

A Systemic Lens on the Multi-store Model/Modal Model

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1. Modal Model of Memory.

In 1968, Richard Atkinson and Richard Shiffrin introduced a general theoretical framework that explains human memory, this model is called the Multi-store Modal Model [1].

This model divides memory into three components:

1. Sensory register;
2. A short term store; and
3. Long term store.

Information that reaches sensory memory has been processed in short-term memory, has been drilled, and then stored in the long term. This is a useful model to understand how the mind works and how memory works.

Sensory Register: This is the place where the information enters via the five senses. Each sense has a sensory memory system, and it is the sensory register that holds the information for short-term memory.

Short Term Store (STS): The STS is also called the auditory-verbal-linguistic and it is a *working* memory where the information from the sensory register and long-term store is processed. It receives selected information from both the sensory register and long term store as depicted in Figure 1. Notably, in the short term store, the information decays completely and can be lost within 30 seconds [1]. The rehearsal process (control process) helps to maintain a limited input in this store in conjunction with the attention of the subject.

Long Term Store (LTS): In contrast, while all information can be lost from the sensory registers and short term stores, the information in the long term store is relatively permanent [1].

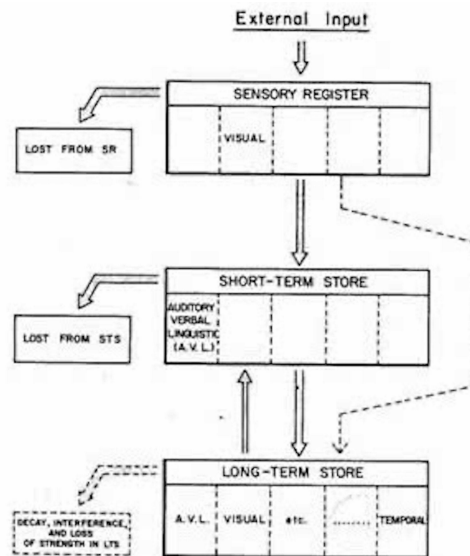


Figure 1: Structure of The Memory System.

Figure 1 illustrates that as information arrives at the sensory register, any attention in the sensory register will lead to a short term store of that information. At this stage, it is both attention and encoding that information in the short term store that will cause the memory to enter the long term memory. Of particular importance is the fact that the flow of information between and among the three components of the Modal Model is in fact, under control of the subject—the degree to which is dependent on the individual's application of attention, rehearsal, and/or the encoding process[1].

2. Pros and Cons of the Multi-store Model/Modal Model.

The Modal Model (MM) provides a generalized, simple, and clear structure of how memory works. Because of its intuitive structure and simplicity, the model has been used for more than 50 years and the original paper upon which it is based has been cited over 11,000 times¹. Evidence related to the Modal Model (MM) is predominantly found in two studies [2,3] on what is now called the *serial effect*—which is the tendency for people to remember the first and last items in a list and forget the middle items. In other words, the serial effect shows the weaknesses in the short term memory and helped to identify the cognitive processes needed to move information into the long term memory,

There are also criticisms of the MM model regarding its validity and the need for its three separate memory stores [4] such as:

- First, the MM proposes that there is a *single* Short Term Store system responsible for maintaining memory items and processing other cognitive tasks [5].
- Second, the MM posits that rehearsal is the *sole* mechanism for transferring the information to the Long Term Store. Other research shows that long-term memory depends on the level of processing of the to-be-remembered material and that ‘keeping’ information does not affect memory performance [5].

¹ Source: Google Scholar

- Third, the MM focuses on memory tasks, mostly on the short-term retention of acoustic and linguistic material—such that visio-spatial information is largely ignored [6].

Healy and Mcnamara (1996) [4] analyzed the MM, offering an associative memory model as an alternative. They provide different structures than the Modal Model such as;

- working memory,
- conceptual short-term memory,
- long-term working memory,
- short-term activation and attention,
- processing streams,
- the feature model,
- distinctiveness, and
- procedural reinstatement.

