words were non-words compared to other non-words that did not sound like real words. Participants must have used the similarities in sounds- acoustics – to call up the meaning of the real words that sounded the same and this led to the slower response time. Their LTM was using an acoustic code as well as a semantic one.

That we can remember a voice we haven't heard for years and can remember a tune to a song is all evidence of an acoustic code in LTM. That we can recall people's faces and the image of our old school provides evidence of the visual code. Smells also bring back vivid memories, such as the smell of sun tan lotion and holiday memories. However, memories related to senses other than hearing and seeing is currently under-researched.

3.Critics argue that memory is not passive but is active and *constructive* in nature. That is, the normal state for memory is one where it actively attempts to create a meaning to the information being learnt. This '*Constructivist*' approach was first developed by Bartlett (1932). In a study he showed participants ambiguous pictures which he later asked them to draw from memory e.g.

When drawing the image many participants would give a verbal description. Some described it as an anchor and others as a pick-axe or shovel. This demonstrates how memory is active in trying to impose meaning on the information one is trying to learn and remember. This led Bartlett to introduce the term 'efforts after meaning'.

Bartlett also arranged for participants to read an obscure story called 'War of the ghosts'. It includes, for Westerners, many unfamiliar events and details and Bartlett found that in recalling the story, participants often created new details that made it appear more logical from a Westerner's perspective. This again illustrates the active nature of memory.

Loftus (1974) has carried out extensive research on the accuracy of eye witnesses' memories (see P303 3rd Ed or P313 4th Ed Gross) and has found that witnesses and participants in studies will often inadvertently create new memories around an event they have witnessed according to what they would have expected to have happened. This show that memory isn't passive but is an active process that attempts to construct meaning and often by drawing on what we would expect to have happened. Where we draw on our experience and expectations to make sense of new information it is called the *Top-down approach*.

4.Glanzer and Meinzer (1967) also argue that memory isn't passive as the Multi-store model suggests. They asked participants to learn words, some by speaking those words aloud and some by reading them silently. The words that were read silently had a much higher recall. The researchers concluded that this was because reading the words silently also allowed the participants to make other connections between the words and the information they have already stored in LTM. This type of rehearsal is called *elaborative* rehearsal. The words read aloud were learnt using *maintenance* rehearsal i.e. they were stored in their acoustic code only

and as such were less well remembered. Elaborative rehearsal allowed the words to be learnt in a more meaningful way.

Questions.

1. Define memory.

2. What is meant by the information-processing approach?

3. With reference to memory, explain the difference between bottom-up and top-down processing.

4. What three features characterise STM and LTM?

5. What does 7+/-2 refer to?

6. In approximately 70 words describe the finding of the Brown-Peterson curve or Glanzer and Cunitz' results.

7. Outline one study that illustrates the dominance of the acoustic code in STM. Use the term *acoustic error* in your answer.

8. Name two pieces of evidence that you haven't so far referred to which supports the Multi-store model.

9. True or false – Sachs' study supports the dominance of the visualisation code in LTM?

10. What is the difference between Anterograde and Retrograde Amnesia?

11. The Multi-store model assumes memory processes information in a passive way and in a bottom-up fashion. Explain what this means.

12. The studies in the Evaluation section provide evidence of an acoustic code in LTM and a semantic code in STM. Name a psychologist to support each piece of evidence and outline one of the studies in fifty words.

13. Explain, in a sentence, what is meant by the Constructivist approach.

14. Why do Glanzer and Meinzer believe that elaborative rehearsal supports the constructivist, top-down approach?

2. The Level of Processing model (Craik and Lockhart 1972)

These researchers put their emphasis not so much on memory stores but on the types of processing that takes place. They argue that it is how the information is analysed or processed that will determine how well it will be remembered.

Craik and Tulving (1975) showed participants words, one at a time and they asked them a yes/no question in relation to each word. The questions used related to either what the word looked like e.g. Is the word in capitals? Or what the word sounded like e.g. Does the word rhyme with ...? Or the questions related to the meaning of the word. Later participants were unexpectedly given a recognition task. They were shown a list of words and they had to pick those they believed they had earlier been tested on. The highest recall came from words that had been paired with a 'meaning' question. Next best were those related to an acoustic judgement and lowest recall came from those paired with a question where one had to make a judgement about what the word looked like (NB by 'looked like' this refers to the image of the actual word rather than what the word might represent). Based on these findings the researchers argued that information can be processed at one of three levels:

1. The Structural or Shallow level – what does the word look like?

2. Intermediate or phonetic level – What does it sound like?

3. Semantic level – What does it mean?

A similar study to Craik and Tulving's was carried out by Elias and Perfetti (1973). They showed participants words and with each word they gave them a task, such as to find a word that rhymes with it or to find a synonym for it. Participants didn't realise that they would later be tested on their recall. A much higher recall was reported for the words that involved a synonym task than a rhyming task. Words related to the synonym task were more deeply processed and were better recalled.

