Do Adolescents Learn or Remember More Effectively
When Materials Are Presented VISUAL or Aurally?

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ABSTRACT

Memory is the mental faculty of retaining and recalling past experiences. Pictorial stimuli are encoded into both a visual store and an acoustic store which is believed to be superior to aurally presented words, which are encoded only into an acoustic store. The present study examined the possibility that visually presented stimuli are more easily recalled than aurally presented stimuli. More specifically that visually presented images are recalled more easily than visually presented words or aurally presented words. 58 student participants were divided into three groups; group 1 were exposed to 20 aurally presented words, group 2 were exposed to 20 visually presented images and group 3 were exposed to 20 visually presented words. The experiment examined the difference in the number of correctly recalled responses by each group and by gender. There was found to be no significant difference in the number of correctly recalled responses by each group and by gender. The present study also examined the possibility that the words located at the beginning and end of a list of words / images / sounds will be more accurately recalled than those in the middle of the sequence. There was found to be a significant difference of correctly recalled words that were located at the beginning of the list.
INTRODUCTION

'Memory is a fallible fluid. Sigmund Freud compared it to a "Wunderblock", a wax tablet overlaid with cellophane on which children practice handwriting. After writing you can lift the cellophane and erase the letters – but the wax underneath keeps traces of them all. It mixes layers of time and experience, creating a new reliability in its own right' (Debrebant, 2012).

Memory is still a terra incognita. Psychology and cognitive science have investigated memory ever since they started as scientific disciplines. They have dichotomised it along various dimensions such as; primary and secondary memory (James 1980), sensory, short-term and long-term memory (Atkinson and Shiffrin, 1968), procedural and declarative memory (Squire, 1987), implicit and explicit memory, episodic and semantic memory etc. (Tulving, 1972). All these approaches are based on the mainstream definition of memory. “The term memory implies the capacity to encode, store, and retrieve information” (Baddeley, 2006, p.514); or as Heinz von Foerster critically put it, one expects “a certain invariance of quality of that which is stored at one time and then retrieved for a later time” (Foerster, 1969, p.102).

Memory Processes

Memory refers to the processes that are used to acquire, store, retain and later retrieve information. There are three major processes involved in memory: encoding, storage and retrieval. In order to form new memories, information must be changed into a usable form, which occurs through the process known as encoding (Einstein & McDaniel, 2004). Encoding allows the perceived item of use or interest to be converted into a construct that can be stored within the brain and recalled later from short term or long term memory (Lemme,
2002). Once information has been successfully encoded, it must be stored in memory for later use. Much of this stored memory lies outside of our awareness most of the time, except when we actually need to use it. The retrieval process is a process of accessing stored memories from long term memory and allowing us to bring those stored memories into conscious awareness. Retrieval cues are a clue or prompt that is used to trigger the retrieval of long term memory (Mooers, 1950). Recall is a type of memory retrieval that allows us access to learned information without being cued (Bartlett, 1932).

**The Classic Research on Working Memory (Short-Term Memory)**

Working Memory is the brief, immediate memory for material that is currently being processed; a portion of working memory also actively coordinates a person’s ongoing mental activities. Working Memory keeps information active and accessible, so that it can be used in a wide variety of cognitive tasks (Cowan, 2003, 2005; Hassin, 2005; Pickering, 2006).

**George Miller’s “Magical Number Seven” (1956)**

George Miller wrote a widely regarded article titled “The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information” (Miller, 1956). Miller examined short-term memory tasks and found that typical subjects could hold only a limited number of items in memory at once. He suggested that people can remember about seven items (give or take two). This was true whether the subjects were holding 7 letters in memory at once, 7 numbers at once, or 7 words at once. Miller’s article proposed that people engage in internal mental processes in order to convert stimuli into a manageable number of chunks. A chunk is a memory unit that consists of several components that are strongly associated with one another (Cowan et al., 2004) and is the basic unit in short-term memory. Miller suggests therefore that short-term memory hold approximately seven chunks.
Further classic research on working memory by John Brown, Lloyd Peterson and Margaret Peterson (1958) demonstrated that material held in memory for less than one minute is frequently forgotten. The Brown/Peterson & Peterson Technique prevented rehearsal, showing that people have only limited recall for items after a brief delay.

Atkinson and Shiffrin (1968)

Atkinson and Shiffrin (1968) proposed the classic information processing model (Multi-Store Model) that focused on the role of short-term memory in learning and memory. The model proposed that memory can be understood as a sequence of discrete steps, in which information is transferred from one storage area to another. External stimuli from the environment first enter sensory memory. Sensory Memory is the initial mental storage system that records information from each of the senses with reasonable accuracy. The information is stored in either visual sensory memory (iconic memory) or auditory sensory memory (echoic memory) for two seconds or less, and then most of it is forgotten. The material that is remembered then passes from sensory memory on to short-term memory. Short-term memory (now called working memory) contains only the small amount of information that we are actively using. Atkinson and Shiffrin argued that memories in short term memory are fragile however not as fragile as those in sensory memory (Brown, 2003). These memories can be lost within about 30 seconds unless they are repeated. Only a fraction of the information in short-term memory passes in to long-term memory (Leahey, 2003). Long-term memory has an enormous capacity because it contains memories that are decades old, in addition to memories that arrived several minutes ago. And, Atkinson and Shiffrin proposed that information stored in long-term memory is relatively permanent and not likely to be lost. However, whilst Atkinson’s and Shiffrin’s multi-store model was extremely successful in terms of the amount of research it generated, as a result of this research, it became apparent
that there were a number of problems with their ideas concerning the characteristics of short-term memory.

**Baddeley and Hitch (1974)**

Building on the research by Atkinson and Shiffrin, Baddeley and Hitch (1974) developed an alternative model of short-term memory which they called working memory. Baddeley and Hitch argued that the picture of short-term memory provided by the multi-store model was far too simple. As previously mentioned, according to the Multi-Store Model, short-term memory holds limited amounts of information for short periods of time with relatively little processing. It is a unitary system meaning it is a single store without any subsystems.