In summary, they propose that the Modal Model needs further development and specificity to be generalized, but it is useful studying and understanding *verbal* learning and memory [4].

3. Applying a Systems Lens to the Modal Model.

There are four structural patterns, acting as simple rules, that lead to the emergent property of cognition. These structural patterns, as explained by Cabrera and Cabrera [7–9] include; making distinctions, organizing systems, recognizing relationships, and taking perspectives (commonly known as ‘DSRP’). These four structural patterns act as simple rules in the Complex Adaptive System (CAS) of cognition. In other words, these patterns are compounding, nonlinear, fractal, and interactive in their collective dynamics, which yields systemic forms of thought. Table 1 lists the universal patterns of cognition and their related elements:

Patterns	Elements
Distinctions (<i>D</i>)	identity (<i>i</i>) ↔ other (<i>o</i>)
Systems (<i>S</i>)	part (<i>p</i>) ↔ whole (<i>w</i>)
Relationships (<i>R</i>)	action (<i>a</i>) ↔ reaction (<i>r</i>)
Perspectives (<i>P</i>)	point (<i>p</i>) ↔ view (<i>v</i>)

Table 1. Universal DSRP Structural patterns and their Elements.

In order to see how Systems Thinking (DSRP) applies to the Modal Model, some of the critically important relationships in the MM that were not highlighted in Figure 1 need to be explicated. Figure 2 illustrates that when attention is paid to environmental information it is registered by our senses (i.e., hearing, sight, smell, touch, and taste). This simply means that information that is not sensed is not attended to, or specifically, if one doesn’t look at something it won’t be seen, or if one doesn’t eat an apple it can’t be tasted, etc. From this point in the model, additional attention ensures that these sensory signals are stored in the sensory memory. Here we recognize visual imperfections, such that if the eyes

look but do not register some aspect of what they are looking at, or if they are drawn to another aspect of the scene, sensory memory will be affected. Here again, additional attention is required for these [fleeting] sensory memories to be converted into short-term or working memory. Yet again, further attention is needed but in the form of rehearsal or encoding (also known as cognition, thinking, structuring, or organizing information in order to make meaning of it) to ensure that these memories are converted into long-term, retrievable memories.

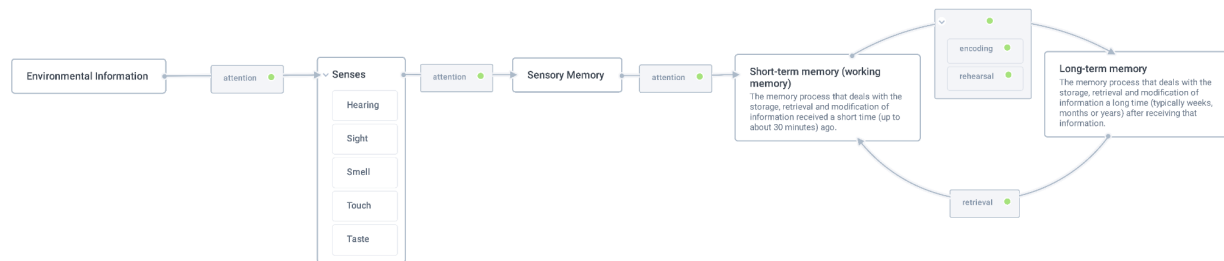


Figure 2: Expanded MM with Relational Detail.

If we now apply a Systems Thinking (DSRP) lens to this Modal Model (in Figure 3) we can see that the dynamic and actionable places in the model are its relationships (composed of attention, rehearsal and structuring or encoding). But when we apply the Systems Thinking (DSRP) lens we see that structuring with DSRP plays a critical role at each and every conversion step in the Model.

