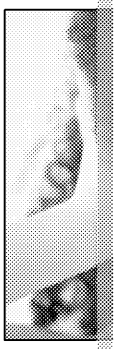
This idea goes against the current model, which argues that there is just one unit be a more precise explanation of the processes involved in working memory but the model can be adapted.

Dysexecutive syndrome

Not all people with prefrontal damage develop dysexecutive syndrome, suggesti may exist in their own right. This suggests that working memory may not be loca brain as not all brain-damaged patients with damage in this area show these sym

Phonological loop (inner ear)

The phonological loop has been extensively studied and its role is to explain preference for auditory encoding in short-term memory.



What is the phonological loop for?

- Accounts for the fact that short-term memories tend to be acoustically encoded
- Stores memories we need to retain for a short amount of time, such as a phone number
- Holds words we are about to say aloud

Split into:
Phonological store – holds acoustic items for a short amount of time
Phonological loop – involved in the rehearsal of acoustic information

Support: the word-length effect

Baddeley et al. (1975) found that it was not the number of letters that was impo say them. The word-length effect is that a greater number of shorter words coul words, as they take less time to say. Baddeley and colleagues found that you sto worth of information.

Try it!

Here are two lists of words; read a list and then try to recall it in order:
List 1: cat, sit, cow, top, man, ink, end, ball
List 2: highlight, ministry, justification, universe, opportunity, monitoring, po

Which list is more difficult to remember?

Methodology (AO3): In this example you could argue that it is not fair to compa words such as 'ministry' as cat is a much simpler concept and we learn it much easier to remember. To test for the word-length effect, the word lists should b how common or frequent they are in usage, what age they are learnt at and wh noun).

Support: the phonological similarity effect

The phonological loop is designed to hold speech-type information. Conrad and
recall a list of letters in the correct order. The letters either rhymed with one an
rhyme (e.g. H, Y, R). Rhyming letter lists were much more difficult to remember
letter lists. The rhyming lists create similar-sounding memory traces which more

Try it!

Here are two lists of words; read a list and then try to recall it in order:

List 1: frog, happy, open, lamp, friend, leap

List 2: fight, bite, night, write, delight, kite

Which list was harder?

The phonological similarity effect occurs in whole words too, but single letters
there is less to discriminate between.

Evaluation of the phonological loop

Articulatory suppression

A competing articulatory task such as saying 'the the the' can prevent rehearsal.
visually, the word-length effect is prevented as it takes the same amount of time

Try it!

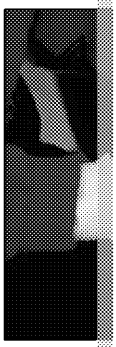
Read this list of words: view, laugh, zebra, chance, play, move, jazz

Immediately afterwards, say 'the the the' over and over again.

Baddeley et al. (1975) found that articulatory suppression using the word 'the' el
as shorter words took the same amount of time as longer words to rehearse. Th
words is dependent on verbal encoding (as performed by the phonological loop)
irrelevant material ('the the the'), results in shorter words taking the same lengt

Musical memory

Schulze et al. (2011) used fMRI to investigate how musical information was incorporated in working memory. Auditory information is handled by the phonological loop but this has primarily concerned verbal memory.



*The cu
accoun*

Most people are 'trained' in how to speak and so demonstrate verbal memory, whereas musicians are trained in both verbal skills and tonal skills.

Their study found that the same structures were involved in both verbal and tonal working memory but musicians activated certain areas only during tonal working memory or verbal working memory.

This suggests that in musicians there are two working memory systems related t
against the idea of a single phonological loop and suggests there may be subsyst
memory model.

Visuospatial sketch pad (inner eye)

When do we use our visuospatial sketch pad?

Example scenarios:

- You are giving your directions from where you are to the local shops.
- You draw a picture of a light bulb.

Both of these activities require you to hold imagery in your mind and use it to pe
a task.

A study of the visuospatial sketch pad…

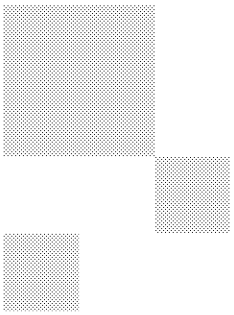
Baddeley et al. (1973) instructed participants to track a moving light using a poin
and at the same time either describe the angle in capital letters (e.g. H or F) or pe
a verbal task. During this dual task, participants experienced difficulty when tryi
light and describe the angle but did not experience difficulties with the verbal tas
suggests that tracking the light and describing the angle compete for attention o
system. This suggests that visual and spatial information require the same compo
verbal information does not, which supports the existence of the visuospatial ske

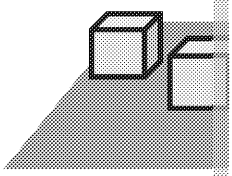
An integrated system or two separate systems?

Logie (1995) argued that there were two systems involved in the visuospatial ske
Visual cache – holds information on visual form and colour
Inner scribe – deals with spatial and movement information and is involved in the
information

Assessing the two different systems

Visual: Pattern Span Task	Spat
• Participants are shown a matrix in which half of the squares are filled in, and they must remember and colour in the same squares on a blank grid.	• The experim and then tap • Participants their spatial taps before





- The matrixes get increasingly larger and their visual span is the maximum size of the matrix before mistakes start to be made.

Support for two separate systems:

Klauer and Zhao (2004) found that:

- a competing spatial task should interfere with a spatial task more than a
- and a competing visual task should interfere with a visual task more than

Sala et al. (2003) conducted a review of research into the neural regions of spatia
They found a difference in neural activation:

- Greater activation in the ventral prefrontal cortex – visual working memo
- Greater activation in the dorsal prefrontal cortex – spatial working memo

This suggests that there are separate pathways to visual and spatial information.

Also, the case study of LH, who suffered brain damage as a result of a road accid performance on tasks of a visual nature than in spatial tasks. This supports there two systems.

However, most real-life tasks require both components, which limits the usefuln components.

Episodic buffer

Baddeley (2000) added the episodic buffer to the model, which allows for the int input. It can be considered a 'general store' as the central executive cannot stor components, it also has a limited capacity.

Why do we need the episodic buffer?

Baddeley et al. (1987) found that while participants could remember only about remember approximately 16 words when in a sentence. This suggests that the in integrates with information in the long-term memory store. This can be account which can interact with long-term memory, as proposed by the model.

Chincotta et al. (1999) looked at memory for Arabic numerals (e.g. 1, 2, 3…) and three…) and found that participants used both verbal and spatial information, an phonological loop and the visuospatial sketch pad, the binding must occur somew Baddeley and Wilson (2002) also noted several amnesic patients who did not hav term memories but could recall stories from their short-term store. The stories r than what the phonological loop could store, which argues for the existence of a This supports the idea of an episodic buffer as temporary storage.

The McGurk effect (McGurk and MacDonald, 1976) – you won't believe your ears, or rather, you shouldn't!

The McGurk effect occurs when two different syllables are presented at the same time, one in visual and the other in auditory, which results in hearing a third syllable which has not been presented at all. For example, if you hear 'ba' and see 'ga' you hear 'da'.

http://www.youtube.com/watch?v=G-lN8vWm3m0

Watch this video and you can see evidence that information from our eyes a together. Then shut your eyes and listen to the video; our eyes will no longe you will hear what is really being said.
The really interesting thing about this is that even knowing about the effect experiencing it!

The McGurk effect provides evidence for the episodic buffer as it suggests th amount of time our auditory and visual information are bound together.

More difficult to study

The episodic buffer is harder to study than other components such as the phono relatively simply. This is because studies have to be careful that they focus on th and not confuse the results with the individual components themselves.

Long-term memory

The working memory model argues that the processing of short-term memory co
memory store.

This is a significant advantage as it explains how we show an advantage in remem
individual letters – we have accessed semantic meaning which is stored in our lo

Classic study: Working memory model: the influence of acoust
on long-term memory for word sequences (Baddeley, 1966b)

This research was conducted by Alan Baddeley, who later (with Hitch) went on to
model. This study, along with others at this time, illustrated that memory was m
thought. It prompted further investigation and the development of the working

The first two experiments

A series of three experiments were conducted; the third experiment is the most
the first two experiments provide important background.

Experiment 1: Baddeley began by trying to test long-term memory. He devised an
heard one of four lists of 10 words. One list contained acoustically similar words, a
similar words and the final two lists were control lists of equal frequency. The lists
which participants spent 20 minutes on a different task and were then asked to re

Baddeley expected that participants who had the acoustic word lists would recall
participants who had the semantic word lists. This is because he believed that lo
semantic encoding and, therefore, would get mixed up when the meanings of wo

However, confusingly, Baddeley found that there was no effect for semantic simi
list, however, was more difficult to recall.

Experiment 2: Baddeley considered that Experiment 1 may not just been testing
delay of 20 minutes, it was clear that long-term memory must be involved in the
trials the lists were immediately recalled, and so it was likely that short-term me
list using acoustically similar words was more difficult to recall due to the fact tha
acoustically.

In Experiment 2, participants performed an interference task to cancel out the ef
task occurred between the presentation of each list and the recall. The experime
semantic similarity. Participants who had been given semantically similar words

The third experiment

In the final experiment, Baddeley wanted to use the technique that he had estab
decided to use a projector because the hearing problems of his participants were

Aim:
To investigate how short-term and long-term memories are encoded.

Method:
72 participants were assigned to learn one of four lists:
List A – 10 acoustically similar words (e.g. man, can, cab, etc.)
List B – 10 acoustically dissimilar words which had been matched to List A for fre
few, etc.)
List C – 10 semantically similar words (e.g. large, big, huge, etc.)
List D – 10 semantically dissimilar words which had been matched to List A for fr
huge, etc.)

There were two conditions:

- Acoustically similar condition used List A and a control group used List B
- Semantically similar condition used List C and a control group used List D

Each participant only ever saw one list.

A projector was used to present the words one every three seconds in the correct
participants completed tasks on memory for digits. After this, participants were g
the word sequence in the correct order. This was repeated for four learning trials
order, was present in the room because the interest was in whether they could re

After the four learning trials, participants completed a 15-minute interference ta
sequences. Finally, there was one final surprise recall test in which participants h

Results:
Acoustically similar condition: Baddeley compared the acoustically similar partic
Initially, participants with the acoustically similar words found it difficult, but the
increased until it overtook the control group (not statistically significant). Betwee
recall test, the scores are very similar. This is evidence that long-term memory d
similarity of words because the participants have not forgotten the list.

Semantically similar condition: The order of semantically similar words gets con
more difficult to learn. Participants recalled significantly fewer semantically simi
dissimilar words.

Conclusions:
The initial difficulty in recalling the word orders in List A suggests that short-term
to encode words that sound similar because they get confused.

Baddeley used this research to conclude that long-term memory encodes seman
becomes confused when presented with several semantically similar words. In c
not struggle with acoustically similar words because the sound is not used in enco

Task 1.1 Evaluation

Consider the information above and use the boxes below to evaluate Baddeley (
the third experiment. Make sure you support your statement by referring to the
Baddeley's study, and then relate this evidence back to the evaluation point.
The first one has been done for you.

Reliability is the extent to which findings can be replicated and are shown to be c
good/~~poor~~ reliability because…

*… he used standardised procedures. Each participant saw the words on the p
a time, experienced the same interference task and recalled the list after the
that the study could be easily replicated by following the precise instructions
lists. Baddeley's Experiment 3 was a replication of his second experiment, wi
the findings were the same, which suggests good reliability.*

Generalisability is the extent to which findings can be applied to the population t
and not just the participants. Baddeley's study has good/poor generalisability be

Internal validity is the extent to which the findings are the result of manipulating
Baddeley's study has good/poor internal validity because…

Ecological validity is the extent to which the findings can be generalised to real li
good/poor ecological validity because….

Features of the model

Coding in the working memory model

Remembering that the working memory model is an account of short-term mem primarily phonologically based. The primary component involved is the phonolo phonological store automatically, whereas the same word presented visually wo phonological code. This type of working memory is often called 'verbal working m spoken words and written words (these are 'mentally spoken').

However, the visuospatial sketch pad is considered to be responsible for visual w might use when remembering where objects are in your environment. The visuo instances of visual information being stored when the capacity of the phonologic Brandimonte et al.'s (1992) study acoustic encoding was prevented by repeating still able to redraw a picture shown to them while under these conditions. This s access to a visual encoding system as suggested by the visuospatial sketch pad.

Capacity in the working memory model

Remembering, once again, that the working memory model is an account of sho working memory is limited. This is important because a person can only do a tas capacity to hold all the information needed. For example, when trying to comple difficult to try to hold all the subcalculations.

The limited capacity of working memory itself is a reflection of the limited capaci of the model. All components (besides long-term memory) have a limited capac two tasks at the same time using the same component, their performance is red

Testing working memory capacity

Tests look at how well you can 'juggle' information in your mind, and capacity co information this is.

Try out the following. Showing a line at a time, quickly work out whether the an 'no' and then try to memorise the word next to it. Do this quickly and then at th order.

(5 x 2) – 4 = 4?	**LAMP**
(3 x 5) – 6 = 9?	**EARTH**
(8 x 3) – 2 = 22?	**SEA**
(2 x 4) + 3 = 13?	**STOVE**
(9 x 3) – 5 = 21?	**TABLE**
(4 x 7) + 6 = 34?	**TREE**

Practical applications of working memory

How important is working memory cap
It has been suggested that differences ir
may underlie reasoning ability (Kylloner
participants complete a number of tests
ability, and assessed their working mem
they were strongly related. There have
differences in working memory capacity
underlies information processing, then i
differences in our abilities for a broader
tasks. This leads to the proposition that
significant implications for general succe

Working memory capacity has been link

Applications to education
There are individual differences in working memory, and educational approaches who have working memory problems. The most common sign in the classroom i instructions because they have forgotten what the instructions are. Teachers ca demands on these children by the way they teach. For example, if given a comp might get lost and give up on the task. The teacher can reduce working memory instructions into steps. Teachers should also help students cope with situations problems. For example, children should be encouraged to ask for the instructio abandoning the task.

Early detection of dyslexia
Developmental dyslexia is characterised by difficulties in reading, and children w tasks such as spelling, understanding the meaning of what they are reading and One proposed explanation is that individuals with dyslexia have a working memo dyslexics do not code phonological information as efficiently as those without dy to cope with the demands of reading.

Turner and Bodien (2007) identified a number of warning signs that suggest a ch included reading without processing meaning, ignoring inferences in text, not att text and ignoring punctuation.

Keeping in mind this working memory deficit in dyslexia has implications for how For example, dyslexic children find it more difficult to decode a sentence and, th about the meaning of the writing. One possible solution is to analyse the paragr encourage focusing on the content. Spelling of words can also be a source of dif Providing a list of key words on the desk can help these children when they enco difficulties.

***Key question**: How can knowledge of working memory be used t of dyslexia?*

Individuals with dyslexia have problems with their working memory and also hav Their poor working memory makes it difficult for them to concentrate on tasks w difficult to hold several pieces of phonological information in their mind, which n (e.g. blending the sounds /t/ /i/ /ck/ to make the word tick). They read more slo associating the sounds with the words, and they may miss the meaning of the te focusing on other aspects of the process.

Below we will examine two different approaches to how knowledge of working m

Classroom approach
A classroom approach to dyslexia involves educators altering their style of teachi
dyslexic students and their working memory problems.

Many of these strategies involve reducing the working memory demands made o
the student:

- Keeping instructions simple
- Breaking down tasks into steps
- Presenting written information concisely
- Giving students enough time to process information
- Using checklists and homework books to keep track of tasks to be done

Other strategies involve targeting the phonological problems:

- Teaching students mnemonics to learn how to spell difficult words
- Putting a list of key vocabulary that will be used in the lesson on the whiteboard
- Using clear, large fonts
- Practising phonological skills; for example, blending
- Using coloured reading rulers which help dyslexics focus on reading a lin
- Using audio and visual methods of learning

Employing these methods consistently has been shown to help dyslexics in the clas
children have differing needs for their dyslexia and this may not be enough help fo
These children benefit from more focused phonological skill development in small g

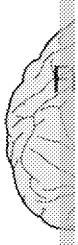
Direct interventions
There have been a number of programmes developed specifically to target dysle
and low reading ability.

One such programme is Fast ForWord Language. Fast ForWord Language is a co
to improve reading proficiency by targeting areas such as working memory, com
awareness through brain exercises.

Temple et al. (2003) investigated whether the programme Fast ForWord was eff
could be seen on brain scans.

Method: Conducted a study which involved a phonological processing task (pushin
with one another, e.g. T and D), a non-phonological task (pushing a button if two le
and a non-letter baseline task (pushing a button if two lines were the same orienta
dyslexia (aged 8–12 years old) performed these tasks while being scanned by an fM
using the Fast ForWord Language programme for 100 minutes per day, five days a
training days. The children then repeated the same tasks in the fMRI machine. The
compared before and after the intervention. Their results were compared with no

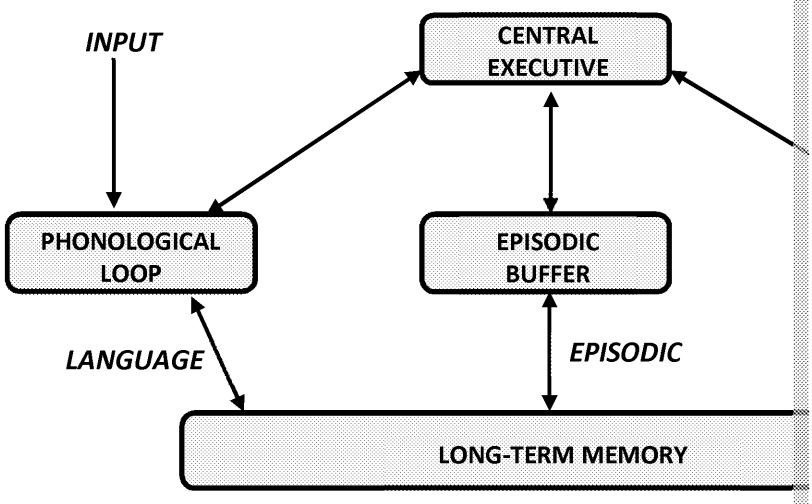
Behavioural results: The dyslexic children showed an improvement in reading ability and passage comprehension. They also showed an improvement in their oral language, although the extent of the improvement varied between the children.



fMRI results: After the intervention, increased activity was shown in the left temporoparietal cortex and left inferior frontal gyrus in the dyslexic children. Prior to the intervention, these areas were underactive compared to non-dyslexic controls. The left temporoparietal cortex had previously been found to be involved in phonological processing. The increase in area is not quite large enough to match the activity patterns seen in non-dyslexics

Conclusions: This suggests that computerised interventions such as Fast ForWor building working memory and phonological skills can lead to changes in brain fu illustrates that children can benefit from this programme, but the long-term effe

The model



Overall evaluation

Individual differences

The model can account for individual differences; for example, Shah and Miyake with good spatial ability were strongly associated with spatial working memory b suggests that there can be individual variability in types of short-term memory.

Individual differences: processing speed

Overall, the working memory model only speaks in general terms about memor differences. However, we know that working memory and other functions can Processing speed is how fast you process, use or comprehend information. Ind speed, and a slow processing speed, especially in a classroom environment, car have a slow processing speed take much longer to complete tasks, which is esp The combination of processing speed and short-term memory capacity can acc longer for some individuals.

Automatic behaviour

The working memory model, although it does not explicitly refer to automatic be performance in dual tasks. Automatic behaviour has reduced attentional deman which allows for being able to do two tasks at once.

Still more to do

The most important component, the central executive, is still not that well under the central executive is too vague and is just a name for processes that are not u research is required on the episodic buffer, which is more difficult to investigate.

Multiple components to the central executive

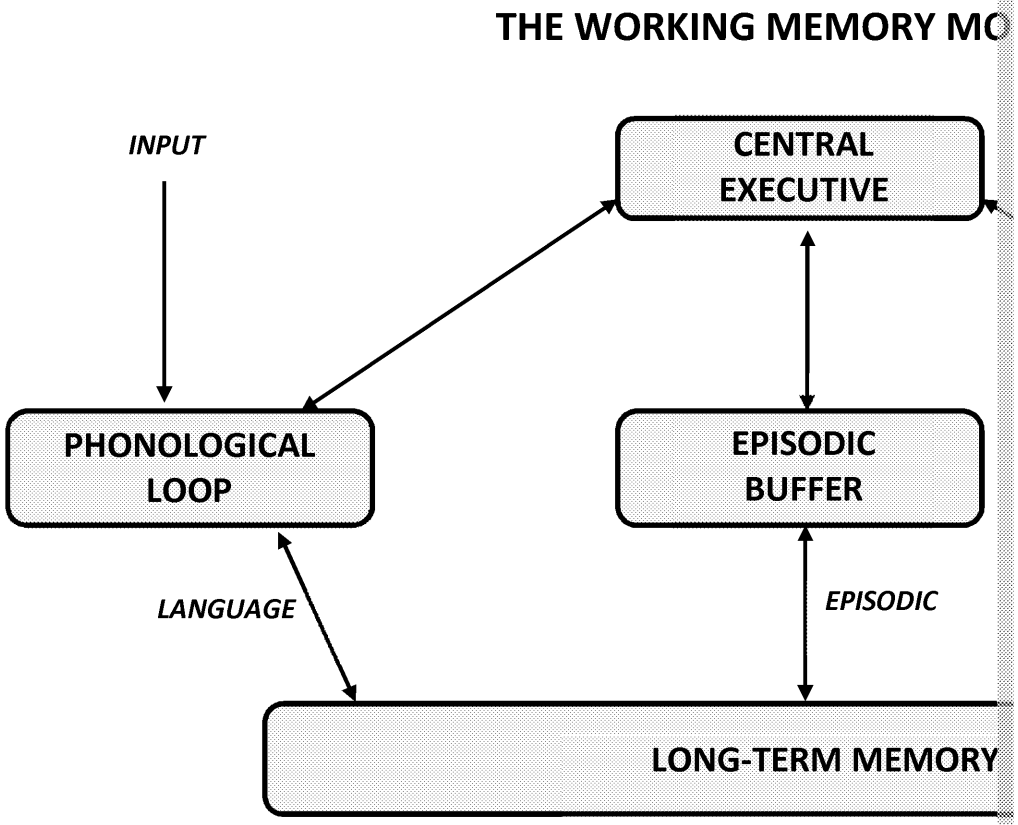
It is likely that there are multiple components to the central executive, as shown some central executive tasks but not others.

Only an account of short-term memory

The working memory model only really accounts for short-term memory and litt the components interact with long-term memory.

Task: Annotate it!

Annotate the model with explanations of what each feature does in the model.



Chapter 1 Activities

Check your understanding!

Q1. Briefly outline what working memory is. (2 marks)

Q2. Explain the purpose of the episodic buffer. (3 marks)

Q3. What does the working memory model say about performing multipl

Q4. Describe how visual and spatial memory can be assessed separately.

Exam-style questions

Q1. An experiment was conducted to investigate the working memory mo
carried out two visual tasks at the same time. Group 2 carried out a v
visual task at the same time. Group 1 performed much worse on the v
Group 2 did on their visual and verbal tasks.

Explain, using the working memory model, why this pattern of perfo

Q2. Dual tasks are used in cognitive psychology to try to determine whic
separate.

Describe dual tasks as a method of investigating human processing re

Q3. Tommy has dyslexia and is struggling in his English class. He finds i
read the text than his other classmates and that sometimes he misses t
altogether.

Explain, using the working memory model, why Tommy is have diffi

Chapter 2: The Multi-store Model of

Overview

In this chapter we examine Atkinson and Shiffrin's multi-store model of memory which represents memory as having three separate memory 'stores': a sensory register, a short-term store (STM), and a long-term store (LTM). We will look at the features of each of these stores, how they relate to one another in the model and the evidence related to there being three separate stores. Finally, we will examine the strengths and weaknesses of the model and conclude on its usefulness.

Learning outcomes

After studying this chapter you should b

- ❑ Describe the different stores of th long-term and sensory, in relation t duration and coding
- ❑ Describe the model as a whole, inc maintenance and rehearsal
- ❑ Consider the evidence for there be
- ❑ Identify the strengths and weakne conclude on its usefulness

Key Terms

Attention	Focus necessary to move sensory information into short-
Capacity	How much information can be held in a store
Chunking	Reducing the amount of information we have to rememb technique that improves short-term memory
Duration	How long a memory lasts before we can no longer recall
Elaborative rehearsal	Organising and creating associations by linking the new n
Encoding	How information changes to be stored in memory
Free recall	Able to recall the items in any order, as opposed to a spe phone number
Long-term memory	Our memory for past events (that is longer than our shor
Maintenance rehearsal	Rehearsal by repetition of the information
Primacy effect	When information we are exposed to first is better recall rehearsed
Recency effect	When information we are exposed to last is recalled bett short-term memory
Rehearsal	Mentally repeating information to maintain the memory
Retrieval	Accessing the stored memory
Sensory memory	The store where sensory information is inputted
Serial position effect	An effect whereby the order of information changes our
Short-term memory	Our immediate memory
Unitary store	A store that operates as one; if damaged, it should stop t to this store

Scene-Setting Questions

- What techniques might you use to remember a phone number?
- Is there an expiration date on our memories?
- What distinguishes the memories we quickly forget from the or

The multi-store model (Atkinson and Shiffrin,

Atkinson and Shiffrin (1968) proposed a model of memory called the 'multi-store term store, a long-term store and a sensory register.

Why do we need models of memory?

The cognitive approach focuses on how we process different types of information, and researchers who follow this approach create models that aim to explain this process. Atkinson and Shiffrin's model was an early endeavour to explain memory using a model.

C
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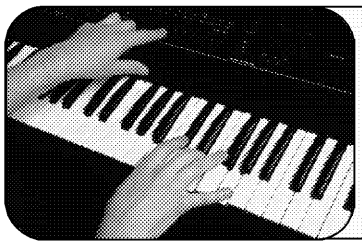
Previous attempts to understand memory used the method of introspection. Introspection involves examining the content of thoughts and analysing the internal mental processes. Components are identified and the researchers try to understand the relationship between the components. However, only the person themselves knows what is inside their mind, which makes it difficult to test accurately and reliably.

The multi-store model represents an early attempt to make explanations of men generates precise predictions about memory which can be tested using experime

How models are developed

Cognitive models of memory do not tell us exactly how memory works. Instead t current findings and offer a proposal of how memory works. The model is evalua evidence fits in with the present model. When evidence fails to be accounted fo the model is revised or a new model is proposed (or in some cases the new infor

One type of evidence often used in cognitive research is research conducted on b example, the model we are about to discuss below, the multi-store model, sugge accounts for long-term memory. However, research on Clive Wearing, who suffe brain infection, found that some of his long-term memories were intact (for exam while others were lost (for example, his time studying at university). This goes a which argues that there is just one unitary store of long-term memory. Later mo which illustrates how new evidence must be accounted for.



Note: Many areas of psychology ignore the findin on what generally happens. Individuals who go a considered to be anomalies and ignored. Howev case in cognitive psychology, a single individual ca model.

How do we gain evidence of the multi-store model?

Atkinson and Shiffrin (1968) proposed that their model was composed of a short and a sensory register. In order to assess whether they are correct, we need to e distinct differences between each store.

We do this by examining three factors:

- Duration: How long the memories last
- Capacity: How much information can be held
- Encoding: How the information is converted for use in the brain

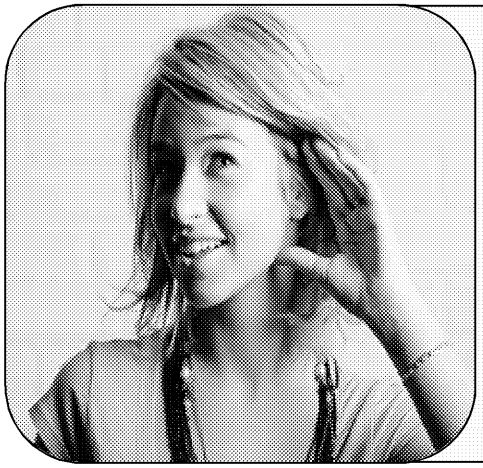
If the components are found to be different, then this supports the multi-store m these stores are distinct.

Sensory register (also known as the sensory st

The amount of information we receive from our different senses at one time is e holds the information from our different perceptual senses. The sensory registe stores for each sense, with the three most extensively studied being iconic memory (visual information), echoic memory (auditory information), and haptic memory (touch and body sensations, e.g. pain).

