A Primer on Memory for Visitor Studies Professionals

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There are at least three reasons why visitor studies professionals need to have an understanding of the psychology of memory. An understanding of memory can help:

- To design more effective exhibits.
- To develop more realistic expectations of exhibit success.
- To select more appropriate measures of exhibit success.

If design teams have a better understanding of how memory works, they will be able to design and organize exhibits more effectively. Exhibits that are designed so that they follow some of the principles outlined in this paper should be recalled easier than exhibits that do not.

Expectations of what kind of and how much information visitors are able to acquire have, by and large, been unrealistic. As a consequence, the visitor literature echos with the complaint that visitors acquire very little knowledge (e.g., Peart & Kool, 1988). From the perspective of the field of memory, such conclusions are ill founded since the methods of measuring knowledge have not been appropriate to the visitor experience. It is unrealistic to expect that visitors will acquire a large number of conceptual facts, especially in an exhibit medium such as a diorama or art gallery dominated by concrete visual images. An understanding of how memory operates should dispel the expectation that a great quantity of factual/conceptual information will be recalled. It is more realistic to expect that visitors will demonstrate good visual memory of their experience, or that they will be able to describe what they did, who they were with, etc.

The third reason memory is important is that knowledge from the field of memory research should lead to more effective measures of exhibit success. For example, only rarely have researchers and evaluators used visual tests of memory. Often, the success of a visual experience such as viewing exhibit objects and/or dioramas is measured by written tests of conceptual knowledge. As described in this article, there are other possible tests of memory that should be considered when assessing exhibit effectiveness.

This article provides a brief overview of the psychology of memory. It is important to note that many of the current theories and concepts in the area of memory are controversial. Theory of memory is still young and developing.

OVERVIEW OF MEMORY

Stages of Memory

Long-term memory is considered to have three distinct stages: encoding, storage, and retrieval. Each of these stages is discussed below.

Encoding

Encoding is the input stage of memory. It involves transformation of items into a form that can be stored. Some experts believe that information can be coded in three ways: iconic (visual); echoic (auditory); and semantic (meaningfulness).

Encoding factual/conceptual information so that it can be later retrieved usually takes a considerable amount of work on the part of the participant. The amount of information presented in a museum visit may be comparable to the information typically included on an university examination. However, students spend a considerable amount of time studying for that examination compared to the brief study of comparable amounts of information by museum visitors. As we all learned as students, without effortful study, little conceptual knowledge is likely to occur. Visitors are not inclined to study museum exhibits in an effortful way.

Below is a brief description of memory concepts related to encoding:

a. *Selective attention.* Focusing attention on an event is an obvious process important to encoding. Successful exhibits should be designed such that they help focus visitor attention on important information. For example, the use of provocative questions is likely to help visitors concentrate on what is important.

b. *Rehearsal.* Rehearsing information repeatedly is a common way to improve memory, although not the most effective way.

c. *Elaboration.* This involves relating the event to be remembered to other facts. It adds information unique to the item or event to be remembered. The more facts to which the event is tied, the easier it will be to retrieve later.

d. *Organization.* A process which groups discrete, individual items into larger units based on a specific relationship among the items (based on conceptual, perceptual, functional, alphabetic, etc.). Organizing information into a meaningful framework such as a hierarchy improves memory. Likewise, placing a list of items into categories makes it easier to remember than attempting to recall the items in the order presented.

e. *Level of processing.* Information that is more deeply processed is more likely to be remembered. Increased cognitive effort is generally associated with deeper process-

ing perhaps because of elaboration or making the item to be remembered more distinctive.

f. *Imagery*. Transforming stimuli into a visual form. Memory is greatly enhanced by this activity, but it is difficult to use visual imagery unless the stimuli are concrete. Since museum exhibits almost always contain concrete objects, imagery should occur almost automatically.

The use of imagery in label text has been under-utilized. Label text can enhance mental imagery by invoking mental pictures or suggesting the visitor take on a particular role. For example, the Anniston Museum of Natural History successfully uses this technique in a label that begins: "Imagine you are the wolf ....."

