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CHAPTER 2
Sensory Persistence and Information Persistence

Multiple Choice Questions

1. Kojima et al.'s (2014) case of "Patient X" is important because _____.
   a) it shows that some kind of sensory memory is modality-specific and independent from short-term memory
   b) it shows that some kind of sensory memory is *not* modality-specific
   c) it shows that sensory memory is equivalent and overlapping to short-term memory
   d) it shows convincingly that sensory memory depends exclusively on the peripheral sensory organs and not the brain

2. As reported by Kojima et al. (2014), "Patient X" could _____.
   a) report more than nine in a series of digits presented *verbally*
   b) not report five digits when a series is presented *visually*
   c) report more than four in a series of digits presented *verbally*
   d) not recall the syllable presented *verbally* to him just one second earlier

3. According to Kojima et al.'s (2014) study, "Patient X" _____
   a) lost the ability to retain auditory information
   b) lost the ability to read
   c) lost the ability to understand words
   d) had a profound attentional deficit

4. Sensory memory is important because it _____.
   a) complements long-term memory
   b) can be long-lasting when linked to an emotional context
   c) was recently shown to be an important source of false memories
   d) we need to be able to detect important and unpredictable stimuli when they arise; among all the information that enters our sensory systems

5. In the classic work by George Sperling (1960), subjects in the "partial report paradigm" with delays *less* than 500 ms recalled _____ compared to those in the "whole report paradigm."
   a) a lower percentage of letters in total and also as a percentage of the set of letters that was cued,
   b) the same percentage of letters,
   c) a lower percentage of letters in total, however a higher percentage of the set of letters that was cued,
   d) a higher percentage of letters in any case,

6. In the classic work by George Sperling (1960), subjects in the "partial report paradigm" with delays *larger* than 500 ms recalled _____ compared to those in the "whole report paradigm."
   a) a lower percentage of letters in total, but a higher percentage of the set of letters that was cued
   b) the same percentage of letters
   c) a lower percentage of letters in total and also as a percentage of the set of letters that was cued
   d) a higher percentage of letters in any case

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7. The main conclusion of Sperling's work is _____.
   a) a large, categorical and modality-specific memory store lasting up to 500 ms is available
   b) a large, pre-categorical and modality-specific memory store lasting up to 500 ms is available
   c) a large, pre-categorical but not modality-specific memory store lasting up to 1000 ms is available
   d) a large, categorical but not modality-specific memory store lasting up to 200 ms is available

8. Sensory register is _____.
   a) a general term referring to a very brief, very large capacity, memory store
   b) a large capacity, short duration, memory store for visual information
   c) a large capacity, short duration, memory store for auditory information
   d) a point where information from modality specific sensory memories comes together into one store

9. "Pre-categorical" refers to _____.
   a) a stimulus that has not be processed to the point of having meaning
   b) a type of memory that can fit in any known system
   c) a type of context that can affect multiple memory systems
   d) an action that can affect multiple memory systems

10. "Output interference," one of the main critiques to Sperling's model, refers to _____.
   a) the use of different channels (i.e. written words vs spoken words, pointing to numbers etc) for reporting recall (the "output") either distorts memories or allows material in short term memory to be lost
   b) the contextual expectations for reporting recall (the "output") either distorts memories or allows material in short term memory to be lost
   c) similar memories either distorts memories or allows material in short term memory to be lost
   d) the very act of reporting recall (the "output") either distorts memories or allows material in short term memory to be lost

11. Several studies have shown that identity information in the partial-report task lasts much longer that location information. This observation is important because _____.
   a) it shows that identity information can interfere with location information
   b) it conflicts with the idea by Sperling that information in iconic memory is just a fading icon, since different aspects seem to fade at different rates
   c) it supports the idea by Sperling that information in iconic memory is just a fading icon, each of which fading at different rates
   d) it shows that location information can interfere with identity information

12. Echoic memory is _____.
   a) a brief categorical auditory memory store that holds *all* incoming auditory information
   b) a brief pre-categorical auditory memory store that holds *all* incoming auditory information
   c) a brief pre-categorical auditory memory store that holds *familiar*, *repeated* incoming auditory information
   d) memory studied in a special room with a lot of echo

13. The modality effect is _____.

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a) the improved recall of the final items of a list when that list is presented verbally in comparison with a visual presentation
b) when recall is better if to-be-remembered items are followed by a suffix that is a non-speech sound than when followed by a suffix that is a speech-like sound
c) when the act of retrieval itself interferes with retrieval
d) when a stimulus has not been processed to the point of having meaning