Duration – how long do sensory memories last?

Given the large amount of information that comes into the sensory register at any one moment, there is too much information to be kept; as such, the duration of sensory memory is very short, with memories lasting approximately 200 milliseconds to a few seconds.



Real life: 'Sorry, what did you say

Imagine the scenario: *You're concentr and a family member knocks on the d quite catch what they said, so you ask before they've had a chance to say an remembered exactly what was said.*

This is evidence of the duration of ech still in the sensory register so you wer said. Research suggests that echoic m to four seconds.

Capacity – how much information can the sensory register hol

Iconic memory – visual information

Sperling (1960) studied the capacity of iconic memory by asking people to recall letters that were shown on a grid for 50 milliseconds. He found that on average participants recalled four or five out of the 12 items, indicating that this was the capacity of iconic memory. However, participants reported saying that they saw more items than they could recall.

In a second part of the study, participants were cued for which row to remembe of tone that occurred immediately after the presentation. Participants in this ve recalled three out of the four items in the row, suggesting that all of the items ar iconic memory but that it decays rapidly.

In reality, a huge amount of information comes into our sensory register and, as however, very little of this information is transferred into our short-term memor role of attention in transferring information from a sensory register to our short- impossible to attend to all the information at once.

Encoding – how is sensory information encoded?
Sensory encoding appears to be dependent on sense, which leads to the proposa
actually formed of different stores for each sense.

For example:
Acoustic encoding: Encoding auditory information
Visual encoding: Encoding visual information
Tactile encoding: Encoding how something feels

The distinction between the different types of sensory registers has been reflecte
involvement. For example, the tactile sense is related to the primary somatosen
contrast, the amygdala has been related to visual encoding.

Attention – how do we decide what gets encoded to the next stage?
An enormous amount of sensory information is received by organs but not all of t
Individuals do not have control over what sensory memories are processed. Sens
attention are likely to be transferred into the short-term store.

The 'cocktail-party effect' is that at a party we can hear many
on just one and ignore the others. Cherry (1953) used a dich
different messages are heard in different ears) and asked pe
sounds coming into just one ear. Participants were able to r
asked to attend to but not the message in the other ear. Ho
was heard in the other ear, this grabbed the participant's att
remember this. However, participants did not *choose* to liste
subconsciously attended to. This suggests that we are proce
auditory information than we are aware of but attention filte
important.

Short-term memory store (STM store)

Short-term memory is your memory for immediate events and it has three key fe
1) A limited capacity of information it can hold
2) A short duration that the memory lasts for
3) Generally acoustically encoded

Duration – how long do short-term memories last?

One of the key distinguishing features between short-term memory and long-ter
is the duration which it lasts for before you can no longer remember it. Short-te
memory lasts a very short term unless we rehearse it. Rehearsal involves menta
repeating the memory over and over again; in theory, a short-term memory coul
rehearsed.

Duration without rehearsal – the Brown–Peterson technique (Peterson and Pe

- The Brown–Peterson technique uses a distractor task to prevent rehearsal o
- They presented a trigram (a group of three consonants which has no meani
example, ZHR) and then asked participants to count backwards in threes fro
recalling the trigram.
- Counting back in threes was to prevent rehearsal, and the time spent
counting backwards (3, 6, 9, 12, 15, or 18 seconds) was varied (this
was termed the 'retention interval').
- They found that approximately 90% of information was remembered
after a three-second delay; nearly 70% was forgotten after a nine-
second delay and 90% after an 18-second delay.
- This suggests that the actual duration of short-term memory in the
absence of rehearsal is very short.

Try it!
Work in pairs:
1) One person writes a trigram (examples: XPL, GHT, MVN) on a sheet of pap
person for a few seconds.
2) The second person has to count aloud backwards in threes from a random
3) Use a phone, watch or stopwatch to record the time interval; you could tr
recall it, then try 18 seconds.
4) At the end of the time, ask the person to recall the trigram.

How successful were they?
- Could the person remember the whole trigram?
- Could they remember part of the trigram (were there partial memories)?
- Which parts were recalled and which parts were not? Was the order corre
- Could any of the letters have been confused with similar-sounding or look

Short-term memories were thought to simply decay over time and this led to the
Nairne et al. (1999) argued that by using different items in each trial, it decreased
interfere with one another. They repeated the study and found that using the sa
recall an item for as long as 96 seconds. Items compete with each other for reca
newer items overwrite the older ones.

Capacity – how much information can the short-term store ho

If someone told you their mobile number and asked you to ring it in a minute, th
chances are you would have forgotten it before you dialled. In the UK, mobile-ph
numbers are 11 digits long – too long to be remembered by our short-term mem

Jacobs (1887) used a digit span technique to test short-term memory; he presen
single digit to a participant and asked them to recall it, then he added a second d
asked the participant to recall these in order; he kept adding digits until the part
made a mistake. The number of correct digits was termed their 'digit span'.

Try it!
Investigate your own short-term memory: for each of the strings below, cover u
group of consonants and try to recall it, then move on to recalling the first two
Stop when you get it wrong.

7 9 6 3 6 1 5 4 8 4 9

L T M O D Q S C H X R

CHAIR FISH HILL RAIN GIANT QUARTZ HEART YACHT GRASS BOOK RAKE B

How many of the list did you remember? Compare this number to a classmate
Do you notice any trends in the ones you remember?
What about the ones you seem to forget?

Jacobs (1887) found that participants could correctly recall an average of 9.3 digi
thought this was because there were only nine possible digits, whereas there we
from.

Chunking

Increasing our short-term memory capacity

Miller (1956) examined digit span research and found that the average digit span items; this was termed 'the magic number 7 ± 2'. He also found that we can reca letters; we 'chunk' things together to help remember them. For example, rather 1974 as 1-9-7-4, we chunk it together as one. However, Cowan (2001) reviewed that the 'magic number' was actually four chunks.

Returning to the earlier example, if you managed to recall the words 'CHAIR FISH actually recalled 22 letters but these have been chunked together into five words phrase, this could also be considered one chunk.

However, Simon (1974) found that we could remember fewer large chunks, such shorter chunks such as single words.

Try it!

Returning to remembering mobile numbers, chunking is a useful technique for Take the completely fictitious number 08867021940 and try to remember it. It is difficult because we are trying to remember 11 separate digits: 0 8 8 6 7 However, we could separate it into chunks: 088 67 02 19 40 and try to remem

Try it now with some real phone numbers – now might be a good time to learn of an emergency!

How do we gain evidence of the multi-store model?

Note that here we can see there are similarities in the capacity between the sens memory store. Both seem to be able to hold about four or five pieces of informat possible modification is to remove the sensory register. However, the duration of different with a much faster decay occurring for sensory information. Therefore, evidence.

Encoding – how is short-term memory changed so that it can b

Typically acoustically

Conrad (1964) showed participants a list of six consonants (e.g. HBJMDN) for less than a second and then asked participants to immediately write down the consonants they had seen. He found that participants frequently mistook consonants for ones that sounded similar (e.g. B was mistaken for P). Letters that looked visually similar but sounded dissimilar were less likely to be mistaken (e.g. D was rarely mistaken for O). From this Conrad concluded that short-term memory was encoded acoustically (by sound).

However, although it appears from Conrad's experiment that written visual tasks cannot generalise this to all types of short-term memory.

Shulman (1970) showed lists of 10 words to participants and recall was tested af Cues were either:

- Homonyms – words that mean different things but sound the same – e.g
- Synonyms – words that mean the same thing but sound different – e.g. p
- Words identical to the original list

He found recall errors from both homonym and synonym cue words and argued be encoded acoustically and semantically.

Therefore, Shulman's evidence, unlike Conrad's, showed that encoding in STM d
encoding; rather it uses both acoustic and visual coding.

Both Conrad and Shulman used laboratory experiments, which are advantageous
and isolate a variable in order to investigate how this variable affects memory. H
tasks (how often are we asked to remember groups of six consonants?) makes it
Real-life memory may work in a very different way from what these experiments
things we need to remember in real life are very different (low mundane realism
arbitrary labels, they may differ from a list of consonants as there is a great impo
succeed socially, and the 'importance' of the information may make it more mem

Sometimes visually
Although for the most part short-term memories are encoded acoustically, there
when visual encoding is used.

Brandimonte et al. (1992) showed participants pictures to remember and prevent
the participants repeatedly say 'la la la'. Participants were successfully able to re
suggesting that they had visually encoded them.

This suggests that while for the majority of the time acoustic encoding is used, e
not restricted to just acoustic encoding.

Rehearsal: from the short-term to the long-term

'All sorts of ideas, if left to themselves, are gradually forgotten' (Ebbinghaus, 188
*Craik and Lockhart (1972) criticised the original model which simply referred to 'r
maintenance and elaborative rehearsal which were accepted in later revisions of*

Maintenance rehearsal:
Maintenance rehearsal is the process of repeating the information as it is over a
information to be accessible in short-term memory.

For example, if asked to remember the sequence 'H8Y25' you might remember i
learning by 'rote'.

Elaborative rehearsal:
Elaborative rehearsal involves examining the deeper meaning and connecting it t
Elaborative rehearsal is the process by which memories are transferred from the
term store.

For example, using the same example of 'H8Y25', it may be easier if you consider
alphabet and that Y is the 25th letter.

A greater amount of 'rehearsal' does not necessarily lead to long-term memory s
'elaborative rehearsal' makes transference to the long-term store more likely.

Long-term memory store (LTM store)

Duration – how long do long-term memories last?

Long-term memories may theoretically last forever:

Bahrick et al. (1975) used high-school yearbooks to test the long-term memories of ex-students. They tested ex-students aged 17 to 74 in several ways:

- Asked to free recall as many names as they could of their old classmates
- Asked to identify photographs of their classmates mixed in with other photographs of non-classmates
- Asked whether they recognised the names of their classmates when mixed i
- Asked to put names to faces

In tests of recall, participants were 20% accurate after 47 years
In tests of recognition, participants were 90% accurate after 20 years and 60% ac

They found that recognition was better than recall memory, presumably because for the information, merely decide whether they have seen it before.

Real-life examples:

- Being unable to remember an old teacher's name but recognising it instan
- It is harder to answer an open-ended question than a multiple-choice que
- Desktop icons use recognition by pairing a related image to a function; we is for each time, we simply click straight away

How do we gain evidence of the multi-store model?

Contrast this study with Peterson and Peterson's (1959) study of short-term mem there is a significant difference between the two models in terms of duration. Th because it suggests that they are distinct systems.

Issues and debates: practical issues in the design and implementation o

It can be very difficult for psychologists to investigate long-term memories. On individuals who have memory loss are from a different generation and their liv through social media as ours have been.

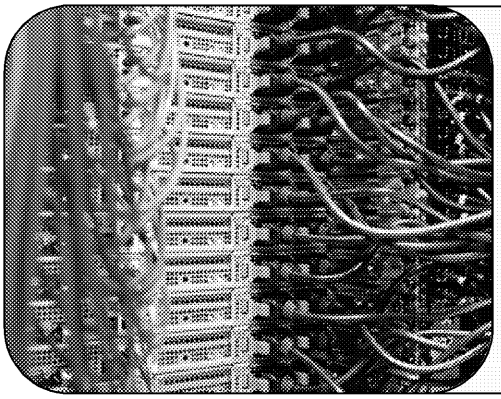
Without detailed records, one problem a psychologist may face is determining memory of the event or if they simply have a general idea what might have hap question 'Do you remember your eighth birthday?' You might respond, 'Yes. I h over and there was a cake and presents.' In this scenario, do you really remem just know what an eighth birthday party might be like?

One study which investigated long-term memory was Bahrick et al. (1975), and of using yearbooks to investigate long-term memory duration. Bahrick et al. el a right or wrong answer. If participants could recall or match the name to the p memory for the person. This meant that it was easier to objectively study whet memories of their classmates.

Additionally, by investigating recognition using the photographs, Bahrick was a had long-term memories that they may not have been able to fully access. His recognise photos of their classmates among other photos even when they coul we may have far more long-term memories than initially thought. This would n simply asking participants about their memories because participants had limit would not be able to verbalise it.

Capacity – how much can the long-term store hold?

Since memories in the long-term store may last infinitely long, it makes theoretic
memory store has infinite capacity. In truth, it is impossible to test, as retrieval f
rather than a loss of information; it reflects a problem with accessibility rather th



Makes you wonder…

In an age of ever-increasing life expec
cope? What might happen if our long
infinite capacity but simply one that h
lose our old memories or be unable to

*Technology has allowed us to dramat
information we can store, but what h
more than we can keep?*

Encoding – how are long-term memories encoded?

Baddeley (1966b) showed participants 10 words in four lists:

- Acoustically similar (sound alike), e.g. bought, taut, fought
- Acoustically dissimilar (do not sound alike), e.g. beyond, line, grape
- Semantically similar (mean similar things), e.g. happy, cheerful, glad
- Semantically dissimilar (mean different things), e.g. table, fear, kneel

Recall was worse when long-term memories of semantically similar words were used rather than semantically dissimilar words.

This suggests that long-term memories of verbal information are encoded semantically.

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Information can also be encoded into long-term memory:

- Visually: for example, Paivio (1986) argues that we create and use mental images and we can recall both the word and the image of an object
- Acoustically: for example, encoding songs and music based on how they sou

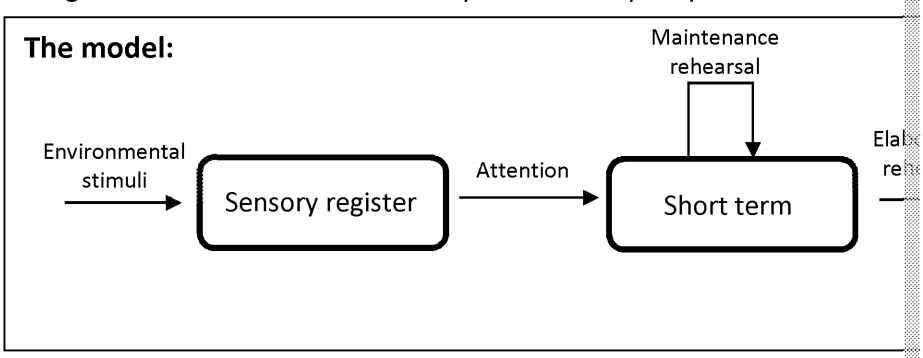
Incidental learning

You can remember information that you have not intended to learn but have lea
something else. Sitting down with the aim of learning information is likely only i
real life we simply learn how to do something without trying…
For example, we may learn that a '.doc' file means that it is a Microsoft Word Do
We did not intend to learn what a '.doc' file was, we simply learnt it unintentiona

How well information is encoded is not dependent on intention. This is a limitat
which argues that attention and rehearsal are key processes involved in storing i
learn something incidentally goes against the idea that more focus and rehearsa
in long-term memory.

The multi-store model

As discussed, the multi-store model describes the structure of the memory syste
- Sensory registers that hold information specific to each sense for a very brie
- A short-term store that holds information but is very limited in capacity
- A long-term store that has theoretically unlimited capacity and duration



How do we gain evidence of the multi-store model?
At the beginning of the chapter we remarked that in order to examine the suppo establish whether the duration, capacity and encoding were different in each of t the model are all found to be different, this supports the model, as it suggests th

The multi-store model: an information processing model

The multi-store model of memory can be considered an information processing m store model can be likened to a computer, with an input, processing and an outp

Input: The information enters our memory through our senses onto our sensory r

Processes: Processes such as attention, maintenance rehearsal and elaborative re so that it can be stored and recalled

Storage: Information is stored in our short-term and long-term stores

Output: Recall is dependent on the processes and storage in the previous stages

The stores in the multi-store model can be likened to computer hardware. Comp called RAM. RAM memory is used to store information that is being used at the t very quickly but is not being stored permanently. This is similar to the idea of sh the multi-store model. Computers also use more permanent memory storage su information takes a longer time to access but is kept there indefinitely. This is si

Like computers, the multi-store model uses serial processing with one task needi A criticism of this is that the human mind uses parallel processing, with several ta

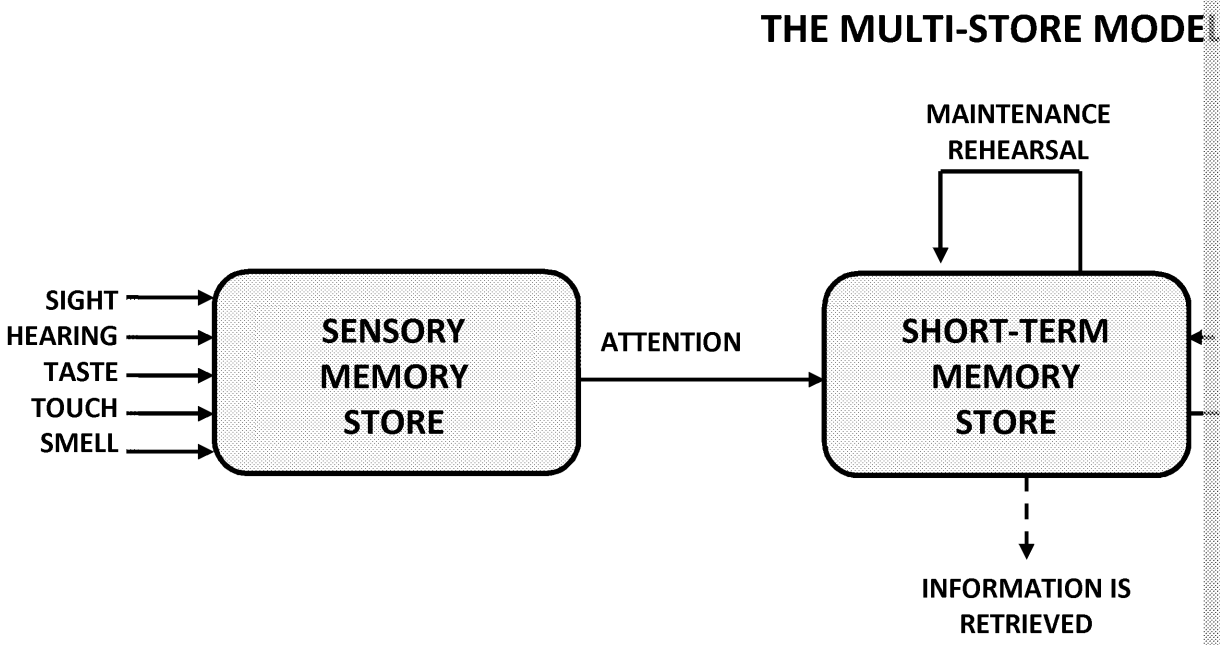
Task 2.1

Use this table to form your own conclusions about the model. Fill in what suggests about each of the stores. Conclude on whether the stores are diff support the model.

	Duration	Capacity
The sensory register		
The short-term store		
The long-term store		
Based on the evidence above, the multi-store model is…		

Task 2.2: Annotate it!

Annotate the model with explanations of what each feature does in the model (don't forget pro



Evaluation of the multi-store model

The serial position effect

One supporting piece of evidence for the multi-store model is that it can explain a position effect.

Glanzer and Cunitz (1966) had participants hear a list of words and then recall the either immediately or after an interference task. They found that when participa words immediately, the first words on the list (primacy effect) and the last words recalled better than the words in the middle. The primacy effect was explained i having rehearsed these words more and transferred them into long-term memo is explained by the fact that these words are still in short-term memory.

This provides evidence that the short-term and long-term memory stores are dis

Try it!

Investigate the serial position effect by having one student (or the teacher) reac order) and then, when they have finished, write down as many as you can reme

LAKE CHICKEN NAIL TRAIN DOG BALLOON KITE JUMPER
CUP RUG BRAIN PURSE PHONE WIND EGG VASE

Compare your results to the original list. Did you follow the classic serial positio did any of the words in the middle stick out for any particular reason? You could variable, as you were already cued to remember the item.

If you made any errors, were they acoustic errors (where you mistake a word fo would be evidence that short-term memories are encoded acoustically.

Real-life applications

Research has shown that we generally recall the first and last things best and 'fo To make an effective argument you could take advantage of this by presenting y beginning and at the end:

A lawyer could arrange witnesses so that the most substantial witnesses are at t testimony.

In an effective essay you might make sure that you line up your most important re-emphasise it at the end.

Neurobiological support for the difference between short-term and long-t

Research suggests that newly learnt information is stored in the hippocamp region and surrounding cortical regions. After strengthening the connections, the memory is slowly transferred to the neocortex, an area away from the hippocampus, where these memories are stored permanently. Brain injuries to the hippocampus area can leave long-term memories unaffected because they are stored in a separate area of the brain. However, the formation of new long-term memories is likely to be affected as information cannot yet be stored away from the hippocampus.

Are the short-term and long-term memory stores distinct?

The multi-store model argues that there is a direct, ordered route to long-term s information that is attended to goes to short-term memory and short-term mem the long-term store.

Logie (1999) argued that short-term memory processing relies on long-term mem
If asked to remember the letters: TREEGRASSEARTHNATURE, you do not simply r
term memory but immediately group them into words and words that all belong
semantic meanings which are stored in your long-term memory.

Ruchkin et al. (2003) studied brain activity in healthy participants and found that
recall real words causes greater activity in the brain than pseudowords; this sugg

More than one type of long-term memory

- The multi-store model presents an oversimplified picture of long-term mem
- Research suggests multiple long-term memory stores rather than a single u
- Schacter et al. (2000) proposed four types of long-term memory:
  - Semantic memory (memory related to meaning and factual knowledge)
  - Episodic memory (memory related to past events)
  - Procedural memory (memory related to how to do actions)
  - Perceptual-representation system memory (memory related to improv been seen before: primed)
- Spiers et al. (2001) in their meta-review of amnesic patients found that sem were not complete, whereas the other two types were.

Stores are conceptually distinct

- All three stores differ in terms of duration and capacity and the processes w one store to another

Issues and debates: reductionism

Reductionism is the process of simplifying a complex idea down to its easier-to
Scientists in many disciplines use reductionist explanations because they offer
and make research easier to conduct. The multi-store model is reductionist bec
memory into different memory stores, but does not account for the multiple ty
pays little attention to the interconnections between the stores. Additionally, t
account of memory and does not acknowledge how long-term memories can i

Case studies of brain-damaged patients

The case of HM (Henry Molaison)	The cas
• HM suffered from frequent epileptic fits and at age 27 he underwent surgery to stop them	• Clive Wearing (not infection called he result of a cold sor
• Large sections of his hippocampus and amygdala were removed, curing his epilepsy	• The virus attacked destroying his hipp cortex
• These areas are crucial for memory and HM suffered severe anterior grade amnesia (normal pre-surgery memory but unable to remember things that happened after the surgery)	• Clive also has seve frequently believe first time after bei
• Short-term memory is normal but he is unable to transfer the information into long-term memory	• He was encourage experiences, whic the time and simil perfectly awake fo previous line cross knowledge of who
• He is able to learn new motor skills but he has to be reminded that he has learnt them	• Along with anterio incomplete memo amnesia)
• HM also suffered moderate retrograde amnesia (forgetting memories before the surgery) with some difficulty remembering events just before the surgery and others up to 11 years before	• For example, he ha university he spen
	• Before his infectio musical field and h
	• He could learn nev repetition but eac time

✓ **How they support the multi-store model…**
HM indicates that there is a clear separation between short-term and long-term memory as his memory of long-term events was mostly preserved in comparison to his short-term memories.

✖ **How they challenge the multi-store model…**
While Clive lost substantial sections of his long-term memory, he still had many preserved skills such as the ability to play complex pieces of music on the piano. The multi-store model proposes that long-term memory is unitary, while Clive clearly indicates that he has lost some types of long-term memory but preserved others. This suggests that there are multiple forms of long-term memory. Most of HM's difficulties were to do with his inability to form new memories but HM also had problems recalling some of his older memories. This suggests that his long-term store was affected in both transferring information to the store and retrieving it.

Issues and debates: socially sensitive research
Research about and using brain-damaged patients can be considered socially s
of the influence of the research on the individual and their family. Severe men
enormous effect on the patient's ability to function normally and the lives of th
their care.

Issues and debates: ethics (and the cost-benefit analysis)
Henry Molaison's inability to create new long-term memories was, and still is, ve
psychologists who wanted to study whether there were different memory store
being studied, but with his extremely short memory span, he never truly unders
he was part of. Did psychologists take advantage of HM?

Costs to HM: Due to his very short memory, HM could not give true informed co
seconds of information and, during this time, it was not possible to understand t
was part of. HM did not appear to mind being researched and would follow the
without protest. However, if he had had awareness that his life would be spent
not have agreed to take part in the research. He is often cited as the most resea
this suggests that he had very little privacy. It might have been better for HM to
that was personally important to him.

Scientific benefits: The study of HM allowed researchers to learn about where m
and showed strong evidence for there being separate memory stores and the ne
them. The finding that HM could still learn procedural skills (Milner 1962), altho
learning the skills, was a key finding in memory research as it pointed to separate
term memory and that these memory systems are located in different areas acr
considered an important figure in the study of memory, it is worth noting that h
and that psychologists have used numerous studies to develop their understand

What are case studies?

A case study is an in-depth study of a particular individual or group of individuals
studies do not manipulate the independent variable but rather look at the effects
such as the effects of an event. Case studies look at how the individual's behavio
behaviour or from what is regarded as normal or typical behaviour by the majori

Case studies have proved especially useful in providing knowledge about differen
brain from studying cases of brain injuries. Although each brain is different, all b
features and processes; this allows us to generalise from one brain to another.

Use of qualitative data in case studies

Qualitative data is of a descriptive nature and cannot be measured in the same w
often looks at less defined issues, such as self-esteem, which are difficult to asse
case studies is considered to be a qualitative approach, although it may incorpora
research (numerical research).

Advantages: This type of data is used to gain understanding of a particular topic b
information. Case studies emphasise the importance of the individual and, there
qualitative information than statistical figures.

Disadvantages: Measurement of qualitative data is said to be subjective because
the data. Researchers must analyse the data by looking for themes and construct
researcher to researcher.

Evaluation of case studies in brain-damaged patients

Advantages	Disa
High level of detail: The amount of relevant information provided by a case study is much greater than provided by an experimental design. This can encourage a deeper level of understanding and uncover relationships that can lead to experimental research. ➔ **Link to brain-damage case studies** HM is considered one of the most researched subjects in psychology. Researchers have been able to learn an enormous amount of information about how his brain works and the involvement of the hippocampus in the memory.	**Lack of generalisability**: It is whole population from a sin study involves unique circun individual being researched When universal cognitive pr from brain injuries are studi ➔ **Link to brain-damage** Both HM and Clive W had brain surgery to r Clive Wearing's hippo were destroyed due t not be wise to infer fr healthy brain functio
Research naturally occurring events: Case studies allow researchers to understand events that occur naturally but would be unacceptable to create in experimental conditions. For example, studies of child abuse or deprivation would not be acceptable to create for research purposes. ➔ **Link to brain-damage case studies** It would not be acceptable to deliberately create the damaged memory systems of HM and Clive Wearing. Instead, researchers were able to benefit from these events without causing them.	**Attrition**: Case studies often study the same individual or However, participants may s which may not give the rese need on the extent of the ch ➔ **Link to brain-damage** In research with brain him/herself is less like taking place. Howeve withdraw the patient
Integrated: Rather than measuring on a specific test, case studies tend to use a variety of typically qualitative research methods. This provides a more holistic understanding of the topic. ➔ **Link to brain-damage case studies** HM was tested in many different ways over his lifetime. These included tests of memory span, of his intellectual abilities, and of his ability to acquire new procedural skills (e.g. mirror tracing). After his death, HM's brain was scanned using an MRI machine and dissected. All of this research was brought together to provide a holistic understanding of the function of the hippocampus.	**Retrospective**: Research usu change that the individual h find out how the individual h at what the individual was li problematic as it relies on se from other sources. This ma whether the individual was ' ➔ **Link to brain-damage** It is difficult to say wh Clive Wearing was no It may be that their m way different from ty
Later research: Case studies can uncover possible relationships and this can encourage future experimental research that may be able to establish causation. ➔ **Link to brain-damage case studies** The finding that HM could create new procedural memories but not other types of long-term memory was a new finding in the study of memory. This led to much new research on motor learning and on where certain types of memory were located in the brain.	**Ethical issues**: In-depth stud care in ensuring the data is k must be apparent to the per can be stopped at any time. experienced abuse or traum researchers do not inhibit th ➔ **Link to brain-damage** It is difficult to know w participants with seve give informed consen be difficult for them t their well-being beca what is going on. Res invested in brain-dam they are damaging th

Issues and debates: nature-nurture debate

Cases of brain damage, such as HM, offer support for brain function being the r
side of the debate argues that our behaviour is the result of our genetics, biolo
damage to his brain strongly suggests that the brain's function is determined b
to his brain led to irreversible deficits in his memory. This suggests that certain
determined by biology and that memory deficits cannot be influenced by life e

In contrast, the other side of the debate, nurture, argues that brain function ar
past lifetime experiences. By extension, the nurture side of the debate offers f
are changeable, whereas our genetics are not. Some studies of brain damage,
and stroke survivors, support the nurture debate. These studies found that the
adaption after brain injury. This suggests that the brain is malleable and that r
and alter our memory.

