Eyewitness Memory

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Historical Context

Since the mid-1970s, eyewitness memory has emerged as a topic of strong interest within the field of psychology. Inspired by Loftus's classic demonstrations of the misinformation effect, researchers collected data showing that witnesses' reports are far from perfect. Their accuracy is affected by numerous factors, including "system" variables that can be controlled by police investigators (e.g., the wording of questions during interviews, lineup composition and instructions) and "estimator" variables that cannot be controlled (e.g., the witness's age and level of anxiety). The implications for the legal system are immense. Since 1989, more than 300 individuals convicted of crimes in the United States have been exonerated through DNA testing, and in approximately 75% of these cases eyewitness error was a factor, making this the single greatest contributor to wrongful convictions (Innocence Project, n.d.). As a result, researchers have endeavored to understand the cognitive mechanisms that progressively engage from the moment a legally relevant event begins to unfold to the witness's testimony before a jury. At the beginning of this progression, attentional processes will determine what, if anything, the witness later remembers about the event and the culprit.

State-of-the-Art Review

This chapter focuses on one of the estimator variables that influences the accuracy of witnesses' descriptions of a perpetrator and their ability to identify the perpetrator in a lineup: allocation of attention during the crime event. For the present purposes, attention is defined as the concentration of mental effort. Witnesses commonly attempt to divide their attention among multiple stimuli, but because attentional resources are finite, such attempts will result in fewer resources allocated to any one stimulus. For example, a convenience store customer who stumbles upon a robbery while approaching the checkout counter might not only study the robber's face in an attempt to remember it but also allocate some attention to the parking lot outside to see if help is
on the way or to her thoughts and fears regarding her safety (Lane, 2006). This division of resources will reduce the level of attention paid to the robber. Given this competition among stimuli, can the witness effectively encode forensically relevant details about the robber so that she will remember and report them later?

**Effects of Divided Attention during Encoding**

Insufficient attention allocated to a target individual can have various consequences, three of which will be discussed here. First, the witness might fail to remember the individual at all when questioned later on. Second, the witness might recall seeing the individual but not remember his or her face very well and therefore might not perform well when asked to view a lineup. Third, insufficient attention can increase suggestibility.

**Inattentional Blindness** Sometimes individuals devote little or no attention to a stimulus, with the result that they do not subsequently remember it at all. In other words, the possibility exists that someone could completely miss seeing a perpetrator commit a crime. Chabris, Weinberger, Fontaine, and Simons (2011; see also Spiegel, 2011, or chapter 9 in the current volume) described a 1995 case in which a Boston police officer, Kenneth Conley, was convicted of perjury and obstruction of justice after he testified that he did not notice two other officers savagely beating a suspect even though he ran right past the attack while chasing a different suspect. The beating victim eventually turned out to be an African American undercover officer, and Conley, who is White, was accused of lying to protect his colleagues.

Chabris et al. thought Conley could have experienced inattentional blindness, defined as an observer’s failure to notice fully visible stimuli when he or she is engaged in an attentionally demanding task (Most, Scholl, Clifford, & Simons, 2005). Previous research had demonstrated that this phenomenon can occur while observers view complex scenes. In one well-publicized study, Simons and Chabris (1999) asked participants to watch a video of two teams of players, one wearing white shirts and the other black shirts, passing basketballs to other members of their team while moving around a small open area. The participants were randomly assigned to watch either the white or the black team and to perform either a relatively easy task (counting the passes made by their assigned team) or a difficult one (keeping separate counts of the aerial and bounce passes made by their assigned team). In one version of the video, a confederate in a gorilla suit walked directly among the group of players, passing through the participants’ region of attentional focus and remaining visible for 5 seconds. Remarkably, a substantial proportion of participants said they did not see the gorilla. Inattentional blindness was more likely when the task was harder; 54% of the participants performing the difficult task noticed the gorilla versus 62.5% performing the easy task. Additionally, a greater proportion of participants counting the black team’s passes reported
seeing the gorilla (70.5%) compared to those watching the white team (46%). Given
that both the gorilla and the black team’s shirts were dark in color, this last result indi-
cates that unexpected stimuli that share visual features with attended stimuli are more
often detected.

Following up on this experiment, Simons and Chabris (1999) tested the limits of
the inattentional blindness effect by creating an additional video in which the gorilla
was more salient. This time, she was visible for 9 seconds instead of 5 seconds, and she
paused in the center of the room to face the camera and thump her chest. A new group
of participants watched this video while performing the easy counting task and watch-
ing the white team. Even under these conditions, which should have led to relatively
high rates of detection, only 50% of the participants noticed the gorilla.

