**\_\_\_\_\_\_\_\_\_\_\_\_\_** and Hitch (1974) argued STM was more complex than just being a single temporary store for transferring information to LTM – which was what the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** saw memory as structured like. They saw **\_\_\_\_\_** as an ‘active’ store, holding several pieces of information while they were being worked on, for example when working on an arithmetic problem or playing chess. The model consists of **\_\_\_\_\_\_** main components, each of which is different, especially in terms of capacity and **\_\_\_\_\_\_\_\_\_\_**.

**The Central \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ -** This acts as a **\_\_\_\_\_\_\_\_\_\_** to determine which information received by the sense organs is and isn’t **\_\_\_\_\_\_\_\_\_\_\_\_** to. It processes information in all sensory forms, directs information to the model’s **\_\_\_\_\_\_\_\_** systems and collects responses. It’s **\_\_\_\_\_\_\_\_\_\_\_\_** in capacity and can only effectively cope with one strand of information at a time. It therefore selectively attends to particular types of information, attaining a **\_\_\_\_\_\_\_\_\_\_\_\_** between tasks when attention needs to be divided between them, for example, while driving.

**Phonological \_\_\_\_\_\_\_ (PL) -** This is one of the slave systems and deals with **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** information and is also called the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.** The PL is similar to the rehearsal system of the MSM. Information is coded **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** so sometimes confusions occur with similar sounding words. The PL is sub-divided:

 The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** store - which stores words you hear.

The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** process, which allows maintenance **\_\_\_\_\_\_\_\_\_\_\_\_** (repeating sounds or words in a ‘loop’ to keep them in working memory while they are needed). The capacity of this ‘loop’ is believed to be \_\_\_\_ seconds worth of what you can say.

**Visuo-spatial \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(VSS) -** The VSS, or **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, is the second slave store. It stores **\_\_\_\_\_\_\_\_\_\_** and/or \_\_\_\_\_\_\_\_\_\_\_\_ information when required. For example if you are asked to work out how many windows you have on your house you visualise it. The VSS helps individuals to **\_\_\_\_\_\_\_\_\_** around and interact with their physical environment, with information being coded and rehearsed through the use of visual images.

**The Episodic \_\_\_\_\_\_\_\_\_\_\_ -** This is the third slave system, added **\_\_\_\_\_\_\_\_\_\_\_** by Baddeley (2000), who suggested that the model needed a general store to operate properly. The PL and the VSS deal with the processing and temporary storage of **\_\_\_\_\_\_\_\_\_\_\_\_** types of information, but have limited capacity, and the CE has no storage capacity, and so cannot contain items relating to **\_\_\_\_\_\_\_\_** visual and acoustic properties. Therefore the EB was introduced to explain how it is possible to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** store information combined together from the other parts. It also transfers information to the **\_\_\_\_\_\_\_.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| LTM | Sketchpad | Articulatory | Visual | Baddeley |
| Rehearsal | Inner Ear | Specific | Attended | Acoustically |
| Inner Eye | Temporarily  | Filter | Navigate | Balance |
| Buffer | Loop | Limited | Four | Both |
| Two | Phonological | Spatial | Executive | Multistore Model |
| Auditory | Slave | Coding | STM | Later |

**AO2 Question**

*Megan is a University Student. During seminars she often plays the computer game “the Sims” on her laptop while listening to her lecturer. She explains to her lecturer that she can still concentrate on what he is saying while playing the game. However, she does notice that if her friend starts chatting to her during seminars then she does lose track of what the lecturer is saying.*

Explain the key components of the working memory model, making reference to Megan’s ability to perform different tasks simultaneously. (6 marks)

**Case Study of KF**

KF suffered brain damage as a result of a motorcycle accident. KF had no problem with long-term memory, but his digit span was only two items (in others words he could only remember two digits at a time whereas, on average, people remember seven digits in short-term memory).  Researchers found that KF’s short-term forgetting of auditory letters and digits (things that are heard) was much greater than his forgetting of visual stimuli. He could remember words if presented visually much better than remembering words presented verbally.

Explain whether this supports or contradicts the model.

What is an issue with using case studies to support theories?