Storage

The second stage involves placing information into one's memory banks. The information is stored as a representation of a particular event. The storage system can be thought of as a large organized register of past events.

Retrieval

The last stage of memory is the output stage. It involves accessing the stored information from memory. It is generally assumed in the literature that the major problem with memory is the failure to retrieve information that is stored in our memory banks. The following concepts are relevant for our purposes:

a. *Associative strength.* A retrieval cue will be effective if it has occurred frequently with the to-be-remembered event. For example, some words are commonly associated with one another (e.g., salt and pepper) and have considerable associative strength. If you are given the stimulus "salt," you automatically think "pepper."

b. *Encoding specificity*. A cue will be more easily recalled if the retrieval context is like the encoding context. If the context does not match, forgetting is likely to occur. This applies only to episodic memory or memories that are associated with time (e.g., "What did you do at the museum?")

c. *Forgetting* (retrieval failure). Most forgetting is assumed to be due to interference. Interference occurs because of a lack of retrieval cues. One of the secrets of good memory is to devise good retrieval cues to minimize interference. Interference can be either of two types:

(1) Retroactive interference: new information interferes with recall of old information.
(2) Proactive interference: old information interferes with recall of new information.

d. *Reconstruction*. Research has shown that distortions occur when individuals attempt to recollect an event. This suggests that we store fragments and reconstruct a memory from these fragments, filling in logical details that we don't remember.

Types of Memory

Textbooks on memory describe several types of memory. While there is considerable theoretical controversy over how memory is organized and what types of memory there actually are, the distinctions below seem to be widely accepted.

Declarative versus procedural knowledge. Declarative knowledge refers to knowledge of facts; procedural knowledge relates to the knowledge underlying our actions. Declarative is explicit knowledge involving concepts, events, and images. The procedural type deals with implicit knowledge of how to perform a skill. Declarative knowledge suffers from considerable interference; procedural knowledge is easier to recall.

Declarative Memory

a. *Episodic memory*. This refers to "storage and retrieval of temporally dated, spatially located, and personally experienced events or episodes." These are events that happen at a given time. It is also called "biographical memory." (Tulving & Thompson, 1973; p. 354).

b. *Flashbulb memory.* Brown & Kulik (1977) argued that emotionally-ladened experiences that produce vivid recollections may elicit a special type of memory. These researchers found that recollections of vivid memories (such as the moment people heard about the John F. Kennedy assassination) can be categorized into: place, what they were doing at the time, who told them, how they felt, and what they did after. Other researchers argue that flashbulb memories do not have any special properties distinct from other episodic memories.

c. *Semantic memory.* Defined by Tulving & Thompson, 1973 (p. 354) as "storage and utilization of knowledge about words and concepts, their properties and interrelations."

This type of memory involves general knowledge of the world. It is not tagged to time but heavily dependent upon the meaningfulness of information. And, it is usually the most difficult type of memory to retrieve and usually the one that museum exhibit researchers attempt to evaluate.

d. *Visual memory and mental imagery.* Our ability to recall visual or pictoral events appears to be very good. For example, Standing, Conezio, & Haber (1970) presented thousands of slides to subjects and later found they could easily discriminate between those presented from others that were not.

There has been some discussion among researchers about whether or not visual memory is different than other types of memory (e.g., Benjafield, 1992). Whether or not

there is a separate type of memory for visual stimuli, two conclusions can be made: we recollect visual information extremely well; and we can improve memory for concrete objects by actively forming mental images.

What is the role of imagery in facilitating memory? The distinctiveness of the image may help; in addition, the image may help to organize memory.

e. Hypermnesia. This refers to "improvements in net recall levels associated with increasing retention intervals" (Payne, 1987, p. 9). A study by Erdelyi, Finkelstein, Herrell, Miller, and Thomas (1976) provide an example. Groups of subjects who were exposed to either pictures or imagery instructions were able to recall more items from a list with successive attempts to recall. However, a group who was given only words did not recall additional items with these successive attempts. This finding suggests that the process for visual memory is somehow different than for semantic memory. The study may also provide an additional method of tapping visual memories in exhibition settings – successive attempts at recalling visual experiences.