Baddeley and Hitch also proposed a working-memory approach where instead of all the information going into one single store, there are different systems for different types of information. They further proposed that working memory has two separate components; the phonological loop and the visuospatial sketchpad both of which have independent capacities. The phonological loop stores information in terms of sound for a short period of time. There is no doubt when recalling lists of unrelated word individuals make heavy use of some form of phonological code. For example, individuals recall lists of long words less well than lists of short words (Baddeley, Thomson & Buchanan, 1975). Research by Conrad and Hull (1964) shows that items stored in the loop can be confused with other-similar sounding items which can affect recall, whilst other related research examined recall for words. When the words sounded different from one another, people recalled more items than when the words sounded similar (Kintsch & Buschke, 1969). In addition the phonological loop is also used
for tasks such as reading, learning vocabulary, problem solving and remembering information.

The second component of Baddeley's model of working memory is the visuospatial sketchpad, which processes both visual and spatial information. The visuospatial sketchpad allows a person to store a coherent picture of both the visual appearance of the objects and there relative positions in a scene (Cornoldi & Vecchi, 2003; Hollingsworth, 2004, 2006; Salla, Logie & Della, 2005). The visuospatial sketchpad also stores visual information that you encode from verbal stimuli (Baddeley, 2006; Pickering, 2006).

The central executive drives the whole system (e.g. the boss of working memory) and allocates data to the subsystems (phonological loop & visuospatial sketchpad). The central executive is important in such tasks as focusing attention, selecting strategies, and suppressing irrelevant information (Baddeley, 2006) however it does not store information.

*Paivio (1986)*

The Dual Coding Theory proposed by (Paivio, 1986) attempts to give equal weight to verbal and non-verbal processing. The principle of the Dual Coding Theory is that recall/ recognition is enhanced by presenting information in both visual and verbal form. This theory assumes that both visual and verbal information are processed differently and that there are two cognitive subsystems, one specialised for the representation and processing of nonverbal objects/events (i.e., imagery), and the other specialised for dealing with language. (Paivio, 1986) contends that "human cognition is unique in that it has become specialised for dealing simultaneously with language and with nonverbal objects and events. Moreover, the language system is peculiar in that it deals directly with linguistic input and output (in the
form of speech or writing) while at the same time serving a symbolic function with respect to nonverbal objects, events, and behaviours. Any representational theory must accommodate this dual functionality."

Many experiments reported by Paivio and others support the importance of imagery in cognitive operations. In one experiment, participants saw pairs of items that differed in roundness (e.g. tomato, goblet) and were asked to indicate which member of the pair was rounder. The objects were presented as words, pictures, or word-picture pairs. The response times were slowest for word-word pairs, intermediate for the picture-word pairs, and fastest for the picture-picture pairs. Paivio and Csapo (1973) and others including Bevan & Steger (1971) and Paivio et al. (1968) have found that, at least among young adults, recall of pictures is superior to recall of the names of the pictures.

**Visual Sensory Memory**

Visual sensory memory (iconic memory) preserves an image of a visual stimulus for a brief period after the stimulus has disappeared (Hollingsworth, 2006; Parks, 2004; Sperling, 1960). We understand what we have seen so quickly with so little effort, ‘we can be deceived into thinking that vision should therefore be simple to perform’ (Hildreth & Ullman, 1989) and likewise for hearing and other senses. Winer, Cottrell, Gregg, Fournier and Bica (2002) asked college students a seemingly simple question, “How does vision work?” using several variations in the task (some involved computer displays, some asked participants to draw a picture or answer a verbal question). In every variation, Winer et al. found a substantial percentage of college students exhibited “extramission,” the belief that vision involves some kind of ray or wave going out from the eyes to the object being perceived. For instance, “when adults were asked to draw whether something comes into or goes out of the eyes when
a person sees a balloon, 69% places outward-pointing arrows on their drawings” (p.419). Another 33% gave extramission responses even when asked about looking at a shining light bulb, where the correct answer should be obvious (the bulb emits light, which comes into the eyes). To the extent that this is a truly a common misunderstanding, vision is not the result of some force or ray or “thing” coming out from our eye toward the thing we’re looking at. Instead, vision is triggered when the reflection of light from an object hit our eyes. The eye sweeps across the visual field in short, jerky movements called saccades, taking in information during brief fixations. The information encoded in these fixations is stored in visual sensory memory; the term iconic memory (Neisser, 1967) is the equivalent, it is the short-duration memory system specialised for holding visual information, lasting no more than about 250ms to 500ms (Trigg & Lerner, 1981). This iconic image fades or can be erased rapidly by subsequent visual stimulation. Much more information is stored in visual sensory memory than can be reported immediately.

A typical iconic memory experiment by Sperling (1961) presented arrays of letters and digits to people for very brief durations. The task was to report what could be remembered from the display. For example, people were shown a series of trials, each with a 3x4 array of letters (three rows, four letters per row). The array was shown for 50ms and was followed by a blank post exposure field. Finally, a signal was given to report letters. Sperling found that people generally reported no more than four or five items correctly in this kind of test. When fewer than five items were shown, performance was essentially perfect; when more than five were shown, people averaged about 4.5 letters correct. For a display of 12 letters, there was 37% accuracy. Furthermore, he found that this level of accuracy remained essentially the same for exposures as long as 500ms and even as short as 5ms (Sperling, 1963). It seemed that an average of 4.5 items correct reflected a default strategy. That is
people said they could not possibly remember all 12 letters, because the display seemed to fade from view too rapidly. Their level of performance, about 4 or 5 items, was what would be expected based on the span of apprehension; the number of individual items recallable after any short display.

Similar results were obtained from a study by Averbach & Sperling (1961) that showed 18 letters in the displays. In Sperling’s words, “The explanation for these results is that the visual image of the stimulus persists for a short time after the stimulus has been turned off, and that the people can utilise this rapidly fading image. In fact, naive participants typically believe that the physical stimulus fades out slowly (p.22).” The results indicated that at least 17 of the 18 letters were available in the initial icon (an image in iconic memory often are called the icon, the visual image that resides in iconic memory).

The evidence collected by Sperling, Averbach many others led to the proposal that iconic memory was the initial step in visual information processing. The phenomenon of visual persistence is the apparent persistence of visual stimulus beyond its physical duration has convinced cognitive psychology that iconic memory existed and that it was the important first phase in visual perception (Neisser, 1967).