**WMM SAQ 30 marks**

1. Three components of the working memory model are the central executive, the phonological loop and the visuo-spatial sketchpad. Briefly outline **each** of these components.
2. **Central executive**
3. **Phonological loop**
4. **Visuo-spatial sketchpad** **[3+3+3]**
5. Choose **one** study of the working memory model. Briefly outline what the participants were asked to do in this study. **[3]**
6. Abdi finds it difficult to read his emails and talk to his wife in an evening. He however has no issues in playing a video game while talking to his wife. His wife finds this crazy that he can multitask in some situations and not others. Explain, using your understanding of the Working Memory Model, why this is the case. **[4]**
7. Outline **one** strength and **one** limitation of the working memory model. [3+3]
8. A brain scan shows that one area of the brain is more active when a person is doing a verbal task. However, when this person is doing a visual task, a different area of the brain is more active.
9. Explain how this could relate to the working memory model. Refer to different parts of the working memory model in your answer. **[4]**
10. Give an example of an appropriate verbal task and an appropriate visual task
which could be used during the brain scan. [2+2]

|  |  |  |  |
| --- | --- | --- | --- |
| **POINT** | **EXAMPLE** | **EXPLAIN** | **ELABORATE/HOWEVER** |
| There is support from **case studies.** | For example…Smith (1995) used brain scans to show how different areas of the brain are active when doing visual or verbal tasks suggesting the PL and VSS are separate systems. | These children have deficits in working memory and the model can provide practical suggestions for helping these children. | This is a weakness because it means aspects of the model haven’t been fully explained and further research is needed. |
| There is support from **brain scanning** studies.  | For example, Baddeley himself said “the central executive is the most important and least understood component”. | This provides support for the subdivisions of the separate visual and verbal stores as they are located in different parts of the brain. | However, this is a lab experiment that lacks ecological validity and mundane realism. It is possible that the tasks given just don’t reflect real life use of memory so little may be understood from such artificial tasks. |
| There are **practical applications** | For example, KF suffered brain damage after a motorcycle accident, and he could process visual info but struggled with verbal info. | This is because the first group had to do two visual tasks, whereas the second group did one visual and one verbal. Thus, suggesting there are separate parts of STM that deal with verbal and visual information. | However, evidence gathered from case studies is limited because it would not be right to suggest all peoples’ memory works in a particular way from evidence from a single person, and a person who has had brain damage as well. |
| **Not all aspects** of the model **are fully understood**. | For example…Baddeley (1993) found that Ps had difficulty tracking a moving light and describing the angles of a letter. Other Ps had little difficulty in tracking the light while performing a verbal task. | For example, it has been argued it has limited capacity but this hasn’t been researched properly with any precision. It is usually defined as being “attention” but it is likely to have other components that just haven’t been researched yet. | For example, by breaking down instructions into simple manageable chunks with frequent repetition. |
| There is support from **lab experiments.** | For example…The model has been argued to be able to be used to help children with ADHD. | This supports the existence of two separate visual and verbal stores in STM. Because it would seem like his phonological loop is the only store to have been affected and his visuo-spatial sketchpad was still functional. | In addition, brain scans have shown different areas of the brain activated with visual and spatial activities. Providing support for a subdivision of the Visuo-Spatial Sketchpad. |

**Memory Experiment – Word Length Effect**

|  |  |
| --- | --- |
| **LIST 1** | **LIST 2** |
| Ball | Afternoon |
| Goat | Butterfly |
| Toy | Battery |
| Sun | Container |
| Root | Personal |
| King | Gravity |
| Flea | Allergy |
| Box | Majesty |
| Team | Barbecue |
| Card | Decorate |
| Man | Multiply |
| Pot | Factory |
| Door | History |
| Pen | Minimum |
| Suit | Telescope |

*Helena works in a busy florists, she finds it really difficult to read customer orders submitted by email when talking to her colleagues. However, she is able to look through photographs of floral displays while listening to the radio.*

Explain and evaluate the key components of the working memory model making reference to Helena’s ability to perform different tasks simultaneously. (12 marks)

|  |
| --- |
| Description  |
| Apply to Helena |
| EvaluationPEEL/H | EvaluationPEEL/H |