Procedural Memory

Declarative memory (including episodic and semantic memory) focuses on factual information; procedural memory, on the other hand, relates to knowledge that does not require conscious effort once it is acquired. For example, physical skills involve how to do something such as riding a bicycle, dialing a phone number, etc.

More recently, a growing amount of evidence suggests that another memory system exists called the "perceptual representation system" (PRS). PRS involves implicit memory that occurs when information previously encoded is expressed without deliberate recollection (e.g., Schacter, 1987). (See "Implicit Measures" below).

Other Memory Concepts

Affective Arousal and Memory

We may recall best that which is associated with positive emotional arousal. Exhibits that create more excitement may be remembered more easily.

State and Locus Dependent Memory

Good memory depends upon the similarity of cues at input and at output. Because of this, the emotional state of the individual and the setting will impact on recall.

State dependent memory. The conditions under which an event is experienced provide strong cues in retrieving information. Thus, recall is better if the individual is under the same emotional state when retrieving as he/she was when encoding.

Locus dependent memory. The location in which you are exposed to information provides strong cues to retrieval. One implication for museum studies is the prediction that measuring knowledge in the exhibit area being tested may improve recall.

Schemas/Scripts

Schema (scripts). This is a long-term memory representation of some complex event like "visiting a museum." The notion is that people develop a generalized representation of experienced events in their memory and this representation is retrieved when a new experience seems to match the old script (e.g., Ashcraft, 1989).

Serial Position Effect

This refers to the common finding that it is easier to recall items at the beginning and end of a list than those in the middle. Thus, we would expect that information encountered by visitors in the middle of an exhibit would be more difficult to remember than information encountered first or last.

Memory Versus Comprehension (Learning)

"Remembering a text and learning from it are by no means equivalent. Remembering a text means that one can reproduce it in some form.... Learning from a text implies that one is able to use the information provided by the text in other ways, not just for reproduction." (Kintch, 1994; p. 294).

"Learning requires deep understanding of the subject matter, so that the information acquired can be used productively in novel environments; for mere memory, as assessed by reproduction of the text, a more shallow understanding suffices. Normally reproduction of a text and real understanding are correlated, so that text memory becomes a prerequisite for learning, although that is not necessarily so.". (p. 296)

Mannes & Kintch (1987) reported a study illustrating that a technique which improves memory may not improve comprehension. In the initial part of this study, participants studied background knowledge about microbes. They were then instructed to read a technical article on the industrial uses of microbes. Some of the background information was relevant to the article, some was not. The background information was presented in two forms:(1) same organization as text; and (2) organized in a way unrelated to the text in the technical article. Memory was better when the organization was the same for the pre-information and the technical article; but, making inferences about the information in the article was better when there was no relationship to the organization.

Knowledge and Exhibit Experiences

Knowledge from experience with exhibits is of several types:

(1) *Visual.* This type includes concrete knowledge of objects and exhibit displays including dioramas (Barnard, Loomis, &

Cross, 1980; Bitgood & Cleghorn, 1994; Lakota, 1975; McManus, 1993).
(2) *Episodic.* This includes recollections of who was with the group, when did they visit, etc. (Falk, 1988; Falk & Dierking, 1990; McManus, 1993).
(3) *Semantic.* This type is the most commonly measured; it involves factual, conceptual knowledge of the world.
(4) *Other sensory/perceptual.* Sounds, smells, touch, and temperature are among sensory experiences that may be part of museum experiences (e.g., Bitgood & Cleghorn, 1994). In addition, perceptual impressions of tension, calmness, etc. may be acquired during a visit.

THE MEASUREMENT OF MEMORY

Generally, memory can be measured by either explicit or implicit methods. Methods for each approach are described below.

Explicit Measures

With this type of measure, the individual is given instructions to recollect the experience. It involves conscious effort to remember. The following methods are generally used.

Free Recall

This measure of memory involves asking the individual to list or describe what they remember. Problems: (1) visual information may be processed by the visitor in a nonverbal way; but tested in a verbal way; (2) it is a difficult task because of the large volume of stimuli that the visitor is exposed to; and (3) it is not as sensitive as recognition.