As always, case studies are particular to the individual and need to be viewed a
complete picture. Currently, the stance is that both nature and nurture are inv

Not all things are bad…

While we have presented some serious threats to the multi-store model, there a
model:

- There is much strong evidence that has been discussed so far on the existen
  different stores
- The model provides a reasonable account of the structure of memory, but t
  explanations of the processes that underlie these structural components
- Later models of memory have used the foundations provided by the multi-s

Issues and debates: comparing the multi-store model with working mer

The multi-store model is an older model of memory and does not have the adva
made through later research. However, the model has provided a strong found
the working memory model. The distinctions between sensory, short-term and
supported. A key strength of the multi-store model is that it offers a complete a
our sensory inputs to our short-term and then our long-term memory.

The working memory model, in contrast, is an account only of short-term memo
the interaction of short-term memory with long-term memory.

The working memory model is considered an improvement over the multi-store

- allows for active retrieval
- is a non-linear process
- can better explain brain-damaged patients
- is involved in higher cognitive tasks
- has a lesser emphasis on verbal rehearsal (strong emphasis on this in th
  less so in later versions of the model)

Task 2.3

Using the information from this chapter, consider how the multi-store model could be regarde

Proposal in the multi-store model	Evidence that suggests that the model
Example... *The multi-store model proposes that there is a single long-term memory store.*	*Example...* *However, Clive Wearing lost many of his l the long-term store is not a single store. still play the piano. This suggests that th memory store which was left undamaged needs additional stores to account for thi*

Chapter 2 Activities

Check your understanding!

Q1. How does HM support the multi-store model of memory? (3 marks)

Q2. Describe a study into short-term memory encoding. (3 marks)

Q3. Identify the independent variable (what is changed to produce an effe
(how the change is measured) in Baddeley's (1966b) study on encodin

Q4. Simon loves to watch and play tennis, while Rob only has a passing in
Rob went to last year's Wimbledon championships. Explain, with ref
why it is easier for Simon to recall the match scores than it is for Rob.

Q5. Briefly discuss one ethical issue that may need to be considered when
patients. (3 marks)

Q6. Compare memory capacity across different stores of the multi-store m

Exam-style questions

Q1. Katie is trying to learn her new mobile number. However, she is havi
remembering all the digits.

Explain, using knowledge of short-term memory capacity, why Katie
her mobile number. (3 marks)

Q2. Storage capacity is how much information a memory store can hold a

Describe the storage capacity within the multi-store model. (3 marks)

Q3. Evaluate the use of brain-damaged patients in psychological research
to Henry Molaison's (HM's) case in your answer. (8 marks)

Chapter 3: Explanation of Long-term

Overview

In this chapter we will move away from the idea that long-term memory is a unified concept and take an in-depth look at the different types of long-term memory. We will examine the characteristics of episodic, semantic and procedural memory and the evidence for the existence of three types.

Learning outcomes

After studying this chapter you should be

- ❑ Describe the differences between e procedural memory
- ❑ Describe and evaluate research sup different types of long-term memo

Key Terms

Autobiographical memory	Another term for episodic memory; autobiographical me memory of personal events in our own life
Declarative memory	Memory that requires conscious thought; it encompasses memories; for example, remembering what you did last T back in time
Episodic memory	Our memory of past events, usually including a time and example, what happened on last year's birthday
Explicit memory	Another term for declarative memory; memory that requ
Implicit memory	Memory that can be formed automatically; it encompass you do not need to consciously think how to walk
Long-term memory	Our memory for past events (which is longer than our sh
Procedural memory	Our memory of how to do actions; for example, how to ri
Semantic memory	Our memory concerned with the meaning of things and c means or what a wrench is for

Scene-Setting Questions

- Clive Wearing is a brain-damaged patient who has severe probl and only some of his long-term memories. What does this tell
- Think of the word 'memory'; can you remember when or how y us about the way memory is organised?
- What behaviours would you say are automatic?

Tulving (1972)

Tulving (1972) was the first to formally distinguish between two different types o
memories and semantic memories. Episodic memories are our memories of pas
birthdays, or learning to drive, whereas, semantic memories hold our knowledge
abstract concepts mean; for example, knowing that Bristol is in the UK or what ty

Episodic memory

Episodic memory (also known as autobiographical memory) is our memory of pa
events. One of the defining features of episodic memories is that a spatio-temporal context is attached to them and we recall the time and place the event happened. For example, 'What happened to your knee?' might be responded to with 'I slipped on the wet kitchen floor yesterday'. Tulving likened our recall of episodic memories to being able to time travel and experience events again.

Researching episodic memories

It is challenging to investigate episodic memories because researchers need to know exactly what happened during the event to validate whether the episodic memory is accurate.

Researchers test episodic memories by testing their recognition or by testing the
recall.

Testing recognition

Two types: familiarity (recognising that you know something but not knowing an
(recognising because you have retrieved contextual information).

The remember-know tasks involve participants indicating whether they are fami
an event / previous learning task. Recollection is more difficult than familiarity.

Do they rely on different processes? Dunn (2008) conducted a meta-analysis of 3
found that they relied on the same processes, and differences were due to mem

Testing recall

Generally, recall is more difficult than recognition. We have to work harder to re

Staresina and Davachi (2006) tested free recall and recognition and found that fr
activation in the dorsolateral prefrontal cortex and in the parietal cortex but reco
areas. This suggests that free recall involves more processes than recognition.

A modern age

The current obsession with chronicling our everyday lives via social media sites such as Facebook will prove useful in the future for researchers interested in examining our episodic memories. While previously it would be difficult to check the correctness of an episodic memory, the masses of information stored on Facebook will make th

Autobiographical memories

Autobiographical memories are sometimes considered separate from episodic m
considered a subtype. Autobiographical memories concern only personal events
also encompass events that might not affect you seriously; for example, a seriou

Flashbulb memories

Flashbulb memories are a special type of episodic memory which are like vivid 'snapshots' of events. With these memories, forgetting is less likely and a large number of details are often recalled. For example, you may have a strong memo
where you were and what you were doing when you found out that Michael Jack
died or about the 9/11 attacks. One reason why these memories might persist is
these memories are often retold; however, these recollections may not always b
accurate.

Consider!
Have a think about your own flashbulb memories. They might be events of personal importance, such as a special birthday or a family death, or world events such as natural disasters or the election of President Obama.

*9/11 is one area that has been extensively stu
flashbulb memories. Research has shown Am
details much like a photograph. British peopl
level of detail for events closer to home such
Princess Diana or the 7/7 terrorist attack in L*

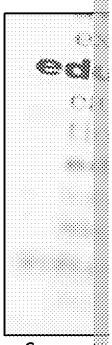
Why do you think we remember th
Did we pay more attention at the tim
we knew it was going to be a signific
Has the story or event been retold m
Do strong emotions cause us to rem

Individual differences: autobiographical memories
A person's autobiographical experiences are unique to that individual. Two peo
event but have different autobiographical memories. Factors such as age, cultur
influence how we experience and recall memories.

Semantic memory

Semantic memory is to do with what things mean. It includes the definitions of words, our understanding of concepts and our generic factual knowledge.

Semantic memories are essential for our ability to use and remember language, and without them words would be meaningless. Not only do we use them to remember the meanings of words, but also the rules for how those meanings interact and change (for example, plurals generally have the rule 'add s' but there are also exceptions to this rule), which are all stored in semantic memory.



Semant

Separate from spatio-temporal context
Unlike with episodic memories, we cannot recall when and where we acquired th
circumstances around learning the word 'superficial' were, it is unlikely that you
information. Thus, while you know what the word 'superficial' means, it can be
context.

Most of the time it is useful for semantic memories and episodic memories to be
if you could recall the time and place for every word and fact you had ever learn
and may affect our ability to function.

Stored in different areas of the brain
Semantic memories and episodic memories are initially connected and rely on th
the episodic parts of the memory are stripped away from the semantic memorie
become consolidated in the neocortex, a structure away from the hippocampus.

As such, damage to the hippocampus should leave our factual knowledge intact but damage our abilities to learn new information.

Schema
Schemata (plural of schema) are mental structures that help us understand and organise conceptual information. For example, a schema for 'dog' might include information that it is a living thing, that it has four legs, that it barks and that it might bite you. As new information about dogs is encountered it is integrated into the existing schema.

Task

Make a list of things you associate with the concept 'dog' then write a para
using the word and see if someone else can guess what it is: our schemata
often similar.

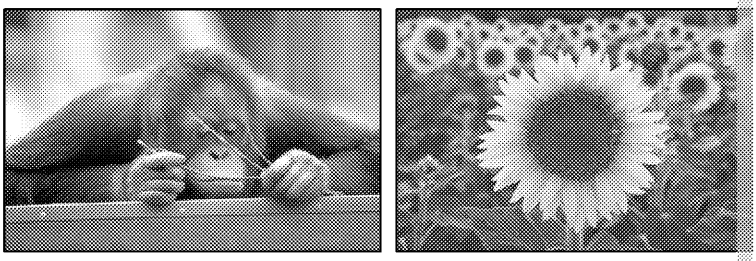
Bransford and Johnson (1972) illustrated the effect of schemata on our underst
They gave participants this passage to read:
'*The procedure is actually quite simple. First you arrange things into different gro*
Of course, one pile may be sufficient depending on how much there is to do. If yo
to a lack of facilities that is the next step, otherwise you are pretty well set. It is i
particular endeavour. That is, it is better to do too few things at once than too m
not seem important, but complications from doing too many can easily arise. A m
The manipulation of the appropriate mechanisms should be self-explanatory, and
first the whole procedure will seem complicated. Soon, however, it will become ju
difficult to foresee any end to the necessity for this task in the immediate future,

Afterwards they asked participants how easy it was to understand. Participants
understand. However, if told that the passage was about doing the laundry, part
to understand.

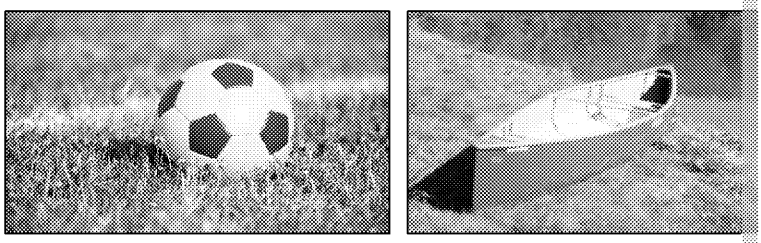
How is semantic memory organised in the brain?
We can use research on language disorders of semantic memory to help us unde
For example, Warrington and Shallice (1984) looked at four patients who had suf
encephalitis, which affects the brain, and found that these patients were much w
living things as opposed to nonliving things. For example, JBR was able to recogn
nonliving things but only two out of 48 living things.

This suggests that our memory is organised differently for animate and inanimat
stored in different areas.

Lose these?



But keep these?



What evidence is there for the dissociation?

Tulving (1972) argued that episodic and semantic memories were two separate t
consider whether this argument holds water.

Evidence from brain-damaged patients

When someone suffers brain damage, it can affect their memory. They may lose
the ability to learn new memories. This, along with the nature of the damage, ca
memory is stored.

The case of KC

KC was in a motorbike accident which left him with an inability to create new memories (anterograde amnesia) and also problems in recalling memories before the accident (retrograde amnesia). Interestingly, his semantic memories were intact but his ability to recall and form episodic memories was severely affected. This supports the dissociation between episodic and semantic memories because only episodic memories were affected, which suggests that semantic and episodic memories are stored in different areas of the brain.

KC i
now

The case of Clive Wearing

Clive Wearing contracted herpes viral encephalitis which attacked his central nervous system. He is unable to form new memories (anterograde amne
memories. He remembers some episodic memories from before the virus, such a
recall the names of the children from his first marriage. Prior to his brain damag
can still recall how to play the piano. This suggests a third type of memory whic
actions. This type of memory was not damaged and, therefore, must be in a diff
other memories. Tulving (1985) later described this as procedural memory.

Individual differences: Brain-damaged patients often have unique patterns of damage and respond differently to treatment. While these patients can provide important insights into the different types of memory, it is important to be cautious about applying these findings to the healthy population.

A review of brain-damage-ind

Maguire and Burgess (2001) revi
which the patient had damage t
bundle of nerve fibres which car
They found that there was episo
the cases but there were few pr
This suggests that the location o
memories must be different.

Neuroimaging evidence

A review by Wheeler et al. (1997) of studies that used PET scans found that in 25 out of 26 studies the right prefrontal cortex showed greater activation during episodic memory retrieval than during semantic memory retrieval. They also found that in 18 out of 20 studies, the left prefrontal cortex was more active during episodic encoding and semantic encoding. This suggests that the prefrontal cortex is more involved in episodic memory than semantic memory, suggesting separate systems.

PET
radio
prod

A more recent study by Burianova et al. (2010) argues that autobiographical, episodic and semantic memories are retrieved by the same neural network rather than separate memory networks. They conducted an fMRI study which used the same photographs but asked participants questions that involved recalling autobiographical, episodic or semantic information.

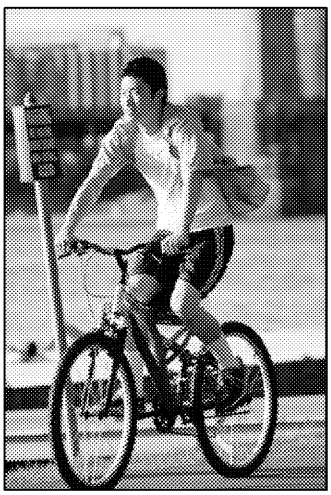
For example, a photograph of a tent was shown and the questions were:

- **Autobiographical**: Think of the last time you went camping.
- **Episodic**: In the picture which you have just seen, what is the colour of th
- **Semantic**: Are there more than 100 camping grounds in Algonquin Park? research was being conducted)

They found that a large network of brain regions was activated in all three types. the left hippocampus, right caudate nucleus and left lingual gyrus in all of the co types of memory are all part of a common network with much overlap between other research which argues for a non-unitary system (i.e. separated into differe

Procedural memory

Procedural memory is separate from episodic and semantic long-term memories memory of how we perform actions; for example, how we ride a bike or use cutl



Brain injuries

Clive Wearing showed that he still retained his ability to play the piano, suggesting that his procedural memories were left intact. In addition, another brain injury patient, HM, was able to form new procedural memories and short-term memories, but other types of long-term memory could not be formed. This suggests that the procedural part of his memory was preserved and existed independently of the other parts. He was able to learn and improve on mirror drawing but had no memory of having ever done it before.

Mirror draw
This task is c
amnesic pat
memories. T
involves trac
only looking
Repeated pr
time it takes

Neurological basis for procedural memory
Unlike other types of memories which are dependent on the hippocampal struct
encoded and stored in other areas of the brain. The involvement of the motor c
areas of the brain such as the cerebellum and the basal ganglia are also involved

How we learn new skills
Fitts (1954) proposed a three-stage model for learning new skills:

1. **Cognitive phase:** The skill is broken up into different parts and knowledge is built upon; attention is required at every part of the skill
2. **Associative phase:** Practising the actions involved until the response of the skill changes (improves)
3. **Autonomous phase:** This involves perfecting the skill until it becomes autonomous and the person does not have to consciously think about doing each part of the skill

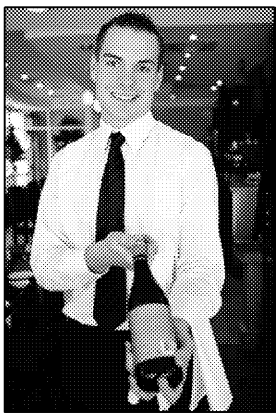
Tadlock (2005) argued that learning new skills was a matter of analysing your responses and improving them. Repeating this cycle over many attempts leads to perfecting a skill.

Divided attention
How easy is it to multitask? Can we really do two things at once?
Spelke et al. (1976) examined the effect of practice in a dual-task experiment. Two students were asked to read and comprehend short stories while noting down words that they heard. Initially, they found it difficult and their comprehension of the stories suffered. However, after six weeks of training for five hours a week, they could comprehend the stories as well as when they read them alone. This suggests that when an activity becomes autonomous, we are able to perform multiple tasks at once.

However, Strayer and Johnston (2001) conducted a simulated driving study that compared braking distance when driving alone to driving while using a hand-held or hands-free mobile phone. They found that mobile phone usage of both forms led to longer braking times, which suggests that even autonomous behaviours are still affected by dual tasks.

Real-life applications
While research suggests that many procedural skills become perfect with practice, in real life people who are at their peak of performance may fail due to pressure (termed 'choking').

For example, David Bedford was a world-record-holding runner, but in the 1972 Munich Olympics the pressure was too much and he only managed a disappointing 12th place.



The effects of alcohol
While alcohol can impair the encoding of our episodic m
blackout memory is a failure to encode memories due t
procedural memories are largely unaffected. Since pro
automatic, they are unimpaired by the problems in con
results in.

Even if you are intoxicated, you can still remember how
without consciously thinking about it, but your reflexes

Further evaluation points

There are more than three types…
Along with procedural memory, which does not require conscious recall, other ty
memory are also unconscious. Priming involves 'preparing' a person for a stimul
which quickens or improves the response.
Exposure to a semantically related word primes the response.

For example, if exposed to the word 'fruit' it speeds up the recognition of the wo
'apple' but not 'hat'.
Another example is that if you read a list of words including 'hall' and were later g
'_ _ l l' to fill in, you would be more likely to use the word 'hall' when numerous o
options exist (e.g. call, ball, cull, dull, fall, tell, poll, roll, to name a few!).

This shows that we are making unconscious links between our memories. Uncon
types of memory, including procedural memory, are grouped under the heading
'implicit memory'.

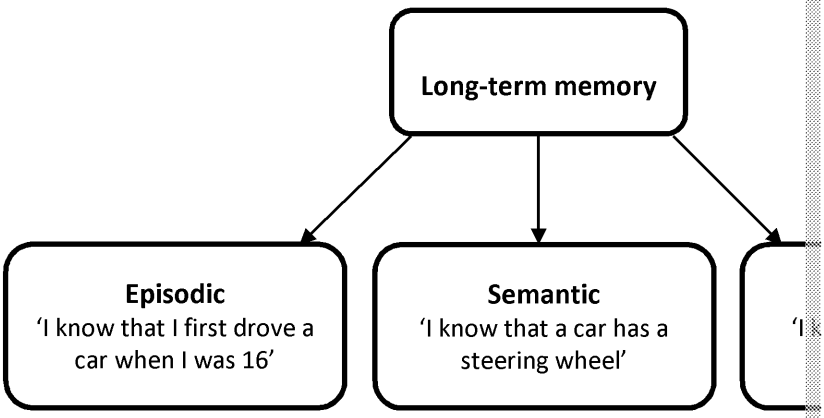
Depth of processing
Models tend to argue that the amount of rehearsal determines whether a memo
enters the long-term memory store. However, Craik and Lockhart (1972) argue t
is not how much rehearsal but how deeply we process the information that
determines whether it enters the long-term memory store.
Shallow processing might involve focusing on the physical characteristics, where
deeper level of processing might involve examining the semantic meaning.

In the multi-store model this is akin to the differences between maintenance
rehearsal and elaborative rehearsal. Maintenance rehearsal does not make it lik
that the memory will be engrained in our long-term memory as it involves a shal
level of processing, but elaborative processing involves a deeper level.

Just one store?
Howard and Kahana's (2002) Temporal Context Model (TCM) argues that rather
than there being multiple stores, there is a single store that is context-dependen
Associations exist between the temporal contexts which act as cues for recall. Th
explain that the recency effect is the result of temporal context. If a person has j
recalled one word, they are likely to recall next the word that has the most close
associated temporal context, which is usually the word next to it.

However, more recent revisions to the model (Sederberg, Howard and Kahana, 2
possibility of a short-term component within the TCM.

Summary of Types of Long-term Memory



Chapter 3 Activities

Task 3.1

Illustrate that you know the difference between the three different types o
the same example but other types of memory:

Type of long-term memory	Example
Episodic	
Semantic	
Procedural	'I know how to ride a bike'

Type of long-term memory	Example
Episodic	
Semantic	'I know that a piano has 88 keys'
Procedural	

Type of long-term memory	Example
Episodic	'I know that I first tied my shoes when I was five yea
Semantic	
Procedural	

Check your understanding!

Q1. Briefly outline the difference between declarative and procedural mem

Q2. Briefly define the three different types of long-term memory. (3 mark

Q3. According to Fitts (1954), how do we learn to ride a bike? (3 marks)

Q4. Describe what flashbulb memories are, and give examples. (3 marks)

Q5. Describe what schemata are, and give examples. (3 marks)

Q6. Discuss whether we can really do two things at once. (4 marks)

Exam-style questions

Q1. Tulving (1972) made the important distinction between episodic and s
Describe semantic memory. (3 marks)

Q2. David was in a car accident and suffered brain damage. David is able
information. He can remember factual information such as the locatio
map. He can also remember what everyday household objects are, su
remember the time when he badly burnt his hand with boiling water.
details from many years before his accident, but he cannot remember
to his divorce which occurred two years before his injury. David is un
He is not able to learn new facts or remember his recent experiences.
distinction between episodic and semantic memories.

Discuss the episodic-semantic distinction in terms of David's ability to
(8 marks)

Chapter 4: Reconstructive Mem

Overview

In this chapter we will learn about Bartlett's (1932) theory of reconstructive memory, including schema theory. We will look at his famous study, The War of the Ghosts, and evaluate the study. We will consider evidence for the reconstructive memory theory as a whole and the theory's strengths and weaknesses.

Learning outcomes

After studying this chapter you should be

- ❑ Describe and evaluate Bartlett's ex
- ❑ Describe and evaluate evidence for
- ❑ Describe and evaluate evidence for
- ❑ Describe and evaluate a contempor

Key Terms

Assimilation	Trying to fit new information into our previously held expectations
Blood-oxygen-level-dependent (BOLD) response	A technique used in fMRI that shows activity in the br oxygenated and deoxygenated haemoglobin
Control group	A group of participants who are not exposed to the ex independent variable and who are compared with the
Ecological validity	The extent to which the findings can be generalised to life and everyday behaviour
Encoding	How information changes to be stored in memory
Functional magnetic resonance imaging (fMRI)	A neuroimaging method which examines brain activity and associated changes
Inter-rater reliability	A method of establishing reliability which compares h with each other
Levelling	Simplifying a story by reducing the number of details
Objective	Free from errors caused by subjective interpretation
Rationalisation	Explaining confusing elements of a story so that they
Reconstructive memory	A theory by Bartlett (1932) which argued that memor reproduced
Repeated reproduction	When the same information is recalled several times memory over time
Retrieval	Accessing the stored memory
Schema (schemata)	Schemata are our mental representations of objects a about what words and concepts mean, and what to e
Serial reproduction	One person learns and recalls information, their versi recalls it, and so on
Sharpening	Overemphasising the importance of certain details in

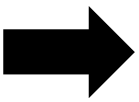
Scene-Setting Questions

- Have you ever questioned the accuracy of your memory?
- Do you think your memory is more accurate for recent events o
- For what situations is it important for memory to be accurate?

Task 4.1.

Try this task with the person next to you. Read the list of words to the per
After you have finished reading, they should write down all the words the

Fight	Mad	Fury	Rage
Mean	Temper	Annoy	Hatred



***Discuss with your partner**: How many words did you rememb
the same? Were any words new?*

Bartlett and Reconstructive Memory

What is reconstructive memory?

Reconstructive memory is a theory proposed by Bartlett (1932), who argued tha
reconstructed rather than simply reproduced. Memory is not like the video ficti
exactly what happens. Instead, every time we try to recall a memory, it is recons
available.

Before Bartlett's theory and the research conducted on the topic, it was thought
and it was often used as the primary evidence in criminal court cases. Now, it is
can be easily distorted and Bartlett believed that the reconstructive process coul
memory.

Bartlett (1932) The War of the Ghosts

Bartlett conducted a famous study called The War of the Ghosts which he used t
become distorted over time.

Key Study: Bartlett (1932) The War of the Ghos	
Aim	To investigate the reconstructive nature of memory and whet (schemata) will affect memory.
Method	Bartlett investigated this in two ways: **Repeated reproduction**: Participants heard a story called The War of the Ghosts, a Nati was unfamiliar to them. The story was told twice and then the after 15 minutes. Recall was then tested at various intervals, w participants at the campus, and this varied from days to month **Serial reproduction**: Serial reproduction is similar to the game Chinese Whispers. T of the Ghosts and then recalled it after a set interval. This new second person, who recalled it, and this was read to the third p
Findings	**Repeated reproduction**: Bartlett found that participants changed the story during recall The number of distortions increased with further recalls. Partic they tried to make sense of it from the cultural perspective the Bartlett found that a number of different kinds of memory erro reproductions of the story. The error types were: • **Levelling**: Participants remembered fewer details abou account each time the story was retold. They simplifie • **Sharpening**: Participants increased the importance of s overemphasised and elaborated on certain details. • **Distortion**: Participants also changed the story during r • **Assimilation**: Participants tried to change the story to f Unfamiliar elements of the story were changed so they participants. Parts of the story that could not be chang different were cut from participants' memories. • **Rationalisation**: Participants provided explanations fo story so that they made more sense. They added extra more similar to an English story. **Serial reproduction:** The same errors were found in serial production but the chang repeated recall. Participants still had the same reconstructive p very inaccurate, then the rest would also be.
Conclusions	Memories are not exact reproductions of the event but are rec active process in which information is compared to existing sch our understanding of the world. Memory gets less accurate over time due to the multiple recon The effects shown in the serial reproduction can explain how in through generations and from culture to culture.

Below is the actual story that participants had to recall:

The War of the Ghosts

One night, two young men from Egulac went down to the river to hunt seals and while they were there it became foggy and calm. Then they heard war-cries, and they thought: 'Maybe this is a war-party'. They escaped to the shore, and hid behind a log. Now, canoes came up, and they heard the noise of paddles, and saw one canoe coming up to them. There were five men in the canoe, and they said:

'What do you think? We wish to take you along. We are going up the river to make war on the people.'
One of the young men said, 'I have no arrows.'

'Arrows are in the canoe,' they said.

'I will not go along. I might be killed. My relatives do not know where I have gone. But you,' he said, turning to the other, 'may go with them.'

So one of the young men went, but the other returned home.
And the warriors went on up the river to a town on the other side of Kalama. The and they began to fight, and many were killed. But presently the young man hea let us go home: that Indian has been hit.' Now he thought: 'Oh, they are ghosts.' He did not feel sick, but they said he had been shot.

So the canoes went back to Egulac and the young man went ashore to his house and made a fire. And he told everybody and said: 'Behold I accompanied the ghosts, and we went to fight. Many of our fellows were killed, and many of those who attacked us were killed. They said I was hit, and I did not feel sick.'

He told it all, and then he became quiet. When the sun rose he fell down. Somet His face became contorted. The people jumped up and cried.

He was dead.

Task 4.2

Bartlett found that the story became a much more straightforward narrati recalls. Supernatural elements were dropped, the prose was more consiste narrative, and the story became about a fight and a death.

Imagine you are a participant and write down the story you might recall.

Issues and debates: culture

Our ability to remember is universal and present in every culture. However, dif
seem to be determined by the cultural and social demands of the context.

Bartlett believed that remembering was related to culture and described the ab
recall characteristics about specific cattle in their herd. In the Swazi culture, ow
central to their livelihood; therefore, it makes sense that they would develop m
their cattle.

Misty and Rogoff (1994) argued that remem
because it is required for important cultura
extraordinary memory of the Itamul elders
recall lines of descent and the history of th
These skills developed so that they could re
and Rogoff (1994) used this example to arg
culturally important goals.