Santa (1977) demonstrated the functional consequence of representing information in a visual image verses representing it in a verbal image. The procedure following Santa’s experiment demonstrated that visual and verbal information is represented differently in mental images. Participants studied and initial array of objects or words and then had to decide whether a test array contained the same elements. Geometric shapes were used in the first condition and words for the shapes in the second condition. Santa’s results from this
experiment showed in the geometric condition, participants would make a positive identification more quickly when the configuration was identical than when it was linear, because the visual image of the study stimulus would preserve spatial information. In the verbal condition, participants would make a positive identification more quickly when the configuration was linear than when it was identical, because participants had encoded the words form the study array linearly, in accordance with normal reading order in English.

Research by Parkinson (1972) indicated that information may remain in a visual store for up to 20 s, an interval well beyond the short life of the icon. However, more recent evidence from a study conducted by Rayner, Inhoff, Morrison, Slowiaczek, and Bertera, (1981) examined performance during a reading task and found that we do not continuously extract information from the visual scene around us but instead extract most of the information we need within the first 50 ms of fixation. Thus, visual sensory memory is a fast-acting rapidly adapting system ideally suited for processing information in real time in a continuously dynamic world.

Auditory Sensory Memory

Auditory Sensory Memory (echoic memory) receives auditory stimuli that consist of sound waves moving the air. Sound waves are funnelled into the ear, causing tympanic membrane, or eardrum, to vibrate. This in turn causes the bones of the middle ear to move, which then sets in motion the fluid in the ear’s inner cavity. The moving fluid then moves the tiny hair cells among the basilar membrane, generating the neural message, which is sent along the auditory nerve into the cerebral cortex (Forgus & Melamed, 1976). From this arises our sense of hearing or audition.
Neisser argues "Perhaps the most fundamental fact about hearing is that sound is an intrinsically temporal event. Auditory information is always spread out in time; no single millisecond contains enough information to be very useful. If information were discarded as soon as it arrived, hearing would be all but impossible. Therefore, we must assume that some 'buffer,' some medium for temporary storage, is available in the auditory cognitive system (Neisser, 1967, pp. 199-200)." Thus function of auditory sensory memory is to encode sensory stimulation in to the memory system and hold it just long enough for the rest of the mental system to gain access to it.

Darwin, Turvey and Crowder (1972) devised a task that presented auditory stimuli briefly, in different locations and in such a way that selected parts could be cued for partial report. The "three-eared man" procedure, involved participants hearing recorded letters and digits through stereo headphones; one message containing three stimuli was played into the left ear, one message containing three stimuli was played into the right ear and the final message containing three stimuli was played into both ears, a total of nine stimuli. Each sequence lasted 1 second on the recording and all three sequences were presented simultaneously. After the auditory messages were presented, participants reported as many of the items as they could remember. Their performance averaged about four items correct. The difference in these results compared with those for visual sensory memory is the estimated amount of information originally stored in auditory memory; was not as impressive as the 75% to 90% values found for visual memory. Participants in the Darwin et al. study exceeded the level of about four items available out of the presented nine only on the third position items, those presented last in the sequence. There is also a distinct possibility that sensory traces reside in auditory memory for a longer time if they represent simpler information. In general, the 4 second duration found by Darwin et al. is longer than most
estimates, probably because of the simplicity of the stimuli they used. In contrast, the 4 second estimate is much shorter than the 10 second storage found by Eriksen and Johnson (1964), but Eriksen and Johnson’s participants merely had to detect a simple tone while performing an attention-capturing task.

**Recall of Visual and Auditory Information**

The majority of studies on short-term retention in adults have primarily concerned the information encoded to an acoustic or auditory storage system although a separate visual storage system has been postulate e.g. Neisser (1967) and Wallach & Averbach (1955). The works of Posner (1967), Posner & Keele (1967), Kroll, Bee & Gurski (1973), Parkinson & Parks (1972) and Parkinson (1972) were directed toward a study of the separate visual and acoustic storage of individual letters and has provided evidence for the existence of both types of encoding, depending on the original presentation modality. Additional evidence on the existence of separate visual and auditory short-term stores has been proved by Murrary & Newman (1973) and den Heyer and Barrett (1971) in a task requiring item position recall from visually presented matrix of numbers or label able objects.

Investigators of imagery have provided consistent results showing superior performance with pictorial stimuli in typical long-term retention tasks cf. Pavio (1971). In general, recall and recognition of picture and concrete words is consistently between than that of abstract words (Bower, 1970; Paivio have interpreted these results in terms of a dual coding hypothesis. Paivio argued that separate imaginal and verbal codes can exist for both picture and concrete words, while auditory words only have a verbal code. In addition, there is a higher probability for pictures than for concrete words being encoded in dual systems. The existence of dual codes should facilitate long term retention because of the multiple stores of item retrieval.
Other short-term retention data are also in accord with the possible dual storage of pictures as contrasted with words. Pictures consistently produce better performance in a serial position recall task involving both a temporal and spatial component (Siegel & Allik, 1973; Allik & Siegal, 1974).

Pictorial stimuli are encoded into both a visual store (as a function of their imaginal properties) and an acoustic store (as a function of their verbal labels) therefore recall is superior to aurally presented words, which are encoded only into an acoustic store (Dhawan, Pellegrino & Siegal, 1975). Thus, the existence of both a visual and acoustic encoding of the stimulus aids recall.

Primacy Recency

Some of the strongest evidence for the multi-store model comes from serial position effect studies. Experiments show that when participants are presented with a list of words, they tend to remember the first few and last few words best and are more likely to forget those in the middle of the list. This is known as the serial position effect. The tendency to recall earlier words is called the primary effect; the tendency to recall the later words is called the recency effect. Murdock (1962) asked participants to learn a list of words that varied in length from ten to thirty words and free recall them. Each word was presented for one to two seconds. He found that words presented either early in the list or at the end were more often recalled, but the ones in the middle were more often forgotten.

In the free-recall task, participants are presented with a list of unrelated items and, immediately after a cue signalling the list are you asked to recall these items in any order that they wish. A U-shaped serial position curve is typically obtained: Recall performance is
excellent for the first and last items in the list (advantages known as the primacy recency effects, respectively) and poor for the middle list of items (sometimes known as the asymptote). The traditional account of the U-shaped serial position curve is that it is composed of two separate components. According to this viewpoint Atkinson and Shiffrin (1968), the primacy effect reflects the advantage in processing (e.g. in terms of the number of rehearsals) given to the first items in the list, resulting in the selective transfer of the early items to a stable long-term memory store long term store. By contrast, the recency effect reflects the direct output of a temporary and highly accessible short-term store of limited capacity.

