Abstract
This study replicated Sperling (1960) to experimentally investigate the duration and capacity of the iconic memory store. Iconic memory is a memory store that holds rapidly decaying visual impressions of a stimulus for 2-3 seconds after it has been removed. The aim of this experiment was to support the theoretical capacity of the iconic memory, which is 4-5 items, and also the rapid decay of information held in the store.

A single blind, independent measure design used an opportunity sample of 30 students from a selective entry Queensland high school aged between 13 and 17. The participants were separated into 3 groups, one of which completed the Whole Report procedure, while the other two completed the Partial Report.

All participants viewed a grid of 9 alphanumeric characters for 500ms. Following this, those participating in the Whole Report were asked to immediately recall as many of these 9 letters as possible. The two groups completing the Partial Report received an auditory cue after viewing the stimulus after a delay of either 500ms or 2 seconds.

The findings of this experiment show the rapid decay of information in the iconic memory with mean recall after 500ms (M = 2.3) almost four times higher than after two seconds (M = 0.6). The results corresponded to those of Sperling (1960).

Introduction
The cognitive approach of psychology attempts to scientifically clarify the internal mental processes responsible for memory encoding, storage and retrieval. The first widely accepted model of memory (Atkinson and Shiffrin, 1968) separated memory into three distinct stores; the sensory, short-term and long-term stores.

The sensory memory retains impressions of stimulus for short periods of time after the stimulus has been removed. This memory store is separated again into iconic and echoic memory stores, of which the echoic memory is responsible for the storage of auditory stimuli. Iconic memory is a rapidly decaying short term visual memory store that stores impressions of stimuli for approximately 500s after the offset of a display. Sperling (1960) first conducted experiments confirming the existence of the iconic memory store, initially named the visual sensory store, investigating its capacity and duration.

Sperling conducted numerous experiments in which participants were required to recall alphanumerical letters arranged in rows of either three or four, with (Partial Report) or without (Whole Report) a guiding auditory cue.
The Whole Report (WR) required participants to recall characters from a presentation with no delay from the display offset. The participants were not restricted as to which characters they recalled.

The Partial Report (PR) gave participants a cue after the viewing of the visual stimulus specifying the characters they were required to recall. This element of the experiment measured the ability of participants to selectively recall information from the iconic memory. The delay following the offset of the stimulus varied thus providing information about the duration information is held in the store.

Sperling (1963) later investigated a working link between echoic and iconic sensory memory stores. He proposed that the information remaining after the initial rapid decay in the iconic memory can be maintained for a further 30 seconds with the support of the auditory memory to internally rehearse the visual impressions. This relationship between memory stores begins to explain the complexities of memory encoding, re-coding and storage.

This experiment aims to replicate the findings of Sperling’s (1960) experiment investigating the capacity and duration of the iconic memory by altering the delay after a visual offset.

**Method**

**Design**

This experiment followed a single-blind, independent measure procedure in which participants were divided into a three groups, one completing Sperling’s Whole Report (WR) procedure, whilst the other two groups completed the Partial Report (PR). The independent measure procedure allowed for the measurement of the duration that information is retained in the iconic memory.

There were no perceived risks in the experiment as the participants were asked to recall a small number of single, alphanumerical characters under non-threatening and supervised conditions. Participants were under 18 years of age thus forming a vulnerable group necessitating the need for parental consent (Appendix A). Deception was required in the experiment to prevent awareness of the experimental aim, though a participant debriefing (Appendix F) clarified this.

The independent variable (IV) utilised in this experiment was the delay of the auditory cue for the participants after the display offset. The number of letters correctly recalled by participants in all conditions was then recorded (DV).

The letters used in the presentation were kept constant between all experimental groups, as was the duration that the stimulus was displayed for. The stimulus contained a grid with 3 letters in each row to ensure that all of the participants in the PR procedure theoretically have the capacity
to store the adequate amount of characters.

**Participants**

The 33 voluntary participants were recruited from a selective entry Australian high school and were aged between 13 and 17. This was an opportunity sample as researchers were not permitted to conduct supervised trials of the experiment outside of this environment. The participants were recruited through the distribution of information (Appendix B) and consent forms (Appendix A) throughout the school. The experiment was also conducted on a class of high school students. The sample is not representative of the general population due to the selection criterion required for entry into the high school. There is a slight male bias in the experimental sample with a 60:40 gender ratio, however this does not impact the findings of the experiment.

**Apparatus/Materials**

The experimental procedure required a laptop computer to present a PowerPoint to the participants. Appended are the participant information sheet (B), PowerPoint slide providing stimuli for participants (C), standardised instructions (D), letter recall sheets for participants (E), and the participant debriefing sheet (F).