14. A modality effect is attributed to _____.
a) echoic memory
b) episodic memory
c) iconic memory
d) generic memory

15. Crowder and Morton (1969) proposed the _____ to account for the suffix effect and the modality effect.
a) pre-categorical acoustic store model
b) modal model
c) triarchic model
d) dual-process model

16. Conrad and Hull (1968) examined recall accuracy as a function of serial position. They found what they called a _____: when participants read the items out loud during the trial they were better at remembering the last two items on the list than they were when they did not read the items out loud.
a) inverse duration effect
b) output interference
c) suffix effect
d) modality effect

17. Morton et al. (1971) explored echoic memory. In one condition they added a buzzer sound as a suffix, and in the other condition they added a _____ sound as a suffix.
a) loud bang
b) whistle
c) speech sound
d) music

18. Neath et al. (1993) demonstrated that the suffix effect could be created or eliminated with identical suffix stimuli depending on what information about the suffix the listener was told in advance. This observation is a problem for the idea of echoic memory as a pre-categorical store, because _____.
a) it contradicts data on interference
b) if a pre-categorical modality specific acoustic store was the only cognitive process being used to recall the items, then the results should have been the same in both conditions
c) echoic memory does not have sufficient capacity
d) the observed effect depends on the length of the suffix

19. The classical approach to study stimulus persistence is _____.
a) serial presentation of nonsense syllables in a very noisy environment

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b) adding suffixes to the items used
c) enhancing the effect of "output interference" by asking the subjects to use more complex ways of responding
d) the temporal integration paradigm experiments

20. The results from various studies suggest that visual stimulus persistence is very brief and is estimated to last about _____ ms in ideal conditions.
a) 10
b) 200
c) 500
d) 1000

21. Stimulus persistence has been studied for auditory stimuli. Efron (1970b) found that no matter how long the *actual* tone lasted, participants perceived the tone as at least _____ ms in duration.
a) 130
b) 500
c) 730
d) 1000

22. In Vincent Di Lollo's experiment (1980), participants were presented with 12 dots placed at random on a 5×5 matrix, which had 25 potential locations. Following an interstimulus interval, dots were placed at random in 12 of the 13 remaining locations and subjects were asked to _____.
a) indicate the location where a dot had *not* appeared
b) remember where a dot had *not* appeared in the previous iteration
c) move the dots according to a preordained pattern
d) remember where a dot had *not* appeared in any previous iteration

23. Vincent Di Lollo's experiment (1980) found that the number of errors increased as the duration of the first set of dots increased, indicating that stimulus persistence appeared to _____, as the duration of the stimulus increased.
a) decrease
b) increase in any case
c) remain the same
d) increase, but only if coloured dots were used

24. In a direct challenge to Sperling's model, Irwin and Yeomans (1986) varied the duration of the stimulus display in a partial-report paradigm experiment. They found a large effect of cue delay and _____.
a) that longer stimulus durations increased recall
b) that longer stimulus durations decreased recall
c) no effect of stimulus duration
d) that longer stimulus durations decreased recall, but only when visual contrast was low

25. Taken together, the results of Di Lollo (1980) and Irwin and Yeomans (1986) suggest that *stimulus* persistence and *information* persistence are _____.
a) two separate and dissociable phenomena
b) two separate but not dissociable phenomena

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c) different aspects of the same phenomenon
d) two separate but dissociable only when visual contrast was elevated

26. The "dorsal stream" is _____.
a) a major pathway linking the primary visual cortex in the occipital lobe with the parietal lobe
b) a major pathway linking the primary visual cortex in the occipital lobe with the temporal lobe
c) a major pathway dedicated to the identification of objects and faces
d) the pathway linking the retina to the primary visual cortex

27. The likely neural substrate of visual *stimulus* persistence is _____.
a) the dorsal stream
b) the optical pathways, from the retina to V1
c) the ventral stream
d) the frontal cortex

28. The likely neural substrate of visual *information* persistence is _____.
a) the optical pathways, from the retina to V1
b) the putamen
c) the frontal cortex
d) the dorsal stream or the ventral stream

29. Information persistence cannot be considered sensory memory because it is _____.
a) modality-independent
b) pre-categorical in nature
c) present also when the sensory systems are inactive
d) not pre-categorical in nature

30. In macaque monkeys, the anterior superior temporal sulcus (STS), which lies along the ventral stream, is active during iconic memory tasks. This is not surprising because the STS _____.
a) is associated with objection recognition
b) tracks changes
c) is linked to stimulus persistence
d) detects brightness

Short Answer Questions

1. What is the difference between iconic and echoic memory?

2. What assumptions did early cognitive psychologists make about sensory memory?

3. What were George Sperling's experiments with iconic memory (1960)?

4. What is a real-world example of a situation where decisions must be made based on visual information that appears only briefly?