When participants remember primary and recent information, it is thought that they are recalling information from two separate stores (short-term memory and long-term memory). This is supported by the H.M. case study. An anonymous memory-impaired man usually referred to only by the initials H. M. has one of the most severe cases of amnesia ever observed. The H.M. case study which was unable to make new long-term memories but whose short-term memories were unaffected and which suggests there are separate LTM and STM stores (McLeod, 2008). This work refers to the U-shaped relationship between a word's position in a list and its probability of recall.

Evidence shows that the recency effect is consistent with the direct output of a fragile short-term store. For example, a period of distracter activity immediately after the end of the list and preceding recall abolishes the recency effect but does not greatly reduce performance on the earlier list items (Postman & Phillips, 1965). Furthermore, the size of the recency effect does not appear to be affected by variables known to affect long-term learning and retention, such as the age or the intelligence of the participants (Glanzer, 1972).
Attention

'Ve sometimes fail to see an object we are looking directly at, even a highly visible one, because our attention is directed elsewhere (Mack, 2003), this is the phenomenon of inattentional blindness, blindness due, in some sense, to our lack of attention to an object. In a particularly dramatic demonstration of this effect, Haines (1991) tested experienced pilots in flight simulators. A few of them proceeded to land the simulator, paying close attention to the gauges and dials on the instrument panel but failing to notice that another airplane was blocking the runway.

Attention defined as 'a concentration of mental activity' allowing our cognitive process to take in limited portions of our environment, our memory and is necessary for successful recall. In a divided-attention task, research shows that performance often suffers when people must attention to two or more simultaneous messages (Ward, 2004). For this reason the present study will look at pictures, words, and sounds all being presented individually. The study undertaken by Kirstin L. Mills and Heather K. McMullan (2009) suggested that students were significantly better at recalling pictures and words together rather than words alone. However, they concluded that recall from pictures and a word together was not significantly better than pictures alone.

Gender Differences in Recall

It is often said that males and females think in different ways. Jausovec and Jausovec (2005) investigated gender differences in resting EEG related to the level of general and emotional intelligence. It was found that male’s brain activity decreased with the level of general intelligence, whereas an opposite pattern of brain activity was observed in females. Therefore, it appears that males and females have different resting EEG correlates of IQ. In a
study conducted by Lawton and Hatcher (2005), the gender differences in manipulation of information in visuospatial short-term memory, specifically, the mental integration of two images that had been briefly presented as separate locations or at separate times was investigated. Men were more accurate than women in recognizing the combined abstract shape that would result if two individual shapes were overlapped and matched by a dot common to both. It was discovered by this study that men responded faster than women did in this type of situation (Lawton and Hatcher, 2005). And, Larabee and Crook found women perform better than men in tasks such as verbal-learning-remembering tasks, name-face association, and first-last-name associations learning (Larabee and Crook, 1993 as cited in Halpern, 2000). All three of these studies show that women and men have very different ways of thinking, therefore they will most likely have different memory and recall as well.

An article published in the Scientific American on Sex Differences in the Brain examines the effects of hormones on brain functioning that show a relationship between cognitive variations and sex. This article states that men have an advantage in tests that require the subject to imagine rotating an object or manipulating it in some other way. Women tend to be better than men at rapidly identifying matching items, a skill called perceptual speed. They have greater verbal fluency, including the ability to find words that begin with a specific letter or fulfil some other constraint (Kinmura, 1992).

Conclusion

Most studies have tried to answer the question are there visual learners and auditory learners? Do some individuals learn and remember better in one sensory modality than in the other? However the results have been far from unanimous. Some investigators have found auditory memory superior to visual (Binet, 1894; Koch, 1930; Munsterberg & Bingham,
1984). Others have found visual superior to auditory (Hawkins, 1897; Henmon, 1912, Kirkpatrick, 1894; O’Brien, 1921; Worchester, 1925; Srivastava & Purohit, 1979) Bay & Beach (1950) who reviewed the entire literature up to 1950, concluded that, in terms of a box score, visual memory is generally better than auditory. The majority of studies show that adults do better on visual than on auditory memory tasks, it appears to be the reverse is true for children (Abbot, 1909; Hawkins, 1897; McDougall, 1904). Visual sensory memory has been found to decline more rapidly with age (over 40) than auditory memory (McGhie, Chapman, & Lawson, 1965). The interaction of words and pictures has also been examined, the outcome of which is to suggest that pictures (mental or real) improve our memory of words e.g. Paivio (1971) and similarly, words seem to influence our memory of pictures (Carmichael, Hogan, & Walters, 1932). Paivio & Csapo (1973) and others (Bevan & Steger, 1971; Paivio et al., 1968) have found that, at least among young adults, recall of pictures is superior to recall of the names of the pictures. The present research was an attempt to investigate whether this statement can be supported empirically.

Aim of the Study

The foregoing sets the background to this experimental study through which it will seek to ascertain (a) if the students in the study are better recalling pictures or words or sounds when presented separately, or (b) when they are ordered in a particular fashion. As part of this study it will also be observed if (c) gender in the context of its relevance, if any, to the ability to recall from short-term memory.
Hypothesis

- *Hypothesis (a)* the sample group have a significantly higher recall for visual images compared to that of visual words and the sound of words.

- *Hypothesis (b)* those words located at the beginning and end of a list of words / images / sounds will be more accurately recalled than those in the middle of the sequence.

- *Hypothesis (c)* there will be a significant difference between males and females in terms of recall based on whether they were in the words, images, or auditory group.
METHODOLOGY

Materials
A total of 20 common line drawings were selected from an existing pool of items composed by Snodgrass & Vanderart (1980) (see Appendix A). These 20 pictures were then transcribed into words and presented in font: Calibri (Body) bold, size 130 (see Appendix B). These words were then recorded on a Boss BR/600 digital recording studio (Audio CD attached). Visual stimuli were presented using a projector onto a white screen and auditory stimuli were presented using an iPod through a Roland Cube 15 amplifier. Participants were provided with a pen and recall sheet.