In a naturalistic study of inattentional blindness, Hyman, Boss, Wise, McKenzie,
and Caggiano (2010) observed that individuals walking through a plaza on a university
campus were less likely to notice a clown wearing brightly colored clothing and riding a
unicycle if they were conversing on a cell phone rather than listening to a music player
or simply walking. The authors proposed that having a cell-phone conversation (but
not listening to music or walking) is sufficiently demanding so as to divert attention
away from other stimuli, even ones that should be quite salient (research involving
attention and cell-phone use will be discussed in more detail in a following section).

Drawing upon findings like these, Chabris et al. (2011) tested their hypothesis that
Officer Conley might have experienced inattentional blindness by attempting to simu-
late the events that occurred that night in 1995. They asked participants to pursue a
confederate who jogged along a 400-meter route through a university campus while
counting the number of times he touched his head (apparently to mimic the mental
effort Conley might have expended while considering how to catch and overpower
his suspect). The participants ran past three other confederates who staged a loud fight
8 meters from the route. After completing the route, the participants were asked first
whether they had seen anything unusual and then whether they had seen a fight.
When tested at night and with the fight visible for approximately 15 seconds, only
35% of the participants noticed. Chabris et al. repeated the procedure during the day-
time and with the fight visible for a longer duration (approximately 30 seconds), but
even then only 56% said they saw the fight. An additional experiment showed that
increasing the task difficulty by requiring participants to count head touches the run-
ner made with his left and right hands separately reduced the proportion who noticed
the fight (42%) whereas eliminating the counting task increased it (72%). The authors
concluded that, although only Officer Conley knows whether he saw the assault on the
undercover officer, it is at least possible that he did not notice it. Conley was initially
sentenced to 34 months of incarceration but successfully appealed.

In sum, the existing research shows that witnesses can completely fail to notice a
person committing a crime if their attention is directed elsewhere, especially if they are
performing a mentally demanding task or if the visual appearance of the perpetrator is inconsistent with the characteristics of the stimuli to which they are already attending. In such circumstances, the witnesses would not be helpful to detectives who need a physical description of the perpetrator or a lineup identification.

Divided Attention and Memory for Faces Although police investigators may be interested in various forensically relevant details, such as a perpetrator's height, body type, and clothing color, it is obviously advantageous if witnesses can recognize his or her face. Divided attention during encoding can impair this ability, which could make witnesses unable to identify the perpetrator in a lineup, or, even worse, they may identify an innocent suspect.

Reinitz, Morrissey, and Demb (1994) asked participants to view faces either while counting stimuli that appeared concurrently or while performing no additional task. Compared to controls, participants whose attention was divided between studying the faces and the counting task were less able to recognize the faces they had seen. They were also less likely than controls to say they “remembered” these faces (i.e., that they explicitly recollected seeing them previously as opposed to merely feeling that they were familiar).

Interestingly, dividing attention while encoding faces seems to have different effects depending on the gender of the witness and the target. Palmer, Brewer, and Horry (2013) pointed out that previous research has shown that female but not male viewers attend more to own-gender faces and subsequently recognize those faces better. One reason for these findings could be developmental. As adults, both men and women may preferentially attend to own-gender faces, but women have a longer personal history of doing so, given that all infants tend to interact more with female adults and therefore spend more time attending to female faces. Thus, men’s attentional preference for male faces is “undermined by an early history of selective attention for female faces” (p. 363). Another possible explanation is that women are more interested than men in initiating and maintaining social interactions with others of their own gender.

Based on this prior research, Palmer et al. (2013) predicted that dividing attention during encoding would impair female witnesses’ recognition of female faces more than it would impair their recognition of male faces. Moreover, the authors expected the attention manipulation to influence male witnesses’ recognition of male and female faces equally. The witnesses watched a video depicting target individuals engaged in various everyday activities. In the divided-attention condition, the witnesses pressed keys to respond to auditory tones varying in pitch. In the full-attention condition, they could hear the tones but were not required to make any responses to them. After watching the video, the witnesses viewed two lineups (each of which was either target-present or target-absent in different conditions), one for a male target from the video and one for a female target.
As predicted, divided attention reduced female witnesses' lineup performance with regard to the female target but had no significant effect on their performance regarding the male target. Unexpectedly, male witnesses performed equally well when trying to identify the female target, regardless of attention condition, but divided attention decreased their performance with respect to the male target. This pattern of results with male witnesses conflicts with some other findings (Palmer et al., 2013), so more work in this area is clearly needed.