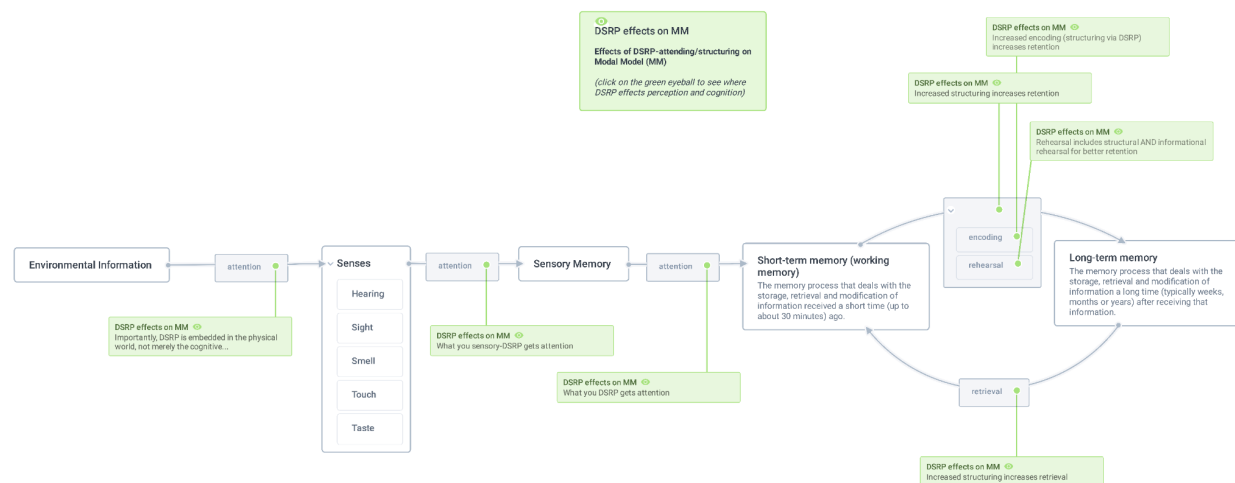


Figure 3: MM + DSRP.

We see for example (depicted in the first green box from left in Figure 3) that because distinctions, systems, relationships and perspectives are embedded in the physical world—in addition to the cognitive—the information received contains structural properties that must be reconstituted or mirrored as cognitive structure.

We see (shown in the second green box from left in Figure 3) in the attentional relationship between Senses and Sensory Memory that, what you sensorially distinguish, systematize, relate or take perspectives on garners attention. That is, for example, the distinctions you make (or are perspectively

capable or prone to making) via the taste (tongue) or sight (eyes) or auditory (ears) senses will be where attention is given.

A similar conversion event occurs (shown in the third green box from left in Figure 3) between Sensory Memory and Short-term memory. That is, what you distinguish, systematize, relate or take perspectives gets about attention. Here the transition is from the sensory (perception) to the cognitive (cognition) and this requires more complex use of the DSRP structures.

The conversion between Short-term memory and Long-term memory is based not only on attention but also on the rehearsal and/or encoding processes, as both increase structure which therefore increases retention of information. Encoding (structuring), in particular, increases retention, because *DSRP structuring is the very definition of encoding*. It is important to recognize that rehearsal itself includes both structural and informational rehearsal for better retention. And, increased DSRP structuring increases the ability to retrieve information.

Perhaps most important of all is not only recognizing that these processes are occurring, but to purposefully become more *aware* of them. This develops metacognition about our attention and how we structure information via DSRP. Systems thinking and metacognition are effective ways to alter course purposefully toward better, improved, less biased, more effective ends of any topic or problem we seek to understand.

What captures our attention persists and moves on to the next conversion stage depicted in the Modal Model of mind. What we encode or structure is based on attentional acquisition. At each and every one of the transition or conversion zones (i.e., the green zones in Figure 3), DSRP influences our attention, and the structuring and encoding processes. This means that bias is a risk in each of these conversion zones, which means bias begins long before it's recognized. Notably, metacognition (i.e., awareness of DSRP) at each of these steps can dramatically improve a subject's agency in both their perceptive and cognitive processes.

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