Design
The research conducted was experimental using independent samples and single experiment. The primary independent variables are words, images or sounds (manipulated by groups). The secondary independent variable is sex (male or female). The dependant variables are the amount of words, images or sounds participants can recall. The second dependant variable is the position of words, images or sounds on free call.

Participants
Fifty-eight secondary school students (31 male, 27 Female) from College Dublin took part in this experiment. The subjects were between 15 and 17 years of age therefore prior consent was obtained from the principle before subjects could take part in the experiment. The subjects were randomly assigned to three groups:

- Group 1 (n = 21). Subjects were presented with 20 auditory words.
- Group 2 (n = 19). Subjects were presented with the equivalent 20 visual images.
- Group 3 (n = 18). Subjects were presented with the equivalent 20 visual words
Procedure

The subjects were tested in three groups in three separate classrooms. There were two visual tests. In the first visual test 20 images were projected onto a large white screen individually one after the other. The rate of visual presentation was automatically controlled for 6 seconds by Microsoft Power Point. In the second visual test the same 20 images were presented in written form only and projected onto a large white screen. The rate of visual presentation was automatically controlled for 6 seconds by Microsoft Power Point.

For the auditory test, the visual display was replaced by a speaker which presented the same 20 words in a normal, clear male voice. The tape recording was made to precisely the same time intervals as the visual presentation. Each word appeared in the same position across all three conditions and no word appeared more than once. Recall was prompted immediately. The subject received a signal to write his response immediately after the last words was presented. The subjects were given 2 seconds for recall.

Instructions

The task was explained to the subjects. To insure that all the subjects understood the instructions and procedure, the test proper was preceded by a practice test consisting of three words. The visual and auditory tests were identical except in the mode of presentation.

Measures

The subjects were instructed to write down in any order as many of the words as they could recall the answer sheet contained 20 spaces for the subject to write his responses. The subject’s score is the total number of words correctly recalled.
Data Analysis

An ANOVA was employed to examine possible differences in the overall correct recall of words (both visual and auditory) and images irrespective of sex as well as to examine that the words located at the beginning and end of a list of words / images / sounds were more accurately recalled than those in the middle of the sequence. An independent samples t-test was employed to investigate if there is a difference between the numbers of correctly recalled responses between males and females.
RESULTS

The purpose of this research was to investigate if adolescence learn or remember more effectively when the material is presented visual or aurally? It was hypothesised that the sample group will have a significantly higher recall for visual images compared to that of visual words and the sound of words. A one-way ANOVA was used to investigate this hypothesis and also to investigate that the words located at the beginning and end of a list of sounds / images / words will be more accurately recalled than those in the middle of the sequence. An Independent-Sample T Test was used to investigate the hypothesis that there will be a significant difference between males and females in terms of recall based on whether they were in the words, images, or auditory group. To test the present hypotheses, the Statistical Package for Social Sciences (SPSS 18) was used for the purpose of analysing data.

As outlined, a total of 58 participants comprised this study, which consisted of 31 males and 27 females. The participants were divided in terms of their class group of fourth year secondary school students.

Results for Correct recall and Total Recall

Table 1: A Summary of Descriptive Statistics for Group differences in Relation to Correct Recall and Total Recall.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Groups</th>
<th>Mean</th>
<th>SD</th>
<th>F</th>
<th>df</th>
<th>(Sig at 2-tailed) P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct x Recall</td>
<td>Words</td>
<td>11.44</td>
<td>2.74</td>
<td>.092</td>
<td>2.55</td>
<td>.912</td>
</tr>
<tr>
<td></td>
<td>Images</td>
<td>11.79</td>
<td>2.72</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sounds</td>
<td>11.67</td>
<td>1.93</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total x Recall</td>
<td>Words</td>
<td>12.17</td>
<td>2.26</td>
<td>.364</td>
<td>2.55</td>
<td>.696</td>
</tr>
<tr>
<td></td>
<td>Images</td>
<td>12.42</td>
<td>2.57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sounds</td>
<td>12.82</td>
<td>2.29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * significant at .05 level
A one-way analysis of variance showed that there was no significant difference between the three groups in terms of correct recall ($F(2, 55) = .092, p = .912$). The hypothesis that the sample group would have a significantly higher recall for visual images compared to that of visual words and the sound of words was not supported. Therefore we must accept the null hypothesis that there is no significant difference in the number of correctly recalled words, number of correctly recalled images and the number of correctly recalled sounds in the sample group.

Fig 1:

![Correct Recall of Sounds/ Images/ Words](image)

Further analysis on total recall was conducted to investigate if the results were constant with the previous findings for correct recall. Total recall refers to the total amount of words recalled by the participant regardless of errors (i.e. incorrect responses).
A one-way analysis of variance showed that that there was no significant difference between the three groups in terms of the total recall of words (F (2, 55) = .364, p = .696) (Table 1). When we examined the mean number of total recall of words for each group a trend difference can be seen between the total number of words, images and sounds recalled, more specifically there were slightly more sounds (M = 12.81, SD = 2.30) recalled than images (M = 12.42, SD = 2.57) and words (M = 12.17, SD = 2.26).

Results for Primacy Recency

Table 2: A Summary of Descriptive Statistics for Category Differences in Relation to Correct Recall.

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>F</th>
<th>df</th>
<th>(Sig at 2-tailed) P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1</td>
<td>15</td>
<td>15.93</td>
<td>3.33</td>
<td>9.305</td>
<td>3.56</td>
<td>.001</td>
</tr>
<tr>
<td>Category 2</td>
<td>15</td>
<td>11.07</td>
<td>3.65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 3</td>
<td>15</td>
<td>9.13</td>
<td>4.41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 4</td>
<td>15</td>
<td>10.13</td>
<td>3.85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>11.57</td>
<td>4.57</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * p significant at .05 level.
** p significant at .01 level.