Evaluating Bartlett's The War of the Ghosts study

Strength: Bartlett's theory and findings generated new research

Bartlett's ideas were new to memory research at the time. Prior to this, there w
simply reproductions. Bartlett argued that this system would not be useful in rea
was every changing and, therefore, we would rarely need to exactly reproduce s
reconstruct the memory in accordance with the information at the time. Later re
viewing memory in this way. A large number of studies supported the idea that
reproductions of the event.

Issues and debates: how psychological understanding has developed ov

Prior to Bartlett, psychology was focused on spatial explanations for memory error. Psychologists argued that we forget things because we do not have the storage capacity to hold all of the available information. Processes such as attention explained why some pieces of information got stored and others forgotten.

However, Bartlett proposed that errors of memory were the result of temporal factors. That is, over time things become less accurate and we are more prone to memory errors. This was a radical shift in how memory was considered and studied, and generated new research which tested this theory.

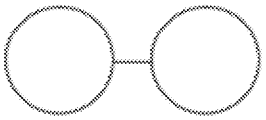
Now, once again, the focus on temporal dynamics has been dropped by cogniti
studying memory from a storage point of view. The future of memory and sche
approach which encompasses storage and temporal factors, along with viewing
active process.

Strength: The War of the Ghosts study was one of the first to investigate more

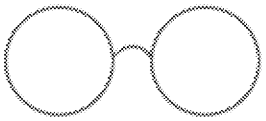
Ebbinghaus's research using nonsense syllables was seen as the gold standard of
Highly scientific and controlled, Ebbinghaus's experiments illustrated a more syst
memory. However, a core weakness of Ebbinghaus's work was that it was difficu
life. Our recall of nonsense syllables, such as WSP, tells us little about how we re
afternoon. Bartlett disliked the methodical approach of Ebbinghaus and wanted
approach. He asked participants to recall a story, which is more like real-life reca
syllables.

Strength: other research shows similar findings
Carmichael, Hogan and Walter (1932) presented participants with a series of figu
objects. Before the figure was shown, the experimenter said 'the next figure res
was from either List 1 or List 2. A control group was not told what the figure rese
asked to draw, from memory, the figures they had seen. The experimenter com
stimulus figures. The participants' drawings in the List 1 group were different fro
drawings resembled the label they had been given.

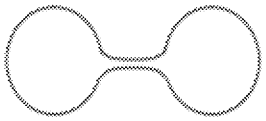
Stimulus



'Glasses'



'Dumbbell'



Here participants were given an a
joined by a line. The participants
drawing resembled glasses or tha

The researchers found that the la
produced in recall to match the l

The researchers argued that mem
reconstructed.

Bransford and Franks (1971) were interested in memory abstraction, which is a c
capture the meaning but do not store the precise wording.

Task: In the acquisition phase, participants listened to 24 sentences and after ea
simple question about the sentence. After a five-minute delay, they were given a
test phase, they had to make a judgement as to whether the sentences had appe
they had not heard the sentence before ("NEW"). The participants also gave a co
they were that they were correct.

In the first list, there were sentences with one, two, or three facts.
One fact: The jelly was sweet.
Two facts: The sweet jelly was on the table.
Three facts: The ants ate the sweet jelly on the table.

For the second test list, participants heard sentences with one to four facts. Mos
presented to the participants before. Sentences with four facts had not been in
Four facts: The ants in the kitchen ate the sweet jelly that was on the table.

Findings: Sentences with a higher number of facts were more likely to be judged
more confident about their judgement. Participants had only seen the simpler se
believed that they had seen the four-fact sentences. Bransford and Franks argue
mind trying to make sense of the disconnected statements by processing them in
four-fact sentences were a close match to the way they had been processed.

Conclusions: Bransford and Franks (1971) found that during encoding we integra
ways and, therefore, we may not recall the information exactly as it happens. Th
is not completely accurate but based on the construction process during encodin

Weakness: Bartlett's findings may have been the result of the instructions he g
Bartlett did not record the exact instructions that he gave to participants, which
to replicate his study precisely. In some instances, he would run into his particip
and ask them to recall the story on the spot, which suggests that his instructions
participant to participant.

Later researchers Gauld and Stephenson (1967) used the same story as Bartlett but gave instructions that emphasised the importance of accuracy in their recalls. This change reduced nearly half of the errors that Bartlett found, which suggests that the instructions Bartlett gave encouraged guessing.

Issues and debates: p
science
Good quality psycholog
scientific journal article
article is that the resea
method they used in th
researchers to replicate
work. This helps psych

Weakness: Bartlett did not test participants at the same time intervals, which makes it difficult to compare participants

Following the initial recall after 15 minutes, participants recalled the story at various intervals depending on when they were came across them on campus. This lack of testing participants at specific time in compare participants. For example, if there is just a single participant for a specific time interval, how do we know that this participant is representative of all people?

Issues ar
psycholo
Researche
important
for coding
types. It i
researche
informati
reliability
of how m
between

Weakness: Bartlett did not have a consistent system for coding errors

Bartlett's findings were recorded as a series of anecdotes rather than using descriptive statistics or other analyses of the results. Bartlett seemed to delight in the fact that the book contained no statistics. This sharply contrasted with Ebbinghaus's earlier work on memory, which was highly scientific. In Bartlett's study, when a participant made an error in their recall, it was coded into different types of error; however there was no systematic method for coding these errors.

Weakness: Bartlett's study has limited generalisability to everyday memory

Bartlett chose to use unfamiliar material because he was interested on how sche material. However, one weakness is that his findings may not be generalisable t

Some researchers have praised Bartlett because he stepped away from the trend nonsense syllables or lists of words to investigate recall. However, critics have ar different from what his English participants were used to that the research is not memory.

EXAM TIP: You could use this to critique Bartlett's study. Here's how you could

Point: The War of the Ghosts story has poor ecological validity because of how memory.

Evidence: For example, the prose in The War of the Ghosts story was very unusu participants to understand the connections between different parts of the story.

Elaboration: Many of the distortions in the participants' recall were to change t English story. In real life, participants would not need to distort their memories t everyday memories may not be as prone to the memory errors Bartlett identifie

Schema

Bartlett (1932) thought that distortions mainly occurred due to the effects of schemata on the reconstructive process. 'Schemata' was the word that Bartlett used to describe our existing knowledge. He argued that we use our existing knowledge to help us interpret and make sense of new information. This active interpretation process plays a role in our reconstructions as we try to fit new information into our existing knowledge. When our memories are incomplete, our schemata help us 'fill in the gaps' with knowledge about what could have happened in that situation.

In The War of the Ghosts study, some participants:

- altered the story so that there was a 'good guy' and a 'bad guy'
- viewed the story from the perspective of a fairy tale
- added a moral to the story
- changed elements that were strange to the participants, e.g. 'hunting se
- removed supernatural elements from the story
- simplified the story to be about a fight and a death

Bartlett argued that these changes were the result of schemata influencing the r to make sense of the story using their existing schemata, and, due to the large nu dropped or changed confusing elements; this made the story more consistent wi

People are more likely to ignore information that conflicts their existing schemat schemata to account for the new information.

LINK TO CHAPTER 3

Definitions of schema (plural schemata)

You have previously come across schemata in Ch at semantic memories.

Bartlett was one of the first to use the word in p disliked the term because of the vague way rese past. Bartlett used 'schema' to mean an active p experiences. All of our prior knowledge comes t understanding of the world, and this understand response to new experiences.

Later researchers developed on our understand inclusion of 'scripts', which are schemata for spe researchers do not necessarily use the word 'sch as Bartlett.

You could use this as a criticism, as researchers u different ways and yet their work is compared e same construct.

Task 4.3

Schemata contain our knowledge and expectations about particular events stored in your restaurant schema?

Schemata and the brain (Mahon et al., 2009)

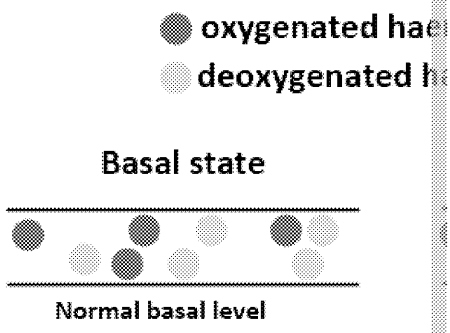
The idea of schemata is a theory that psychologists have created to explain their observations and findings. But do schemata have a biological basis?

Mahon et al. (2009) researched which areas of the brain were activated for different types of objects (animals, tools and non-manipulable objects). If different areas of the brain were activated for different types of object, this would suggest that they were organised conceptually in the brain. The researchers were also interested as to whether blind and sighted people would show different activation patterns because if they did, this would suggest that organisation was l
However, if they were the same, then this would suggest that organisation was b
such as whether the object was inanimate.

Issues and deba
This study sugges
has evolved to or
conceptual inform
that reconstructiv
– our biology, evo
the other hand, th
is a direct respons
experiences, whic
influenced by nur

New technology allows new insights:

Mahon et al. used functional magnetic resonance imagining (fMRI) to measure the neuronal activity of their participants. When an area of the brain is more active, there is an increased demand for oxygen, and higher blood oxygenation shows up differently on the scans. This imaging technique is known as blood-oxygenation-level-dependent (BOLD) imaging. Mahon et al. wanted to see if there would be different BOLD responses for the different types of object.

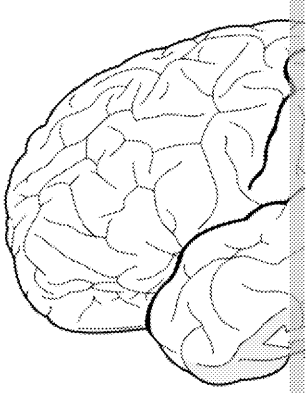


Issues and debates: psychology as a science

Our understanding of the brain is increasing in proportion to the advances in tec
new ways to research the brain. One of the advantages of neuroimaging technic
objective. Neuronal activity patterns are not subject to the same kinds of error a
responses. Objective research is not influenced by factors such as the researche
Objectivity is a key feature of science. Despite the results being objective in neu
researcher's interpretation of the results may not be objective.

What did participants do? Seven normally sighted and three congenitally blind (
took part in an fMRI study. The participants listened to groups of six words, all fr
category (animal / tool / non-manipulable object). Participants were told to think about the size of the first item, and then to compare the size of the other items to this first item. If participants judged all the sizes to be the same, they pushed a button with their right hand; if one or more of the objects were of a different size, then they pushed a button with their left hand.

What were the study's findings? Both sighted and blind participants showed higher BOLD responses in **medial** regions of the ventral stream for tools and non-manipulable objects compared to living things (e.g. animals).


Ventral stream

*The ventral stream is kn
term 'medial' refers to
bein*

Both sighted and blind participants showed higher BOLD responses in **lateral** reg
living things compared to tools and non-manipulable objects.

This suggests that the brain organises information not based on visual informatic
participants had similar results) but on conceptual schemata, such as whether ar
al. argued that the human brain is structured around the different conceptual ca
categories would have been important for evolutionary survival.

Takeaway point: Mahon et al. (2009) found that the existence of
neuroimaging evidence showing that different types of construct
brain.

Is there evidence to support the involvement of schemata infl

Below we will consider some of the studies investigating Bartlett's schema theor

Supportive study 1: **Sulin and Dooling (1974)**
Task: They gave participants a story about a brutal dicta
Gerald Martin or Adolf Hitler. Sulin and Dooling wanted
identification of Hitler would lead to activations of a 'Hi
to him. After reading the story, the participants were t
test after a short or long interval of time. The recogniti
hated the Jews particularly and so persecuted them.'

Findings: They found that of the participants who had b
about Hitler, those who had the long interval between
believed that the sentence had appeared in the story. T
were not affected. This suggests that the number of m
over time due to the effects of schemata in reconstructing the memory.

Takeaway point: Sulin and Dooling (1974) found that activation o
schema-consistent recall. This effect occurs when there has beer
and recall, whereas shorter intervals were recalled correctly, sug
schemata when intervals are short.

Evaluation:

- **Strength:** The study was well controlled. The only difference between the two stories was the name that was used. This suggests that the difference between the two findings can be attributed to the change in name.
- **Weakness:** In real life, the information that Hitler persecuted the Jews would be likely to be present because he is very strongly associ
  Therefore, in real-life this error would not be a problem.

Cons
migh
sche

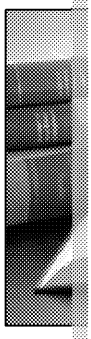
Supportive study 2: Anderson and Pichert (1978)
Task: Participants read a story about two boys who skipped school one day and w
because no one was home on Thursdays. The story included details about the ho
roof and a damp basement, but was in an attractive neighbourhood. Objects, su
and a rare coin collection, were mentioned as being in the house. The story cont
been previously rated for their importance to a burglar or to a prospective home
read the story from the perspective of a burglar and half of them from the persp
participants were asked to recall everything they could remember and then com
minutes. The participants were again asked to recall the story, but this time half
perspective and half of the participants kept the same perspective as earlier.

Findings: Participants who changed perspective recalled 7.1% more information t
perspective and not important to the first. Participants who shifted perspective r
that was unimportant to their new perspective. Participants who did not change
of information that was still unimportant to their perspective.

Takeaway point: Anderson and Pichert (1978) found that schema
retrieval process. Participants recalled more details of the story th
and recalled fewer details that were irrelevant to the schema.

- **Strength**: High level of control in the experiment allowed the researcher
schema activation (due to perspective change) led to different amounts o
- **Weakness:** It is difficult to know whether participants recalled informatio
they knew that their second recall was based on a different perspective, t
omitted information that was unimportant to the new perspective.

Supportive study 3: Brewer and Treyens (1981)
Task: They investigated whether our memory of objects in an office is influenced by the existing schemata about what objects are typically in an office. Their 30 participants waited in what appeared to be a graduate's office for 35 seconds. They were then taken to another room and asked to write down everything they could remember from the room.



Sc
ther

Findings: Participants recalled more schema-consistent objects (e.g. typewriter) than schema-inconsistent objects (e.g. skull). Participants also recalled schema-consistent objects that were not actually present in the room (e.g. filing cabinet and books).

Takeaway point: Brewer and Treyens (1981) found that schemata
an environment is not consistent with the schema. Schema-consi
present in the room were falsely believed to be present.

Evaluation:

- **Strength**: A recent study by Steyvers and Hemmer (2012) replicated thes
schema-consistent objects were well recalled, and also very schema-inco
were not expected to be found in that environment. This suggests that t
- **Weakness:** The study was a conducted in a laboratory and, therefore, th
representative of memory in real life. Steyvers and Hemmer (2012) argu
useful, and that in a normal environment a filing cabinet and books woul
memory would not be prone to these types of error.

Contemporary study: Reconstruction from memory in naturalistic environments (Steyvers and Hemmer, 2012)

Steyv
partic
in rea

Steyvers and Hemmer argued that memory in real-life is not prone to the kind of error that laboratory experiments often demonstrate. Laboratory experiments manipulate the environment so that it does not match our expectations. For example, an experimenter might ask participants to recall objects seen in an office but the experimenter has deliberately included no books in the photograph. A common finding in this type of experiment is that participants falsely recall that books were present. Steyvers and Hemmer argued that these errors were the result of experimental manipulation and not an accurate representation of how memory works in a natural environment.

Instead of focusing on errors produced in research as being evidence of the fallib
the insights these errors could provide into the function of memory. They argue
use real-life settings because this would provide insight into memory's true funct

Aim:
To investigate how our prior knowledge (schemata) influences our recall of episc
wanted to investigate our recall for naturalistic scenes that had not been experim

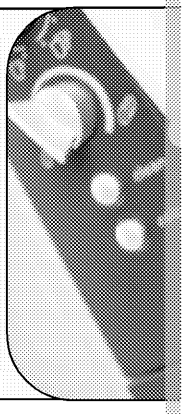
Issues and debates: psychology as a science
Steyvers and Hemmer's (2012) study was a response to the findings of Brewer a
Steyvers and Hemmer argued that the finding had been the result of experimen
of naturalistic settings (where schema-consistent items would be common and s
uncommon) would not be prone to errors. A key feature of psychology as a scie
replication of others studies and attempts to improve the theory. The aim of psy
understanding of human behaviour.

Task 4.4

Name all the objects you might expect to find in a kitchen. What are your

Testing perceptual judgements
A separate group of participants provided perceptual judgements of photos of th
objects they could see in the image). Twenty-five images were used, five from e
high-resolution and in colour. The frequency of named objects was recorded. Th
necessary because although an object may be in the picture, it might not be perc
researchers found that perception was accurate among the participants.

Individual differences
Our prior knowledge and expectations (schemata) vary between individuals. If you compare a schema between two people, there will likely be overlap but also differences. For example, one person might think that a kitchen is incomplete without a coffee maker, whereas a non-coffee drinker may not expect to find that object in a kitchen. Since schemata guide our reconstructive process, there will also be individual differences in how memories are reconstructed.



Memory condition
Forty-nine participants from the same university were randomly selected to take
These participants had not taken part in either the expectation or perception tes

Ten photos from the perceptual judgements test were used in the scene, two fro
divided up into two groups of five photos (each with one photo from each scene). Each participant only saw one set of photos.

Participants were shown each photo for either two seconds' or 10 seconds' duration. This was to alter how much participants relied on their prior knowledge when retrieving the memory. It was expected that when participants have only viewed the scene for a short period of time then they have not had time to fully encode all the detail in their episodic memory. In this situation they would rely more heavily on their prior knowledge (semantic memory) to fill in the missing blanks. Those who have had have encoded more of the details of the scene and can reconstruct the memory knowledge.

It was believed that in situations where the expectation did not match the photo recalled when participants had time to encode the photo into their episodic mem would lead to the false memory of there being books in an office without books to rely on their prior knowledge.

The orders of the pictures were randomised, and researchers recorded the recall

Results and conclusions:
Low-probability items were more likely to be recalled when not actually presen
Errors occurred when a participant named an object that was not in the photogra errors in terms of the probability that the object would be in the scene. Probabil responses participants gave when testing their prior expectations. The overall er objects was 9% and for low-probability objects 18%. These results conflict with B finding of higher error rates for high-probability objects.

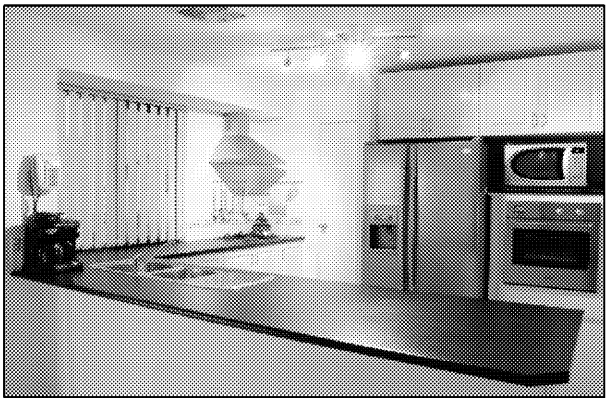
➔ Explanation: Steyvers and Hemmer argued that when the environment is r objects are likely to be in the scene and this leads to the lower error rates. activated, they will usually not lead to errors because the objects will be in

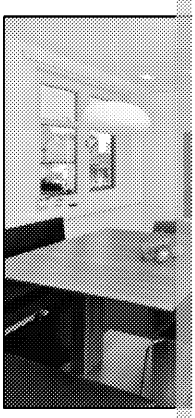
In naturalistic settings, it is rare that false memories occur for objects that are n
They also investigated the false memories of recalling an object that was not pre the scene; for example, Brewer and Treyens' finding that participants recalled bo that were not there. Due to the naturalistic environment, there were few items caused this error to occur. In one picture a tablecloth was absent from a dining s A tablecloth had been identified as a high-probability item in the prior expectatio task. An error rate of 19% was found. This error rate is much lower than Brewer Treyens' finding of 30% error rate in recalling books that were not in an office.

➔ Explanation: Steyvers and Hemmer point to the importance of using naturalistic scenes. It would be very unlikely to find an office without bo and, therefore, this type of error would be rare in real life. In their natur scenes, objects that are schema-consistent with the scene are likely to b present.

Both schema-consistent and schema-inconsistent objects have better recall
Brewer and Treyens found that objects that are consistent with the room schem better remembered. However, they had specifically manipulated the environme look for this type of error. Steyvers and Hemmer calculated whether the object

consistent by looking at whether all five pictures of the scene contained the obje
contain a stove?) and then compared this with the recall rates. They found that
schema-inconsistent objects were recalled better.





Objects that were in all five photographs were rated to be the most consistent; objects th
photograph were the least consistent

➔ Explanation: In a naturalistic environment consistent objects are likely to
recalled. The use of schemata may make inconsistent objects more noti
match our expectations and, therefore, are recalled well.

Participants used their episodic memory in addition to their semantic memorie
It is difficult to work out how much of what was recalled was due to the particip
schemata) and how much due to episodic memories. Steyvers and Hemmer inve
knowledge of images without any stimuli (for example, guessing what objects wo
scene) with what was actually recalled. Recall was approximately 25% higher in t
episodic memories are also used.

➔ Explanation: Prior knowledge, in the form of schemata, gives participant
However, the scenes vary and, therefore, it is important that participant
memories. For example, the small wooden sailing boat that was in one p
stored in the participant's schema of that scene. However, some particip
shows that they used their episodic memories.

Evaluation:
The main strength of Steyver and Hemmer's approach is their attempt to use mo
to studying memory. By using natural settings which have not been experimenta
greater ability to learn about how memory works in real life.

One real-life application of Steyver and Hemmer's research is eyewitness testimo
allow the individual to gain the gist of the setting, which frees up cognitive resou
match their expectations. Therefore, in an eyewitness situation people may be m
details that do not match their expectations.

However, the researchers themselves identify that their experiment is not as hig
be. Unlike Brewer and Treyens' study in which participants entered a physical ro
study was also conducted in a laboratory instead of a natural setting. This sugge
a more ecologically valid choice, the findings may not represent how memory fu

Steyver and Hemmer defend their choice of research method by arguing that the
between the need for ecological validity and the need to control and measure th

Task 4.5

Identify two aspects of the study that Steyver and Hemmer controlled, and
controlled them.

Real-life application: eyewitness testimony

An eyewitness testimony is a statement made by a witness about what they saw. It is used as evidence in a criminal court to try to determine what happened and whether the defendant is guilty. It is understandably very important that the witness statement is accurate, as the testimony influences the defendant's fate.

Loftus and Palmer (1974) conducted research to investigate some factors that could influence the accuracy of eyewitness testimony. In one part of their study they investigated the effects of misleading information on recall.

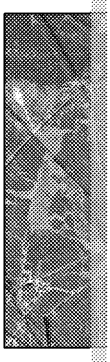
The experiment

One hundred and fifty students viewed a short video of a car accident and were asked questions on the accident. The critical question regarded the speed of the vehicles:

Fifty participants had the question 'About how fast were the cars going when they **hit** each other?'.

Fifty participants had the question 'About how fast were the cars going when they **smashed into** each other?'.

Fifty participants were not asked about the speed.



The p
seve

A week later, the participants answered 10 questions, and the critical question was 'Did you see any broken glass?' and there was no broken glass in the video.

Of the 50 participants in each condition:

- Hit: seven participants said 'yes'
- Smashed: 16 participants said 'yes'
- Control: six participants said 'yes'

Linking the findings back to schemata

Participants who were asked the question using the verb 'smashed' activated a schema associated with a severe accident. When asked whether they participants had not stored the information related to the question. Their schem missing gap with what seemed likely. In a severe accident it would be likely that this led the participants to incorrectly recall there being broken glass.

Issues and debates: social control

One of the most interesting things about psychology is that it has many applica

One area in which cognitive psychology has been particularly influential is eyew research has shown that eyewitness testimony is not as accurate or reliable as because memory is reconstructive in nature, which can lead to inaccuracies wh led to changes in legal practices, including how police officers interview witness testimony is regarded in criminal courts.

Psychology research has identified that certain fac less reliable. For example, they found that memory witness saw the incident in good lighting, had time and recalled the memory with little delay. Howeve does not match these factors, it can call into quest

In this sense, psychological knowledge has been us dictating who can give eyewitness testimony and v accurate.

Evaluating schema theory

Strength: There is considerable support for the influence of schema on recall

From the research we have reviewed above, there are many findings to suggest t
and that our recall is not an exact replica of what we have seen. There is some d
influence recall. For example, Brewer and Treyens argued that schemata can lea
environment is not consistent with the schema, whereas Anderson and Pichert (1
increased recall of relevant information and decreased recall of irrelevant inform
schemata are very useful.

Strength: There are important real-life implications

In situations where it is very important that memory is accurate, such as eyewitn
know how schemata can influence recall. For example, Loftus and Palmer's stud
activate schemata and lead to false schema-consistent memories, whereas Steyv
schemata can aid recall by allowing people to focus on schema-inconsistent deta
useful information to the police. These implications illustrate how important it is
our memories are before we use them as evidence that someone is guilty or inno

Weakness: The majority of research has been conducted in laboratory settings

Despite real-world implications, much research has been done with artificial stim
photographs (Steyvers and Hemmer, 2012) and stories (Anderson and Pichert, 19
Only Brewer and Treyens' study used an actual real-life setting; however, the env
manipulated, which limits its ecological validity. The use of artificial stimuli and r
that we should be cautious about whether these findings tell us anything about r
More research needs to be done on how schemata influence our day-to-day mem

Issues and debates: how psychological understanding has developed o

Findings on the reconstructive nature of memory have challenged the idea tha
accurate. This has been particularly important in changing the way that we use
courts. Previously, these testimonies were assumed to be very reliable, and def
on an eyewitness statement. It is thought that many people have been wrongly
eyewitness testimonies, despite the witnesses being certain that their accounts

Research by psychologists such as Loftus and Palmer found that our memory fo
studies resulted in a shift of focus from testimonies to forensic evidence. Eyewi
the court of law, but there must be a wide range of other evidence taken into a
conviction.

Other researchers have examined how to improve our recall of important even
al. (1985) developed the cognitive interview technique as an alternative metho
new interview method involves encouraging the interviewee to recreate the co
everything and examine the event from different orders and perspectives. A m
(2010) found that the cognitive interview technique led to more correct inform
increase in incorrect information. There is a need for more research to be done
understand the benefits and drawbacks of using this technique on witnesses.

Chapter 4 Activities

Task 4.6

Write notes on Steyvers and Hemmer (2012) in the table below. Try to do
You can always reread the information afterwards and add anything you

Contemporary study: Reconstruction from memory in naturalistic e Hemmer, 2012)	
Aim	
Method	
Findings and conclusions	
Evaluation	

Check your understanding!

Q1. Briefly describe Bartlett's (1932) study of repeated reproduction. (4 m

Q2. Describe one type of memory error that Bartlett identified. (3 marks)

Q3. Briefly discuss the ecological validity of The War of the Ghosts story.

Q4. Briefly describe one study that supports the theory that schemata infl

Q5. Identify and describe one strength of Steyvers and Hemmer's (2012) r

Exam-style questions

Q1. Explain two weaknesses of the methodology used in Bartlett's (1932)

Q2. Bartlett (1932) used the concept of schemata to explain his findings o
Describe his schema theory. (3 marks)

Q3. Evaluate one contemporary study that has been used to explain the n
(8 marks)

Chapter 5: Experimental Research Methods Investigation

Overview

In this chapter you will learn how to tackle the practical investigation part of your assessment. You will learn about experimental research methods, quantitative data analysis and decision-making, and interpretation of inferential statistics. Throughout ,you will be shown how this knowledge can be applied to your practical research exercise. A strong understanding of research methods will also come in handy for understanding and evaluating the experiments you come across in your course.