**Procedure**

Participants with the appropriate consent forms (Appendix A) were divided into three groups in a single-blind procedure. All participants were read pre-written instructions (Appendix D). Following this, the participants were shown the PowerPoint presentation containing a grid of nine letters, none of which were repeated (Appendix C) on a projection screen for a period of 500ms (half a second).

The group completing the WR procedure were required to recall as many of the 9 letters as possible without a delay after the display offset. The second group, completing the PR procedure, viewed the presentation and received an auditory cue in the form of a tone 500ms after viewing the stimulus. Three differently pitched tones were used to correspond to the three rows of letters in the display (Appendix C). The second PR group received this cue 2 seconds (2000ms) after viewing the presentation. The participants were asked to write the letters they recalled onto a sheet of paper replicating the grid on the presentation. To conclude the experiment all participants were debriefed (Appendix F).

**Results**

The number of alphanumeric letters correctly recalled by the participants in all groups was tallied. The maximum possible recall in the WR was 9, and 3 in the PR. The findings are graphically represented in Figure 1.
Figure 1: Mean Number of Letters Recalled by Participants in both the Whole and Partial Reports with the Error Bars Representing the Standard Deviation.

Figure 1 shows the rapid decay of the alphanumeric characters stored in the iconic memory between the two PR groups, the first with a delay of 500ms (M = 2.3), and the second with a delay of 2 seconds (M = 0.6). The standard deviation is represented by the error bars. The small standard deviation in the WR data suggests the results are accurate therefore supporting Sperling’s theory that the capacity for the iconic memory is 4-5 items (M = 4.1).

These results are consistent with Sperling’s (1960) experimental results.

**Discussion**

The aim of the experiment was to replicate Sperling’s (1960) study on iconic memory and support the theoretical capacity of the store. The results of this experiment support Sperling and the findings of the original experiment. The mean recall of the PR with a delay of 500ms was higher than recall with a 2 second delay and in accordance to Sperling’s theory on the rapid deterioration of iconic memory.

Sperling’s paper on iconic memory suggested that in the WR procedure the total capacity of the iconic memory is be 4-5 items. Supporting this, the mean number of letters recalled in the WR in this experiment is 4.1.

When participants recall characters in the PR, Sperling argued that an interaction between the echoic and iconic memories allowed for the storage of a small amount of information for up to 30 seconds after a stimulus was removed. This is due to the internal auditory rehearsal of the stimuli. These findings are supported by the results of this experiment in which, after a 2 second delay between the delay offset and the cue, participants are still able recall 1-2 letters from the original stimulus. To
determine whether the letters recalled in this group of PR participants was from only the iconic memory, or a combination of both the echoic and iconic memory stores, further experimentation would be needed. Additional measures of the IV should be implemented after display offset delays of larger than 2 seconds, however less than the predicted 30 seconds that this information is available. Additional measures of the IV would also monitor the decay in the iconic memory, as well as the point at which recall plateaus, either with complete deterioration of the iconic memory or the introduction of auditory rehearsal.

This experiment was conducted under laboratory conditions, in a synthetic environment, and therefore lacks ecological validity. In saying this, the variables are well controlled and accurately manipulated and therefore can be isolated. Outside distractions can be minimised for the participants, as can a potential overload of sensory information that could interfere with the experimental stimulus. This allows for the maximum capacity and duration of the iconic memory to be accurately measured. Although the sensory memory is being examined out of context, this control over the variables ensures that the experiment yields accurate results that support Sperling’s original findings.

It was shown that the rate of rapid deterioration of the iconic memory allowed stimuli to be readily recalled after delays of 500ms following the removal of the stimulus, but not 2 seconds. The results of this experiment also strengthen Sperling’s findings on the capacity of the iconic memory. These findings support Sperling (1960) and provide further support for the theoretical capacity and duration of the iconic memory.

References
Participant’s Name (capitals): ___________ ________ ___ 
__________ Name of Project: A replication of Sperling’s (1960) study of iconic memory

1. I consent to participate in the above project, the particulars of which – including details of tests or procedures – have been explained to me.

2. I authorise the investigator or his or her assistant to use with me the tests or procedures referred to under (1) above.

3. I acknowledge that
   (a) The possible effects of the tests or procedures have been explained to me.
   (b) I have been informed that I am free to withdraw from the project at any time and to withdraw any data just supplied.
   (c) The project is for the purpose of research and/or teaching and not for treatment.
   (d) I have been informed that my anonymity is guaranteed and that the confidentiality of the information I provide will be safeguarded.