**Working Memory Evaluation Match Up - ANSWERS**

|  |  |  |  |
| --- | --- | --- | --- |
| **POINT** | **EXAMPLE** | **EXPLAIN** | **ELABORATE/HOWEVER** |
| There is support from case studies. | For example…KF suffered brain damage after a motor cycle accident and he could process visual info but struggled with verbal info. | This supports the existence of two separate visual and verbal stores in STM. Because it would seem like his phonological loop is the only store to have been affected and his visuo-spatial sketchpad was still functional. | However…evidence gathered from case studies can be considered limited because it wouldn’t be right to suggest all peoples memory works in a particular way due the evidence from a single person, and a person who has had brain damage as well. |
| There is support from brain scanning studies.  | For example…Smith (1995) used brain scans to show how different areas of the brain are active when doing visual or verbal tasks suggesting the PL and VSS are separate systems. | This provides support for the subdivisions of the separate visual and verbal stores as they are located in different parts of the brain. | In addition brain scans have shown different areas of the brain activated with visual and spatial activities. Providing support for a subdivision of the Visuo-Spatial Sketchpad, which deals with visual & spatial info differently. |
| There are practical applications | For example…The model has been argued to be able to be used to help children with ADHD. | These children have deficits in working memory and the model can provide practical suggestions for helping these children. | For example, by breaking down instructions into simple manageable chunks with frequent repetition. |
| Not all aspects of the model are fully understood. | For example, Baddeley himself said “the central executive is the most important and least understood component”. | For example it has been argued it has limited capacity but this hasn’t been researched properly with any precision. It is usually defined as being “attention” but it is likely to have other components that just haven’t been researched yet. | This is a weakness because it means aspects of the model haven’t been fully explained and further research is needed. |
| There is support from lab experiments. | For example…Baddeley (1993) found that p’s had difficulty tracking a moving light and describing the angles of a letter. Other p’s had little difficulty in tracking the light while performing a verbal task. | This is because the first group had to do two visual tasks, whereas the second group did one visual and one verbal. Thus suggesting there are separate parts of STM that deals with verbal and visual information. | However…this is a lab experiment that lacks ecological validity and mundane realism. It is possible that the tasks given just don’t reflect real life use of memory so little may be understood from such artificial tasks. |

Working Memory Model - ANSWERS

**Baddeley** and Hitch (1974) argued STM was more complex than just being a single temporary store for transferring information to LTM – which was what the **Multistore Model** saw memory as structured like. They saw **STM** as an ‘active’ store, holding several pieces of information while they were being worked on, for example when working on an arithmetic problem or playing chess. The model consists of **four** main components, each of which is different, especially in terms of capacity and **coding**.

The Central **Executive** - This acts as a **filter** to determine which information received by the sense organs is and isn’t **attended** to. It processes information in all sensory forms, directs information to the model’s **slave** systems and collects responses. It’s **limited** in capacity and can only effectively cope with one strand of information at a time. It therefore selectively attends to particular types of information, attaining a **balance** between tasks when attention needs to be divided between them, for example, while driving.

Phonological **loop** (PL) - This is one of the slave systems and deals with **auditory** information and is also called the **inner ear**. The PL is similar to the rehearsal system of the MSM. Information is coded **acoustically** so sometimes confusions occur with similar sounding words.

The PL is sub-divided:

 The **phonological** store - which stores words you hear.

The **articulatory** process, which allows maintenance **rehearsal** (repeating sounds or words in a ‘loop’ to keep them in working memory while they are needed). The capacity of this ‘loop’ is believed to be **two** seconds worth of what you can say.

Visuo-spatial **sketchpad** (VSS) - The VSS, or **inner eye**, is the second slave store. It stores **visual** and/or **spatial** information when required. For example if you are asked to work out how many windows you have on your house you visualise it. The VSS helps individuals to **navigate** around and interact with their physical environment, with information being coded and rehearsed through the use of visual images.