Learning outcomes

After studying this chapter you should be

- ❑ Design a laboratory experiment
- ❑ Collect quantitative data and prese appropriately
- ❑ Analyse your data using a non-para and draw conclusions
- ❑ Evaluate your study's strengths an consider how to improve your stud
- ❑ Write up your study in the style us

Key Terms

Abstract	A section at the beginning of a journal article which gives overview of the study
Aim	What the study intends to research
Cause and effect	The idea that changing one variable causes a change in ar prediction possible
Confidentiality	Experimenters are not to disclose confidential informatio a way that the participant is not identifiable from the dat are replaced by numbers
Control	Preventing variables other than the independent variable study
Counterbalancing	To avoid order effects, the order in which participants tak changed; for example, half of participants may do Condit half may do Condition B then Condition A
Critical value	A value found in a critical values table, which is used to d
Debrief	A process after the study of revealing the true nature of t
Deception	Deception is the act of deliberately misleading someone a experiment
Demand characteristics	When the participant's behaviour is a reflection of how th behave; responding to the 'demands' of the situation
Dependent variable	A variable which measures the presumed effect of the ind
Descriptive statistics	Numerical ways of describing the data by identifying key
Directional hypothesis	The researcher predicts the direction of the effects
Discussion	A section of a journal article that relates the findings back how the results compare to previous research outlined in
Double-blind technique	Neither the participant nor the experimenter knows whic placed in; often used in drug trials
Ecological validity	The extent to which the findings can be generalised to ot and to everyday behaviour
Experimental design	How participants are chosen and allocated to the differer
Experimenter effects	When the researcher provides subtle clues about the nat participant to behave differently
External validity	The extent results are generalisable across settings and p
Extraneous variables	Variables that may influence the behaviour in addition to manipulation of IV) and so should be controlled for
Field experiment	An experiment that occurs in real-life settings but the exp

Key Terms

Hypothesis	A prediction of the outcome of the research
Independent groups	Different participants take part in each condition
Independent variable (IV)	A variable which is manipulated to produce a presumed c
Inferential statistics	Tests conducted on the raw data to try to determine whe
Informed consent	The participant knows exactly what is going to happen in Differs from just consent, when the person does not have but agrees to take part.
Internal validity	The extent to which the behaviour is the result of the pre in the IV)
Introduction	A section of a journal article which discusses the reasons identifies the hypothesis and aim of the research
Laboratory experiment	An experiment conducted in an artificial environment tha involves manipulation of the independent variable to exa
Levels of significance	The level chosen (typically 0.05) which determines the cr
Mann–Whitney U test	A statistical test that can be used for independent groups
Matched pairs design	Each participant is matched to another participant to forn factors that are important for the study. Each participant with their opposite number acting as the control.
Mean	An average that is calculated by adding together all the v values there are. This measure takes into account the ex
Measures of central tendency	Measures that aim to find the central value of a data set
Measures of dispersion	A measure that describes how spread out the data is
Median	An average that is calculated by ordering the data by size
Method/procedure	A section in a journal article that describes exactly how th
Mode	An average that is calculated by ordering the data and ide most often
Non-directional hypothesis	The researcher predicts that there will be an effect but d direction the effect will be
Normal distribution	A bell-shaped curve where the peak is the mean value, w the peak
Null hypothesis	States there will be no effect
Operationalisation	Precisely defining your variables so that a hypothesis can
Opportunity sample	A sample drawn from whoever is available at the time of criteria for participation
Order effects	When the later condition is affected by an earlier conditi
Participant variables	Characteristics of the participants which may affect the re
Population validity	Whether the findings can be generalised to people outsid
Predictive validity	Predictive validity is whether the performance in the test think it should be able to predict.
Probability	The likelihood of an event happening
Protection from harm	Participants should be protected from psychological and aware of anything that may present a risk to them
Random sample	A sample that is drawn so that members of the populatio being selected
Randomisation	Altering the order of the material to reduce order effects
Range	A measure of spread that is calculated by subtracting the greatest value
Reliability	The extent to which results are consistent across observe
Repeated measures design	The same participants take part in all of the study conditi

Key Terms

Results	A section in a journal article which presents the descripti inferential statistics
Right to withdraw	It should be made clear to participants that they have the point, and that any data from the study can be destroyed
Sampling	The method of selecting participants from the required p your study
Sampling bias	When the way the sample is selected does not represent
Significant result	The calculated value of the statistical test is less than or e determined by the level of significance
Situational variables	Variables in the environment which may affect the result
Skewed distribution	A bell-shaped curve that is skewed towards one side and mean
Standard deviation	A measure of spread that uses every point of data and co
Standardisation	The procedures and materials are identical, which expose environment and allows other researchers to repeat the
Stratified sample	In a population with several groups, the number of peopl the size of each group; the correct numbers of these grou
Systematic sample	Selecting the participants at a fixed interval after random
Test-retest reliability	The study is repeated more than once to check for the re
Type I error	When we reject the null hypothesis when we should have
Type II error	When we accept the null hypothesis when we should hav
Volunteer sample	Participants self-select; they choose to participate in the
Wilcoxon signed-rank test	A statistical test used on studies with a repeated measure

Scene-Setting Questions

- How do we design an experiment?
- Why is it important that research is objective?
- What do psychologists mean when they say a finding is 'signific

The practical investigation

As part of your course, you will design and conduct a practical investigation into a purposes of this chapter, we will be focusing on designing and conducting an exp psychology.

In order to do well in this part of your assessment, you need to have sound know that surround experimental psychology and then apply that knowledge successfu chapter will focus on helping you acquire that knowledge and apply it.

Throughout the chapter, we will be working through the example of using an exp acoustic similarity of words will have an effect on short-term memory.

Designing and conducting an experiment

What do you think of when someone says the word 'experiment'? Do you think o white lab coats and flasks of strange-smelling chemicals? An experimenter does r need to wear a lab coat, and experiments do not need to take place in a laborato

An experiment is a study that manipulates one variable (the independent variabl measure the effect on another variable (the dependent variable). All other varia are controlled to make sure that it is only the effect of the independent variable we are measuring. These controlled variables are called 'extraneous variables'. some types of experiment (field experiments) it is not possible to control all of th extraneous variables and because of this we should be more cautious about attri the cause to the independent variable.

Types of experiment: laboratory and field experiments

The two types of experiment that you need to understand are laboratory and fie experiments.

Laboratory experiments

A laboratory experiment is conducted in an artificial environment which is contro that every participant experiences the same environment. The experimenter ma 'independent variable' (IV) and investigates to see whether this manipulation pro variable termed the 'dependent variable' (DV).

For example, an experimenter might manipulate the length of words in each wor better remembered than others.
Independent variable: Word length
Dependent variable: Number of words recalled from each list

The goal of laboratory studies is to establish 'cause and effect', which means tha same, then the change must be because of the independent variable.

Field experiments

A field experiment is an experiment that occurs in normal settings but still involves the manipulation of the independent variable. As a result, it tends to be more representative of real life compared to laboratory experiments, but field experiments also suffer from reduced control. Some participants in field experiments may not be aware that they are taking part in the experiment and this can result in ethical problems.

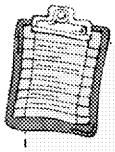
For example, an experimenter could stage a theft but alter whether the thief has could then be asked to identify the thief from a line-up.
Independent variable: Whether the thief has a knife or a gun
Dependent variable: Identification of the thief from a line-up

Field experiments are also interested in 'cause and effect' but they are not as co experiments. This means that factors called 'confounding variables' might influe Confounding variables are things that have not been controlled for that might in and confuse the findings. In the example above, it may be that the witness was t and, therefore, their attention was not on the thief.

Although field experiments have less control due to the natural environment the control for some extraneous variables. In the example above, one thing the exp the same actor in both the knife and gun conditions. By using the same actor, it dependent variable cannot be attributed to the actor having a more memorable

A comparison: laboratory and field experiments

- A laboratory experiment is more artificial than a field experiment becaus very different from real-life settings. This makes the finding less generali realism) because behaviour may be different from when it is produced in
- Field experiments have higher mundane realism, which means that the e and, therefore, the findings are more likely to be similar to real life.
- Field experiments are not rigorously controlled in the same way as a labo there may be environmental factors that influence the results.
- Both studies focus on establishing 'cause and effect' as the IV is directly m on the DV. However, the difficulty in controlling extraneous variables in f caution should be applied when establishing cause and effect.
- Laboratory experiments are more prone to suffering from demand chara Demand characteristics occur when the participant guesses the study's a 'demands' of the experiment by behaving in a way that conforms to the e rather than how they would normally act.
- Field experiments often have ethical problems with informed consent be know they are taking part. In contrast, in laboratory studies, researchers before the study begins.



Practical investigation: an investigation into whether the acoustic s effect on short-term memory

Our study will be a laboratory study. This type of experiment has be to study the effects of acoustic similarity in a natural environment. By using a all the other factors can be carefully controlled to minimise the effects of ex

Task 5.1

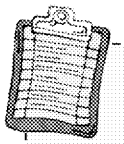
Consolidate your knowledge by filling in these tables. Try to do it without
you can always add extra details afterwards.

Laboratory experiment	
Definition:	
Advantage:	**Write it fully:**
Disadvantage:	**Write it fully:**

Field experiment	
Definition:	
Advantage:	**Write it fully:**
Disadvantage:	**Write it fully:**

Aim

The aim is a statement about what the researcher intends to study in their resea
researcher is asking 'What am I trying to find out?'. For most research, it is a fair
the theory or effects rather than specific experimental method. The aim does no
the study, although it might remark that it is testing whether a certain theory or
pieces of research could have the same experimental aim but use different meth



**Practical investigation: an investigation into whether the acoustic s
effect on short-term memory**

Our aim is to investigate the effect of the acoustic similarity of words

This aim originates from previous findings that have found that the short-ter
encoding and, therefore, similar-sounding words may be poorly encoded and
acoustically dissimilar words.

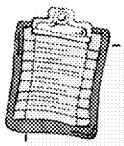
It is important that you know a bit about the background of your study befor

The independent variable and the dependent variable

Once the aim has been decided, you need to decide what variable you are chang
this change.

The independent variable (IV) is the variable that you alter or manipulate with th

The dependent variable (DV) is the variable which measures the change that is (
independent variable.



**Practical investigation: an investigation into whether the acoustic s
effect on short-term memory**

We are interested in the EFFECT of acoustic similarity. This means th
manipulate is how acoustically similar the words are. Our independent varial
acoustically similar or dissimilar.

We want to know the effect of acoustic similarity ON short-term memory. Th
recall from short-term memory. Our dependent variable is how many words
memory.

Hypothesis

A hypothesis (plural hypotheses) is a testable prediction about what the researc
study to be. The hypothesis is written in specific terms that relate to the experin

Directional and non-directional hypotheses

Hypotheses can either be directional or non-directional. A directional hypothesi
of the effect, whereas a non-directional hypothesis simply states that there will
use a directional hypothesis when they have evidence from past research that su
findings.

Null hypothesis

A null hypothesis is an alternative statement that says that there will be no effec
the dependent variable. The null hypothesis is accepted if the experimental hyp
supported.

Practical investigation: an investigation into whether the acoustic s effect on short-term memory

We have two possible hypotheses:

- Directional: A greater number of acoustically dissimilar words w similar words.
- Non-directional: There will be a difference in the number of aco words recalled.

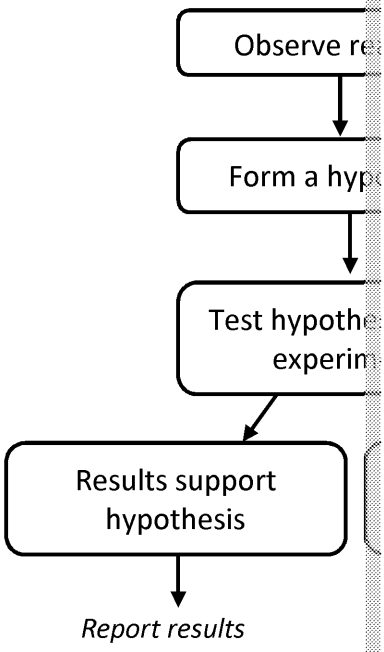
We are going to choose to use the directional hypothesis 'A greater number will be recalled than acoustically similar words.' because prior research has s greater difficulties in recalling acoustically similar words and letters.

Our null hypothesis will be that there is no difference between the number o dissimilar words recalled. If we accept our null hypothesis, this means that w differences to chance.

Hypothesis construction

Science uses the hypothetico-deductive method, which argues that theories sho by experiments, and then the theory is refined. A hypothesis is formed and if the hypothesis, then the hypothesis needs to be altered and investigated again.

Hypotheses do no arrive out of nowhere. The researcher uses real-life observations, past research or preliminary research to propose an answer to a research question.



A hypothesis should be clear and direct

A hypothesis should be a simple statement about what is expected to happen. It should not include too much technical terminology. A hypothesis should be around 20 words or less.

A hypothesis should be testable

A hypothesis should be able to be tested through an experiment. The hypothesis should be worded in a way that tells readers how it will be tested. You should include the independent variable (what you are changing) and how this change will be measured (the dependent variable).

Experimental designs

An experimental design concerns whether participants take part in all of the exp

Repeated measures design

In a repeated measures experiment, all participants take part in all of the conditi
repeated measures is a pre- and post-test comparison. In this comparison, resea
conducted before an intervention and measurements conducted afterwards.

Advantages	Di
Fewer participants: If there are only two conditions, a repeated measures design would require half the number of participants compared to an independent groups design. Reducing the number of participants saves time spent on recruitment and may be more economical in terms of time and payment for participants.	**Order effects:** Order e fatigue can alter how a conditions. A person d another might improv they have already com worse if they are bore same thing again.
No individual differences: In repeated measures, each person acts as their own control as they compare their results to their own results. There are no individual differences, which may make repeated measures a more accurate method of research.	**Materials need to be** conducting a before-a need to be designed s terms of difficulty and be compared for a diff

Independent groups design

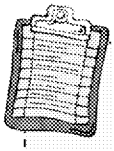
In the independent groups design, each participant only takes part in one of the

Advantages	Di
No order effects: As participants only take part in one condition, the effects of previous conditions cannot carry over and affect results in other conditions.	**Individual differences** unevenly within the ex not be appropriate to
Sometimes the only option: In some cases, particularly with naturally occurring independent variables, a participant cannot be part of more than one condition. For example, in the case of gender, the participant cannot be both male and female.	**More participants:** Inc requires new participa can be costly in terms the participants are be

Matched pairs design

A matched pairs design involves having separate participants in each condition, b
being similar to each other. Factors important to the experiment are identified (
and each participant is matched to another participant that is similar in terms of

Advantages	Di
No order effects: Individuals do not repeat the conditions, which means the effect of one condition does not carry over to the next.	**Difficult to match:** It c impossible to match p that are identified as b more difficult it becom all the qualities.
Similar participants (fewer individual differences): In each pair, the participants act as controls for one another. The results from one participant are compared to someone who has few differences, and this method also allows the researcher to avoid practice effects.	**Not always all factors** important to the expe identified until after th have been ignored. Th have been caused by the independent varia



Practical investigation: an investigation into whether the acoustic s effect on short-term memory

In this study we will use an independent groups design. One group o list of acoustically similar words and another group of participants will study words.

The main reason this design has been chosen is to eliminate order effects. If tasks (repeated measures), then it is likely that the second task may be affec Participants may put in less effort for the second list because they find it bor Alternatively, there may be improved performance on the second list. This w because a factor other than our independent variable is influencing recall rat

A matched pair design has not been chosen because memory is not greatly i differences. It is difficult to identify factors that would need to be matched a so.

Sampling techniques

The population is all the people your study is relevant to. Usually the population difficult to study every single person. Instead, you take a sample of people draw part in your study. The sample should be designed so that it represents your pop each person.

Random sample

A random sample is drawn so that members of the population have the same ch one person being more likely to be picked than another. The idea is that each pe therefore, representative of the population.

For example, if you are interested in all the students who are doing A Levels at y all the students who meet this criterion and put all of the names in a hat and pic

Advantages	Disad
• Sample is representative of your entire population • Removes bias as all participants have an equal chance of being selected	• Usually the population is sampling to be conducte • Not everyone may agree those that refuse may be accept, making the samp

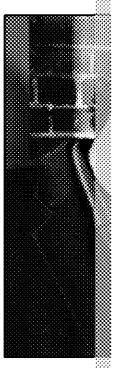
Systematic sampling

Systematic sampling involves regularly selecting participants according to a fixed long list of people and selecting every 10th person. The first participant is selecte there is no bias introduced with the selection of the first participant. The freque determined by the desired sample size; for example, in a list of 1,000 with a desi person would be selected.

Advantages	Disadvantag
• Simple, easy-to-do approach which is less time-consuming than random sampling • Evenly selected, which makes it likely that the sample will be representative of the entire population	• It does not account for the whole popu • The sample is not necessarily random; distribution of participants. It may be shares some quality that affects the re unrepresentative of the population. Fo almost the entire sample selected is fe make up a small number of the popula

Stratified sample

When you want to account for a population that has several groups, to get an accurate representation of the whole population you could sample a proportional number of people from each group.



Grou

For example, if you want to study attitudes to a new measure that will affect the entire school, you want to divide the population into important subcategories. For example, you might want to take into account the opinions from pupils according to their year group.

If there are a lot more Year 7s than there are Year 10s, to get representative data you use stratified sampling. You examine what percentage e total population then, when randomly selecting your sample, that percentage is

	Year 7	Year 8	Year 9	
Number	260	220	180	
Percentage of total population	26%	22%	18%	
Sample of 50	13	11	9	

Here a sample of 50 is desired. How many should be selected from each year gr out the proportion of the group in the population (the percentage). This can the total sample size divided by your total actual target population.

The percentage:

$$\frac{260}{1000} = 26\%$$

For a sample of 50:

$$26\% \times \frac{50}{1000} = 13$$

Note: It is only stratified sampling when the selection of your stratified sample conducted by another method, it is termed 'quota sampling'.

Advantages	Disadvantages
• Sample is more representative than other methods • Equal chance in being selected	• It can be more difficult to recruit the numbe be that Year 7s are readily available but Yea so have less time to take part in the study • Not all populations can be clearly divided in class is not just determined by economic sta making it difficult to divide people into lowe

Opportunity sample
An opportunity sample is a sample drawn from whoever is available at the time o
required criteria for participation (for instance, they must be female or speak En

For example, you might ask your friends and family to participate in a questionna
street.

Advantages	Disadvan
• These participants are easy to recruit • Suitable for processes that are thought to be universal, for example, attention, memory, etc.	• Often results in quite a limited san • The sample is likely to be biased; f the street on a Tuesday morning a include young people, who may b working during this time.

Volunteer sample
In a volunteer sample the participants choose to respond to an invitation or adve
is, they self-select.

For example, people might respond to an advert they have seen online for a stud

Advantages	D
• Usually allows for a wider sample than opportunity sample • Fairly suitable for investigations in which people are unlikely to differ significantly from the whole population	• Likely to be biase not be the same a an invitation • Sample is restrict asked or seen the

Which sampling technique should I choose?
As you can see, there are quite a few different sampling options. In your choice o
sampling technique you should aim to avoid sampling bias and ensure your findi
are generalisable to the population.

Avoiding sampling bias: Random sampling is usually seen as the gold standard in research because if a sample is not selected randomly, there will be a sampling b Sampling bias occurs when the way in which a sample is selected makes certain people more or less likely to be selected. A non-random sample will always be biased, but a random sample can be biased too as it might not represent the population well. Additionally, volunteer sampling is often affected by self-selecti bias which occurs when participants who volunteer are in some way different fro those who do not volunteer.

Make the findings generalisable: The sampling technique chosen has an effect o the degree to which the findings can be applied to other people: generalisability. If researchers want to apply their findings to the whole population, their sample characteristics of the whole population. Findings are most generalisable when th random samples tend to represent the population better.

Issues and debates: psychology as a science
Your choice of sampling is important because it determines how generalisable are to the studied population. If research is not generalisable to the populatio usefulness as it tells us little about the people we are interested in.

Practical investigation: an investigation into whether the acoustic s
effect on short-term memory
In this study we will use a volunteer sample.

This design has been chosen because:

- the participants want to take part in the study and so are less likely t
- it's an easier and less time-consuming method of recruiting participa
random sampling
- results are unlikely to be affected by self-selecting bias because pers
memory
- memory is a universal characteristic and, therefore, most people (ex
problems) will be suitable for the study and representative of the po

You need to be able to justify your choice of sampling technique. Think caref
will choose and why.

Operationalisation

Operationalisation involves very precisely defining your independent and depend
effects can be accurately measured. Another advantage of operationalising is th
replicate your work, check it and improve on it.

Practical investigation: an investigation into whether the acoustic s
effect on short-term memory

How the IV will be operationalised: Participants will see one of two lists: an a
acoustically dissimilar list. Both conditions will see a list of 10 words; all the w
occur frequently in the English language. Each word will be presented for thr

How the DV will be operationalised: Recall rates will be measured by countin
participants recalled from each list. The test will be of free recall.

Control and control issues

In an experimental design, it is crucial that you control for all other factors that could
variable. The researcher should identify possible extraneous and confounding variab
If these variables are not controlled for, then they will go on to influence the depend

Extraneous variables

Extraneous variables are extra variables that may have an effect on the DV in add
researcher is studying. Extraneous variables should be controlled so that they do
extraneous variables are identifiable and can be controlled by exposing all partici
In the ideal experiment, the only thing that differs between the conditions is the

Example: A study investigates whether age affects attention. They split participants into two groups: Those who are aged 20 to 30 and those who are aged 50 to 60, and both groups perform the same computerised attention task. They found that younger participants performed better, suggesting there is an effect on attention.

However, what they failed to mention was that when the 20 to 30 group performed their tests the thermostat was broken and it was noticeably colder. Cooler temperatures are associated with improved attention and so this may have contributed to the results. This extraneous variable could be controlled for by making sure that all participants complete the task at the same temperature.

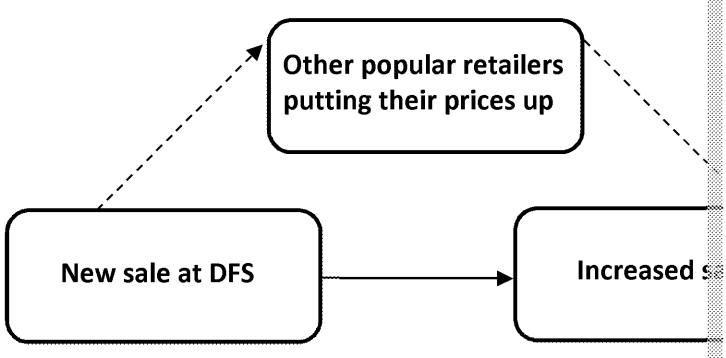
Task 5.2

A psychology study wants to assess whether gender influences levels of d
a presentation on the topic of aeroplanes to a group of strangers.

Identify as many extraneous variables as you can, and, for each variable, d
controlled for.

Confounding variables

A confounding variable is a hidden third variable that produces the effect on the
confounding variables are not controlled, then a study will have poor internal va
believe the change in the DV is caused by the IV, but in fact it is caused by the co
variables damage the causal relationship between the IV and the DV.



Extraneous and confounding variables can be subdivided into two different type
participant variables.

Situational variables

Situational variables are extraneous variables found in the study's environment.
time of day, insufficient lighting, or noise could influence the results of the study
controlled for. For example, the time of day might influence a study investigatin
changes throughout the day; in particular, we are much less alert if it is very earl
variable of time of day, all participants take the study at the same time of day so
participants equally. Other situational factors should be eliminated to stop them
very important that participants do not have unwanted background noise, the st
soundproof room.

Participant variables

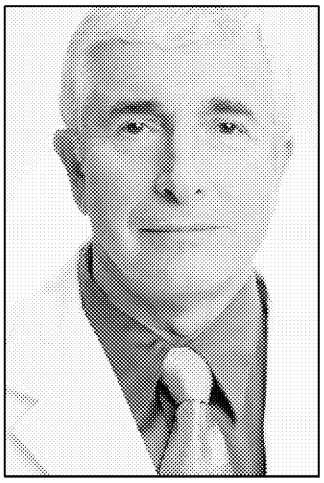
Participant variables are the individual characteristics that participants bring to the experiment. These characteristics include IQ, personality, age, past history and mood. One individual characteristic that might be controlled for in a memory study is age. Older age people often experience short-term memory problems, while their long-term memories remain intact. Therefore, when studying short-term memory, it would be wise to control for the variable of age.
It would be extremely difficult to control for all possible situational and extraneous variables. Instead, those that might have an undesirable effect on the dependent variable should be controlled or eliminated.

Personality factors do
may need to contr

Issues and debates: gender

Gender bias occurs when research and theory are based on one gender and app
danger, for example, in only using male research subjects, because we cannot g
behave the same. Memory is mostly stable across both genders; however, there
women have stronger working memory and can hold more items of verbal infor

Experimenter effects



The presence of an observer, particularly one that is given a higher status as an experimenter means that participants are unlikely to behave the same or feel as comfortable as they would in real life

Experimenter effects (also called 'investigator effec
the experimenter behaves changes the way the par
way an experimenter unconsciously acts towards th
participant clues about the experiment.

For example, a drug trial study has two groups of pa
compulsive disorder (OCD), one that receives the re
placebo. If the experimenter knows that the partici
then they may unconsciously show surprise or doub
symptoms.

Investigator effects can be reduced using a double-b
technique, neither the participant nor the experime
participant has been allocated to or the exact natur
contrasts with a single-blind technique, such as the
above, when the experimenter, but not the particip
participant is in.

EXAM TIP: It is just as useful to be able to id
design as it is to offer a remedy for it.

Knowing how to reduce a problem can set y
you answer the question 'How would I desig

Demand characteristics

Demand characteristics occur when the participant interprets clues that tell them about the nature, aims or predictions of the experiment. This can cause them to adjust their behaviour (consciously or unconsciously) and act according to the aims.

Critics have argued that studies that show extreme results may have been subject to demand characteristics.

Demand characteristics can be reduced by making it less clear what the nature of the experiment is. This may be achieved by using deception, natural settings or participants who are not aware they are participating (such as in observation studies).

Real life.
A surpris
research
students
This is a p
students
aims of a
who has
before. S
follow-up
question
what the

Reducing order effects

Sometimes, the order in which participants complete tasks or view stimuli can in
The two main order effects are the fatigue effect (the participant does worse on
effect (the participant improves on later tasks).

If researchers anticipate these effects, then they can take them into consideratio

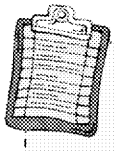
Counterbalancing

Counterbalancing is performed to reduce order effects, such as the effect of prac
the order in which participants do certain tasks affects the results.

To counterbalance, participants are divided into two groups, with half of particip
them doing Test 2 first.

For example, a study is interested in a new drug that has been designed to impro
study, all participants took Test 1 to assess their baseline performance and then
the drug and half of the participants received a placebo. The participants then to
Test 1, and their performance was assessed. Surprisingly, the researchers found
worse in Test 2. What happened?

Participants may have done much worse on Test 2 because of boredom. Having
have put reduced effort into Test 2, resulting in poorer performance. To reduce
participants could do Test 1 first and half could do Test 2 first. Although this will
make each test more comparable.



**Practical investigation: an investigation into whether the acoustic s
effect on short-term memory**

Counterbalancing is very important for a repeated measures design b
over from one task to the next. We are using an independent groups design
exposed to one condition, and so there should not be any order effects.

If you are doing a repeated measures design, you should consider whether t
that you need to account for. You can use counterbalancing by having half o
first and half of the participants do Task 2 first. You should randomly assign t

Randomisation

To reduce order effects, materials are also presented in different orders.

For example, imagine there are three tasks:

A) A difficult task involving attention and memory
B) A personality questionnaire
C) A questionnaire that asks personal information about participants' drug a

It may be that the order of these tasks affects how participants respond. For exa
may make participants bored and not concentrate for the rest of the task, or doi
questionnaire may make participants reluctant to be truthful throughout the stu

This may be randomised so that an equal number of participants do:
ABC ACB BAC BCA CBA CAB

Practical investigation: an investigation into whether the acoustic s effect on short-term memory

Our experiment only has one task which limits order effects. It could be that lists themselves influences recall. However, since the words in each list are a there would be large order effects.

You should only take measures to control order effects if you think they are

Method/procedure

Once your participants have arrived, what happens next? In your write up, it is i what your participants had to do, the order in which tests were given and how lo complete the tests.

Practical investigation: an investigation into whether the acoustic s effect on short-term memory

The participants read the participant information sheet which gave details o have to do during the study and then signed a consent form agreeing to par randomly allocated to either the acoustically similar condition or the acousti watched one of two PowerPoint presentations. The presentations showed t with each slide presenting the word for three seconds before moving on the participants used the pen and paper provided to write down any words that were to begin writing immediately at the end of the presentation and had o list. Participants were thanked for their participation and given a debrief for predictions of the study. They were reminded that they could withdraw thei their data would be kept anonymous.