Evaluation.

1.Tyler (1979) argues that 'Deep-processing' needs to be redefined. He argues that the synonym task is likely to have required more *time* and *effort* and it may have been these factors more than the semantic processing that took place that explains the higher recall.

In his own study he asked participants to solve anagrams. Some were difficult (e.g. OCDRTO) and some easy (e.g. DOCTRO). All would involve semantic analysis to decode them and so the Levels of Processing model would predict that there would be no particular pattern to the results. However, the more difficult anagrams were those that were better remembered and this supports Tyler's claim that it is the more *effort* and *time* and number of *elaborations* involved (i.e. the number of attempts at solving the anagram) that are important in determining how effectively it will be stored and recalled. (You could remember these factors by the word TEE).

2.Craik and Lockhart were accused of providing only a description of what happened i.e. information that was semantically analysed was better remembered but they didn't attempt to explain why this should be so. Tyler's TEE offers an explanation and other psychologists have emphasised the importance of *elaborative encoding* – that is, in processing information at a deep level more links are made with existing memories. This also adds weight to the idea that memory is constructive and active and searches for meaning, rather than the Atkinson and Shiffrin interpretation of memory as one that absorbs information passively.

Questions.

15. Name and briefly define the three levels of processing in Craik and Lockhart's model.

16. In not more than fifty words describe one of the two studies referred to.

17. What does TEE stand for? Explain why Tyler argues the factors the term represents are important.

3. Tulving's (1972) Episodic, Semantic and Procedural memory.

Tulving criticised the Multi-Store model for being too simplistic. He argued that this was because the experiments on which its features are based did not reflect how memory worked in the real world (they lacked ecological validity). Atkinson and Shiffrin argue that we have a memory of images, where we use the visualisation code. Tulving re-defines this *as Episodic memory*, a kind of autobiographical memory – a memory of personal experiences, of events, people and situations we have experienced. It includes not just images of the objects, people and buildings from these events but also the kinds of emotions associated with the event (referred to as the *subjective element*) as well as information on *where* and *when* it occurred (*spatio-temporal* factors). Flashbulb memories are a special kind of Episodic memory and refer to the memory of an event that is special and significant and where the details of the memory, when and where it occurred and associated emotions, are vivid, such as where we were and what we felt when the Twin Towers collapsed on 11th Sept. 2001.

In place of how the Multi-store model and the Levels of Processing model define the *Semantic memory*, Tulving broadens its definition to include not just the meaning of words but also our memory of general knowledge. It is like an encyclopaedia-cum-dictionary.

Later, in 1985, Tulving argues that memories can also be categorised into *Procedural* and *Declarative* memories. Procedural memories refer to learning and the use of memories that do *not* require conscious effort. For example, motor skills such as swimming, riding a bike or driving can be undertaken without conscious effort to the motor skills involved. Declarative memories refer to our responses where we consciously draw on our memories to produce a response. For example, you use Declarative memory when you write and essay and when first learning to drive a car one consciously draws on the memory of what the clutch, brake and accelerator do and how they need to be co-ordinated.

From Tulving's account of memory you can see that it attempts to explain how memory functions in the real world and later models have attempted to analyse memory in more ecologically valid ways.

Questions

18. Define and give an example of Episodic and Semantic memory.

19. What is the difference between Procedural and Declarative memory?

20. Outline one way in which Tulving's interpretation of memory differs from that of earlier approaches.

4. The Working Memory.

Baddeley and Hitch (1974) criticised Atkinson and Shiffrin's interpretation of the STM as simply a passive container of inputs that have been learnt by repetition and which holds that information until it can be passed on to LTM or is lost. One finding, not considered by Atkinson and Shiffrin's interpretation of the STM, is that its efficiency is determined not just by its ability to send information on to the LTM but also on its ability to *receive* information from the LTM. DeGroot (1966), for example, found that expert chess players, if shown a chessboard and the pieces for only a few seconds were able to report the location of most of the 32 pieces on the 64 squares so long as the pieces corresponded to the rules of chess. This feat was way beyond most non-chess players tested and it was possible because the chess players were able to draw on their rules of chess in their LTM and use this to analyse and organise the information they are presented with for a few seconds in their STM.

For Baddeley and Hitch the STM is better conceived as a Working Memory (WM). It is not a passive recipient of information but an active processor of information. It contains four features – The Central Executive which acts as a manager and allocates sensory information to the other parts of the WM. The Primary Acoustic Store is our memory of what has just been said and this can be referred to as our '*inner ear*'. The Articulatory loop or phonological loop refers to where we are reading silently or are articulating words in our mind. It is aform of inner speech and is referred to as the '*inner voice*'.

When you are reading part of a text book you may re-read it a few times silently and if it appears particularly complex you may decide to read the text aloud to see if it helps you understand it better. In the first case you are using your inner voice and in the second your inner ear. By double-processing information in this way you are attempting to process it more deeply.

