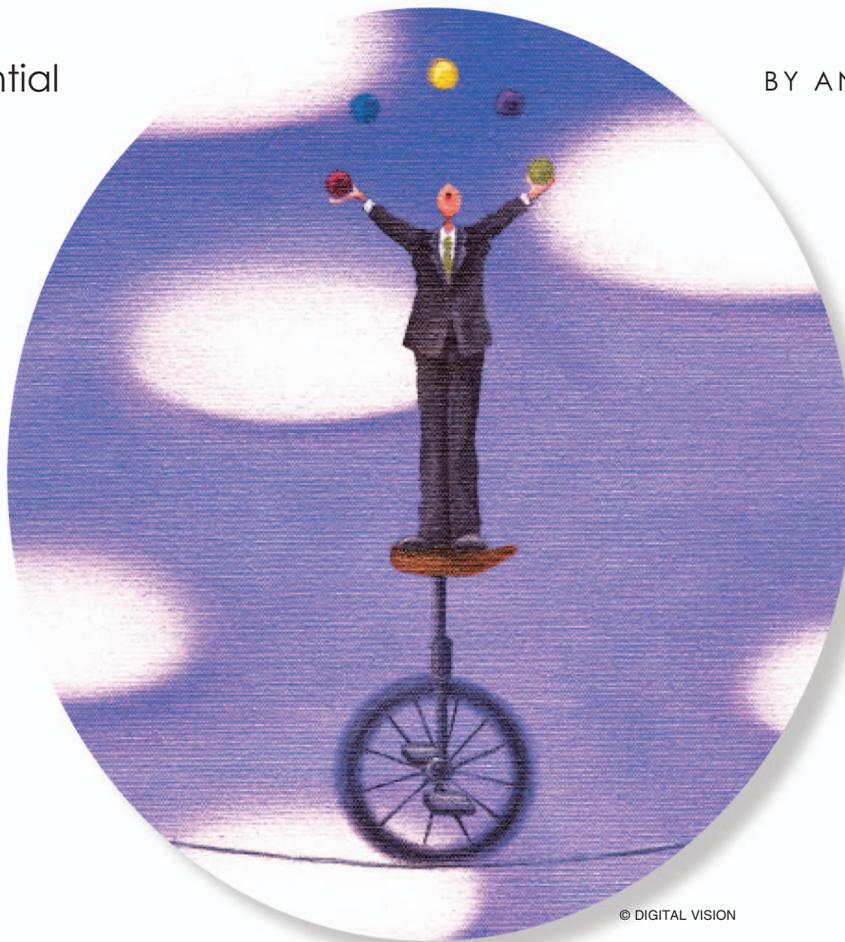


# MULTITASKING AND THE ILLUSION OF SAFETY

The potential impact in certain electrical hazard scenarios

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**E**VIDENCE SUGGESTS THAT CONDUCTING TWO OR MORE tasks simultaneously (i.e., multitasking) leads to decreased attention overall and plays a contributing role in accidents and injuries. This article examines the potential impact multitasking can have in a work environment influenced by electrical hazards. This article 1) provides an example of an incident scenario in which multitasking could play a role, 2) describes the psychology of multitasking,

3) explains why we overestimate our multitasking ability and how this leads us to take risks, and 4) suggests how to apply this knowledge in certain electrical hazard scenarios.

### Electrical Hazard Scenarios

Every year in workplaces in the United States alone, more than 3,000 electrical injuries and 300 electrical fatalities are caused by unsafe work practices, lack of effective safety management systems, inherently hazardous designs, faulty equipment, insufficient training, miscommunication, inadequate maintenance, and poor planning [3]. Yet even the minimization of such hazards does not guarantee a safe work environment: human factors may also come into play [4].