5. What is echoic memory?

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6. What are the modality effect and the suffix effect in echoic memory research?

7. What are stimulus persistence and information persistence?

8. What parts of the brain are responsible for stimulus persistence?

Essay Questions

1. What occurred during the experiments by Di Lollo (1980) and Irwin and Yeoman (1986)? What were their main conclusions? Why are these conclusions important for sensory memory research?

2. What is an example of a temporal-integration paradigm experiment and what does this experiment demonstrate? You may want to include a diagram to illustrate your answer.

3. What are the relevance of dorsal and ventral streams in stimulus and information persistence? You may want to include a diagram to illustrate your answer.

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Answer Key

Multiple Choice Questions

1. **a** (p. 31)
2. **d** (p. 31)
3. **a** (p. 31)
4. **d** (p. 31)
5. **c** (p. 32)
6. **c** (p. 32)
7. **b** (p. 33)
8. **d** (p. 31)
9. **a** (p. 33)
10. **d** (p. 33)
11. **b** (p. 33)
12. **b** (p. 35)
13. **a** (p. 36)
14. **a** (p. 36)
15. **a** (p. 36)
16. **d** (p. 36)
17. **c** (p. 36)
18. **b** (p. 36)
19. **d** (p. 38)
20. **b** (p. 38)
21. **a** (p. 38)
22. **a** (p. 38)
23. **a** (pp. 38–39)
24. **c** (p. 39)
25. **a** (p. 39)
26. **a** (p. 40)
27. **b** (p. 40)
28. **d** (p. 40)
29. **d** (p. 39)
30. **a** (p. 40)

Short Answer Questions

1. Iconic memory is the sensory register thought to maintain incoming visual information. Echoic memory is the sensory register thought be responsible for incoming auditory information. (p. 31)
2. When cognitive psychology was still in its infancy, researchers proposed that the first stage of the human information processing system is *sensory memory*, which allows for all information to be *available* for processing, but only a subset to be *selected* for processing. Sensory memory was assumed to be modality specific; a given representation was thought to contain information from only one sense (sight, sound, smell, taste, or touch). Together these sensory memory stores are called *sensory registers*. The most widely studied sensory registers are *iconic memory*, the register thought to maintain incoming visual information, and *echoic memory* for incoming auditory information. (p. 31)
3. Sperling (1960) began his examination of iconic memory by asking participants to report as many letters as possible from a briefly presented display consisting of three rows of four letters. The 50 ms presentation was so brief that it appeared only as a flicker to participants. This became known as Sperling's *whole-report paradigm*. Sperling found that participants were only able to report, on average, about 4.6 out of the 12 letters in the whole-report paradigm. Sperling had two possible explanations for this effect: either participants only *saw* 4.6 letters because the presentation was so brief, or participants could only *report* 4.6 letters before their visual sensory memory faded. To test these two possible explanations, Sperling devised the *partial-report paradigm*, where participants were shown an array of several rows of items and are then presented with a cue indicating which row of items they should report. The logic was that the capacity of iconic memory could be quantified as the number of letters a person can report from a randomly chosen row multiplied by the number of possible rows. If the whole-report performance was the result of only being able to see 4.6 letters, then performance on the partial-report task should be 4.6 ÷ 3, or about 1.3 letters per trial; however, if the whole-report score was because of rapidly fading memory, partial-report scores should be higher than whole-report scores for the duration of iconic memory. Indeed, at cue delays up to about 500 ms, Sperling found a *partial-report advantage*. From his experiments, Sperling inferred that iconic memory has an unlimited capacity, but a duration of less than 500 ms. (pp. 31–32)
4. In the past, our ancestors would have had to decide how to act based on brief flashes of animals in the wild, while in present day we often have to make choices based on information flashed very briefly on a video screen. In these situations, when stimuli are seen and disappear, people must rely

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on visual sensory memory to make decisions. (p. 34)

