Levels of processing on memory recall

In 1890, William James made a clear distinction between short-term and long-term memory stores, based purely on introspection, which he called primary memory (PM) and secondary memory (SM) (James, 2012). These concepts are more commonly known today as short-term memory (STM) and long-term memory (LTM), with the STM reflecting the current contents of consciousness and the LTM consisting of memories from the past that have to be recalled back into the consciousness through some means of retrieval process in order to be used (Passer & Smith, 2009). This retrieval process can be defined as the revival of memory to recollect and remember what has been (Carlson, Martin, & Buskist, 2007).

Much like a computer's memory, a person's memory has to enact several processes on the information contained within it. Firstly the information enters and this is done through a process of encoding, secondly it is retained through the process of storage and finally it is recalled when needed via the process of retrieval (Myers, 2005). It is recognised that LTM has no observable limit of storage capacity, as opposed to STM who storage is predominantly limited to a relatively small amount of data, averaging around seven items for no longer than approximately 30 seconds (Miller, 1956).

The earlier work on James memory concept has been enhanced, developed and maintained in several influential memory models that were later developed by psychologists such as Atkinson & Shiffrin (1968), with their proposal of the ' multi-store model' (MSM), which introduced the concept that STM and LTM had differing and distinct modes of storing information. In 1974 Baddeley & Hitch introduced their " Working Memory" (WM) model, a more dynamic memory system which suggested the use of two distinct

short-term memory buffers, the phonological loop and the visuospatial sketch pad, along with an argument that these buffers allowed a greater flexibility in memory storage (Baddeley & Hitch, 1974). Baddeley (1986) argued that the term working memory implies a system for the temporary holding and manipulation of information during the performance of a range of cognitive tasks such as comprehension, learning, and reasoning. Baddeley also proposed that verbal data are usually coded phonemically within the STM but predominantly in terms of its semantic features within LTM (Baddeley, 1986).

Holdings within a person’s LTM can in some ways be likened to those within a library, in that they must be organised in order for them to be readily available for retrieval. Therefore an argument can be made that the more effectively material is encoded into LTM, the greater the likelihood of retrieving it (Passer & Smith, 2009). It has been proposed that encoding occurs through both automatic processing, where large amounts of information is encoded with little or no effort and effortful processing, where information is retained through a certain amount of attention and effort through a process of rehearsal (Myers, 2005). The early work of Hermann Ebbinghaus (1885) indicated that the amount of time and effort spent rehearsing had a direct result on the levels of encoding and the amount of information available for retrieval. Kolers (1975) suggested that after repeated practice some effortful processing becomes automatic, much as learning to read or ride a bike.

When a person rehearses information by making lists, repeating things over and over to themselves or taking notes, they are engaging in effortful

processing. Remembering how to do things, learning new skills all involves effortful processing; encoding that is intentionally initiated and requires regular attention to maintain (Adam, Hommel, & Umilta, 2005; Hasher & Zacks, 1979). Craik and Lockhart (1972) believed that individuals performed two separate rehearsal strategies, maintenance rehearsal and elaborative rehearsal. Maintenance rehearsal is the process which is said to store verbal information into STM and is described as information that is being continually repeated. Elaborative rehearsal is a deeper semantic process that relates new information with existing information within LTM (Craik & Lockhart, 1972).

Craik and Lockhart's (1972) concept of their levels of processing theory (LOP) is based on an individual's attention and perceptual processes taking place when absorbing data and that the more deeply an individual processes information, the better they will remember it. Craik (2002) claimed that the LOP theory reinforced the idea of remembering as an activity of mind, processing in action as opposed to the structural ideas of memory traces as entities that must be searched for within a storage facility before being found and reactivated.

Craik and Lockhart (1972) believed that information is encoded differently within the memory system resulting in different retrieval outcomes. They argued that a word may be encoded in terms of its orthographic, phonemic or semantic features and that differently encoded representations can persist within the memory system for differing periods of time. In 1975 Craik and Tulving carried out a study which provided supporting evidence for the LOP theory as it found that those individuals who participated in the study

scored higher in their ability to recall words that had been processed more deeply (semantically) (Craik & Tulving, 1975).

This study did support the LOP theory and that the deeper the LOP the greater the affect on the retrieval ability of information stored; however the acknowledgement of the limited capacity within the memory system should also be taken into consideration along with the roles played by perceptual and rehearsal processes (Craik & Lockhart, 1972). Another important factor of the LOP theory to be considered is one that is based on the stability of the memory trace and whether it is affected by the depth of the information being processed. The depth of the process indicates the significance of processing, the more significant the extent of semantic or cognitive processing (Banyard & Grayson, 2008).

An experiment similar to the study by Craik and Tulving (1975) was conducted for the purpose of examining the evidence for Craik and Lockhart's (1972) LOP theory and to support the hypothesis that a greater amount of data can be recalled from within a persons STM when deeper levels of processing (semantic) are used compared to the use of phonological and orthographic levels of processing.

Method

Participants

In total, a group of 41 randomly selected participants were voluntarily recruited by various researchers who formed an undergraduate student seminar group, enrolled on the Swansea Metropolitan University's Psychology Joint Hons degree course. Due to the nature of the recruitment,

no data is available about the gender split or age range of all the participants. The only requirement of the study was that participants had to be over the age of 18 to take part to which a consent form was read and signed by each participant.