Materials/apparatus

You need to think about any materials or apparatus you might need to use in you from questionnaires and photographs to computer equipment or medical equipm Often it will be important that the same materials or equipment are used for eve sure that something other than the independent variable is not affecting the cha

Practical investigation: an investigation into whether the acoustic s effect on short-term memory

We will be using word lists in our experiment. We have a list of 10 w similar and 10 words that are acoustically dissimilar. Participants will only be

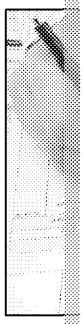
Acoustically similar		Acoustically dissimi
tin	inn	once
fin	thin	ace
sin	win	day
twin	skin	live
pin	bin	bee

Our lists have been designed so that the words are all monosyllabic because recall is affected by the number of syllables rather than the word length. The words that are frequently used. Infrequently used or difficult words may be unfamiliarity. By designing our lists this way, we have eliminated some of th could alter recall.

Other necessary materials may include:

- a participant information sheet which participants read before taking pa
- a consent sheet to gain consent to take part in the study
- a debrief form which participants read after the study to learn about its

Objectivity



Re
t

Objective research is free from bias caused by the experimenter. Research must be carefully designed to produce objective measurements that are not influenced by the experimenter's wishes or other subjective factors.

Some types of data are easy to measure objectively; for example, using a stopwatch will give you an objective measurement of the time and this measurement cannot be disputed. However, if you were to guess how long the time had been, this would not be objective. For example, your measurement of time might be influenced by how long you expect a certain task to take, and whether you are impatient or bored.

Memory is a construct and, therefore, not possible to directly measure. However, carefully controlled experiments and neuroimaging techniques can allo objective data.

Reliability

Reliability concerns how consistent a measure is; that is, would the results chang you had conducted an experiment, you would not want the findings to be differe conducted because this would suggest that some other variable was influencing t

There are a number of different ways to assess reliability, but test-retest reliability is the most important to know for experiments.

Test-retest reliability: Are the results consistent across time?
This method involves having the participant complete the test once and then repeat the test after some time has passed. The results are then compared and examined to see if they have changed.

If an adult completed an IQ test, we would expect the results to be the same a month later; it should have good test-retest reliability. However, other tests, such as when testing depression, may not be expected to be as consistent because a person's symptoms may improve or get worse.

How can we improve reliability?

- **Standardise experiments**: Participants in the same experimental conditio same experiment. This minimises differences which may affect the reliab example, participants may receive different instructions which may alter questions.
- **Easy-to-understand questions and instructions**: Participant confusion m Reliability can be improved by making it clear how to answer questions o questionnaires that are received through the post, it is important that re questions as there is no opportunity to ask questions to the researchers. important instructions are easy to understand.

Validity

Validity concerns the accuracy or correctness of the results. Validity is generally s and external.

Internal validity is concerned with whether the results are correct and accurate. Internal validity is interested in whether the research has established cause-and-effect between the independent variable and dependent variable, or whether the result has been influenced by confounding variables. The researcher should consider whether there are alternative causes that might explain their results.

One method of assessing internal validity is by examining predictive validity. Predictive validity is whether the performance on the test can predict an outcom that we think it should be able to predict. For example, we would expect that GC results would be able to predict academic success in A Levels.

External validity is concerned with how generalisable the research findings are. The two main types of external validity are ecological validity and population validity. Ecological validity refers to whether research can be generalised to settings outside of those the research was conducted in; for example, everyday settings. Research with high ecological validity usually uses naturalistic, real-life settings, which means that the findings are more representative of real life. In contrast, research with poor ecological validity often uses artificial stimuli and la the generalisability of the findings. Population validity is whether the findings ca than the research sample. All research aims to be generalised to the population t interested in studying, but sometimes unique qualities of their sample mean tha to the sample. Reducing sample bias leads to higher population validity.

How can we improve validity?

- **Double-blind technique:** Demand characteristics are reduced when neith experimenter know the true nature of the study
- **Real-life setting:** Laboratory settings may produce demand characteristic aware that they are being tested
- **Standardised procedure:** A standardised procedure means that all the pa same instructions, which reduces differences between the participants th
- **Counterbalancing:** This reduces order effects, which minimises the risk th conditions are the result of order effects
- **Careful sampling:** Careful sampling such as randomised sampling and str results are not the consequence of a sampling bias

Ethical issues in experimental research

Before conducting any study, researchers should consider ethical problems that m the research and how they could ameliorate them. Psychologists must submit th ethics committee for review and approval. The participants' safety should be of p researcher and should be put before any research aims.

Ethical issues include:

Informed consent: Participants should agree to participate in the study while hav important components. In studies that use deception but still have participants a only collects 'consent' rather than informed consent.

What can be done? *Participants should be provided with the impo before participating, and be asked for consent. After the study, pa with a debrief form which gives the full details of the research. Th deception and the reasons for using deception in the research.*

Deception: Deception occurs when a participant has been misled about what the investigating. The most common reason for deception is that participants will ch know what is being studied, which makes it difficult to accurately study the beha

What can be done? *The decision to use deception should not be used when the research cannot be conducted successfully withou participants will act differently if they know they are being studie deciding to use deception, researchers should consider whether t information to be known. There can be serious ethical problems information or when the findings might have personal or legal co have been deceived should be fully debriefed and told the true na be told that their results will be anonymous and that the findings if they wish.*

Protection from harm: Participants should be protected from experiencing psych lasts beyond the confines of the study. Psychologists should take suitable preven follow-up care if they believe harm may have been caused.

What can be done? *Research can sometimes put participants un cases, even cause physical harm. All efforts should be made to m The researcher should not conduct any research that is expected psychological or physical harm to the participant. Participants sh harm prior to taking part in the study and should be allowed to s The researcher should also carefully monitor the participant and they judge that the psychological or physical harm being experie should be offered if the participant has experienced harm.*

Right to withdraw: Participants should be offered the right to leave the study at findings removed from the results.

What can be done? *Participants should be told about their right study takes place. In studies which place the participant under st should be emphasised. At the end of the study, participants shou withdraw their findings for any reason.*

Confidentiality: It is important for participants' results to remain anonymous, es sensitive or unique nature. Failure to do so affects the individual's right to priva

What can be done? *The findings of the study should never use th be replaced with a random number or initials to protect their ide be stored on separate files so that if one file is read, the reader d participant's information.*

Practical investigation: an investigation into whether the acoustic s effect on short-term memory

Participants will be protected by:

- informing participants about the study and asking for consent befor
- not using any serious form of deception
- the fact that no harmful effects are anticipated
- informing participants that they can leave the study at any time and data withdrawn from the findings
- keeping participants' identity anonymous by using a number rather
- debriefing the participants and telling them about the full details of

Your raw data

While doing your study, you will need to collect your results on a participant-by- them all together afterwards. Usually, the easiest way to organise your results is

Practical investigation: an investigation into whether the acoustic s effect on short-term memory

Table 1. Participant scores for the number of words recalled

Acoustically similar words		Acoustically d
Participant	**Number of words recalled (max = 10)**	**Participant**
1	6	1
2	4	2
3	5	3
4	4	4
5	6	5
6	8	6
7	4	7
8	7	8
9	4	9
10	5	10

The recall scores for acoustically similar words are generally higher than tho words.

However, we cannot say that our experimental hypothesis is supported just Further analysis needs to be done before we can reach any conclusions.

You may be able to see patterns in your raw data; for example, whether high or l whether there is a large difference between the groups. While it is good to be fa draw any conclusions without further analysing it.

Issues and debates: psychology as a science

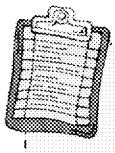
Science is objective: In order for psychology to be considered a science, resear in such a way that the researcher does not bias the results of the study. If the r sound and extraneous variables have been controlled for, then the findings sho do not match the researcher's own expectations.

Presenting your results: Tables and graphs

The way data is presented can alter how easy it is to understand and interpret.

Tables

Tables are useful as they are an effective way of presenting and organising large
However, it can be difficult to see relationships or trends in the data and to inter



Practical investigation: an investigation into whether the acoustic s effect on short-term memory

Table 2. A frequency table showing how many participants recalled each wo list

Word	Number of participants
once	10
ace	8
day	7
live	6
bee	7
wood	7
air	4
ball	8
tip	8
cat	10

Although this table says 'Number of participants' this is just another way of s tables are one of the most commonly used tables, but tables can be used to information.

Why use a table to present information?

Tables can be very useful for organising information so that it can be read more locate information in a table than in unorganised lists.

When should you not use a table?

If you have very little information to present, it can be better to simply write the Alternatively, if you have a lot of information or if you wish draw comparisons be to put some or all of the information into a chart.

Tips on creating tables

Follow these tips when creating your table:

- Use clear headings for each column.
- Too many columns and rows may mean that you are trying to present to table.
- Label your table with *Table 1. (or 2, or 3, etc.)* followed by a short descrip

Bar charts

Bar charts are useful for representing frequency information in a way that it can b
bar tends to represent a category, and its height determines the frequency.

**Practical investigation: an investigation into whether the acoustic s
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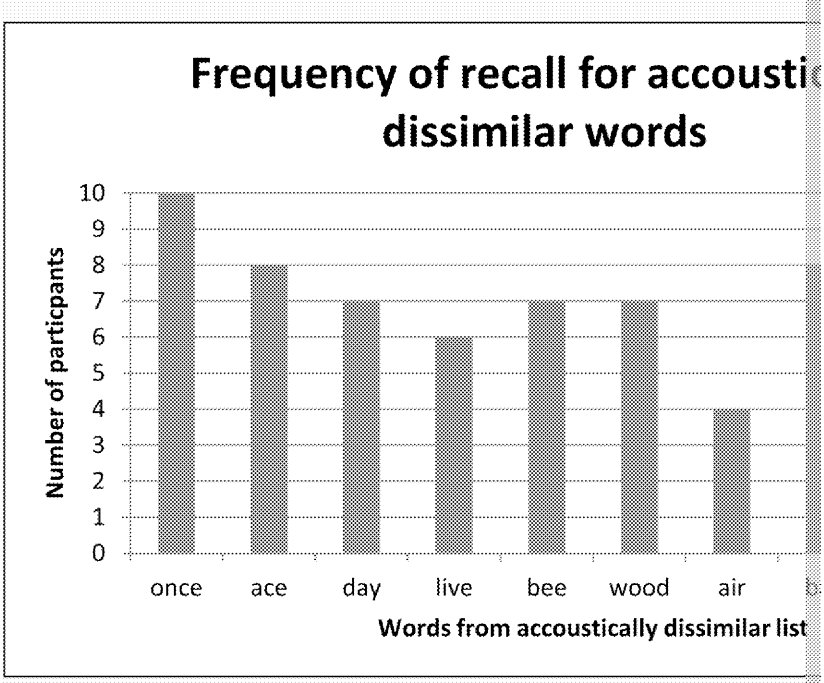
Figure 1. A bar chart showing frequency of recall for words from the acoustic



Why use a bar chart to present information?

The main reason for using a bar chart instead of a table is that it is easier to com
For example, it is very easy to see that 'air' is the smallest bar and to see how thi

When should you not use a bar chart?

If you have very few categories, it may be better to use a table or to simply write
whether the bar chart will add anything extra that text or a table would not show

Tips on creating bar charts

Follow these tips when creating your bar chart:

- The frequency should go on the y-axis and your categories should go on
- Make sure you label your x-axis and y-axis clearly; put any necessary unit
- Write a title for your bar chart that reflects what it shows.
- The bars on your bar chart should all be the same width.
- An axis that uses numbers does not have to start at 0; choose a number
- Label your bar chart with *Figure 1.* (or 2, or 3, etc.) followed by a short de

Histograms

Histograms allow you to present frequency data that has been grouped into diffe
might split up the data of your participant ages in ranges of 20–25, 26–35, etc. N
to be equal and, therefore, the widths of the bars do not need to be equal.

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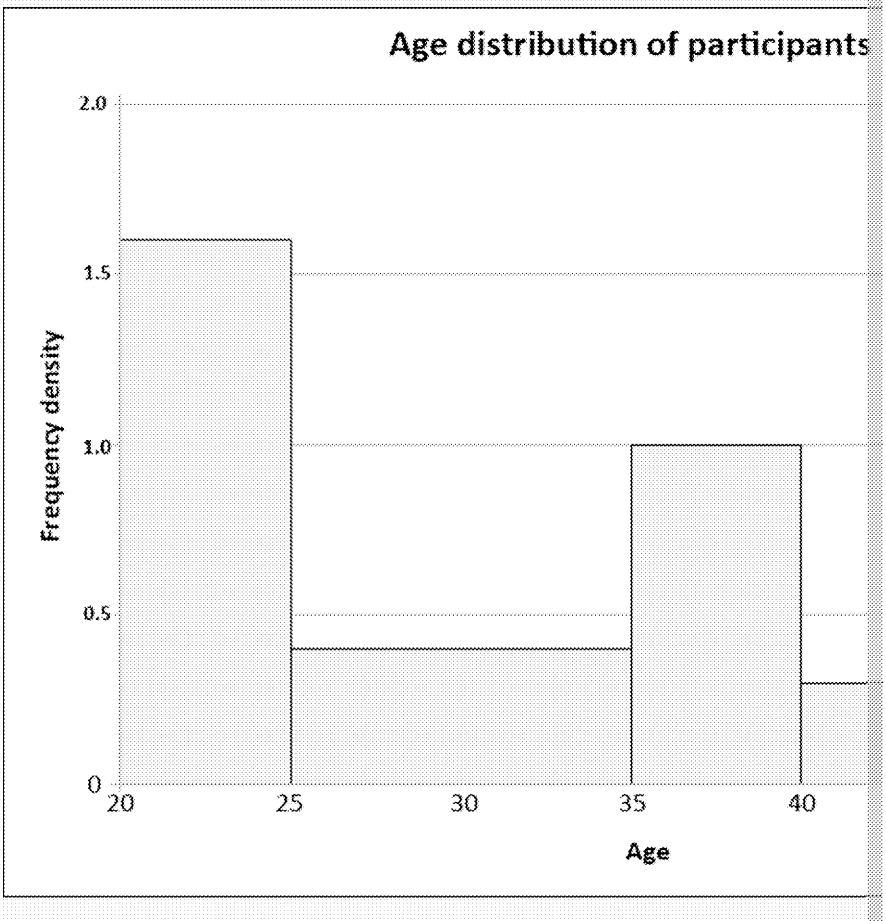
Figure 2. Histogram showing the age distribution of the 20 participants who



To work out the frequency of a bar, you need to multiply the width of the ba
density). You need to be able to work out the frequency of each bar; remem

The histogram above was produced using this table:

Age (years)	Frequency	Class width	Frequency density
$20 < a \leq 25$	8	5	1.6
$25 < a \leq 35$	4	10	0.4
$35 < a \leq 40$	5	5	1.0
$40 < a \leq 50$	3	10	0.3

In histogra
the bar ra
be incorre
called 'fre

Frequency

Class width
work this o
column.

Our first ca
22, 23, 24 a
width is 5.

Our first column shows how we have divided age into different categories.

$20 < a \leq 25$ means that ages that are greater than 20 but less than or equal to 25 fit into this category. This is participants with the ages 21, 22, 23, 24 and 25.

Frequency is how many participants fit into this category. If you are looking at the histogram, frequency is the area of the bar.

Why use a histogram to present information?
Histograms are used to show the distribution of data, and differ from bar charts i
be of equal size. They are useful for showing data such as length, time, or test sc

In some situations it can be useful to group these into unequal ranges. For exam
may wish to separate those that are very low and very high from the rest of the d

When should you not use a histogram?
You should not use a histogram to present small amounts of information that wo
text. You should not use a histogram to represent non-numerical categories such
should use a bar chart for this. Use histograms to represent ranged data.

Tips on creating histograms
Follow these tips when creating your histogram:

- The frequency density should go on the y-axis and your ranges should go
- Start with a blank table like the one below:
    - Start by filling in your ranges, which will form the bars of your hi
    - Count the frequency of the data that fits each range.
    - Work out the class width by counting out how many numbers fit
    - Calculate the frequency density by dividing the frequency by the

Ranges	Frequency	Class width	Frequenc

- The numbers on your frequency density axis tend to be small and are oft
  choose an appropriate scale.
- Label your histogram with *Figure 1.* (or 2, or 3, etc.) followed by a short d

Frequency graphs

Frequency graphs (frequency polygons) are useful for showing the frequency of g
these graphs for equal ranges because the shape of the line can tell you interesti
of the data.

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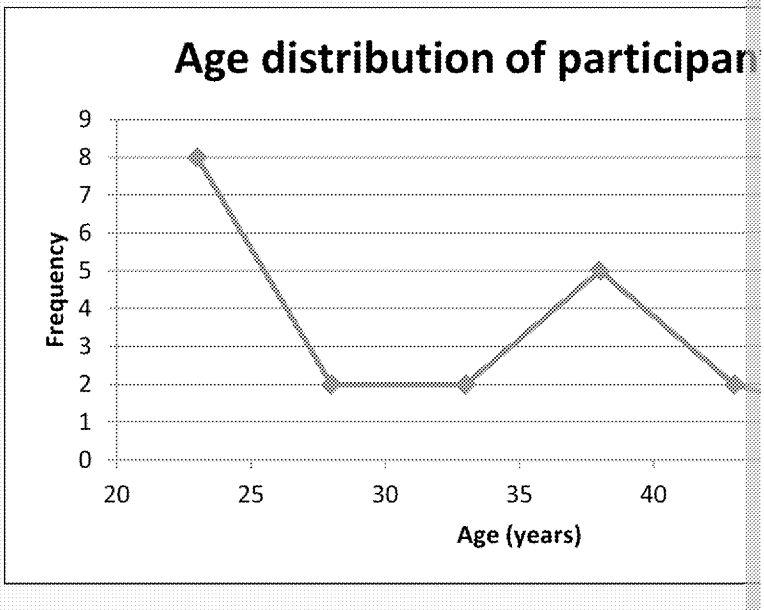
Figure 3. A frequency polygon showing the age distribution of 20 participant



This frequency polygon was produced from the table below:

Ranges	Midpoint	Frequency
21–25	23	8
26–30	28	2
31–35	33	2
36–40	38	5
41–45	43	2
46–50	48	1

Our first column shows how we have divided age into different categories.

You could also represent this information as inequalities.
E.g. $21 \leq a < 25$

The midpoint is the middle num

You can calculate this by adding
and dividing your answer by 2.
21 + 25 = 46
46 ÷ 2 = 23

Why use frequency polygons to present information?

Frequency polygons are useful because they provide a visual for ranged data. Th
tell you about the distribution of the data. You will read more about this in the n
statistics.

When should you not use a frequency polygon?

You should not use a frequency polygon to present small amounts of information
table or text. You should not use a frequency polygon to represent categorical n
'cat', 'dog' or 'bird'; you should use a bar chart for this. Use frequency diagrams

Tips on creating frequency polygon

Follow these tips when creating your frequency polygon:

- The frequency should go on the y-axis and a suitable scale for the topic y
  the x-axis.
- Start with a blank table like the one below:

Ranges	Midpoint	Frequency

  - Start by choosing how you will divide the topic you are measuri
  - Calculate the midpoint by adding the upper and lower boundari
    answer by 2.
  - Count the frequency of the data that fits each range.
  - Draw a point for the midpoint and frequency of each row.
- Label your frequency polygon with *Figure 1.* (or 2, or 3, etc.) followed by
  frequency diagram.

Analysing your results: Descriptive statistics

Descriptive statistics are used to describe what the data shows by identifying key

Measures of central tendency

Measures of central tendency look at what the central value of the data set is, ar
the mean, median and mode.

Mean – the mean is the most used measure of central tendency. It is found by a
data set and dividing by the number of values there are.

For example, the mean of 14, 18, 9, 23, 14, 7 and 99 would be found by doin

$$\frac{(14+18+9+23+14+7+99)}{7} = \frac{184}{7} = 26.3$$

Median – the median is the middle point of the data. This is calculated by rearra
in order and then identifying the middle number.

For example, the median of 14, 18, 9, 23, 14, 7 and 99 would be found by:

First rearranging it in order: 7, 9, 14, 14, 18, 23, 99
Then considering that there are seven numbers and 14 is in the middle, so t

If there is an even number of data points, then there will be no single middle nu
middle numbers and work out the point halfway between them. This will be you

Mode – the mode is the value that occurs most frequently in the data set. This c
many times each value occurs.

For example, the mode of 14, 18, 9, 23, 14, 7 and 99 would be found by:

Noticing that there is one of each number, except 14 where there are two. T

Sometimes there is more than one mode; for example, in the set: 18, 28, 17, 42, 1

In this case, both 18 and 17 occur twice so they are both the modes; this is c

When all the numbers only occur once, then we say there is 'no mode'.

Measures of dispersion

Measures of dispersion look at how spread out the data is. For example, in the d might say that it is not very spread out because all the values are quite similar. I 39, 89, 6 is much more spread out.

Range – a simple measure of dispersion that uses the highest and lowest values o subtracting the lowest value from the highest value.

For example, the range of 14, 18, 9, 23, 14, 7 and 99 would be found by:

Subtracting the lowest from the highest value: 99 – 7 = 92

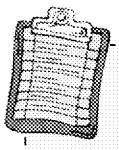
Standard deviation – a more accurate measure of dispersion that uses all of the v standard deviation looks at how far each value is from the averaged mean, or ho the average. A smaller spread will mean the average is more representative of th spread will mean the average does not represent the entire group well enough.

For example, the standard deviation of 14, 18, 9, 23, 14, 7 and 99 is 32.5.

This is the formula:

$$s = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$$, where:

- S = standard deviation
- ∑ = sum of
- x = the scores
- n = number of subjects/scores
- √ = square root



Practical investigation: an investigation into whether the acoustic s effect on short-term memory

Table 3. Calculated averages and dispersion for acoustically similar and dissi

	Acoustically similar words	Acoustically dissimil
Mean	5.3	7.5
Median	5	7.5
Mode	4	9
Range	4	5
Standard deviation	1.4	1.8

What conclusions can we draw from our descriptive statistics? Our mean, m for the acoustically dissimilar list. This says that, on average, the acoustically s better than the acoustically similar words. Both the range and standard devi acoustically similar words. This tells us that there is slightly more variation in for the participants in the acoustically dissimilar list in comparison to the aco

Task 5.3

Chris is interested in whether temperature affects the time it takes for a pa finish a task.

He has half of his participants do the task in a hot room then a cold room, a task in a cold room and then a hot room (to minimise order effects). The t remained the same for all of the participants and the results were measure

	P1	P2	P3	P4	P5	P6	P7
Hot	63	75	69	59	83	54	63
Cold	49	54	60	57	84	45	74

Calculate the mean, median, mode and range for the hot room and for the

Do you think that temperature does affect speed? Back up your answer w

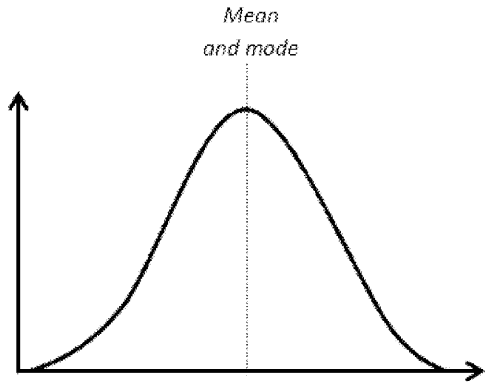
Distributions

How the data is spread across the group is referred to as its distribution. For exa grades, the possible grades are: A*, A, B, C, D, E and U. If we want to know the d examine how many people have got each grade and then compare the grades to

Characteristics of normal distribution

Normal distribution is the most common type of distribution and it occurs natura distribution has the shape of a bell curve, and this shape indicates that the majo range and the frequency of the data on either side of the curve decreases symm

Here is a normal distribution curve:

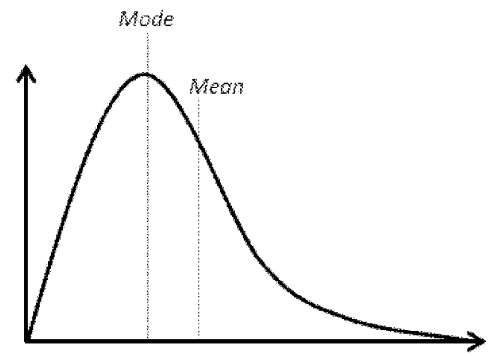


The precise shape of the normal distr the mean and standard deviation of t the peak of the curve, and a short an large standard deviation (the data is v and narrow curve is a reflection of a s data is similar).

Note that most data only fits the curv exactly.

Characteristics of skewed distribution

Quite often in data, we get skewed distribution, where the peak of the curve is s



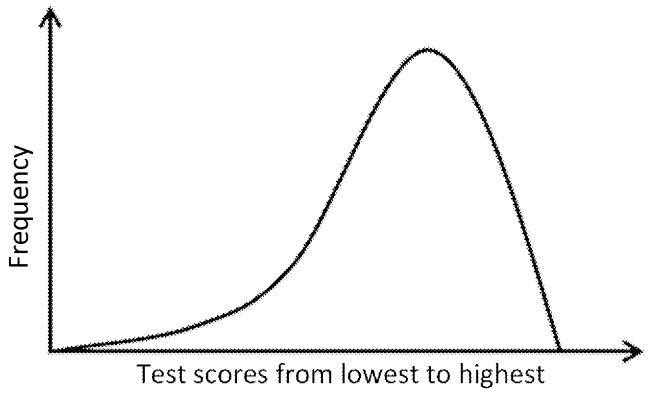
In this skewed distribution, most o rather than the centre of the graph

In skewed distribution, the peak of the mean but by the mode. This c distribution curve, where the mode top of the curve.

Why is it important?
It is important to know the type of distribution as this will affect which statistical t
of statistical test (parametric tests) require data to have a normal distribution. Th
with comparing with the mean. When using the mean, it is important that the nu
because outliers will affect the results.

Task 5.4

Examine the curve below:



a) What type of distribution is this?
b) What does the curve say about test scores?
c) Label the mean on the curve.
d) Label the mode on the curve.
e) Explain why the mean and mode are labelled this way.

Analysing your results: Inferential statistics

The most common reason for statistical testing is that we want to know if our da
What this essentially means is how sure we can be that any effect found was due
not just a chance event or an error.

There are two tests you need to know:

- Mann–Whitney U for studies that use an independent groups design
- Wilcoxon signed-rank for studies that use a repeated measures design

We will go through a worked example for each test. Here is some information th

Probability

Probability is the likelihood of something happening. If you flip a coin, there is a 5
heads. This can also be written as 0.5, where 1 means that something will alway
something will never happen.

When we use statistical tests, we are testing the probability that the difference b
chance or error. We want the probability that the difference is due to chance or
However, within psychology it is almost impossible to guarantee that the change
caused the change in the dependent variable.

In statistical testing, we say that we are testing the null hypothesis because the n
will be no effect of the independent variable. If we accept the null hypothesis, th
variable did not affect our dependent variable (any differences are attributed to

Levels of significance

We use our statistical tests to determine whether the difference between the co
must attribute it to chance or error. If the difference is small enough, then we ac
difference between the conditions tells us that we can reject our null hypothesis
hypothesis. This is what is meant when we say our results are statistically signifi

How small does the difference need to be to attribute the findings to chance o
There are different levels of probability depending on how certain you need to b
chance. You choose the level prior to doing the test. The most common level is p
a 5% probability that the results are due to chance but that we are 95% confiden

In other situations it may be important to be stricter. For example, when testing
need to be very certain that any improvement is due to the drug and not chance
a significance level of $p \leq 0.01$. This means there is only a 1% probability that the
that we are 99% confident that the results are real.

Error types

Type I error

A type I error occurs when we reject the null hypothesis but we shouldn't have. Y
positive. In this type of error we believe that there is a difference in our results b
use a significance level of 0.05 we are saying that there is a 5% chance of a type I
confident that we are correct in rejecting our null hypothesis.

Type II error

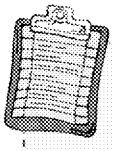
A type II error is the opposite. In this case we accept our null hypothesis when w
can think of this as a false negative. We believed there was no difference betwe
was. A type II error involves a failure to detect a change. When we choose a stri
more likely to make a type II error. This is because we are making it more difficu

A real-life application is a pregnancy test:

- A type I error occurs when the test says that a woman is pregnant but she is
  change but there was no change).
- A type II error occurs when the test says that a woman is not pregnant but s
  detect the change).

Mann–Whitney U: Use for independent groups

Our experiment used independent groups, so our worked example will use the s



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Step 1: rank your results

Create a column for each of your groups and title them 'Rank'. You rank all o regardless of which group they are given. The smallest number of words rec the next smallest will be given a rank of 2, and so on.