Prompted Recall

Instead of free recall, the subject could be prompted to recall information by providing either some context or some partial information. This measure is obviously more sensitive than free recall.

Recognition

The individual is presented with stimuli such as photographs similar to original and some different from original. The task is to detect which are originals and which are different.

Major advantages: (1) recognition does not require as difficult retrieval as recall; thus, it is a more sensitive measure; and (2) recognition can include both visual (e.g., photos) and text stimuli.

Implicit Measures

Recently, memory rearchers have shown considerable excitement about implicit measures of memory. This type of measure gives the subject a task that attempts to tap memory without explicitly referring to information from a previous experience. Thus, the individual is not told to recall anything. Presumably, there is much memory that occurs without conscious awareness. Even if an individual cannot consciously recall specific information, there are ways to tap information if it is stored in memory.

Roediger (1990; p. 1045): "Implicit or indirect tests seem to tap a different form of retention than do traditional explicit tests, such as recall or recognition." Squire (1987) suggested that explicit measures tap declarative memory, while implicit measures tap procedural memory.

Word-fragment Identification

The subject is told to identify a mutilated word such as e _ _ ph _ _ _ for "elephant."

Word-stem Completion

The individual is told to produce the first word that comes to mind that completes a stem (e.g., eleph... for elephant).

Perceptual Identification

For this method, the respondent reads briefly exposed words at a fast rate; some of the words were part of material previously presented, some for the first time. The fluency of reading (time to read the word) is considered an indication of implicit memory if there is greater reading fluency for words presented previously than for unfamiliar words.

Whether or not measures of implicit memory will be fruitful to visitor researchers remains to be seen. Potentially, these measures could be a valuable way to tap memories that have been difficult to measure using traditional techniques.

Re-learning

This measure involves having an individual re-learn the same material and noting the savings in time or number of trials by comparing the difference between the first and second learning session. Ebbinghaus (1885) developed this measure to tap memories that were not accessible to awareness when individuals attempted to recollect information. Note the similarity to implicit memory.

RECOMMENDATIONS

1. *Amount of information*: Results from studies such as Barnard et al. (1980), Cota and Bitgood (1993), and Dobra (1929 suggest that the more information (visual or semantic) that the visitor is exposed to, the less retention will occur.

2. *Organization*: Since good organization facilitates recall, organize the material in a way that makes sense to visitors (be careful about codes that only make sense to scientists).

3. *Distinctiveness.* Make important information distinctive.

For example, important concepts could be written in bold text or underlined for emphasis.

4. *Make it meaningful to the visitor.* Front-end and formative evaluation results can be used to find out what is or is not meaningful.

5. *Use imagery.* When appropriate, have the visitor form images. This could be accomplished, for example, by encouraging visitors to put themselves in the place of someone in history.

6. *Use elaboration.* Give sufficient detail to link a single idea to others. But, remember that exhibits must deliver their message quickly if they are to be successful.

7. *Stimulate emotional arousal.* Exhibits that have a powerful emotional impact are most likely to be remembered. Try to create excitement, evoke sympathy, elicit surprise, etc.

8. *Use hands-on activities.* If carefully designed to promote "minds-on," hands-on activities can help focus visitor attention more effectively.

9. *Select measures appropriate to the experience.* Visual memory measures should be selected for visual experiences; semantic measures are appropriate for text content, but remember visitors will have very limited exposure to the information. It is also important to select measures that are most sensitive for detecting memory if your purpose is to show how much visitors actually learned or recalled.

10. *Select measures that are most accurate for the purposes they were selected.* Measures should accurately tap all types of knowledge (semantic, episodic, visual) if the purpose is to measure the visitor experience as a whole. Measures that sample only one type of knowledge (e.g., semantic) cannot be thought to encompass the realm of what is learned.

11. *Try novel techniques* (e.g., implicit measures, hypermnesia). Also provide better prompts to assist in retrieving information that may be stored, but lacks good retrieval cues.

12. *Use repetition of key ideas* to allow visitors to rehearse information.

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