**Divided Attention and Suggestibility**  

*Eyewitness suggestibility* refers to witnesses' tendency to report details consistent with misleading suggestions made to them after they observed a target event. For example, Schooler, Gerhard, and Loftus (1986) showed witnesses a slide sequence of a traffic accident. The critical slide showed a car at an intersection. Half of the witnesses saw a yield sign in this slide, and half saw the same slide with the sign removed. Next, witnesses completed a written questionnaire that included 17 items about the event. Witnesses who did not view the sign read a question that suggested its presence ("Did another car pass the red Datsun while it was stopped at the yield sign?") whereas those who did view the sign answered a different, nonmisleading question. Finally, all witnesses completed a final memory test asking whether they remembered several objects from the event depicted in the slides. Of the witnesses who did not see the sign, 25% reported that they did. Further research indicated that several variables (e.g., the amount of elapsed time between the event and exposure to the misleading information) influence the likelihood that witnesses will claim to remember suggested details or objects.

As Lane (2006) noted, after years of study researchers eventually concluded that errors due to misleading suggestions are probably source misattributions such that witnesses mistakenly ascribe information derived from a postevent source to the target event. Source monitoring is a demanding process in which individuals examine a memory to see whether it contains characteristics typical of perceived events, such as perceptual and contextual details, or characteristics more associated with imagined events, such as information related to the cognitive processes involved. Top-down processes may also be engaged—for example, to evaluate plausibility. As an illustration, consider a witness in Schooler et al.'s experiment who saw no yield sign. During the final memory test, when asked whether there was a yield sign, this witness might remember something about a yield sign and try to determine where he encountered this information. Inspecting his memory, he might realize that perceptual details such as the exact height of the sign are sparse, as are contextual details like its precise location on the street corner. Moreover, he remembers some cognitive operations that arose in response to encountering information about the sign; for example, he thought to himself that it made sense for a yield sign to be placed at the intersection to slow down traffic moving in the same direction as the Datsun. Although it would
not be implausible or inconsistent with other known information for a yield sign to be present, the witness might conclude that, given his overall review of his memory, the source of the sign must have been the questionnaire, not the target event.

Because source monitoring is effortful, Lane (2006) hypothesized that dividing witnesses’ attention during encoding of the target event would reduce the ability to perform this task effectively. His participants watched a slide sequence of a maintenance man stealing from an office. The divided-attention witnesses completed a secondary task simultaneously, whereas the full-attention witnesses completed that task later, so that they had nothing else to do while watching the slides. Next, the witnesses answered a questionnaire that suggested the presence of six nonexistent objects. As the final step, they listened to a list of 25 objects and indicated for each whether they saw it in the slides and whether they read about it in the postevent questionnaire. Note that witnesses could report encountering an object in both sources or neither. Compared to full-attention witnesses, those in the divided-attention condition were less likely to make correct source attributions for suggested objects as well as for objects that actually appeared in the slides.

Some Reasons for Division of Attention during Encoding
Divided attention can occur because, while in the presence of a target individual, witnesses simultaneously try to attend to one or more other tasks or stimuli. As a result, details associated with the perpetrator may not be encoded well, and the witnesses may be unable to provide very accurate or complete descriptions later on. This section will review three tasks that can elicit attention from witnesses: encoding information about a weapon held by a perpetrator, trying to comprehend accented speech, and judging the veracity of an individual.

Weapon Focus If witnesses allocate a large amount of attention to a weapon brandished by a perpetrator, then they are probably not paying a high level of attention to forensically relevant details associated with the perpetrator’s identity. The weapon-focus effect is that witnesses tend to direct their attention toward a weapon held by a perpetrator, which causes them to remember the perpetrator’s physical features and clothing less accurately than they would have without the weapon’s presence. Numerous studies have demonstrated the effect with many types of weapons and using not only slide sequences and videos but also live, staged events (for a review, see Fawcett, Russell, Peace, & Christie, 2013). Moreover, meta-analyses show reliable effects for both identification accuracy and the accuracy of witnesses’ descriptions of the perpetrator although the size of the former is smaller (Fawcett et al., 2013).

