Lecture Notes

# Chapter 4: Attention: Deploying Cognitive Resources

## Learning Objectives

* Recognize how the cognitive process of attention applies to the task of driving a car
* Explain the theories that apply to selective attention
* Analyze the possible explanations for the abilities of individuals to have divided attention
* Discuss how automaticity and practice affect cognitive processing
* Evaluate the role that mindfulness meditation plays in controlling attention
* Describe neuroscience research findings regarding attention

## Outline

**I.** Setting the Stage

**A.** It is hard to establish rigid boundaries between attention and other, related cognitive processes such as perception and working memory.

**B.** Attention refers to mental effort or concentration employed in a situation.

**1.** The study of attention is concerned primarily with cognitive resources and their limitations.

**a)** At any given time, people have only a certain amount of mental energy to devote to all of the tasks and information confronting them.

**b)** If people devote some portion of those resources to one task, less is available for others.

**c)** The more complex and unfamiliar the task, the more mental resources must be used to perform it.

**2.** People who design equipment and instruments need to know how people process large amounts of information and often consult human factors psychologists to help predict human behavior.

**II.** Selective Attention

**A.** The term **selective attention** refers to the fact that we usually focus our attention on one or a few tasks or events rather than on many.

**1.** This implies that we shut out other competing tasks.

**2.** But how much information do we process about the things to which we are *not* paying attention?

**3.** To answer this question, cognitive psychologists use **dichotic listening tasks,** in which different messages are simultaneously presented to the right and left ears via headphones, and participants are asked to repeat aloud (shadow) just one of them.

**a)** When asked to recall content presented to the unshadowed ear, participants usually cannot recall the content of the message or even the language in which it was spoken.

**b)** They can, however, recall whether the voice contained speech or noise, or whether a speaking voice was male or female, and sometimes notice something odd if the unattended message is being played backward.

**B.** Broadbent’s **filter theory** explains these findings by stating that, if the amount of information available exceeds your capacity to process it, you use an attentional filter that lets some information through and blocks the rest.

**1.** The filter is based on a physical aspect of the message—for example, the direction that the message is coming from, or its pitch or loudness.

**2.** Only material that gets past the filter can be analyzed for meaning.

**3.** Results such as the “cocktail party effect,” however, contradict this theory.

**a)** Shadowing performance is disrupted when a listener hears his or her own name in the unattended message.

**b)** Furthermore, the person sometimes notices and remembers hearing his or her name, even though it was presented in a message that was supposed to be completely blocked by the attentional filter.

**4.** Treisman’s research showed that, when participants listen to two messages and the content of the message was switched between the two ears, many participants repeated words from the unattended ear to follow the content of the message.

**5.** Other researchers have shown that participants’ attention can be “captured” by backward speech or hearing their names; this phenomenon can be particularly strong for people with lower working-memory spans.

**C.** Anne Treisman has proposed a modified filter theory called **attenuation theory.**

**1.** This theory argues that when we attend to one message, we mentally “turn down the volume” on unattended messages.

**a)** Meaningful information (such as your name) has a lower threshold for breaking into conscious awareness.

**b)** The context of a message can also temporarily lower the threshold for an expected word that is **primed** by that context.

**2.** We process information only as much as is necessary to separate the attended from the unattended message, at a physical, linguistic, or semantic level as the information requires.

**D.** Other cognitive psychologists have proposed a spotlight metaphor for attention, in which the perceiver chooses to *focus* attention much as a spotlight moves from one part of a stage to another.

**1.** Attention, like a spotlight, has fuzzy boundaries.

**2.** It can be directed at more than one object (task) at a time, depending on the size of the object (the demands of the task).

**E.** Daniel Kahneman proposed a slightly different model, in which attention is seen as a limited mental resource, like money.

**1.** As an investor can deposit money in one account or several, so a person can allocate attention to one or more tasks.

**2.** The availability of mental resources is affected by the state of *arousal* (alertness) and other factors.

**3.** We choose to allocate our attentional resources based on our enduring preferences, momentary intentions, and evaluation of capacity demands

**F.** Ulric Neisser offered a completely different idea of attention, called **schema theory.**

**1.** He argued that we do not filter or attenuate unwanted material—we just never acquire it in the first place.

**2.** Selective looking tasks, in which people fail to notice unexpected events in an unattended film, show evidence for this view.

**3.** The phenomenon known as **inattentional blindness** also shows that people sometimes do not notice a stimulus or a change in a stimulus that is right in front of them.

**III.** Divided Attention

**A.** Spelke and colleagues showed that university students can be trained to write dictated words while they simultaneously read short stories.

**1.** After 6 weeks of practice, reading rates approached normal speed and scores on reading comprehension tests were comparable to their undistracted scores.

**2.** The participants could also categorize the dictated words by meaning without sacrificing reading speed and comprehension.

**3.** How could this be accomplished?

**a)** Other research indicated that switching attention between tasks could not account for the results.

**b)** There was also no evidence that the dictation task had become automatic with practice.

**c)** The favored explanation is that the participants learned to combine the two tasks with practice.

**B.** Logan and Etherton have proposed the **attention hypothesis of automatization,** which states that attention is needed during the practice phase of a task and determines what gets learned during practice.