Words were grouped into four categories based on their position before analysis. The sounds / images / words grouped as follows: words 1-5; Category 1, words 6-10; Category 2, words 11-15; Category 3 and words 16-20; Category 4. A one-way analysis of variance showed that the number of words correctly recalled differed significantly between the four categories (F (3, 56) = 9.305, p < .001) (Table 2). More specifically Tukey HSD post hoc analysis highlighted that Category 1 (M = 15.93, SD = 3.33) was recalled significantly more than Category 2 (M = 11.07, SD = 3.65, p = .005), Category 3 (M = 9.13, SD = 4.41, p = .000) and Category 4 (M = 10.13, SD = 3.85, p = .001). Therefore the hypothesis that the words located
at the beginning and end of a list of words / images / sounds will be more accurately recalled than those in the middle of the sequence can be accepted.

**Fig 2.**

![Graph showing primacy recency of correctly recalled responses](image)

**Table 3: A Summary of Multiple Comparisons for Number of Correct Recall in each Category.**

<table>
<thead>
<tr>
<th>Primacy Recency group (I)</th>
<th>Primacy Recency group (J)</th>
<th>Mean Difference (I-J)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td>2</td>
<td>4.867*</td>
<td>.005</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>6.800*</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>5.800*</td>
<td>.001</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>1</td>
<td>-4.867*</td>
<td>.005</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1.933</td>
<td>.515</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>.933</td>
<td>.909</td>
</tr>
<tr>
<td><strong>3</strong></td>
<td>1</td>
<td>-6.800*</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-1.933</td>
<td>.515</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-1.000</td>
<td>.891</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>1</td>
<td>-5.800*</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-.933</td>
<td>.909</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1.000</td>
<td>.891</td>
</tr>
</tbody>
</table>

*Note: *The mean difference is significant at the 0.05 level*
A Tukey HSD was performed. In this case the statistically significant differences exist between Category 1 (Words 1-5) and the other three categories (Table 3).

- Difference - Category 2 (words 6-10) and Category 1 (words 1-5)
- Difference - Category 3 (words 11-15) and Category 1 (words 1-5)
- Difference - Category 4 (words 16-20) and Category 1 (words 1-5)
- No difference between Category 2, Category 3 and Category 4.

**Results for Differences in Correct Recall between Males and Females**

Table 4: Summary of Descriptive Statistics for Gender Differences in Relation to Correct Recall

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>T</th>
<th>df</th>
<th>(Sig at 2-tailed) P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male x Correct Recall</td>
<td>31</td>
<td>11.55</td>
<td>2.49</td>
<td>- .298</td>
<td>56</td>
<td>.767</td>
</tr>
<tr>
<td>Female x Correct Recall</td>
<td>27</td>
<td>11.74</td>
<td>2.41</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: * significant at .05 level

It was hypothesised that there will be a significant difference between males and females in terms of recall based on whether they were in the words, images, or auditory group. An independent samples t-test found no significant difference between male and female correctly recalled responses (t (56) = - .298, p = .767).
A Univariate Analysis of Variance found no significant difference between males and females based on what form of stimuli they received (sounds, images, words) and what the number was of correctly recalled ($F(2, 52) = 1.268, p = .290$).

Table 4: Summary of Descriptive Statistics for gender of participant and correct recall

<table>
<thead>
<tr>
<th>Gender of participant</th>
<th>Group</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td>Sounds</td>
<td>11.73</td>
<td>1.95</td>
</tr>
<tr>
<td></td>
<td>Images</td>
<td>12.20</td>
<td>3.12</td>
</tr>
<tr>
<td></td>
<td>Words</td>
<td>10.70</td>
<td>2.31</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>Sounds</td>
<td>11.60</td>
<td>2.01</td>
</tr>
<tr>
<td></td>
<td>Images</td>
<td>11.33</td>
<td>2.29</td>
</tr>
<tr>
<td></td>
<td>Words</td>
<td>12.38</td>
<td>3.11</td>
</tr>
</tbody>
</table>

When the mean number of correct recall of sounds, images and words for males and females was examined a trend difference can be seen between male’s correct recall for sound, images and words and females correct recall for sounds images and words. More specifically males recalled slightly more images ($M = 12.20, SD = 3.12$) than sounds ($M = 11.73, SD = 1.95$) and words ($M = 10.70, SD 2.31$) compared to females who recalled slightly more words.
(M = 12.38, SD = 3.11) than sounds (M = 11.60, SD = 11.33) and images (M = 11.33, SD 2.29).

Fig 4.

![Correctly Recalled Responses by Males and Females](image)

It was hypothesised that there will be a significant difference between males and females in terms of recall based on whether they were in the words, images, or auditory group. The present study did not find support for this; therefore the null hypothesis must be accepted that there is no significant difference between males and females in terms of recall based on whether they were in the words, images, or auditory group.
DISCUSSION

The aim of this study was to investigate if the sample group would have a significantly higher recall for visual images compared to that of visual words and the sound of words. The study also investigated if the words located at the beginning and end of a list of words / images / sounds will be more accurately recalled than those in the middle of the sequence. Lastly, the study investigated the differences in the recall between male and female participants.

Recall

The principle question this study was devised to answer is; do adolescence's have better short-term memory in one modality than in the other? Previous research identified that, at least among young adults, recall of pictures is superior to recall of the names of the picture (Bevan & Steger, 1971; Paivia et al, 1968). However more research indicated that adults do better on visual than on auditory memory tasks, it appears to be the reverse is true for children (Abbot, 1909; Hawkins, 1897; McDougall, 1904). This study was therefore devised to investigate if there was support for previous research which suggested higher recall for visual images compared to that of visual words and the sound of words.

A one-way analysis of variance showed that there was no significant difference between the three groups in terms of correct recall ($F (2, 55) = .092, p = .912$). The hypothesis that the sample group would have a significantly higher recall for visual images compared to that of visual words and the sound of words was not supported in the aspect that images were better remembered than words or sounds in group recall and that males and females did not differ in recall for words / images / sounds.
When the mean number of correct recall of words for each group was examined, a
trend difference can be seen between the total number of words, images and sounds recalled,
more specifically there were slightly more images (M = 11.79, SD = 2.72) recalled than
sounds (M = 11.67, SD = 1.93) and words (M = 11.44, SD = 2.74). These results did not
show to differ significantly therefore it cannot be concluded that adolescence's have better
short-term memory in visual memory over auditory memory. The null hypothesis that there is
no significant difference in the number of correctly recalled words between groups must be
accepted.