In some cases, several participants have recalled the same number of words up all the ranks they would assume and then divide by the number of partici

For example, below we have four participants who recalled four words. This recalled, so these four participants would assume the ranks 1, 2, 3 and 4. We calculate 1 + 2 + 3 + 4 = 10 and then divide this answer by 4 because the this score.

10 ÷ 4 = 2.5

All of our participants who recalled four words are given a score of 2.5.

When working out the next ranking, remember the ranks that have been alr participants who recalled five words. Remember that we have already filled participants who have recalled five words fill the ranks 5, 6, 7 and 8.

5 + 6 + 7 + 8 = 26 and 26 ÷ 4 = 6.5

Acoustically similar words			Acoustical	
Participant	Number of words recalled (max = 10)	Rank	Participant	Nur words (ma
1	6	10	1	8
2	4	2.5	2	9
3	5	6.5	3	7
4	4	2.5	4	9
5	6	10	5	6
6	8	15.5	6	7
7	4	2.5	7	9
8	7	13	8	5
9	4	2.5	9	10
10	5	6.5	10	5

Step 2: add up all of the ranks for your first group

Add up the ranks for acoustically similar words to get $\sum R_{a\ (similar)}$

$$\sum R_{a\ (similar)} = 10 + 2.5 + 6.5 + 2.5 + 10 + 15.5 + 2.5 + 13 + 2$$

Step 3: add up all of the ranks for your second group

Add up the ranks for acoustically dissimilar words to get $\sum R_{b(dissimilar)}$

$$\sum R_{b(dissimilar)} = 15.5 + 18 + 13 + 18 + 10 + 13 + 18 + 6.5 +$$

Step 4: work out n_a and n_b

n_a is the number of participants in your first group

$n_a = 10$

n_b is the number of participants in your second group

$n_b = 10$

Step 5: work out U_a

The provided formula for U_a is:

$$U_a = n_a n_b + \frac{n_a(n_a + 1)}{2} - \sum R_a$$

Substituting in our values, this gives us:

$$U_a = 10 \times 10 + \frac{10(10 + 1)}{2} - 71.5$$

$$U_a = 100 + \frac{10(11)}{2} - 71.5$$

$$U_a = 100 + \frac{110}{2} - 71.5$$

$$U_a = 100 + 55 - 71.5$$

$$U_a = 100 + 55 - 71.5 = 83.5$$

$$U_a = 83.5$$

$\sum R_a$ is our answer from Step 2. It
in group 1.

In algebra, when two letters are n
multiply them together.
$n_a n_b$ means $n_a \times n_b$
$n_a(n_a + 1)$ means $n_a \times (n_a + 1)$

Step 6: work out U_b

The provided formula for U_a is:

$$U_b = n_a n_b + \frac{n_b(n_b + 1)}{2} - \sum R_b$$

$$U_b = 10 \times 10 + \frac{10(10 + 1)}{2} - 138.5$$

$$U_b = 100 + \frac{10(11)}{2} - 138.5$$

$$U_b = 100 + \frac{110}{2} - 138.5$$

$$U_b = 100 + 55 - 138.5$$

$$U_b = 100 + 55 - 138.5 = 16.5$$

$$U_b = 16.5$$

$\sum R_b$ is our answer from Step 3. It
in group 2.

Step 7: work out U

U is the smaller of U_a and U_b

Our $U_a = 83.5$ and $U_b = 16.5$

So our $U = 16.5$

Step 8: use critical value tables

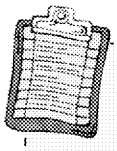
To be significant, our calculated value of U has to be **equal to or less than** th
To use a critical value table, we need to know our **N_a** our **N_b** and whether we
two-tailed test. From Step 4, our $N_a = 10$ and our $N_b = 10$. We have a directio
doing a one-tailed test.

Our critical value for a one-tailed test at $p \leq 0.05$ is 27:

	N_b										
	5	6	7	8	9	10	11	12	13	14	15
N_a											
$p \leq 0.05$ (one-tailed), $p \leq 0.10$ (two-tailed)											
5	4	5	6	8	9	11	12	13	15	16	18
6	5	7	8	10	12	14	16	17	19	21	23
7	6	8	11	13	15	17	19	21	24	26	28
8	8	10	13	15	18	20	23	26	28	31	33
9	9	12	15	18	21	24	27	30	33	36	39
10	11	14	17	20	24	**27**	31	34	37	41	44
11	12	16	19	23	27	31	34	38	42	46	50
12	13	17	21	26	30	34	38	42	47	51	55
13	15	19	24	28	33	37	42	47	51	56	61
14	16	21	26	31	36	41	46	51	56	61	66
15	18	23	28	33	39	44	50	55	61	66	72
16	19	25	30	36	42	48	54	60	65	71	77
17	20	26	33	39	45	51	57	64	70	77	83
18	22	28	35	41	48	55	61	68	75	82	88
19	23	30	37	44	51	58	65	72	80	87	94
20	25	32	39	47	54	62	69	77	84	92	100

Our critical value for a one-tailed test at $p \leq 0.01$ is 19:

	N_b										
	5	6	7	8	9	10	11	12	13	14	15
N_a											
$p \leq 0.01$ (one-tailed), $p \leq 0.02$ (two-tailed)											
5	1	2	3	4	5	6	7	8	9	10	11
6	2	3	4	6	7	8	9	11	12	13	15
7	3	4	6	7	9	11	12	14	16	17	19
8	4	6	7	9	11	13	15	17	20	22	24
9	5	7	9	11	14	16	18	21	23	26	28
10	6	8	11	13	16	**19**	22	24	27	30	33
11	7	9	12	15	18	22	25	28	31	34	37
12	8	11	14	17	21	24	28	31	35	38	42
13	9	12	16	20	23	27	31	35	39	43	47
14	10	13	17	22	26	30	34	38	43	47	51
15	11	15	19	24	28	33	37	42	47	51	56
16	12	16	21	26	31	36	41	46	51	56	61
17	13	18	23	28	33	38	44	49	55	60	66
18	14	19	24	30	36	41	47	53	59	65	70
19	15	20	26	32	38	44	50	56	63	69	75
20	16	22	28	34	40	47	53	60	67	73	80



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To be significant, our value of U has to be **equal to or less than** the critical va

Our critical value for a one-tailed test at $p \leq 0.025$ is 23:

								N_b			
	5	6	7	8	9	10	11	12	13	14	15
N_a											
$p \leq 0.025$ (one-tailed), $p \leq 0.05$ (two-tailed)											
5	2	3	5	6	7	8	9	11	12	13	14
6		5	6	8	10	11	13	14	16	17	19
7			8	10	12	14	16	18	20	22	24
8				13	15	17	19	22	24	26	29
9					17	20	23	26	28	31	34
10						**23**	26	29	33	36	39
11							30	33	37	40	44
12								37	41	45	49
13									45	50	54
14										55	59
15											64
16											
17											
18											
19											
20											

Our critical value for a one-tailed test at $p \leq 0.005$ is 16:

								N_b			
	5	6	7	8	9	10	11	12	13	14	15
N_a											
$p \leq 0.005$ (one-tailed), $p \leq 0.01$ (two-tailed)											
5	0	1	1	2	3	4	5	6	7	7	8
6		2	3	4	5	6	7	9	10	11	12
7			4	6	7	9	10	12	13	15	16
8				7	9	11	13	15	17	18	20
9					11	13	16	18	20	22	24
10						**16**	18	21	24	26	29
11							21	24	27	30	33
12								27	31	34	37
13									34	38	42
14										42	46
15											51
16											
17											
18											
19											
20											

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Step 9: determine significance

Look at the Mann–Whitney U critical values tables above. There are four tab with.

Write down the critical values for your test and the significance level
Critical value at $p \leq 0.05 = 27$
Critical value at $p \leq 0.025 = 23$
Critical value at $p \leq 0.01 = 19$
Critical value at $p \leq 0.005 = 16$

U value = 16.5
If your U value is **less than or equal to** the critical value, then the result is sig

You choose your significance level; typically it will be 0.05. However, if your p value (e.g. 0.01), this is even better. You want the lowest critical value that for. Significance at $p \leq 0.01$ is better than significance at $p \leq 0.05$.

Our result is significant at $p \leq 0.01$ because our U value (16.5) is less than ou This supports our experimental hypothesis that more acoustically dissimilar acoustically similar words.

What conclusions can we draw from our inferential statistics?

Our hypothesis was that more acoustically dissimilar words will be recalled t Our Mann–Whitney U test found our hypothesis to be significant. Significanc is a high level of significance. This suggests that there were large differences recalled in each list. Significantly more acoustically dissimilar words were rec words.

Wilcoxon signed-rank: Use for repeated measures

If you have chosen to use a repeated measures design, you will need to use the W
determine whether the difference between the two conditions is statistically sign

Here is an example scenario that follows the test process.

Scenario: A researcher wants to investigate whether attention to visual details is
afternoon. Each participant is shown two identical photographs but with one ph
have one minute to spot the 10 differences. Half of the participants complete th
participants at 2pm. A week later, with different photographs, the same particip
condition.

Previous research has found that in the afternoon we experience a cognitive slum
and alertness compared to other times in the day. The researcher's hypothesis is
identified in the morning condition than the afternoon condition.

Ten participants completed the study and produced the following results:

Table 1. Number of differences that participants identified in the morning and a

Participant	Morning condition	Afternoon condition
1	7	5
2	6	4
3	8	3
4	5	5
5	4	7
6	8	7
7	5	4
8	10	9
9	7	5
10	9	8

Follow the steps below to learn how to conduct the Wilcoxon signed-rank test:

Step 1: Calculate the difference of each pair

Create a column and label it 'Difference'. Calculate the difference between your

We did this by subtracting the afternoon condition from the morning condition.
the opposite way round, but make sure you use the same method for every part

Participant	Morning condition	Afternoon condition	Differenc
1	7	5	2
2	6	4	2
3	8	3	5
4	5	5	0
5	4	7	-3
6	8	7	1
7	5	4	1
8	10	9	1
9	7	5	2
10	9	8	1

Step 2: Rank the differences
Create a new column in your table and title it 'Rank'. If any of your differences a

Ignore the signs and look for the smallest difference (other than 0) and give a ra
difference a rank of 2, and so on.

If some of your differences are the same, then work out the ranks they would as
number of differences.

In the data below we have four differences of 1. These scores would assume the
We work out 1 + 2 + 3 + 4 = 10 and then divide this answer by the number of 1s,
10 ÷ 4 = 2.5. A rank of 2.5 is given to all the differences of 1.

We also have three differences of 2. Remember that 1 is taking up the ranks of 1
the next highest so will take up the rank of 5.
There are three differences of 2, so this will be ranks 5, 6 and 7.
We work out the rank by working out 5 + 6 + 7 = 18 and then dividing this by the
18 ÷ 3 = 6. A rank of 6 is given to all the differences of 2.

Participant	Morning condition	Afternoon condition	Difference
1	7	5	2
2	6	4	2
3	8	3	5
4	5	5	0
5	4	7	-3
6	8	7	1
7	5	4	1
8	10	9	1
9	7	5	2
10	9	8	1

Step 3: Add together all the ranks that belong to positive scores

Positive scores: 6 + 6 + 9 + 2.5 + 2.5 + 2.5 + 6 + 2.5 = 37

Step 4: Add together all the ranks that belong to negative scores

Negatives scores: 8

Step 5: Find the value of W (W stands for Wilcoxon)
The smaller answer to Step 3 and Step 4 is the value of W.
W = 8

Step 6: Find the value of N
Our value for N is the number of differences (we ignore any that gave us a differe

There are nine differences (because we omitted one).
N = 9

Step 7: Find the critical value
Look at the critical Wilcoxon values.

	Level of significance for a one-tailed test		
	0.05	0.025	0.01
	Levels of significance for a two-tailed test		
n	0.1	0.05	0.02
N=5	0	-	-
6	2	0	-
7	3	2	0
8	5	3	1
9	8	5	3
10	11	8	5
11	13	10	7
12	17	13	9

Use you

For most studies, it is important that they are significant at a level of 0.05. Some need to be significant at a level of 0.01 because it is very important that the resu reduces the odds of false positives (detecting a difference when there is no diffe

Step 8: Determine significance
We use the table above and our W value to determine whether our finding is sig

We have a directional hypothesis so we use a one-tailed test. (If you have a non use a two-tailed test.)
Looking at the table above for a one-tailed test:
Critical value at $p \leq 0.05 = 8$
Critical value at $p \leq 0.025 = 5$
Critical value at $p \leq 0.01 = 3$

W value = 8

You choose your significance level; typically it will be 0.05. However, if your stud (e.g. 0.01) this is even better. If your W value is **less than or equal to** the critical significant.
You want the lowest critical value that your result is still significant for. Significa significance at $p \leq 0.05$.

Our result is significant at $p \leq 0.05$ because our W value (8) is equal to our critica supports our experimental hypothesis that more differences will be identified in afternoon condition.

Discussing your study and writing it up

Evaluating your study

Every researcher who publishes their study in a scientific journal must also write a
They consider what they have done well and poorly, and how they can improve.

Here are some questions that you should ask yourself:

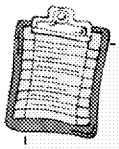
- Can my findings be generalised to the population?
- Is my study valid?
- Are my findings reliable?
- Is my study ethical?
- Can my findings be applied to other cultures?
- Does my study use a natural or artificial setting?
- Can my study tell us about real life?
- What applications does my study have?

You don't ne
questions bu
areas your st
areas that ne

Strengths and weaknesses of our study

From asking yourself the questions above, you should be able to identify strengt
design.

Below is an example of how you can use questioning to write your evaluation.



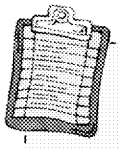
**Practical investigation: an investigation into whether the acoustic s
effect on short-term memory**

Is my study ethical? No.
Why is my study unethical? The study lacks informed consent because parti
nature of the word lists.
Why is this a problem? The participants did not have all the information nec
decision about whether they wanted to participate. They may have felt unco
true nature of the study afterwards.

The write up:
One weakness of the study is that informed consent was not obtained from t
participants were not told about the true nature of the word lists, that they w
sounding word list or a dissimilar-sounding word list, and that the researche
the performance on the two lists. Although consent was obtained, participa
information to make an informed decision about their choice to participate. T
may have felt discomfort when they found out this information had been wi

Improvements
Looking at the weaknesses you have identified is one way of seeing which areas y

Not all weaknesses are easy or even possible to improve on. For example, one w
experiments is that the environment is artificial and, therefore, not representati
often not easy to improve this because it is a core feature of the study.



**Practical investigation: an investigation into whether the acoustic s
effect on short-term memory**

One weakness of the study was that validity may have been threatened beca
not controlled for. Participants who completed the experiment late in the da
fatigue, which could alter their ability to concentrate and attend to the stimu
who completed the study during the late afternoon may not have performed
who completed the study earlier in the day. One possible improvement wou
experiment during the morning. If all participants complete the experiment
mean that the participants' results can be safely compared.

Sections of a scientific report

Journal articles must be reported in a specific manner and are often split up into

Abstract
The abstract is a short summary of the research which includes key features such
the hypothesis was and whether the findings supported this hypothesis. The abs
researchers to see if they want to read the whole article.

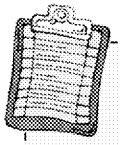
Introduction
The introduction is arguably one of the most important sections of the whole art
researcher discusses the reason for deciding to conduct their research. This inclu
research, what is yet to be known and how the researcher aims to remedy this.
the aims and hypothesis of the researcher.

Method
This section discusses how the researcher conducted the research. The method s
as the idea is that another researcher could repeat the experiment exactly using
method. It is usually split up into:

- **Participants:** Details of how many participants, the distribution of their ge
population they were drawn from and the method of selection, and whe
take part in the study. This section will also state if there were any speci
study that asks participants to recall small details from a picture may req
perfect vision.
- **Materials:** This gives details of any materials or equipment used in the st
used word lists, then it will include information about which words were
selected. If the design involved a computerised task, it may include deta
abilities and the size and resolution of the monitor screen.
- **Design:** The experimental design is briefly described, such as whether th
measures design, independent groups design or matched-pairs design. T
the participants were formed into their conditions.
- **Procedure:** A detailed description of what instructions were given to par
taken to reduce order effects and how long the participants had to comp

Results

The results section first begins with describing the data using descriptive statistic scores. It then moves on to show the results of any statistical or qualitative anal what their statistical significance is. This section is very fact based as the researc interpretation to the results.



Practical investigation: an investigation into whether the acoustic s effect on short-term memory

Here is our write-up of the results:

A Mann–Whitney U test was performed. The calculated value of the test wa critical value of 19 for a one-tailed test at $p \leq 0.01$. The result is significant a hypothesis, which states that a greater number of acoustically dissimilar wo acoustically similar words.

You can change the underlined words to write your own results section.

Discussion

In the discussion section, the researcher links the statistical findings to the resea whether they support or contradict the predictions of their study. The results ar research that was identified in the introduction section and whether these new r discussion section, the researcher also considers the implications of the findings a

To write the discussion section, answer these questions (in this order!):

- Did the results support your hypothesis?
- How do your findings relate to previous research?
- Was your study an appropriate test for your hypothesis?
- Did you encounter any methodological problems?
- If your data does not support your hypothesis, does it support an alterna
- What are the implications of your findings?
- What future work still needs to be done on this topic?

* A Level exam-style questions

Q1. *Dyslexia is a reading disorder that is associated with a poor working memory dyslexia have problems associating letters to the sound they produce and this reading speed and difficulties reading certain words. They struggle to hold s information in their heads because of their poor auditory working memory. I interventions for dyslexia have been based on working memory theory.*

Discuss – using concepts, theories and/or research from cognitive psy society of whether knowledge of working memory can inform the trea make reference to the context in your answer. (8 marks)

Q2. *Claire was talking to her friend on the phone when a man ran out of a store a she was surprised and angry, Claire was unharmed and thought no more abo was contacted by the police to give an eyewitness statement of the notorious h difficult to recall details about the man.*

Discuss how the multi-store model of memory explains how memorie eyewitness situation. You must make reference to context in your ans

Q3. Describe episodic memory. (4 marks)

Q4. Evaluate whether research into the reconstructive nature of memory l memory in real life. (8 marks)

Chapter 1

Task 1.1. Suggested answers:
Generalisability is the extent to which findings can be applied to the population that the
not just the participants. Baddeley's study has good/~~poor~~ generalisability because… he u
differences in memory would be accounted for. Memory is a universal characteristic tha
Therefore, very large samples are not needed because individual differences are low, wh
to other people.

Internal validity is the extent to which the findings are the result of manipulating the ind
Baddeley's study has good/~~poor~~ internal validity because… Baddeley used a number of c
variables that might influence the results. For example, the participants recalled word o
which minimises the chance that some words were easier or harder to recall for some pa
more likely that the findings were due to the manipulation of the independent variable.

Ecological validity is the extent to which the findings can be generalised to real life. Badd
ecological validity because… remembering the order of word lists is unlike our uses for m
need to remember individual words (e.g. shopping lists) but we very rarely have to reme
presented. This makes it difficult to generalise Baddeley's findings to real life.

Check your understanding!

Q1. Working memory is the type of memory used to hold and manipulate information, a
processes (1). For example, if doing a complicated sum you may separate the sum
them in order to add the results later (1).

1 mark for basic definition
1 mark for example or elaboration

Q2. The episodic buffer allows information to be integrated from multiple sources of inp
that while we could only recall five words alone, we could recall 16 words in a sente
term and long-term information is integrated, which would require the use of an ep

1 mark for basic definition
2 marks for examples and elaboration

Q3. The working memory model argues that the limited capacity of the components me
tasks that use the same components without impairing performance (1). Additiona
components, then their performance should be unimpaired as this does not affect t
components (1).

1 mark for using the same component
1 mark for using different components
Could also talk about autonomous tasks instead

Q4. Visual memory can be assessed using the visual patterns task which involves showin
size that are half shaded in and requiring them to fill in the correct squares on a bla
capacity is said to be the matrix size before errors begin to occur (1). Spatial memo
span task, which involves the experimenter laying out blocks on a desk and tapping
Participants must repeat the pattern in a particular order, and spatial span is how m
before making mistakes (1).

1 mark per each definition
1 mark per explanation of the actual measure; that is, how this type of memory is d

Exam-style questions

Q.	Answer
Q1.	**AO2 (1 mark), AO3 (2 marks)** One mark is awarded for identifying the problem (AO2). Two marks are awarded for justification of the problem (AO3). For example: Group 1 did much worse on their tasks because both tasks used the same work (1). The visual tasks used the visuospatial sketch pad, whereas the verbal tasks use When group 1 tried to do two visual tasks at the same time, this exceeded the resources (1). Credit other appropriate points
Q2.	**AO1 (3 marks)** A mark is awarded to each point relating to dual tasks. Together, the points sh description worth up to 3 marks. For example: In a dual task, participants complete two tasks at the same time and their perfo the performance is unaffected, then it is said that the two components belong working memory (1). If the performance on the tasks is affected, this suggests working memory component because they are competing for the same resourc The visual tasks used the visuospatial sketch pad, whereas the verbal tasks use Credit other appropriate points
Q3.	**AO2 (1 mark), AO3 (2 marks)** One mark is awarded for identifying the problem (AO2). Two marks are awarded for justification of the problem (AO3). For example: Individuals with dyslexia have poor or inefficient working memory (1). Tommy takes longer to read than his classmates because he encodes phonolog inefficiently (1). Tommy struggles to work out the meaning of the sentence because it involves information at one time, which requires greater working memory (1). Credit other appropriate points

Chapter 2

Consider!

What does this study tell us about the duration in short-term memory?

The Peterson and Peterson study suggests that short-term memory is very short without something to interrupt rehearsal, we already start to transfer the information into our lo prevented, then we begin to forget after three seconds.

Task 2.1.

	Duration	Capacity
The sensory register	Rapid decay 200 milliseconds to a few seconds	Large capacity but we cannot attend to much information Sperling (1960) iconic memory four or five items but actually rapid decay (row presentation)
The short-term store	Peterson and Peterson (1959): duration very short; if no rehearsal then 90% information remembered after three seconds	Miller (1959) 'the magic number 7 ± 2' Chunking increases the amount of information but larger chunks means fewer chunks
The long-term store	Theoretically, forever, e.g. Bahrick et al. (1975), but in reality may not be able to recall	Theoretically infinite
Based on the evidence above, the multi-store model is… shown to have both some similarities and some differences. The capacities of the sensory appear to be similar. Additionally, there is some overlap, with the short-term store and lo information acoustically and visually, although they differ in their primary form of encodi be generally different; however, there is clearly some overlap. One possible modification is		

Check your understanding!

Q1. HM demonstrated an intact short-term memory but a difficulty in forming long-ter idea of there being separate short-term and long-term stores; otherwise both areas Additionally, as he had brain surgery that removed some sections of his brain and t memory, it is also likely that the physical locations of the short-term and long-term s

Marks for linking HM to the multi-store model (1) and explaining this link (2)

Q2. Conrad (1964) presented a list of six consonants for less than a second and asked p had seen (1). They found participants confused consonants with ones that sounded while participants were fine with consonants that looked similar but sounded differ term memory is encoded acoustically rather than visually (1).

Marks for description of appropriate study; could include aim, method, findings or c

Q3. IV: The list participants were presented with (acoustically similar, acoustically dissim semantically dissimilar)

DV: Number of words recalled in the list

1 mark each correct

Q4. Simon has many pre-existing long-term memories of tennis from watching and play (1). This suggests that his elaborative processing will be deeper as he will make mo term memories, making them more likely to be recalled at a later date (1). For exa being 6–4 for the first set because he had the same score playing himself a few wee arbitrary score with no connections, making it harder to recall (1).

Marks for direct application of elaborative rehearsal to the situation, use of exampl

Q5. Brain-damaged patients are unlikely to be able to give informed consent (1). For ex could never reach a true understanding that he was participating in research as he w were in a short space of time (1). Although carers or family members may provide whether the patient would truly want to participate in the experiment as they have them (1).

1 mark for identifying a relevant ethical issue and 2 marks for linking this to brain-d

Q6. We have a limited capacity in our sensory memory; for example, Sperling (1960) ex found that participants could remember four or five out of 12 visual items (1). How the participants were cued about which row to recall and participants tended to re This suggests that we remember more information in our sensory memory but that (1956) argued that we remember 7 ± 2 items' worth of information in our short-ter information can be 'chunked' to increase capacity and multiple items can be remem compared to L A S T (1). However, we cannot have an unlimited amount of informa found that we can remember fewer large chunks than small chunks (1). The capaci theoretically infinite; however, this is difficult to test as we often do not have acces long-term memory at once (1).

Marks for identifying each memory store (3) and for identifying the capacity of each

Exam-style questions

Q.	Answer
Q1.	**AO2 (1 mark), AO3 (2 marks)** One mark is awarded for identifying the problem (AO2). Two marks are awarded for justification of the problem (AO3). For example: Miller et al. (1956) found that the average digit span was seven give or take tw There are 11 digits in a mobile number, which means that Katie is unlikely to be digits (1). With insufficient short-term memory capacity, the extra items will be Credit other appropriate points
Q2.	**AO1 (3 marks)** A mark is awarded to each point relating to storage capacity. Together, the po description worth up to 3 marks. For example: Research has found that participants can store four or five visual i register (1). In contrast, Miller (1956) found that we could store 7 ± 2 digits, wh capacity than the sensory register (1). Long-term memory has potentially unlir difficult to prove experimentally (1). Credit other appropriate points
Q3.	**AO1 (4 marks), AO3 (4 marks)** **AO1:** • Brain-damaged patients are used in psychology to learn about the functio brain • There are ethical issues with using brain-damaged patients, such as the in consent and difficulties in withdrawing from the research • Brain-damaged patients are extremely vulnerable individuals, and, theref applied before using them as research subjects • Other ways of studying the brain should be considered, such as using hea neuroimaging techniques or dissecting brains after death • There are practical issues, and the extent of damage can greatly restrict w damaged individuals can complete • HM was unable to give informed consent • HM was one of the most studied individuals in psychology, which may ha privacy **AO3:** For the use of brain-damaged patients in psychological research • When questioned, HM appeared to have a positive attitude towards the r given as an indication that he consented • Research can gain new insights about the normal working brain by studyi brain-damaged individuals • For example, research on HM highlighted the importance of the hippocar was later confirmed by other case studies and neuroimaging evidence

	• Studies of brain-damaged individuals are usually case studies, which pro holistic understand of the topic Against the use of brain-damaged patients in psychological research: • The pattern of the brain damage and the patient's response to the dama patient, which limits our ability to generalise to other populations • The way a brain behaves when it is damaged does not necessarily provi behaves when it is healthy • There are ethical issues such as inability to give informed consent to the patient cannot understand or remember the research aims. Additionall overly invested in the patient and fail to recognise when research is dan being or prognosis outcomes. • Brain-damaged patients may prefer to spend their lives in a way that ref remaining abilities, rather than as research subjects • It is not always possible to establish whether the brains of these patient incident that caused the brain damage Credit other appropriate points

Level	Mark	Descriptor
		AO1 (4 marks), AO3 (4 marks)
Candidates should focus equally on knowledge and their evaluation/conclusion.		
Level 0	0	No creditworthy material
Level 1	1–2 marks	Candidate shows limited knowledge and understandi A generic conclusion may be present. Evidence suppo There is a partial attempt to answer the question. (A
Level 2	3–4 marks	Candidate shows largely accurate knowledge and und Argument uses statement rather than logical chains o for the argument using generally accurate factual det (AO3)
Level 3	5–6 marks	Candidate shows accurate knowledge and understand Arguments show mostly sound reasoning. Reasoning conclusion. The answer shows knowledge of differen not be balanced. (AO3)
Level 4	7–8 marks	Candidate shows accurate and comprehensive knowle The evaluation is logical and shows sound reasoning. comprehensive knowledge of different arguments and

Chapter 3

Task 3.1.

Type of long-term memory	Example
Episodic	'I know that I rode my bike 10 miles in the pouring r
Semantic	'I know that the triangle frame on a bike is designed
Procedural	'I know how to ride a bike'

Type of long-term memory	Example
Episodic	'I know that I played *Für Elise* in my piano lesson las
Semantic	'I know that a piano has 88 keys'
Procedural	'I know how to play a piano'

Type of long-term memory	Example
Episodic	'I know that I first tied my shoes when I was five yea
Semantic	'I know that shoe laces have stiff ends designed so t through eyelets'
Procedural	'I know how to tie my shoes'

Check your understanding!