In one of the first experimental investigations of weapon focus (Loftus, Loftus, & Messo, 1987), participants viewed a slide sequence depicting customers moving
through the order line at a fast-food restaurant. On four critical slides a target individual held either a handgun or a personal check. He extended the object toward the cashier, who gave him some cash. Compared to the witnesses who saw the check, those in the weapon condition were less likely to identify the target in a photo lineup (in two experiments), and they provided poorer descriptions of him (in one experiment). An important aspect of this study is that the authors collected evidence using an eye-tracking device that the witnesses directed considerable visual attention toward the gun. Eye fixations on the gun were more frequent and lasted longer than fixations on the check, suggesting that there was a trade-off between the gun and the target in the weapon condition such that paying more attention to one meant paying less attention to the other (see also Biggs, Brockmole, & Witt, 2013).

Researchers have not yet settled the question of why weapons at crime scenes attract attention. One possibility, which was originally founded on Easterbrook's (1959) cue-utilization hypothesis, is that the weapon elevates witnesses' anxiety as they recognize it as a threatening object that could be used to injure or kill them or someone else. In turn, this increased anxiety enhances the effects of competition among stimuli, as Mather and Sutherland (2011) have shown; specifically, high-priority stimuli that are already receiving a relatively large amount of resources will attract even more attention while attention to low-priority stimuli will be further diminished. Although priority is determined partly by bottom-up cues, such as perceptual contrast, it is also influenced by top-down variables, such as the viewer's goals. Assuming that witnesses would define a weapon as informative and important to the goal of self-preservation, anxiety should amplify their tendency to attend to the weapon at the expense of low-priority stimuli, such as the perpetrator's articles of clothing, that are less relevant to the goal. Some data from weapon-focus investigations (e.g., Davies, Smith, & Blincoe, 2008) support this anxiety/threat explanation. It is important to note, however, that not all witnesses to crimes, including ones involving weapons, feel intense fear while observing the event (Pickel, 2007).

An alternative explanation for the weapon-focus effect is that weapons might attract attention because they seem unusual in many environments, and observers tend to look longer and more often at unusual rather than expected objects as they attempt to reconcile the presence of the incongruous items with the scene context (Gordon, 2004). Thus, for example, our convenience store customer would know from past experience that such establishments usually contain a cash register, packages of candy on shelves, and soda machines, and therefore she would expect to see these objects. She would not, however, expect to see a 9-mm pistol in someone's hands. Upon entering through the front door, she would acquire a gist for the visual scene that greeted her and begin identifying objects within 100 ms (Gordon, 2004). If a gun were present, she would recognize its inconsistency with the convenience store schema and begin attending preferentially to it. She might feel fear, but that would not be necessary to
elicit the weapon-focus effect. Several studies (e.g., Hope & Wright, 2007; Mitchell, Livosky, & Mather, 1998; Pickel, 1999, 2009) provide evidence in favor of the unusualness hypothesis.

Anxiety/threat and unusualness may both contribute to the weapon-focus effect, as suggested by Fawcett et al.’s (2013) meta-analysis. The two explanations are not incompatible, and either may be sufficient to produce the effect. In any case, it is clear that a visible weapon attracts witnesses’ attention so that they subsequently remember the perpetrator less accurately.

**Comprehending Accented Speech** Another situation in which divided attention during encoding may impair memory for the perpetrator is when witnesses must try to understand a message spoken with an accent. Perpetrators sometimes talk to victims or bystander witnesses, giving them instructions or asking questions, or witnesses might overhear a perpetrator conversing with an accomplice. In such cases, comprehending this communication might be important for survival. Moreover, through travel or immigration, witnesses might interact with a perpetrator who speaks with what they perceive as a foreign accent. Previous research (e.g., Munro & Derwing, 1995) indicates that listeners have to work harder to understand accented versus unaccented messages. Accented speech includes deviations from native speaker pronunciation norms, so listeners may have trouble identifying some of the speaker’s phonetic segments or words. Noting these results, Josh Staller and I (Pickel & Staller, 2012) predicted that trying to comprehend accented rather than unaccented messages would interfere with witnesses’ ability to encode information about a perpetrator simultaneously. Specifically, we thought that witnesses’ attempts to split their attention between two demanding tasks (semantically processing the message and encoding the perpetrator’s appearance) would lead to worse performance on the forensically relevant, latter task.