The present study's findings do not support previous research (Hawkins, 1897;
Henmon, 1912, Kirkpatrick, 1894; O'Brien, 1921; Worchester, 1925; Srivastava & Purohit,
1979; Bay & Beach, 1950) that visual recall is superior to auditory recall. The present
research also does not support Paivio et al. 1968 that found, at least among young adults,
recall of pictures is superior to recall of the names of the pictures.

Furthermore it was investigated if the sample group have a significantly higher total
recall for visual images compared to that of visual words and the sound of words. An
analysis on total recall was conducted to investigate if the results were constant with the
previous findings for correct recall. Total recall refers to the total amount of words recalled
by the participant regardless of errors (e.g. incorrect responses). A one-way analysis of
variance showed that there was no significant difference between the three groups in terms of
total recall (F (2, 55) = .364, p = .696). Total recall was the total number of words/ images/
sounds that students recalled inclusive of errors. These errors included words that students
thought they were presented with, for example before each experiment the experimental
group was presented with an example task consisting of three example words/ images/ sounds
to maximise their understanding of the task. Therefore some students confused the example words/ images/ sounds with the actual twenty words/ images/ sounds to be recalled.

People learn in many different ways and no two people learn in exactly the same way. Visual learners want to see how something is done. Auditory learners prefer to hear explanations and like to talk their way through things. A person should be able to learn more effectively by understanding which learning style works best for them. A person is not just limited to one learning style however it is important that a person is part of an environment that makes the most of their learning ability.

The visual style of learning is one of the three sensory learning styles. Visual learning relates to the fundamental ways in which people take-in information. This type of learner accounts for approximately 65% of the population (Smith 2002). Visual learners are best at collecting information with their eyes, for example looking at visual images or reading text. These types of learner prefer to watch demonstrations, graphics, illustrations, charts and would often get a lot out of videotaped instruction as well. Other types of learners would ask if you could do it again, or explain it again, but visual learners will often say they want to see it. Visual learners are able to remember details and ideas in picture form typically based on what they have seen before.

Auditory learners can often follow directions very precisely after being told only once or twice what to do, this type of learn accounts for approximately 30% of the population (Smith 2002). Auditory learners are best at collecting information with their ears, this includes listening and talking and although easily distracted this type of learner learns by memorizing sound. For instance, auditory learners learn instructions by repeating them over and over again, even in silent form suggesting auditory learners show a more predominant
primacy effect. Hearing and speaking are so closely related, auditory learners often use their voice as well as their ears. Often auditory learners will often repeat what has been said back to the person which helps them process the information. Some learners of this nature concentrate better when they have music in the background block out interruption noises, or retain new information better when they talk it out.

In their experimental study, Srivastava & Purohit (1979) found short-term retention for pictures to be superior to short-term retention for words. When distractions were presented during the picture and word recall both saw decreases, but memory became even more decreased for word recall. The present study shows a slight preference for the correct recall of images over words or sounds. Taking into account also the present study was carried out among students in a classroom where distractions were inevitably in place, the participants recall for visually presented words were poorest.

However there are some problems that can occur with regard to making use of previously learned information. The retrieval process does not always work perfectly. Have you ever felt like you knew the answer to a question, but couldn't quite remember the information? This phenomenon is known as a 'tip of the tongue' experience. You might feel certain that this information is stored somewhere in your memory, but you are unable to access and retrieve it. While it may be irritating or even troubling, research has shown that these experiences are extremely common, typically occurring at least once each week for most younger individuals and two to four times per week for elderly adults (Schacter, 2001). In many cases, people can even remember details such as the first letter that the word starts with (Brown, 1991). Errors can occur when transferring and retrieving information from the long term memory if not done accurately. This problem is solved by encoding the information as efficiently as possible and if the information has been encoded effectively, this
problem is already partially solved. In addition, it is important to practice retrieving the
information. Otherwise, fading or distortion may occur.

**Primacy Recency**

Another aim of this study was to investigate if the words located at the beginning and
end of a list of words / images / sounds will be more accurately recalled than those in the
middle of the sequence.

Previous research has shown the U-shaped relationship between a word’s position in a
list and its probability of recall. The serial positioning effect shows a strong primacy effect,
with better recall for items at the beginning of the list, presumably because people rehearse
these items more frequently. The curve also demonstrates a strong recency effect, with better
recall for items at the end of the list, presumably because they are still held in short-term
memory. Short-term memory is the part of memory where items and sensory information first
enter and are temporarily held. Short-term memory lasts for about 20 to 30 seconds after
which it is lost, or begins the process to enter into long-term memory (Lemme, 2002).

A one-way analysis of variance showed that the number of words correctly recalled
differed significantly between the four categories ($F (2, 33) = 9.305, p < .001$). More
specifically it was found that the first five words / images / sounds presented at the beginning
of a list were recalled best and words / images / sounds presented in position six to ten of a
list were recalled next best.
The results of this study supported the hypothesis that the words located at the beginning and end of a list of words/images/sounds will be more accurately recalled than those in the middle of the sequence.

It was suggested by Murdock (1962) that words early in the list were put into long term memory (primacy effect) because the person has time to rehearse the word, and words from the end went into short term memory (recency effect). Words in the middle of the list had been there too long to be held in short term memory (due to displacement) and not long enough to be put into long term memory. Previously, Waugh (1960) suggested that subjects rehearse a serial list “cumulatively” – that is during presentation, subjects repeat to themselves the items from the beginning of the series up to the item being presented. This implies that earlier items are therefore more thoroughly rehearsed, and this would account for the pronounced primacy effect (i.e., superior recall of the first items as compared to the last typically found in short-term serial memory).

It was observed when correcting the participants data that nine participants attempted to recall in the order the stimulus was presented. Although participants were instructed to write down in any order as many of the words as they could recall, nine participants left gaps on their answer sheets where there should be a word but the participant could not recall it. This could be because from a young age children are taught to remember things in serial order, for example: 1, 2, 3 or A, B, C therefore throughout a child’s life this notion is embedded in their memory and becomes automatic.
**Gender Differences in Relation to Recall**

This study investigated the difference in the recall between male and female participants. It was hypothesised that there will be a significant difference between males and females in terms of recall based on whether they were in the words, images, or auditory group. An independent samples t-test found no significant difference between male and female correctly recalled responses ($t (56) = -.298, p = .767$), therefore the null hypothesis must be accepted that there is no significant difference between males and females in terms of recall based on whether they were in the words, images, or auditory group. Furthermore, a univariate analysis of variance found no significant difference between males and females based on what form of stimuli they received (sounds, images, words) and what the number was of correctly recalled ($F (2, 52) = 1.268, p = .290$).