### Experienced Person

**Qualified Person**—One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. [2]

“How could a highly qualified, experienced person make such a mistake?” This question often accompanies a review or investigation of electrical incidents and injuries in the workplace. Several papers presented at IEEE conferences have explored the area of human error in electrically hazardous environments, e.g., [5] and [6]. The industry has put into place precautions to minimize the likelihood of such errors (such as simplicity, redundancy, and multilevel schemes) [6]. Even with these important precautions in place, the reality is that an individual meeting the definition of a highly qualified person can and will make judgment decisions and perform actions that unintentionally place him or her in harm’s way. People may misjudge, misread, or intentionally take shortcuts during tasks that can lead to increased risk of injury.

This article investigates an avenue through which mistakes can be made by looking into the cognitive challenges faced when employees perform more than one task at a time. It also builds an explanation of how multitasking during a job contributes to an increased likelihood of poor judgment or risky behavior.

### Multitasking

“*Multitasking* \-tas-kiŋ\ The concurrent performance of several jobs by a computer” [7]. The term was originally used to describe computer processes in 1966. Over the past few years, the phrase has been expanded to describe human behavior when people perform or attempt to perform multiple tasks at one time. These tasks can be physical (e.g., manipulating tools), as illustrated by Gary’s situation in Figure 1, as well as mental (e.g., dwelling on an upsetting argument or daydreaming about an upcoming social event).

People do have the ability to multitask for some activities. This explains why one can sip water and have a

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conversation during dinner, why it is possible to navigate through traffic while listening to the radio in the car, and why one can read a book while eating a snack. However, these types of scenarios misled us into believing that we can be good at multitasking in other situations.

Although not obvious, one of the tasks at hand in each of those examples is what cognitive psychologists call an automatic process and the other a controlled process. Automatic processes require no conscious attention: drinking, listening to the radio, and eating all happen automatically with no concentration required. Having a conversation, navigating busy traffic, and reading are controlled processes. These activities require

conscious effort. If one is not paying attention, these activities either do not take place or will be done very poorly. Most people have had the experience of reaching the end of a paragraph, realizing that they do not know what it was about, only to realize that they had been daydreaming. This is an example of how we cannot engage in a controlled process when distracted and of how we do not recognize the fact that we are distracted until much later.

To investigate this further, we are able to do two automatic processes at the same time—chewing gum and walking would be an example—and we are able to do one automatic process and one controlled process at the same time—such as drinking water and conversing. However, our ability to multitask breaks down when we attempt two controlled processes at once.

Cognitive psychologists explain that we have a limited capacity to mentally process information,

While performing a routine substation inspection, Gary noticed that the oil level guage was reading slightly low on the bushing of a 69-kV power potential transformer (PPT). He suspected that the guage was stuck and wanted to take a closer look. Gary left the scene to get a 6-ft ladder. He returned, placed the ladder along the side of the PPT, climbed up a few steps, looked at the guage, and decided it was stuck. He climbed a little higher and, keeping his eyes on the guage, reached into his tool belt for a wrench, and began to reach up to the brushing to tap the guage with the wrench. An arc occurred and flashed over Gary’s right arm to the right mid-abdomen area. Gary fell to the ground, dazed, but was able to call his dispatcher to report what had happened. *Why did Gary seem to “forget” that he was working in a potentially hazardous situation? Why did he suddenly seem “blind” to the dangerous location of the guage?*

1

An example of an incident illustrating a possible multitasking error based on U.S. Occupational Safety and Health Administration (OSHA) Safety Alert [1].

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which means that we can only focus on one thing at a time and only make decisions about one thing at a time. Part of the reason that we have a cultural illusion of multitasking abilities is because we do not recognize that our ability to navigate traffic and listen to the radio (a controlled with an automatic process) will not generalize to navigating traffic and discussing business deals over the phone (two controlled processes). The illusion is painted further because, for most of the time, we *can* navigate traffic while talking on the phone.