We first used a secondary visual task to verify that processing an accented message is in fact more effortful than processing unaccented speech. Next, we conducted two experiments in which participants watched a video of a target individual delivering a brief message and subsequently tried to remember information about him. For example, in the first of these experiments, witnesses were asked to imagine that they were driving a car and had stopped for a red light when a carjacker jumped in and started giving orders. Like actual victims would, they were asked to attend to his message in order to avoid getting hurt. In one condition, the carjacker spoke with the same Midwestern U.S. accent that our witnesses did (which they would perceive as no accent), and in another condition he spoke with an Irish accent. Witnesses who heard the Irish accent described the carjacker less accurately than those who heard the Midwestern accent, and they also were less likely to identify his voice in a voice lineup. Furthermore, listening to a more complex message containing a greater number of details,
which should require more effort to understand than a simpler message, caused witnesses to report less correct information about the perpetrator.

**Judging Veracity** Another task that witnesses could try to perform while observing a suspect or perpetrator is judging his or her veracity. For instance, a store manager might evaluate the truthfulness of a customer who denies being a shoplifter's accomplice. The manager might let the customer go, only to realize her involvement later, at which point he would want to be able to describe her for police.

Determining whether someone is lying requires substantial attentional resources (e.g., Reinhard & Sporer, 2008). To detect lies, people monitor and evaluate cues they believe indicate deception, including nonverbal behaviors (e.g., gaze aversion, fidgeting), and cues within the content of the target's message (e.g., logical inconsistency). Notice that these deception cues are not forensically relevant details, like height and hair color, that police investigators usually hope to obtain from witnesses. Teresa Kulig, Heather Bauer, and I (Pickel, Kulig, & Bauer, 2013) hypothesized that, because judging veracity is demanding, performing this task should interfere with concurrent attempts to encode details associated with a suspect, making witnesses' subsequent reports less accurate than they would otherwise be.

Our participants watched a video of a suspect delivering a brief message. Beforehand, we asked the witnesses either to decide whether the suspect was lying or simply to observe. After watching, the witnesses completed a questionnaire asking them to provide details about the suspect's appearance and to recall his or her message as completely as possible. As expected, witnesses who judged veracity remembered the suspect's appearance and message less accurately than those who simply observed him or her. Additionally, inducing witnesses to be suspicious about the suspect's truthfulness amplified the memory effect, apparently by prompting witnesses to allocate even more resources to the judgment task as they scrutinized the suspect closely.

In follow-up research (Pickel, Klauser, & Bauer, 2014), Brittney Klauser, Heather Bauer, and I found that, like inducing suspicion, motivating witnesses to try hard to judge veracity accurately intensified the memory impairment effect. Motivation encourages witnesses to work harder to monitor cues associated with deception (Reinhard & Sporer, 2008), with the consequence that the judgment task consumes a greater amount of attentional resources.

We also discovered another intriguing result. As explained above, judging veracity leads witnesses to scrutinize the suspect. In actuality, they inspect cues they believe signal deception (e.g., gaze aversion), but we conjectured that the experience of carefully studying the suspect would cause witnesses to develop the false sense that they had elaboratively encoded forensically relevant details about him or her (e.g., hair color, height). In turn, we thought this belief would increase their self-reported levels
of certainty about the accuracy of their memory and would also inflate their ratings of other "testimony-relevant judgments" (Wells & Bradfield, 1998) about the quality of their witnessing experience and their performance. The results supported our hypothesis. Although judging veracity impaired their memory of the suspect, the witnesses who performed this task ironically expressed greater certainty than controls in their physical descriptions (in one of two experiments) and in their ability to remember the suspect's message, and they reported having a better view of the suspect and paying more attention to his or her face. Also, in one experiment witnesses who judged the suspect's veracity said they had a clearer image of him in their memory compared to controls. These inflated ratings are important because jurors' verdicts are greatly affected by witnesses' expressions of certainty.

Within the context of this chapter, the major finding from this line of research is that judging a suspect's veracity and attempting to encode information about him or her are both tasks that require a high level of attentional resources. As a result, successfully performing them concurrently may be problematic for witnesses.

Integration

In order to encode details about a crime event and its perpetrator that will be valuable to police investigators, witnesses must complete two steps. First, they must notice the perpetrator and begin allocating attention to him or her. Second, they must encode sufficient information related to the perpetrator even though there may be pressure to perform another task at the same time. Two theoretical frameworks, each addressing one of these encoding steps, are briefly outlined below. The frameworks may be useful in illuminating the mechanisms underlying each and in guiding future research. Other theoretical accounts may also be applicable, but these two will be helpful illustrations of the general attentional processes that may unfold during encoding.