A trend difference did show men to have a slightly higher recall for images ($M = 12.20, SD = 3.12$) than recall for sounds or words. Perhaps a larger sample size would yielded more significant results which would support previous research by Lawton and Hatcher (2005) that found men were more accurate than women in recognizing the combined abstract shape that would result if two individual shapes were overlapped and matched by a dot common to both. It was discovered by this study that men responded faster than women did in this type of situation. Furthermore, a trend difference showed females recall for words ($M = 12.38, SD = 3.11$) to be slightly higher than that of sounds or images. As previously stated, perhaps a larger sample size would yield more significant results in support of Larabee and Crook’s (1993) study that found women perform better than men in tasks such as verbal-learning-remembering tasks, name-face association, and first-last-name associations learning.
Limitations

The limitations of this study would include the sample size, which consisted of 58 participants. It is possible that a larger sample size may have yielded more significant results. Another limitation of this study was the age range of participants. A comparison between first to sixth year students would have provided a larger age range which could have resulted in a significant difference between males and females. Moreover, participants did not always participate in the same location and also subjects performed the tasks amongst fellow classmates. If the task could be carried out on participants one at a time and in the same location this would eliminate the chance for participants to cheat and their attention would be focused solely on the experiment which may have yielded more significant results.

Future Research

The current research showed evidence of a higher recall for images than words or sounds. Previous research suggests adults do better on visual than on auditory memory tasks and that it appears to be the reverse is true for children (Abbot, 1909; Hawkins, 1897; McDougall, 1904). Therefore, future research could include a more in depth look at age differences for memory recall using the same method. Further research of this nature would provide a larger sample and a possible visible change from younger students recalling sounds better to older students recalling images better. There the study could then be generalised to a population that includes all ages. If this research were to be proved true then the current findings that there is no significant difference in recall between students aged 15 and 17 would stand to be correct. Possible future findings could show this age group to be in a period of transition where students no longer have preference between aurally or visually presented stimuli.
In student text books there is a vast amount of information that must be remembered, and sometimes along with the text there will be picture to aid in understanding and remembering that information. Previous studies have found pictures (mental or real) improve our memory of words similarly as proffered by Paivio (1971); words are also suggested to influence our memory of pictures (Carmichael, Hogan, & Walters, 1932). Further research could investigate if sounds improve our memory of pictures (mental or real), because visual learners account for 65% of the population and auditory learners only account for 30% of the population more research has been conducted in regard to visual learning. Thus future research of this nature could provide students and teachers with an alternate learning techniques and strategies. Moreover, further research could include kinesthetically oriented people who account for the final 5% of learners, who want to get lots of hands-on experience so they can feel how something is done.

Implications

This study implicates that there is no preferred method of learning for school going students aged between fifteen and seventeen. The method of delivery of information to students doesn’t differ in terms of their learning experience. This research shows that students are well balanced in terms of understanding information when presented to them. A reason for this could be, they are in there fourth year of secondary school and last year were required to take state exams therefore they have had time to acquire the ability and necessary skills to encode affectively visual and aural stimuli.

Conclusion

Assuming the subjects had no primary visual or auditory defects, the only source of differences in visual and auditory memory would be in the effectiveness with which subject’s
transformed visual input into an auditory memory trace. This can be thought of as a kind of mediation process. It might well be that, young children, the mentally retarded, the senile, and certain types of brain-damaged subjects would show marked individual differences in auditory and visual memory span. A secondary school population, on the other hand by its very nature has been thoroughly, though indirectly, screened for these conditions.

One would expect a more or less uniformly high level of development of the rudimentary transformational or meditational skills involved in recall among a young, intellectual segment of the population (the present subjects were all secondary school students aged between fifteen and seventeen). The present results therefore cannot safely be generalised to the population that includes all ages, all levels of intelligence, or organic brain abnormalities. Other sensory systems could also be examined; the somatosensory system in regard to touch and proprioception, the gustatory system in regard to taste and the olfactory system in regard to smell. Finally, the question of the superiority of visual or auditory memory cannot be given a general answer that covers all conditions and types of subjects. An experimental analysis of the specific conditions that make for superiority of one or the other is needed.

Overall, the current study revealed interesting and significant findings in relation to the ‘Primacy Recency Effect’ of correct recall. It was found that the words located at the beginning and end of the list of words / images / sounds were more accurately recalled than those in the middle of the sequence. However the present study found that the sample group showed no significant difference in recall for visually or aurally presented stimuli and also found no significant difference in recall between male and female participants.
The outcomes from previous research have been far from unanimous and the findings of the current research lie inconclusively in the middle of previous findings. Although no significant differences for correct recall were found, this evidence shows all-rounded capability and consistency in terms of recall.

Do adolescence's have better short-term memory in one modality than in the other? The results from this study conclude that the answer is no. Future studies however may wish to explore this area more, embracing a larger population and examining the area in both a broader and deeper approach as recommended earlier. The current study provides a basic foundation for which such future research could be based upon.
REFERENCES


MacDougall, R. Recognition and recall. *Journal of Philosophy, Psychology, and Scientific Method, 1904, 1*, 229-233


O'Brien, A. A. Quantitative investigation of the effect of mode of presentation upon the process of learning. *American Journal of Psychology*, 1921, 32, 249-283


Parkinson, S. R. Short-term memory while shadowing: Multiple item recall of visually and aurally presented letters. *Journal of Experimental Psychology*, 1972, 92, 256-265


Worchester, D. A. Memory by visual and auditory presentation, Journal of Educational Psychology, 19225, 16, 18-27
BIBLIOGRAPHY


APPENDICES
Appendix A – Images used in research

[Car drawing]

[Earthworm drawing]
Appendix B – Words used in research

Car
Worm
Bat
Teapot
Pizza
Lighthouse
Mouse
Rocket
Toilet
Lion
Glass
Strawberry
Paper clip
Bath
Mail box
Kite
Fish
Nail
Bird
Church
Appendix C – Words used in research (CD ROM)