Materials

The study materials consisted of a Microsoft power-point presentation consisting of 11 slides. Within the presentation three individual slides listed groups of eight words that related to orthographic, phonological and semantic conditions respectively. Instruction slides preceded each of the different word sets, explaining what action was to be performed by the participant. An example of the word sets used within this experiment can be seen in the power-point presentation found in Appendix I.

A blank piece of paper and pen was also provided to each participant in order to record any data that was to be written down. A separate score sheet was retained by the researcher to calculate each participant’s scores for each of the conditions of processing.

Design

This quantitative within-participant study sought to investigate the scores obtained for an independent variable (IV) with three conditions; these being the different levels of processing, phonological, orthographic and semantic. Thus the IV was represented by the three different word sets used and the dependent variable (DV) was that of the recall scores for words from each of the word sets by the participants. All the data was analysed using a single

group repeated measures ANOVA with the level of processing as a within-subject factor.

Procedure

Participants were required to read and sign a consent form prior to participating in the study. A brief explanation of the experiment procedure was provided to each of the participants who were then asked to follow the instructions provided within the power-point presentation.

Upon start of up of the power-point presentation, slides were displayed listing instructions for the participant to follower. The first set of words to be displayed were those for the orthographic condition, which were timed to be displayed for eight seconds, following which the participant was asked to verbally state how many words were capitalised. This step was repeated for both the phonological and semantic sets of words, with verbal answers being asked for after group had been shown. After all word sets had been displayed, the participant was asked to write down their results for each group of words and total them up.

The last slide then instructed the participant to try and recall any of ALL of the words shown within the three word groups on the piece of paper provided to them. Once they had finished recalling as much as they could the recall sheets were returned to the researcher who calculated their scores for each of the different conditions by relating scores for words within each group recalled. A short debrief was then provided and the participants were thanked for their time. The results were collated by all the researchers

together to give an overall data set of 41 sets of scores for each of the conditions of the IV.

Results

As shown in Table 1, the mean scores for each level were orthographic M= 0. 95 (SD= 1. 00), phonological, M= 2. 22 (SD= 1. 37) and semantic M= 3. 39 (SD= 1. 28), indicating that participants scored higher on the semantic LOP by recalling more words in comparison to the other two LOP.

Analysis of the results was performed using a one factor repeated measures ANOVA within SPSS, with the sphericity assumption being met using Mauchly's Test of Sphericity. The main effect was found to be significant for the level of processing, F (2, 80) = 54. 24, p <. 001. A table showing the SPSS analysis of the data can be found in Appendix II.

Discussion

The results obtained in this study have shown that there is a clear difference in the depth of levels of processing used when storing information into memory. The mean scores for each of the LOP indicate that words with a semantic association are recalled easier than those with a phonological or orthographic association to them. These results support other studies on the depth of processing on recall effects in STM research (Craik & Tulving, 1975; Rose, Myerson, Roediger III, & Hale, 2010; Loaiza, McCabe, Youngblood, Rose, & Myerson, 2011) and in turn support the Levels of Processing theory as proposed by Craik and Lockhart (1972).

There are however a number of critques of the LOP theory and of Craik and Lockharts interpretations of some of their results (Eysneck, 1978; Marmureck, 1995; Nairne, 2002). One limiting factor of the theory was put froward by Craik and Lockhart themselves when they claimed that deeper levels of processing would logically take more time to execute than the shallower processes and that it was unclear whether it was the time taken to process any information or in fact the level of processing itself that was the actual cause of better recall (Craik & Lockhart, 1972). It has been argued that encoding for the shallower levels of processing can be performed quicker than at the deeper level and this can have a direct impact on immediate recall results as opposed to time-delayed recall results, with this time factor being accountable for several differences in study outcomes on the effects of LOP (Eysneck, 1978; Rose, Myerson, Roediger III, & Hale, 2010; Loaiza, McCabe, Youngblood, Rose, & Myerson, 2011).

Another criticism of earlier studies such as Craik and Tulvings 1975 experiment, have argued a lack of ecological validity with claims that visual and/or structural processing might be higher if participants had been asked to recall images other than just words, supporting the working memory model concept and its use of the visuospatial sketch pad memory buffer to cognitively process information (Baddeley & Hitch, 1974). However, in a study on the effects of LOP on emotional memory it was found that semantic processing was significantly evident in the recognition and recalling of details, both positive and negative in nature, when individuals were shown emotional images (Xu, Zhao, Zhao, & Yang, 2011).

The use of the LOP theory has proven to be useful within the academic environment, with studies showing that students opting for more semantic processing to real world applications of memory in an aid to increase their knowledge base and recall abilities (Bugg, DeLosh, & McDaniel, 2008). This in itself is a reflection of the early work of Piotr Ivanovich Zinchenko in the 1930's, whom Craik and Lockhart have recently acknowledged as the forefather of their LOP theory (Craik & Lockhart, 2008). In Zinchenko's work on memory development amongst school children, he identified the differences between involuntary and voluntary memorisation that was dependent on the use of both cognitive and mnemonic processes (Meshcheryakov, 2008).

Craik and Lockhart have demonstrated the importance of the depth of processing and that a deeper or more elaborative encoding process typically produces the best retention, however it should be acknowledged that there are exceptions and instances in which shallower processing prevails (Morris, Bransford, & Franks, 1977). Whereas the LOP theory is supported by this study, that deeper processing enhances memory encoding, it should be noted that there are other factors that may be equally important and should be considered in the event of any further studies. These include the stability of the memory trace, the very nature of different retrieval cues and the discriminability of relevant and irrelevant information to be stored (Eysneck, 1978; Nairne, 2002; Banyard & Grayson, 2008).