Allocating Attention
The first step for witnesses is to notice the perpetrator in the act of committing a crime. As described above in the section on inattentional blindness, it is possible for witnesses to fail to notice even an unexpected and dramatic event, particularly if they are already engaged in an attentionally demanding task. How do different factors interact to determine whether witnesses will notice the perpetrator and begin attending to him or her?

Most et al. (2005) attempted to answer this question by building on Neisser's (1976) concept of the "perceptual cycle," in which individuals perceive, interpret, and re-interpret information using both bottom-up and top-down processes. The basic idea is that certain stimulus properties can elicit an orienting response, at which point expectations and schemas can guide attentional exploration. As additional information is
detected, it adjusts observers' interpretations of the stimuli that may be present and helps direct further exploration. As Most et al. explained, "This cycle of attentional guidance continuously enriches the emerging representations and modifies the observer's expectations, eventually leading to a conscious percept" (p. 224). The entire process happens rapidly.

Using data from experiments in which participants viewed shapes or human faces on computer displays, Most et al. (2005) refined Neisser's conceptualization. They proposed that individuals engaged in an effortful task might automatically shift their attention to an object because of its salience. This capture of attention will probably be transient and will not lead to conscious perception unless supplementary sustained processing occurs. According to the authors, sustained attentional processing depends upon attentional set, or the observers' predisposition to receive specific types of information. Specifically, if the properties of a newly encountered stimulus match those of the target stimuli to which observers are already attending, sustained attentional processing is more likely to follow the transient attentional shift to the new stimulus. Thus, a greater proportion of Simons and Chabris's (1999) participants reported seeing the dark-colored gorilla if they had been counting the passes made by the black rather than the white team.

Because observers cannot constantly and perfectly maintain an attentional set, Most et al. (2005) allowed that there could be points in time when a salient stimulus would be especially likely to be noticed, even if its properties are dissimilar to those of the target stimuli. Moreover, attentional sets can be voluntarily changed. For example, a convenience store customer waiting her turn in the checkout line might have been calculating the amount of money needed to pay for her purchases before noticing a man shouting at the clerk to empty the register, but then she could adopt a different goal that involved attending to the robber.

Multiple Resource Theory

After witnesses have become aware of a perpetrator, they nevertheless might not devote their full attention to him or her because of some concurrent task that also demands attention. What happens as witnesses try to multitask? Research on this issue reveals that, when participants attempt to complete two tasks at once, performance on at least one often suffers, although several variables can moderate this effect. Many recent studies of multitasking focus on cell-phone use while driving (see chapter 18 in the current volume). In some, driving performance is evaluated by behavioral responses such as reaction time to a traffic signal. More relevant to the present discussion are measures involving participants' ability to encode and remember objects encountered while driving.

Strayer and Drews (2007) asked participants to drive in a simulator that realistically recreates real-world driving environments. Their simulator was constructed using the
dashboard instrumentation, steering wheel, and foot pedals from a Ford Crown Victoria sedan with an automatic transmission. It has three high-resolution displays that afford a 180° field of view, and it includes software that allows participants to navigate through various lifelike scenarios under assorted traffic conditions. An eye tracker monitors participants’ eye fixations.

In a series of experiments, the authors compared participants’ performance in a dual-task condition (driving while conversing with a confederate using a hands-free phone) with their performance in a single-task condition (just driving). In the first experiment, participants completed a surprise recognition test for objects in the environment after they finished driving a simulated route. Dual-task participants were much less likely than single-task participants to recognize road signs upon which they had fixated, even when controlling for the duration of the fixation. Experiment 2 showed that participants’ ratings of the relevance of various objects (e.g., pedestrians, billboards) to safe driving were not correlated with recognition memory, implying that drivers do not strategically reallocate attention from less relevant objects to the phone conversation while maintaining high attention to very relevant objects. Finally, in the third experiment, participants followed a pace car that braked randomly on a simulated freeway. The authors measured the amplitude of the P300 component of the event-related potential corresponding to the onset of the pace car’s brake lights. The P300 indicates the amount of attention allocated to a stimulus. The P300 amplitude was 50% smaller in the dual-task versus the single-task condition, suggesting that “drivers using a cell phone fail to see information in the driving scene because they do not encode it as well as they do when they are not distracted by the cell-phone conversation” (Strayer & Drews, 2007, p. 130).

