**L4/5 group 3 sprint 1 – Memory Skills**

**Short term information processing in the human brain**

**Research**

Miller's article

In his article, Miller discussed a coincidence between the limits of one-dimensional absolute judgment and the limits of short-term memory. In a one-dimensional absolute-judgment task, a person is presented with a number of stimuli that vary on one dimension (e.g., 10 different tones varying only in pitch) and responds to each stimulus with a corresponding response (learned before). Performance is nearly perfect up to five or six different stimuli but declines as the number of different stimuli is increased. The task can be described as one of information transmission: The input consists of one out of n possible stimuli, and the output consists of one out of n responses. The information contained in the input can be determined by the number of binary decisions that need to be made to arrive at the selected stimulus, and the same holds for the response. Therefore, people's maximum performance on one-dimensional absolute judgement can be characterized as an information channel capacity with approximately 2 to 3 bits of information, which corresponds to the ability to distinguish between four and eight alternatives.

The second cognitive limitation Miller discusses is memory span. Memory span refers to the longest list of items (e.g., digits, letters, words) that a person can repeat back in correct order on 50% of trials immediately after presentation. Miller observed that memory span of young adults is approximately seven items. He noticed that memory span is approximately the same for stimuli with vastly different amount of information—for instance, binary digits have 1 bit each; decimal digits have 3.32 bits each; words have about 10 bits each. Miller concluded that memory span is not limited in terms of bits but rather in terms of chunks. A chunk is the largest meaningful unit in the presented material that the person recognizes—thus, what counts as a chunk depends on the knowledge of the person being tested. For instance, a word is a single chunk for a speaker of the language but is many chunks for someone who is totally unfamiliar with the language and sees the word as a collection of phonetic segments.

The "magical number 7" and working memory capacity

Later research on short-term memory and working memory revealed that memory span is not a constant even when measured in a number of chunks. The number of chunks a human can recall immediately after presentation depends on the category of chunks used (e.g., span is around seven for digits, around six for letters, and around five for words), and even on features of the chunks within a category. Chunking is used by the brain’s short-term memory as a method for keeping groups of information accessible for easy recall. It functions and works best as labels that one is already familiar with—the incorporation of new information into a label that is already well rehearsed into one’s long-term memory. These chunks must store the information in such a way that they can be disassembled into the necessary data.[5] The storage capacity is dependent on the information being stored. For instance, span is lower for long words than it is for short words. In general, memory span for verbal contents (digits, letters, words, etc.) strongly depends on the time it takes to speak the contents aloud. Some researchers have therefore proposed that the limited capacity of short-term memory for verbal material is not a "magic number" but rather a "magic spell".[6] Baddeley used this finding to postulate that one component of his model of working memory, the phonological loop, is capable of holding around 2 seconds of sound.[7][8] However, the limit of short-term memory cannot easily be characterized as a constant "magic spell" either, because memory span depends also on other factors besides speaking duration. For instance, span depends on the lexical status of the contents (i.e., whether the contents are words known to the person or not).[9] Several other factors also affect a person's measured span, and therefore it is difficult to pin down the capacity of short-term or working memory to a number of chunks. Nonetheless, Cowan has proposed that working memory has a capacity of about four chunks in young adults (and less in children and older adults).[10]

**How does this inform our design?**

Through conducting this research, we can make some assumptions about the amount of ingredients for a recipe that our players are likely to be able to accurately recall.

* Players aged over 11 all have approximately equal short term memory capacity for chunks
* Seven items +/- 2 is the average number that can be remembered
* However, this amount for words is more like 5 on average
* Short words, are easier to remember, thus the more that can fit into a small 2 second buffer the easier it is to remember
* Given this our recipes should include only a few ingredients, and preferably ingredients that have short names. Although we will be using iconography the verbal constituent of the ingredients name should be considered.
* Familiarity with the lists improves recall function, as the recipes start to become committed to long term memory, thus as the game progresses the amount of ingredients should increase. We could do this in several ways:
  + Increase the number of times an ingredient needs to be used, for example the recipe card asks the user to make 2 x omelette (card shows, egg, milk, cheese) the player will need to double up on the number added to the mixing bowl.
  + Increase the complexity of the recipe, for example vegetable omelette (card shows egg, milk, cheese, onion, peppers)
* Even further into the game we could increase the difficulty be trying to make the player remember multiple lists to make for example a three-course meal
  + Card(s) show (Soup tomatoes, water, stock) , Omelette (egg, milk, cheese), Ice Cream (cream, milk, sugar, vanilla)
* And finally we could start to test which recipes the player has now seen often enough to have long term recall. The card could simply state make Omelette with no ingredients stated.

References

[Miller, G. A.](https://en.wikipedia.org/wiki/George_Armitage_Miller) (1956). ["The magical number seven, plus or minus two: Some limits on our capacity for processing information"](http://psychclassics.yorku.ca/Miller/). *Psychological Review*. **63** (2): 81–97. [doi](https://en.wikipedia.org/wiki/Digital_object_identifier):[10.1037/h0043158](https://doi.org/10.1037%2Fh0043158). [PMID](https://en.wikipedia.org/wiki/PubMed_Identifier) [13310704](https://www.ncbi.nlm.nih.gov/pubmed/13310704).

Baddeley, A (1992). "Working memory". Science. **255** (5044): 556–9. [*doi*](https://en.wikipedia.org/wiki/Digital_object_identifier):[*10.1126/science.1736359*](https://doi.org/10.1126%2Fscience.1736359). [*PMID*](https://en.wikipedia.org/wiki/PubMed_Identifier) [*1736359*](https://www.ncbi.nlm.nih.gov/pubmed/1736359).