The episodic **buffer** - This is the third slave system, added **later** by Baddeley (2000), who suggested that the model needed a general store to operate properly. The PL and the VSS deal with the processing and temporary storage of **specific** types of information, but have limited capacity, and the CE has no storage capacity, and so cannot contain items relating to **both** visual and acoustic properties. Therefore the EB was introduced to explain how it is possible to **temporarily** store information combined together from the other parts. It also transfers information to the **LTM.**

Working Memory Match Task

|  |  |  |
| --- | --- | --- |
| 1. Why did Baddeley and Hitch develop WMM?
 |  | 1. A task that requires a person to perform 2 tasks at once. They could be both verbal/ visual or one verbal & one visual task.
 |
| 1. What are the main 4 features of the WMM?
 | 1. Episodic Buffer: general temporary storage of both visual and verbal info and transfer info to LTM
 |
| 1. What is meant by dual performance task?
 | 1. Visuo-Spatial Sketchpad
 |
| 1. What feature is like a ‘conductor’ coordinating all other slave systems?
 | 1. Phonological Loop is acoustic and Visuo-Spatial Sketchpad is visual (and spatial).
 |
| 1. What would the model argue would happen with performance on dual performance tasks?
 | 1. People can do dual performance as long as the two tasks are using different stores (I.e. one verbal and one visual)
 |
| 1. What are the two subdivisions of the phonological loop?
 | 1. The MSM was limited by assuming the STM was a single store.
 |
| 1. Which features are the slave systems?
 | 1. The articulatory process and the phonological store
 |
| 1. What feature has a limited capacity of approx. 3-4?
 | 1. Phonological Store/Inner Ear
 |
| 1. Which was the most recent feature and why was it added?
 | 1. Central Executive
 |
| 1. How is each feature coded?
 | 1. Central Executive, Phonological Loop, Visuospatial Sketchpad and Episodic Buffer
 |
| 1. What ‘feature’ holds words you hear?
 | 1. Its likely location is the prefrontal cortex.
 |
| 1. What is the capacity of Articulatory Process (inner voice)
 | 1. How much can be said in 2 seconds (job is to rehearse words/maintenance rehearsal)
 |
| 1. What evidence is there for the capacity of the phonological loop?
 | 1. Baddeley showed through the word length effect that it wasn’t a number of items but how many items could be spoken in 2 sec’s.
 |
| 1. What has brain scanning research shown about the central executive?
 | 1. Phonological Loop, Visuospatial Sketchpad and Episodic Buffer
 |

Working Memory Match Task - ANSWERS

|  |  |  |
| --- | --- | --- |
| 1. Why did Baddeley and Hitch develop WMM?
 |  | **The MSM was limited by assuming the STM was a single store.** |
| 1. What are the main 4 features of the WMM?
 | **Central Executive, Phonological Loop, Articulatory Process and Episodic Buffer** |
| 1. What is meant by dual performance task?
 | **It is a task that requires a person to perform on two tasks at once. They could be both verbal/visual or one verbal and one visual task.** |
| 1. What feature is like a ‘conductor’ coordinating all other slave systems?
 | **Central Executive** |
| 1. What would the model argue would happen with performance on dual performance tasks?
 | **People can do dual performance as long as the two tasks are using different stores (I.e. one verbal and one visual)** |
| 1. What are the two subdvisions of the phonological loop?
 | **The articulatory process and the phonological store** |
| 1. Which features are the slave systems?
 | **Phonological Loop, Articulatory Process and Episodic Buffer** |
| 1. What feature has a limited capacity of approx. 4?
 | **Visuo-Spatial Sketchpad** |
| 1. Which was the most recent feature and why was it added?
 | **Episodic Buffer: general temporary storage of both visual and verbal info and transfer info to LTM** |
| 1. How is each feature coded?
 | **Phonological Loop is acoustic and Visuo-Spatial Sketchpad is visual (and spatial).** |
| 1. What ‘feature’ holds words you hear?
 | **Phonological Store/Inner Ear** |
| 1. What is the capacity of Articulatory Process (inner voice)
 | **How much can be said in 2 seconds (job is to rehearse words/maintenance rehearsal)** |
| 1. What evidence is there for the capacity of the phonological loop?
 | **Baddeley showed through the word length effect that it wasn’t a number of items but how many items could be spoken in 2 seconds.** |
| 1. What has brain scanning research shown about the central executive?
 | **Its likely location is the prefrontal cortex.** |