Studies like these serve as the foundation for theoretical accounts of dual-task performance. One successful model is multiple resource theory (MRT; Wickens, 2002, 2008). According to MRT, mental resources are limited and allocatable. Every task requires some amount of resources to support it, and difficult tasks require more than easier ones. Further, resources are organized into distinct dimensions with different levels, and some dimensions are nested inside others. For example, the “stages of processing” dimension contains the perceptual and the cognitive levels. Inside the perceptual level is the “modalities” dimension containing the visual and auditory levels. Each level represents a sort of compartment of resources that are reserved for certain kinds of tasks. Thus, a visual task would draw resources from the visual level within the modalities dimension but would not draw from the auditory level. However, a very difficult visual task might deplete its modality-specific resources and require general perceptual resources that exist within the perceptual compartment but that are not specifically assigned to either modalities level.

In sum, two tasks can be performed simultaneously if there are enough available resources to support both. Success is obviously more likely if the tasks are dissimilar
(i.e., they pull resources from different rather than the same levels along a particular dimension). However, task difficulty matters as well. As explained above, two dissimilar tasks can still compete for common resources, as when very challenging tasks deplete their respective level-specific resources and require supplementation from a larger common pool. Thus, whether the tasks involve different levels or not, it may be impossible to perform them together if they are sufficiently taxing. In this case, the task prioritized by the individual may be completed satisfactorily while performance on the secondary task falters. Of course, it is also possible that the individual will make errors on both tasks.

The experiences of eyewitnesses can be conceptualized using MRT. For instance, consider a driver who is stopped at a red light when a carjacker jumps into the front seat of her car. If someone had asked her on the previous day whether witnesses should try to remember a carjacker's appearance so that they can later help police find and arrest him, she would have agreed. Thus, studying the robber is one of her goals. However, it is not her only goal. The carjacker begins giving instructions, demanding that she drive him to a certain location using a particular route. To avoid injury, she must listen to his directions carefully so she can follow them without error. In this way, comprehending the carjacker's message becomes the driver's primary task, and encoding the robber's physical appearance is relegated to secondary status. Although these two tasks involve different modalities (i.e., the primary task is auditory and the secondary is visual), they may each be effortful enough to compete for common perceptual resources. In addition, the primary task's difficulty will increase if the carjacker speaks with an accent or if his message includes a high level of detail (Pickel & Staller, 2012). Performance on at least one of the tasks must suffer, and because processing the message is prioritized, encoding the carjacker's appearance is more likely to be impaired. Specifically, prioritizing the message may render the witness less able to encode the carjacker's features and clothing elaboratively; she may not notice as many physical details, engage in semantic-level processing, or connect newly acquired information to other details in the environment and to knowledge in her long-term memory.

MRT predicts that, like interpreting an accented message, executing any primary task (e.g., judging the perpetrator's veracity, attending to a weapon) while trying to encode a perpetrator's appearance can impair the encoding task. A pair of tasks may be similar or heterogeneous, but they will nevertheless end up competing for the same general resources if they are both challenging enough.

The discussion thus far assumes that encoding the perpetrator's appearance is always the secondary task, with some other task taking priority. Actually, however, MRT allows for individuals to decide where to direct their attention and for attentional allocation to change over time. In fact, focus on a weapon is not inevitable, and witnesses who have been educated about the weapon-focus effect can remember the appearance of an armed perpetrator as accurately as the appearance of an unarmed one (Pickel, Ross,
& Truelove, 2006). Although allocation policy issues are explicitly incorporated into MRT, Wickens (2008) has commented that the model could be improved by a better understanding of the variables that govern it.

Although not currently addressed within MRT, it seems reasonable to suppose that an individual's overall amount of available resources fluctuates over time—for example, in response to stress or anxiety (Deffenbacher, Bornstein, Penrod, & McGorty, 2004; Easterbrook, 1959). Therefore, witnesses experiencing high levels of fear may display performance decrements on both the primary and the secondary tasks as their total resource capacity shrinks. Consistent with this proposal, Josh Staller and I (Pickel & Staller, 2012) discovered that witnesses remembered both the perpetrator's message and appearance less accurately if the message was highly threatening rather than low in threat. We argued that hearing the threats caused a defensive stress response in witnesses that diminished overall attentional capacity.

**Future Directions**

In theory, any concurrent task that witnesses perform while observing a perpetrator or suspect could impair subsequent memory for that individual if the task is effortful enough. Moreover, the more demanding the task, the greater the impact it should have on memory. This presents a problem for police investigators trying to obtain useful information from witnesses. How can researchers help?