Q1. Declarative memory is formed memories of facts, including semantic and episodic me
to recall (1). In contrast, procedural memory focuses on skill-based memories and ca

1 mark per definition

Q2. Episodic memory is long-term memory to do with our past events, which often incl
the event occurred (1). Semantic memory is formed of our knowledge and underst
Procedural memory is the memory of how we form actions and is different from th
unconscious (1).

1 mark per definition

Q3. Fitts (1954) proposed that there were three stages to learning new skills. Applied t
The cognitive phase: The person learns each separate stage of riding a bike, and ma
such as peddling at different speeds and using the brakes. Attention is required at e

The associative phase: The person knows each of the actions involved in riding a bik

The autonomous phase: The person can ride a bike without thinking about it; the sk

1 mark per each stage

Q4. Flashbulb memories are a type of episodic memory in which vivid memories are for
'snapshot' in time (1). These are often of strong events such as the 9/11 attacks, w
recall details very well even after a long period of time. (1) One explanation for the
they are often retold compared to normal memories. (1)

1 mark for basic definition
2 marks for further detail and/or examples

Q5. Schemata are mental structures in the brain that organise conceptual information (
butterfly may involve the information that it is an insect, has large wings and is ofte
'butterfly' activates the schema which retrieves all of this information and, likewise
'butterfly' (1).

Marks for definition, usefulness, how they work, and examples

Q6. Multitasking involves doing two tasks at the same time without performance impai
(1976) looked at whether you could train participants to be able to multitask succes
and comprehend short stories and also dictate words they heard aloud, and found t
both tasks together as well as they could alone (1). This suggests that multitasking
considerable practice (1). However, Strayer and Johnston (2001) used braking dista
measure of performance and found that both hand-held and hands-free mobile pho
even when the driver was experienced (1).

Marks for definition of multitasking / divided attention, autonomic behaviour, impo
(e.g. driving)

Exam-style questions

Q.	Answer
Q1.	**AO1 (3 marks)** A mark is awarded to each point relating to semantic memory. Together, the po coherent description worth up to 3 marks. For example: Semantic memories are our memories of facts, definitions and concepts (1). Sem important for understanding our world and language; without them, words wou Unlike episodic memories, semantic memories are independent of the time and them (1). Credit other appropriate points
Q2.	**AO1 (4 mark), AO2 (4 marks)** **AO1:** • Tulving (1972) formed a distinction between two types of long-term memo • Episodic memories are our memories of past events • Episodic memories are important for our identity; they make up who we ar • Semantic memories are our memories of facts and our knowledge about w • Semantic memories are needed to function easily; for example, to read and objects are around you • Episodic memories contain the time and context in which they occurred; in memories are stored separately from this information • Initially, semantic memories have time and context attached to them, but memories are lost • Episodic and semantic memories are thought to be stored in different area **AO2:** • David can recall semantic memories (he knows where countries are on a m everyday objects are) • His long-term memory for episodic memories has been damaged (he canno about his divorce or burning his hand) • He cannot form new memories, which suggests he cannot transfer informa memory – he cannot form semantic or episodic memories • He will have problems doing everyday tasks because he will not be able to doing, e.g. he will forget the conversation he just had or what comes next w • He will still be able to understand his environment because he has retained Credit other appropriate points

Level	Mark	Descriptor
		AO1 (4 marks), AO2 (4 marks)
Candidates should focus equally on knowledge and understanding and application to th		
Level 0	0	No creditworthy material
Level 1	1–2 marks	Candidate shows limited knowledge and understandin Makes very limited or no mention of relevant evidence
Level 2	3–4 marks	Candidate shows largely accurate knowledge and unde Discussion is not fully developed, and is not balanced importance to the arguments. Arguments are infrequ evidence from the context. (AO2)
Level 3	5–6 marks	Candidate shows accurate knowledge and understand Discussion shows mostly sound reasoning. The answe arguments but the discussion may not be balanced or importance to the arguments. The discussion is suppo the context. (AO2)
Level 4	7–8 marks	Candidate shows accurate and comprehensive knowle The discussion is logical and balanced, and shows soun comprehensive knowledge of different arguments whi relevant evidence from the context. (AO2)

Chapter 4

Consider!
How similar is this story to stories that his participants may have read before? How do
The War of the Ghosts is very different from the English stories that the participants wou
The prose is less connected, which makes it difficult to understand how parts of the story
another. There are unusual elements such as the realisation that the warriors were ghos
went to hunt seals.
This reduces the ecological validity of the study because participants would find the story
understand and remember than they would an English story.

Consider!
What information might be stored in the 'Hitler' schema?
Hitler schema: leader of the Nazi party, dictator of Germany, active during the 1930s–19
instigated the Holocaust and responsible for the death of millions (Jews, Poles, Soviet pri
homosexuals, disabled people, gypsies and more), believed in racial hygiene, gave impre

Consider!
Why might the researchers decide to show each participant only one set of photos?
Seeing more than one photo of a scene could lead to the participants' memories becomi
object belongs to which photograph.

Task 4.1.
You may have falsely remembered the word 'angry' because all of the words are associa
the word was not actually present.

Task 4.2.
Example story: Two men heard noises and thought that the sounds might be coming fro
arrived in a canoe and asked the men to join their war party. One man said that he did n
the men said that they had spare arrows in the canoe. The man said that he did not wan
suggested that the other man go with them. The other man joined the warriors and they
of a town. Many people were killed. The man realised he had been shot and he died.

Task 4.3.
Knowledge that might be stored in a restaurant schema: serves food, physical building, m
reservation, shown to a table, choose from menu, waiter or waitress takes order and bri
bill, leaving a tip

Task 4.4.
Common objects include: fridge, freezer, food, stove, oven, microwave, knives, cutlery, c
pans, kettle, toaster, coffee machine, cupboards, drawers, crockery, glasses, sink, dish ra

Task 4.5.
Example answer:
1) Participants were shown only one photo of each scene – this prevents them from c
each photo
2) How long the image was shown for – the amount of time the participant has to stud
how well it is recalled

Task 4.6.

Contemporary study: Reconstruction from memory in naturalistic environments	
Aim	Investigate the effects of prior knowledge (schemata) in recalling ob
Method	**Prior expectations test**: Participants asked to name the objects they different scenes (kitchen, office, dining room, hotel room and urban objects was counted. **Perceptual judgements test**: Participants were asked to write down set of photographs. Twenty-five photographs were used, with five f Prior expectations and perceptual judgements were used as a baseli scene. **Memory condition**: Forty-nine participants who had not taken part i in the condition. Ten photographs were used – two from each scene set of five. Participants were shown each photo for two or 10 secon objects. The objects and the order of recall were recorded.
Findings and Conclusions	Low-probability items were more likely to be recalled when not in th items, i.e. overall error rate 9% high probability, 18% low probability Few false memories occur for objects that are not in the scene, but a without a tablecloth Objects that are consistent with the room schema are recalled well Objects that are inconsistent with the room schema are recalled wel identify unusual items that the people do not expect to see Episodic memory was used in addition to semantic memory; 25% mo
Evaluation	**Strengths**: Encouraged ecological validity within memory research Used naturalistic settings over experimentally manipulated settings Has real-life applications: Witnesses may notice salient details that c **Weaknesses**: Used photographs rather than taking participants to a real room May not tell us about memory in real life

Check your understanding!

Q1. Participants heard a Native American folk tale, called The War of the Ghosts, twice after an interval of 15 minutes, and then again at different intervals (1). Bartlett fou were not accurate but showed distortion in a number of different ways (1). For exa simpler, which Bartlett termed 'levelling' (1).

4 marks for description of the repeated reproduction study, including specific detai method of testing recall

Q2. One error that Bartlett identified was levelling (1). Participants lost details about the and more straightforward (1). After several recalls, the story had been reduced to a t

1 mark for identification of a type of memory error
2 marks for description of that error

Q3. The War of the Ghosts study has poor ecological validity (1). The Native American f different style from English stories, used unusual language and had unfamiliar elem the errors participants made were attempts to make it sound more like an English s life as the information would already be in that format (1).

1 mark for commenting on the ecological validity of the study
2 marks for elaboration/evidence/examples that support this

Q4. Sulin and Dooling (1974) gave participants a story about a brutal dictator and name Martin or Adolf Hitler (1). After a short or long interval, participants were given a re sentence 'He hated the Jews particularly and so persecuted them' (1). They found who had been told the story was about Hitler falsely recognised the sentence as be story activated a Hitler schema but that recall is only affected when there has been

4 marks describing a study that supports the effects of schema on recall: material t and any results/conclusions

Q5. One strength of Steyvers and Hemmer's (2012) methodology is that they used natu naturalistic scenes they could study the types of memory error and the error freque This gives the study higher ecological validity and a greater ability to generalise the f

1 mark for identification of a relevant strength
2 marks for elaboration and examples of the strength

Exam-style questions

Q.	Answer
Q1.	**AO1 (2 marks), AO3 (2 marks)** One mark for each weakness identified (2 AO1) One mark for the justification of the identified weakness (2 AO3) For example: Bartlett (1932) gave participants vague instructions which may have encouraged (1). His finding of high rates of memory distortion may actually be the result of g reconstructive process (1). Bartlett did not have a consistent system for coding the errors his participants sh the accuracy of his findings because participants may be more or less prone to th suggested (1). Credit other appropriate points
Q2.	**AO1 (3 marks)** A mark is awarded to each point relating to schemata. Together, the points shou description worth up to 3 marks. For example: Schemata are our mental representations of objects and events (1). Bartlett arg missing information from our memories, we use schemata to fill in the gaps (1). reconstructions are based on our prior knowledge, which does not always transl Credit other appropriate points
Q3.	**AO1 (4 marks), AO3 (4 marks) [Maximum of 2 marks for 'For' and 2 m** This mark scheme corresponds to using the contemporary study discussed in thi (Steyvers and Hemmer, 2012). The contemporary studies by Schmolck et al. (20 Hernández-Gil (2012) are alternatives that could be used to answer this questio **Steyvers and Hemmer (2012)** **AO1** • Researching how prior knowledge (schemata) influences recall of episodic m • A response to Brewer and Treyens' (1981) study and other studies that exper scenes • Compared prior expectations (naming objects for a scene) and perceptual j that could be seen in photographs) with actual recall rates • Used photographs of five scenes • Found that participants recalled schemata consistent objects well • Found that schemata inconsistent objects were salient and, therefore, reca **AO3** • Improved ecological validity by using naturalistic, non-manipulated, scenes • Use of photographs limits ecological validity: memory for photographs may memory for real-life scenes • High levels of control, and participants experienced standardised condition compare participants • Application: Eyewitness testimony – schemata can allow eyewitnesses to g and identify unusual details that do not match their schemata Credit other appropriate points

Chapter 5

Task 5.1.

Level	Mark	Descriptor
		AO1 (4 marks), AO3 (4 marks)
Candidates should focus equally on knowledge and their evaluation/conclusion.		
Level 0	0	No creditworthy material
Level 1	1–2 marks	Candidate shows limited knowledge and understanding (A A generic conclusion may be present. Evidence supportin There is a partial attempt to answer the question. (AO3)
Level 2	3–4 marks	Candidate shows largely accurate knowledge and underst Argument uses statement rather than logical chains of reas the argument using generally accurate factual details. A sh
Level 3	5–6 marks	Candidate shows accurate knowledge and understanding Arguments show mostly sound reasoning. Reasoning lead The answer shows knowledge of different arguments but balanced. (AO3)
Level 4	7–8 marks	Candidate shows accurate and comprehensive knowledge The evaluation is logical and shows sound reasoning. The knowledge of different arguments and forms a balanced c

Laboratory experiment	
Definition: A laboratory experiment is a carefully controlled study that manipulates the independe the dependent variable.	
Advantage: Replicable	**Write it fully:** One of the advantages of a laboratory experiment is tha same. Precisely operationalising the variables and stand experiment means that the experiment means that each conditions. This is beneficial as it allows the researcher t or other researchers to investigate the reliability of the r
Disadvantage: Operationalisation	**Write it fully:** A laboratory experiment is carefully operationalised to a the effect of the IV; however, the operationalisation may they are measuring is used in real life. For example, in M is doubtful that in real life an average citizen would ever on orders from an authority figure. Demonstrations of c shown by less extreme actions, making it difficult to gen experiment to real life.

Field experiment	
Definition: A field experiment is an experiment that manipulates the independent variable but the settings rather than artificial settings.	
Advantage: Higher mundane realism	**Write it fully:** A field experiment occurs in natural settings, which mak mundane realism than laboratory studies. Since findings their environment, findings that are produced in natural relevant and applicable to real life. For example, researc their shopping list is more likely to provide insight about than having someone sit in a laboratory and memorise a
Disadvantage: Ethical implications	**Write it fully:** Participants in field studies may be unaware they are tak raises serious ethical issues. Participants do not consent unethical as they may not want to take part and would n asked. In addition, those who do not know they are taki withdraw from the study. Due to the manipulation of IVs, in situations they are uncomfortable with. If participants discover that they are being studied, they which has a wider implication of damaging reputation in

Task 5.2.
Possible extraneous factors:

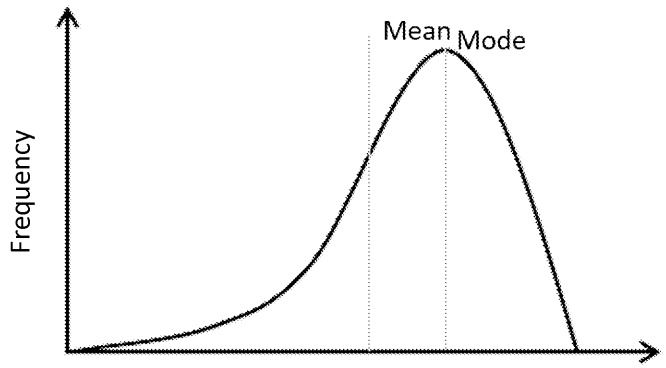
- How familiar they are with the topic – could be controlled for by allowing them to
with or rating for familiarity and controlling for the difference in analysis
- How much experience they have with giving presentations – rating for experience
or using all similarly experienced individuals
- The age, gender, status, etc. of the audience, e.g. whether they are a group of exp
having the same audience and same information about the audience each time

Task 5.3.
Hot:
Mean = 66.3
Median = 63.5
Mode = 63
Range = 29

Cold:
Mean = 60.4
Median = 58.5
Mode = 60
Range = 39.0

The mean of the cold room was slightly lower (60.4 vs 66.3) than the mean of the hot roo
encourages faster completion. However, the range is much greater in the cold room (39
mean in the cold room has been affected by outliers.

Task 5.4.
a) Skewed distribution curve (to the right)
b) The majority of test scores tend to be higher
c) and **d)** see below



e) The mode is the most common and so it forms the peak as that represents the high
average; this will be affected by the fact that the majority of values are higher and s
the right.

A-Level exam-style questions

Q.	Answer
Q1.	**AO1 (4 marks), AO2 (4 marks)** **AO1:** • Working memory (Baddeley and Hitch, 1974) is our capacity to hold and m our short-term memory • Working memory is divided into a number of different stores, including a deals with sound-based information • Individuals differ in their working memory abilities, and poorer working m poorer performance in memory tests and difficulties in everyday life • Dyslexics have poorer or inefficient working memory • Dyslexics code phonological information ineffectively, which makes it diff phonological tasks, such as blending sounds to make words and reading c **AO2:** • A heavy working memory load in the classroom can be reduced by splittin information concisely and using checklists to track what the child needs t demands on their working memory and allows them to avoid losing track multi-step task. • Classroom strategies can target phonological working memory problems; blending skills in small groups. Blending is difficult for dyslexic children d holding multiple pieces of sound information in their short-term memory • Direct interventions have focused on improving working memory and pho than teachers trying to address these difficulties in the classroom. • Temple et al. (2003) found the direct intervention programme Fast ForWo improved reading performance and changes in the neural activation of dy increased activity in their left temporoparietal cortex, an area that is assc processing, which came near to the activity shown in normal controls. • More research is needed on the long-term effectiveness of these interver Credit other appropriate points

Level	Mark	Descriptor
		AO1 (4 marks), AO2 (4 marks)
Candidates should focus equally on knowledge and understanding and application to th		
Level 0	0	No creditworthy material
Level 1	1–2 marks	Candidate shows limited knowledge and understanding (Makes very limited or no mention of relevant evidence
Level 2	3–4 marks	Candidate shows largely accurate knowledge and under Discussion is not fully developed, and is not balanced o importance to the arguments. Arguments are infreque evidence from the context. (AO2)
Level 3	5–6 marks	Candidate shows accurate knowledge and understandi Discussion shows mostly sound reasoning. The answer arguments but the discussion may not be balanced or c importance to the arguments. The discussion is suppor the context. (AO2)
Level 4	7–8 marks	Candidate shows accurate and comprehensive knowlec The discussion is logical and balanced, and shows sounc comprehensive knowledge of different arguments whic relevant evidence from the context. (AO2)

Q.	Answer
Q2.	**AO1 (4 marks), AO2 (4 marks)** **AO1:** • The multi-store model of memory (Atkinson and Shiffrin, 1968) is compo and short-term memory and long-term memory stores. • Attention is the process that determines whether information in the sen short-term memory store. Information that is not attended to is forgott • Short-term memories must be rehearsed to enter the long-term store. M been rehearsed are forgotten. • Short-term memory has a limited capacity of five to nine items (e.g. Mill hold more information than this capacity; additional information may be the old information. • Information may be stored in the long-term store forever (Bahrick et al., information is accessible. **AO2:** • Claire, who was not expecting the attack, may not have been paying atte time of the incident. Failure to attend to the sensory information leads t information. • Rehearsal is necessary to ensure that the memory is retained in long-term m rehearsed the information about the man because she did not realise the sig • Claire may have been using her short-term memory capacity for other th unable to store extra information. • Claire may have seen details about the man but be unable to access thes term memory. Credit other appropriate points

Level	Mark	Descriptor
		AO1 (4 marks), AO2 (4 marks)
Candidates should focus equally on knowledge and understanding and application to th		
Level 0	0	No creditworthy material
Level 1	1–2 marks	Candidate shows limited knowledge and understandin Makes very limited or no mention of relevant evidence
Level 2	3–4 marks	Candidate shows largely accurate knowledge and unde Discussion is not fully developed, and is not balanced c importance to the arguments. Arguments are infreque evidence from the context. (AO2)
Level 3	5–6 marks	Candidate shows accurate knowledge and understandi Discussion shows mostly sound reasoning. The answer arguments but the discussion may not be balanced or c importance to the arguments. The discussion is suppo the context. (AO2)
Level 4	7–8 marks	Candidate shows accurate and comprehensive knowle The discussion is logical and balanced, and shows soun comprehensive knowledge of different arguments whi relevant evidence from the context. (AO2)

Q.	Answer
Q3.	**AO1 (4 marks)** A mark is awarded to each point relating to episodic memory. Together, the p coherent description worth up to 4 marks. Example: Episodic memories are our memories of past events (1). When recalling episo remember the time and place attached to the events (1). Episodic memories a each individual (1). A specific type of episodic memories is autobiographical m only personal events (1). Credit other appropriate points

Q4.	AO1 (4 marks), AO3 (4 marks)
	AO1: • Ecological validity is the extent to which research findings can be applie experiment itself, such as real life • Ecological validity is higher when the study uses natural settings and na participants do not know they are taking part • Ecological validity is lower when the study is conducted in a laboratory a and the participants are affected by demand characteristics • Research into reconstructive memory includes Bartlett's (1932) The Wa which participants heard a Native American folk tale and had to recall th • The War of the Ghosts used unusual terminology and style of prose • Participants found it difficult to understand how different parts of the st **AO3:** • Other more ecologically valid research has been conducted; for example (1981), who had participants come to an office and then gave them a su ecological validity is due to the use of real-life setting and to testing inci how many memories are formed in real life. • However, Brewer and Treyens (1981) manipulated which objects were i the memory errors may not been typical of our normal everyday memo • Steyvers and Hemmer (2012) used natural, non-manipulated environme error rates, which suggests that it is important to use ecologically valid s • Reconstructive memory has important real-life implications such as eye therefore, it is important that research on the reconstructive nature of m real life • Loftus and Palmer (1974) found that misleading information could alter situation; however, they used videos of crashes which do not produce t as a real-life witness situation • An increase in ecological validity often means a decrease in control, and ecological validity must strike a careful balance between the two • Rigorous control allows researchers to posit causal explanations but red of the research Credit other appropriate points

Level	Mark	Descriptor
		AO1 (4 marks), AO3 (4 marks)
Candidates should focus equally on knowledge and their evaluation/conclusion.		
Level 0	0	No creditworthy material
Level 1	1–2 marks	Candidate shows limited knowledge and understandi A generic conclusion may be present. Evidence suppo There is a partial attempt to answer the question. (AO
Level 2	3–4 marks	Candidate shows largely accurate knowledge and und Argument uses statement rather than logical chains o for the argument using generally accurate factual deta (AO3)
Level 3	5–6 marks	Candidate shows accurate knowledge and understand Arguments show mostly sound reasoning. Reasoning conclusion. The answer shows knowledge of differen not be balanced. (AO3)
Level 4	7–8 marks	Candidate shows accurate and comprehensive knowle The evaluation is logical and shows sound reasoning. comprehensive knowledge of different arguments an (AO3)

Glossary

Abstract	A section at the beginning of a journal article which giv
Aim	What the study intends to research
Articulatory process	Rehearses auditory information (inner voice) to prever
Assimilation	Trying to fit new information into our previously held k
Attention	Focus necessary to move sensory information into sho
Autobiographical memory	Another term for episodic memory; autobiographical r personal events in our own life
Blood-oxygen-level-dependent (BOLD) response	A technique used in fMRI that shows activity in the bra and deoxygenated haemoglobin
Cause and effect	The idea that changing one variable causes a change ir prediction possible
Capacity	How much information can be held in a store
Central executive	Determines how resources, including attention, are all
Chunking	Reducing the amount of information we have to reme technique that improves short-term memory
Confidentiality	Experimenters are not to disclose confidential informa a way that the participant is not identifiable from the d are replaced by numbers
Control	Preventing variables other than the independent varia study
Control group	A group of participants who are not exposed to the ex independent variable and who are compared with the e
Counterbalancing	To avoid order effects, the order in which participants changed; for example, half of participants may do Con other half may do Condition B then Condition A
Critical value	A value found in a critical values table, which is used to
Debrief	A process after the study of revealing the true nature o
Deception	Deception is the act of deliberately misleading someor experiment
Declarative memory	Memory that requires conscious thought; it encompas memories, for example, remembering what you did las thinking back in time
Demand characteristics	When the participant's behaviour is a reflection of hov behave; responding to the 'demands' of the situation
Dependent variable	A variable which measures the presumed effect of the i
Descriptive statistics	Numerical ways of describing the data by identifying k
Directional hypothesis	The researcher predicts the direction of the effects
Discussion	A section of a journal article that relates the findings b how the results compare to previous research outlined
Double-blind technique	Neither the participant nor the experimenter knows w placed in; often used in drug trials
Duration	How long a memory lasts before we can no longer reca
Ecological validity	The extent to which the findings can be generalised to and everyday behaviour
Elaborative rehearsal	Organising and creating associations by linking the nev
Encoding	How information changes to be stored in memory

Episodic buffer	Temporarily stores information and integrates inform
Episodic memory	Our memory of past events, usually including a time a example, what happened on last year's birthday
Experimental design	How participants are chosen and allocated to the diff
Experimenter effects	When the researcher provides subtle clues about the participant to behave differently
Explicit memory	Another term for declarative memory; memory that r
External validity	The extent results are generalisable across settings a
Extraneous variables	Variables that may influence the behaviour in additio manipulation of IV) and so should be controlled for
Field experiment	An experiment that occurs in real-life settings but the
Free recall	Able to recall the items in any order, as opposed to a a phone number
Functional magnetic resonance imaging (fMRI)	A neuroimaging method which examines brain activi associated changes
Hypothesis	A prediction of the outcome of the research
Implicit memory	Memory that can be formed automatically; it encom example, you do not need to consciously think how t
Independent groups	Different participants take part in each condition
Independent variable (IV)	A variable which is manipulated to produce a presum
Inferential statistics	Tests conducted on the raw data to try to determine
Informed consent	The participant knows exactly what is going to happe Differs from just consent, when the person does not experiment but agrees to take part.
Internal validity	The extent to which the behaviour is the result of the in the IV)
Inter-rater reliability	A method of establishing reliability which compares h with each other
Introduction	A section of a journal article which discusses the reas identifies the hypothesis and aim of the research
Laboratory experiment	An experiment conducted in an artificial environmen involves manipulation of the independent variable to
Levelling	Simplifying a story by reducing the number of details
Levels of significance	The level chosen (typically 0.05) which determines th
Long-term memory	Our memory for past events (which is longer than ou
Objective	Free from errors caused by subjective interpretation
Maintenance rehearsal	Rehearsal by repetition of the information
Mann–Whitney U test	A statistical test that can be used for independent gr
Matched pairs design	Each participant is matched to another participant to factors that are important for the study. Each partici with their opposite number acting as the control.
Mean	An average that is calculated by adding together all t values there are. This measure takes into account th
Measures of central tendency	Measures that aim to find the central value of a data
Measures of dispersion	A measure that describes how spread out the data is
Median	An average that is calculated by ordering the data by
Method/procedure	A section in a journal article that describes exactly ho

Mode	An average that is calculated by ordering the data ar most often
Non-directional hypothesis	The researcher predicts that there will be an effect b effect will be
Normal distribution	A bell-shaped curve where the peak is the mean valu the peak
Null hypothesis	States there will be no effect
Operationalisation	Precisely defining your variables so that a hypothesi
Opportunity sample	A sample drawn from whoever is available at the tim criteria for participation
Order effects	When the later condition is affected by an earlier co
Participant variables	Characteristics of the participants which may affect t
Phonological loop	Encodes auditory information
Phonological store	Holds the auditory information (inner ear)
Population validity	Whether the findings can be generalised to people o
Predictive validity	Predictive validity is whether the performance in the think it should be able to predict.
Primacy effect	When information we are exposed to first is better r rehearsed
Probability	The likelihood of an event happening
Procedural memory	Our memory of how to do actions; for example, how
Protection from harm	Participants should be protected from psychological a aware of anything that may present a risk to them
Random sample	A sample that is drawn so that members of the popu being selected
Randomisation	Altering the order of the material to reduce order ef
Range	A measure of spread that is calculated by subtracting greatest value
Rationalisation	Explaining confusing elements of a story so that they
Recency effect	When information we are exposed to last is recalled b short-term memory
Reconstructive memory	A theory by Bartlett (1932) which argued that memo
Rehearsal	Mentally repeating information to maintain the mem
Reliability	The extent to which results are consistent across ob
Repeated measures design	The same participants take part in all of the study co
Repeated reproduction	When the same is information is recalled several tim time
Results	A section in a journal article which presents the desc
Retrieval	Accessing the stored memory
Right to withdraw	It should be made clear to participants that they hav point, and that any data from the study can be destr
Sampling	The method of selecting participants from the requi your study
Sampling bias	When the way the sample is selected does not repre
Schema (schemata)	Schemata are our mental representations of objects about what words and concepts mean, and what to e

Semantic memory	Our memory concerned with the meaning of things a means or what a wrench is for
Sensory memory	The store where sensory information is inputted
Serial position effect	An effect whereby the order of information changes
Serial reproduction	One person learns and recalls information, their ver recalls it, and so on.
Sharpening	Overemphasising the importance of certain details i
Short-term memory	Our immediate memory
Significant result	The calculated value of the statistical test is less tha determined by the level of significance
Situational variables	Variables in the environment which may affect the r
Skewed distribution	A bell-shaped curve that is skewed towards one side mean
Standard deviation	A measure of spread that uses every point of data a
Standardisation	The procedures and materials are identical, which e environment and allows other researchers to repea
Stratified sample	In a population with several groups, the number of p to the size of each group; the correct numbers of th
Systematic sample	Selecting the participants at a fixed interval after ra
Test-retest reliability	The study is repeated more than once to check for t
Type I error	When we reject the null hypothesis when we should
Type II error	When we accept the null hypothesis when we shou
Unitary store	A store that operates as one; if damaged, it should s to this store
Volunteer sample	Participants self-select; they choose to participate i
Visuospatial sketch pad	Encodes visual information
Wilcoxon signed-rank test	A statistical test used on studies with a repeated me
Word-length effect	People find it easier to remember shorter words tha
Working memory	The capacity to hold and manipulate information in c