Signed: ___________________________ ______ Date: ________________
(Participant)

If participant is under the age of 18yrs Parent/Guardian to also sign: 
Signed: ___________________________ ___ ______ Date: ________________
(Parent/Guardian)

Names of Investigators (print): 

_________________________ ___________ ___________ ___________
(Signature of investigator) (Signature of Supervisor)

Appendix B

Participant Information Sheet

Project title: An Experimental Replication of Sperling’s (1960) Study of the Duration of the Iconic Memory Store.

Investigators: Names of Investigators
Supervisor: Supervisor

Area of Investigation: Iconic Memory in Cognitive Psychology

Experimental Task: To recall a small series of letters viewed for a period of time less than one second.

Type of Participants: Volunteers over 13 years of age

You are invited to participate in a study of iconic memory. The aim of this experiment is to replicate Sperling (1960). This experiment was
designed by Sperling to investigate the capacity and duration of the sensory memory store.

**Procedures to be followed:**
The participants will be randomly sorted into groups and given a sheet of to write down the selectively recalled letters from a visual stimulus that will be displayed for 50ms. Certain groups of participants will hear a cue following the viewing of the nine letters contained in the visual stimulus. This cue (in the form of a tone) will advise the participants of which letters they are to recall. The participants will be debriefed and informed of the experimental aims and predicted results at the conclusion of the experiment.

**Possible Discomforts and Risks:**
There are no perceived discomforts or risks associated with the conduct of these experiments. However, we are ethically obliged to provide you with a suitable contact person should you experience any distress. This is the Dean of Student Services, Name (P: contact number).

**Responsibilities of the Researcher:**
No personal information will be required in order to participate in this study. All data will be collected anonymously, thus cannot be linked in any way with the participant. All results will be reported as aggregate data only.

**Responsibilities of Participant:**
It is the responsibility of the participant to fully disclose information which could affect safety or the value of the research.

**Freedom of Consent**
Participation in this study is entirely voluntary. You will be free to withdraw from the experiment at any time and to withdraw your personal data and responses.

**Inquiries**
If you have any inquiries please contact the project supervisor: Contact Details:

PLEASE KEEP THIS INFORMATION SHEET
Appendix C
Appendix D
Standardised Instructions for Participants
This is an experimental replication of Sperling’s experiment on iconic memory, which is a short-term store for a visual representation of a scene.
To remind you, you are free to withdraw from this experiment at any time, and all data collected is confidential. Please do not write your name on the sheet of paper we are handing you. You will first be divided into three groups.
The projection screen at the front of the room will show a square containing nine letters, three in each row. These letters will flash on the screen for one second. The experiment will be explained at the end after you have all completed it and you can also ask more questions then.
Group one, immediately after the letters have flashed onto the screen, you will write down all of the letters that you recall. Are there any questions?
Present the PowerPoint Slideshow
Group two, half a second after the grid of letters is flashed on the screen you will hear a tone that is either low, medium or high pitched. Are you all able to clearly distinguish between the three tones or would you like them played again.
The nine letters on the screen are arranged into three rows, and the pitch of the tone will alert you as to which line of letters you are to focus on and recall. For example, the high pitch tone corresponds to the top line of
letters.
Immediately after the letters have been flashed on the screen you can write down the letters you recall from the specified row. Are there any questions?
Present the PowerPoint Slideshow
Group three, two seconds after the grid of letters is flashed on the screen you will hear a tone that is either low, medium or high pitched. Are you all able to clearly distinguish between the three tones or would you like them played again.
The nine letters on the screen are arranged into three rows, and the pitch of the tone will alert you as to which line of letters you are to focus on and recall. For example, the high pitch tone corresponds to the top line of letters.
Immediately after the letters have been flashed on the screen you can write down the letters you recall from the specified row. Are there any questions?
Present the PowerPoint Slideshow
Appendix E
Yrite down the letters you recall below in the correct order

Appendix F
Debrief (delivered verbally to participants)
Thank you for your participation in this experiment. The aim of this experiment was to investigate the duration of the iconic memory by replicating Sperling’s experiment which was done in 1960. Iconic memory is part of the sensory memory which is memory store in the brain that holds a raw, unprocessed visual impression of a scene for 2-3 seconds which is lost unless reinforced. If this information is reinforced, for example through rehearsal using the auditory memory, it progresses to your short term memory.
Are there any questions more about the experiment?
If you would like the general results of this experiment please don’t hesitate to email us. For confidentiality reasons you cannot retrieve your own, nor anyone else’s, individual results.
Appendix G

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<td>Number of Letters Recalled by Participants</td>
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