One step forward could be to extend current findings by trying to identify additional tasks, besides those already known to researchers, that witnesses are likely to perform, to learn more about how they prioritize tasks, and to understand how increases in anxiety moderate prioritization. Witnesses' behaviors during encoding, however, are not under the control of police investigators, so there is no simple way to eliminate their negative effects on memory even after these behaviors have been recognized. On the other hand, witnesses could be asked during police interviews what mental activities they engaged in while in the presence of the perpetrator as a way of taking into account the possibility that those activities decreased the accuracy of the memory report (Pickel et al., 2014). This precaution has limited value, though; knowing that a witness was multitasking enables one to predict the relative validity of his or her statement but not to establish its absolute accuracy (Wickens, 2008).

Alternatively, researchers could examine whether witnesses could be taught to control their attentional allocation more effectively so that, when it is safe to do so, they will prioritize the task of encoding descriptive information about the perpetrator. Some previous data suggest that this tactic could be feasible (Pickel et al., 2006). Convenience store clerks, bank tellers, and other individuals who are relatively likely to become witnesses to crimes could be targeted for this type of training. It is unknown, however, how beneficial such training would actually be or how long its effects would last.
Another approach that some have suggested is to supplement laboratory studies with archival analyses involving the descriptive reports and lineup identifications of actual eyewitnesses. Lab simulations are sometimes criticized for being too artificial. For example, unlike real witnesses, lab participants know their responses will not affect the course of another person’s life, they may feel less anxiety or fear during the critical event, and they are typically questioned minutes after the event rather than hours, days, or months later. Analyzing real-world cases may appear to offer a way to test the actual effects of different factors, such as divided attention, that have been examined in lab studies. However, archival studies bring their own set of problems (Horry, Halford, Brewer, Milne, & Bull, 2014; Pickel, 2007). One of the most important is the absence of ground truth, meaning that researchers usually cannot determine with certainty who the perpetrator was or what he or she looked like at the time of the crime, which makes it impossible to evaluate the accuracy of witnesses’ identifications and descriptive reports. Additionally, predictor variables may be confounded; for example, the amount of attention the witness allocates to the culprit’s face may be positively correlated with exposure time. Other variables that could affect accuracy may go unmeasured and uncontrolled, such as the sobriety of the witness at the time of the crime. Another potential problem is that the behavior of police investigators (e.g., nonverbal cues) could alter the witness’s lineup decision. As a final example, the witnesses included in an archival study may represent a biased sample because police detectives may choose not to interview or present a lineup to witnesses who seem reluctant, uncooperative, unreliable, or deceptive.

Horry et al. (2014) observed that “archival studies are often considered to be tests of whether effects found in the laboratory generalize to the field” (p. 106). Because of crucial methodological issues, however, the authors argued that it is not meaningful to compare the results of these two types of investigations. Furthermore, they concluded that the usefulness of archival research is fairly limited:

Well-designed and appropriately analyzed archival studies can possibly tell us something about the factors that are related to a specific population of cases: those in which the police choose to test an eyewitness and in which the identity of the perpetrator is unknown. Whether this knowledge is particularly valuable is unclear. (p. 106)

Nevertheless, researchers could try to continue to identify and correct the problems that exist within archival studies in general and then find ways to explore attentional allocation during actual crime events.

In summary, attentional processes engaged during encoding clearly delineate the accuracy and completeness of witnesses’ subsequent memory of a suspect or perpetrator. Police investigators, prosecutors, and jurors may wish to discover what else a witness was doing while observing a crime event and to take this information into account when evaluating the witness’s report.
Box 21.1
Key Points

- Witnesses' allocation of attention during a crime event determines the accuracy of their memory of the perpetrator.
- Witnesses can experience inattentive blindness, failing to notice a fully visible perpetrator because they are performing an attentionally demanding task and therefore do not engage in sustained attentional processing of the perpetrator.
- Even when witnesses notice a perpetrator, divided attention during encoding may impair their subsequent memory for details associated with him or her.

Box 21.2
Outstanding Issues

- It is important to identify additional cognitive tasks that witnesses are likely to perform, to learn more about how they prioritize tasks, and to understand how increases in anxiety moderate prioritization.
- More work is required to understand whether witnesses could be taught to control their attentional allocation more effectively so as to prioritize the task of encoding descriptive information about the perpetrator.
- More naturalistic research approaches are also important—although common approaches, such as archival research studies, present unique challenges.

References