5. *Echoic memory* is a term frequently used to describe a brief pre-categorical auditory memory store that holds *all* incoming auditory long enough for the listener to select and further process the information of value. Conceptually, echoic memory is identical to iconic memory; the only difference between them is that echoic memory holds auditory, instead of visual, information. (p. 35)
6. A *modality effect* is the improved recall of the final items of a list when that list is presented verbally in comparison with a visual presentation. A modality effect occurs when participants read the items out loud during the trial they were better at remembering the last two items on the list than they were when they did not read the items out loud. A *suffix effect* is when recall is better when to-be-remembered items are followed by a suffix that is a non-speech sound than when followed by a suffix that is a speech-like sound. A suffix effect was thought to be the result of speech-like suffixes interfering with echoic memory. (p. 36)
7. Stimulus persistence is residual neural activity that is produced by the presentation of a stimulus and fades quickly over time (or is replaced if a new stimulus is presented). Information persistence is the availability of stimulus information after the stimulus has been removed. (p. 36)
8. Stimulus persistence results from sustained activation in the visual pathway between the retina and the primary visual cortex (V1) in the occipital lobe. In the retina, rods and M and P ganglion cells may remain active after the offset of a stimulus, as may cells in V1. Stimulus persistence results from sustained activation in the visual pathway. (p. 40)

Essay Questions

1. In a classic experiment, Vincent Di Lollo (1980) presented participants with 12 dots placed at random on a 5×5 matrix, which had 25 potential locations for the dots. The dots were presented for 10, 40, 80, 120, 160, or 200 ms. Following an interstimulus interval (ISI) of 10 ms, dots were placed at random in 12 of the 13 remaining locations in the matrix. The participant's task was to indicate the location where dots had *not* appeared. Di Lollo found that the number of errors increased as the duration of the first set of dots increased. Participants reported that at durations of 100 ms or less, the two arrays appeared to be presented simultaneously; however, when the first array appeared for more than 100 ms, the first and second arrays appeared to be presented sequentially, making the task more difficult (even though in both cases the arrays were in fact presented sequentially). Di Lollo thus reported an *inverse duration effect*: stimulus persistence appeared to decrease as the duration of the stimulus increased, which explains why, at longer durations, participants experienced sequential, instead of simultaneous, arrays.

   In a related experiment, David Irwin and James Yeomans (1986) varied the duration of the stimulus display in a partial-report paradigm experiment. Participants were presented with a 3×4 array of letters for either 50, 200, or 500 ms and were cued following a delay ranging from 50 to 500 ms. Irwin and Yeomans found a large effect of cue delay but found no effect of stimulus duration; partial report was equally accurate at 50 ms as at 500 ms. If partial report was being completed because of stimulus persistence, then an inverse duration effect should have been observed; reports should have been less accurate at longer durations. The fact that no such effect was found led the researchers to conclude that participants were using another resource, which they termed *information persistence*, to perform the task.

   Taken together, the results of Di Lollo and Irwin and Yeomans suggest that stimulus persistence and information persistence are two separate and dissociable phenomena. Stimulus persistence is pre-categorical and has a duration of about 500 ms, while information persistence is categorical and has a duration up to 30 seconds. (pp. 38–39)

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2. Visual stimulus persistence has been studied in the visual modality using temporal-integration paradigm experiments (e.g., Loftus & Irwin, 1998). In these experiments, two stimuli are presented with varying interstimulus intervals (ISIs) and the participant indicates those trials where the stimuli appear distinct. Stimulus persistence is estimated by noting the longest ISI where two stimuli appear as one. The results from these studies suggest that stimulus persistence is very brief and is estimated to last about 200 ms in ideal conditions, and thus cannot be used to explain the partial-report advantage in iconic memory experiments. In their answers, students may draw Figure 2.4, which illustrates that, in a temporal-integration paradigm, two halves of a shape may be presented at varying inter-stimulus intervals. At short intervals, the stimuli appear as one; at long ISIs the stimuli appear to be distinct. Temporal integration is evidence for a brief period of stimulus persistence but its fleeting nature discounts the typical descriptions of iconic memory. (p. 38)
3. Stimulus persistence results from sustained activation in the visual pathway between the retina and the primary visual cortex (V1) in the occipital lobe. In the retina, rods and M and P ganglion cells may remain active after the offset of a stimulus, as may cells in V1.

   While stimulus persistence results from sustained activation in the visual pathway, information persistence relies on sustained activation in cortical areas that lie beyond V1. Researchers studying the brains of macaque monkeys have found the anterior superior temporal sulcus (STS), which lies along the ventral stream, to be active during iconic memory tasks. This is not surprising because the STS is associated with objection recognition. The middle occipital gyrus (MOG), which is linked to change detection, is also active during iconic memory tasks and remains active for up to 2000 ms after the onset of a stimulus. Genetic factors that influence the production of a nerve-growth factor known as brain-derived neurotrophic factor (BDNF) also influence iconic memory; mutations in genes linked to BDNF are associated with shortened and less stable informational persistence. Students may illustrate their answers with Figure 2.7. (p. 40)

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