The Visuo-spatial scratchpad refers to our memory of visual and spatial information. For example, if you imagine the journey from home to college you will be able to recall not just the images of the buildings you pass and the roads en route but you will also have a memory

of the *distance* involved on the journey and the *time* it would take to complete it. These are the spatial inputs. This is referred to as the '*inner eye*'.

You may be thinking that this is all information in the LTM and the WM is supposed to be a substitute for the STM. The point is, this information is in LTM but can only be accessed through the STM and so the STM must have the facility to deal with such information and Baddeley and Hitch's WM does.

Activity – Work out how many windows there are in your house. Write down your answer and then try and explain the processing that is involved in terms of the WM.

Baddeley and Hitch challenged Miller's claim that the STM had a *capacity* of 7+/-2 items of information. They tested participants' recall on lists of words learnt by repetition. Eight words were in each list but in some lists the words were long and in some short. Miller would predict that there should be similar recall in each list because they contain the same number of items. However, Baddeley and Hitch found that there was significantly lower recall in the lists with the longer words. They used these findings to argue that the Articulatory loop is analogous to a strand of audio tape which will be filled by fewer words if those words take longer to say when pronounced and vice versa for the shorter words. This illustrates that the *capacity* of the STM has to consider the nature of the stimulus. A feature which is considered by the WM.

Heyer and Barrett showed participants eight letters arranged randomly in a four by six square grid. Each grid was shown for five seconds and the participants had to recall the letters and their locations. The participants would remember the letters by repeating them in their head - the Articuatory loop. To remember the location of the letters in the grid they have to visualise them using their Visuo-spatial scratchpad. The researchers also required participants to complete an interfering task before filling-in the blank grid with their answers. Sometimes the interfering task involved counting backwards aloud for ten seconds and sometimes it involved solving a short visual jigsaw before filling-in the grid with what they can remember of the letters and their locations.

Question – What results would the researchers expect and why?

When the interference task involved speaking numbers aloud this affected the Articulatory loop which would have been trying to store the letters from the grid, hence - the participants' memory of the letters was affected. The interference task led to 'articulatory suppression'. When the interference task related to the Visuo-spatial scratchpad, the participants still had a good memory of the letters but could remember less well where those letters went in the grid. The jig-saw task involved Visuo-spatial reasoning and so affected the participants' memory of the location of the letters. The interference tasks affected the performance of particular parts of the WM and the information that each part was processing. Such findings support Baddeley and Hitch's interpretation of how the WM functions.

ACTIVITY 7

Work through the following list of words at a steady pace, thinking of a rhyming word for each word marked (R), or a meaning-related word for each of those marked (M). For example a rhyme for 'bread' could be 'head', a meaning-related word for 'tree' might be 'leaf'.

boy	(M)	flower	(M)
ship	(R)	lake	(R)
house	(R)	milk	(M)
book	(M)	sand	(R)
arm	(M)	gate	(M)
cow	(M)	ink	(R)
sky	(R)	ball	(R)
bell	(R)	map	(M)
face	(R)	hill	(M)

Now cover up the list and write down as many words as you can recall. Then check your answers and total up the number of M (meaning) words and the number of R (rhyming) words you remembered.

e)

List 1	List 2	List 3	List 4	List 5	List 6
barricade	*armchair*	*icicle*	*proud*	*parchment*	*sepulchre*
children	*glow-worm*	*instructor*	*stirrup*	*gold*	*gnome*
diet	*outhouse*	*kidney*	*villain*	*baroness*	*stage*
gourd	*troll*	*lapel*	*zodiac*	*lever*	*patriarch*
folio	*handshake*	*crooner*	*deer*	*manservant*	*diploma*
meter	*hoarfrost*	*funnel*	*arbitrator*	*divan*	*minstrel*
journey	*elephant*	*carpet*	*beginner*	*emporium*	*mayonnaise*
mohair	*pumpkin*	*haystack*	*courtroom*	*wood*	*portcullis*
phoenix	*graveyard*	*hopper*	*hobby*	*gorge*	*dyke*
crossbow	*capsule*	*chancery*	*measles*	*windscreen*	*effigy*
alligator	*file*	*simpleton*	*ogre*	*armada*	*tiger*
doorbell	*package*	*theatre*	*nosegay*	*beverage*	*wage*
muffler	*playhouse*	*stencil*	*film*	*flowerpot*	*yacht*
menu	*ferry*	*urn*	*peg*	*lotion*	*maggot*
nebula	*dumpling*	*slug*	*flagon*	*archer*	*inspector*
	overcoat		*head-dress*	*pharmacy*	*deformity*
Recall	Recall	Recall	3	9	6
			+7	−5	−3
			−6	+6	+7
			+5	+3	−2
			−4	−1	+9
			−1	+4	+5
			+2	−8	−8
			+9	−2	+4
			−8	+7	−1
			Recall	Recall	Recall