**IV.** Automaticity and the Effects of Practice

**A.** As we become practiced at a task, the act takes less of our attention to perform.

**B.** The **Stroop task** provides a demonstration of how a highly practiced task can become automatic.

**1.** Participants are shown bars or words printed in different colors of ink.

**2.** Participants can easily name the ink colors when presented with bars.

**3.** However, when the printed words are color names and are printed in different ink colors than the color named in the word (for example, the word “brown” printed in red ink), then people find it difficult to name the ink color without being distracted by the meaning of the word.

**C.** A task is considered to have become **automatic** when three criteria are met.

**1.** It must occur without intention.

**2.** It must occur without involving conscious awareness.

**3.** It must not interfere with other mental activity.

**4.** Schneider and Shiffrin used a *visual search* task to study automatic processing.

**a)** Participants are asked to search for one or multiple targets in a background of other stimuli that are either similar or not to the target.

**b)** In their *varied mapping* condition, the targets changed from one trial to the next, so that a J could be a target on one trial and a distractor on a later trial; this condition was expected to require concentration and effort.

**c)** In their *consistent-mapping* condition, targets were never used as distractors, and targets were always from a different category than the distractors (for example, letters on a background of numbers); this was expected to require less attentional capacity.

**d)** Schneider and Shiffrin also varied several other factors that were expected to change the cognitive demands of the task—frame size (number of items in the display), frame time, and number of targets to be searched for.

**e)** In the varied mapping condition, performance was affected by frame size, frame time, and number of targets.

**f)** However, in the consistent mapping condition, frame size and number of targets had no effect on performance, indicating that the simple processing required in this condition was *automatic* and occurred in parallel.

**g)** Schneider and Shiffrin argued that the more difficult varied mapping condition required **controlled processing,** which operates serially and hence is affected by the size of display and number of targets.

**5.** If we practice a task extensively, we may learn to use automatic processing instead of controlled processing to complete it.

**D.** Anne Treisman investigated the role that attention and automaticity play in perception, developing what is now called **feature integration theory.**

**1.** According to this theory, we perceive objects in two distinct stages.

**a)** In the first stage, which is automatic, we register features objects such as color or shape.

**b)** In the second stage, attention allows us to “glue” the features together into a unified object.

**2.** When attention is divided or overloaded, we can make errors in gluing the features together.

**a)** For example, if we see a red Honda and a blue Cadillac, we may remember seeing a red Cadillac.

**b)** This type of error is called an *Illusory conjunction.*

**E.** When a stimulus seems to “pop out” or demand our attention, we say that **attentional capture** has occurred.

**1.** Many describe this as a bottom-up process, driven by the characteristics of the stimulus.

**2.** However, with enough time, top-down processes can override intentional capture.

**V.** Controlling Attention

**A.** Mindfulness meditation is one technique used by clinicians to improve well-being, reduce anxiety, and improve the regulation of behavior.

**1.** This involves period of sitting quietly, staying focused on one’s current experience, and being aware of the moment.

**2.** Descriptions of the practice emphasize controlling mental focus—in short, controlling one’s attention.

**B.** Research suggests that the regular practice of mindfulness meditation is correlated with higher satisfaction and other positive outcomes, and lower incidence of depression, absent-mindedness, and social anxiety.

**C.** Neurologically, mindfulness is associated with activation of the prefrontal cortex and lower activity in the area of the amygdala.

**VI.** Neural Underpinnings of Attention

**A.** The parietal lobe appears to be an area that is active when a person attends to a stimulus or event.

**1.** Parietal lobe damage can lead to sensory neglect, in which patients ignore sensory information local in the visual field opposite to the damaged hemisphere.

**2.** Research has established that sensory neglect is actually attentional rather than sensory.

**B.** Areas of the frontal lobe also play a role in people’s ability to select motor responses and develop plans.

**C.** Visual attention involves several networks or systems.

**1.** The operational or enhancing-of-processing network is distributed across the frontal and parietal lobes and is used when a person has already decided where and on what to focus attention.

**2.** A separate network, also located in the frontal, parietal, and subcortical lobes, is used to control attention.

**3.** Studies of children with attention-deficit/hyperactivity disorder (ADHD) suggest that their major deficit is an inability to inhibit an ongoing response in order to sustain vigilance on a dull or repetitive task.

**D.** Studies measuring **event-related potential (ERP)** have shown that information is processed very differently in attended versus unattended channels.

**VII.** Divided Attention Outside the Laboratory: Cell Phone Usage While Driving

**A.** Studies of cell phone usage while driving represent an important application of **dual-task performance** in the real world.

**1.** Strayer and Johnston asked participants to perform a pursuit-tracking task, either by itself, while listening to a radio broadcast or while talking on a cell phone with a confederate of the experimenters.

**a)** Listening to the radio broadcast did not decrease performance on the pursuit tracking task.

**b)** Talking on a cell phone, however, slowed reaction time and increased errors.

**2.** Talking to a passenger in a car is less risky than talking on a cell phone because passengers can adjust their speaking in response to challenging road situations.

**B.** A metaanalysis examined the results of 57 different naturalistic driving studies (real drivers in their own cars) and showed that cell phones were associated with increased risk of accidents in a number of ways.

**1.** The odds of a crash or near-crash rose by 4.04 when dialing a handheld cell phone.

**2.** The odds of a crash or near-crash increased by 3.57 when locating a handheld cell phone.

**3.** The odds of a crash or near-crash increased by 10.30 for text messaging or browsing.