Why? Most of the time, driving really does require little cognitive effort. Traffic runs steady, we stay between the lines, and very little happens out of the ordinary. With the exception of student drivers, navigating traffic under these circumstances can become an automatic process. We automatically brake when we sense a red signal ahead, and we *can* stay in our lane with little effort. However, occasionally, driving can suddenly shift to be a controlled process—we have to make conscious decisions about what to do when we suddenly realize that we have missed an exit and are lost. Road signs must be read, and exit numbers must be noted. If we are on the phone with a business partner, and suddenly find ourselves lost, we are going to have to shift our attention to focus on one thing: either the driving or the business, and one will suffer. We would hope that the business would quickly become second priority, but statistics indicate that talking on the phone increases the risk of an accident four times, and texting while driving increases risk by 23 times [8]. Cell phone drivers miss or are slower to notice traffic signals, stop signs, and brake lights [8]. Using a cell phone reduces your attention to these safety indicators by 37% [8]. That is not a smart business deal. The deficits seen in these situations may partially be attributable to the physical components of phones (e.g., handling devices and dialing numbers) but most are attributable to the cognitive components (e.g., concentrating on the conversation). Being mentally focused on something like a conversation can create inattention blindness—we fail to cognitively perceive something that we physically see when we are

mentally attending to something else [9]. This explains why someone driving while conversing might stop at a stop sign, look left, right, and left, and pull out in front of a large oncoming vehicle. They went through the now automatic driving processes of stopping and looking, but with their cognition already on something else, they did not really see. This concept has also been referred to as situational awareness [5], which has been suggested to play significant roles in causing electrical accidents [5], and might explain some of what happened to Gary in Figure 1. Attempting to do two controlled processes at once (conversing and navigating traffic; thinking about an upcoming ball game and reading a voltage meter) increase the likeli-

hood of being blind to certain circumstances (an approaching car; a mislabeled meter).

### Attention and Task Switching

There are a few other concepts that should be discussed to fully understand how multitasking is misunderstood. First, attention: what determines where we focus our attention? Goal-directed attention is what happens when one decides to allocate attention to a certain object intentionally. Stimulus-driven capture is what happens when attention is captured by an outside event (see Figure 2).

It is difficult to refocus attention on a task once distracted. Research by psychologists [10] shows that we are slower at a task and are more prone to error just after a task switch; so Louis (Figure 2) will need to take some time to collect his thoughts and is more likely to do a poor job every single time he switches his attention from an e-mail alert to the shutdown and lockout plan and back again. The danger here is that when returning to the shutdown and lockout plan document, he could, for example, mis-identify a circuit breaker, completely skip a step in the plan, or overlook the application of temporary safety grounds. Psychologists know that stimulus-driven capture usually wins out over goal-directed attention [11], so we are easily distracted by and have trouble refocusing after every ping, beep, and vibrate with which our technologically advanced society provides us. This is particularly dangerous because, like drivers driving under the influence, multitaskers do not notice the objectively observable deficits in their performance [12]. Remember reaching the end of that paragraph and only then realizing that you were daydreaming—this means that multitaskers may not realize the danger in which they put themselves and others and thus do not feel the need to change their behavior.

It is possible that many mind on task attributable accidents occur just after a task switch (refer to Figure 2). Because of the extra cognitive effort needed to channel attention back to the task at hand, if an error occurs during

Louis is writing an electrical shutdown and lockout plan. He sits down at his desk, opens his file, thinks back over the preliminary planning he did, and starts typing. He is intentionally focusing his attention on the task (goal-directed attention). Then—*bing!*—a small square appears in the lower right-hand corner of the monitor. “You have mail.” He clicks the box to read the e-mail. His attention has been taken away from the task he was working on and is now focused on the e-mail message (stimulus-driven capture).

2

An example of two types of attention.

this time, we are not as likely to notice it. If this happens while writing an e-mail, we may misspell a word or have an extra sentence embedded. If it occurs while drafting a shutdown and lockout plan, we may skip steps. If it occurs while reading a voltage meter, we may mistakenly think the work area is safe.

### But I'm Different

There is another final psychological issue to consider here. As human beings, much of our thought processes and actions are designed to help us feel that everything is going to be all right. By nature, unless clinically depressed, we all think that we are above average [13], good things will happen to us, and bad things will not [14]. We also think we are more in control of our environment than we actually are [15], [16]. Although these optimistic bias cognitions play an important role in helping us wake up in the morning without feeling an impending sense of doom, they can also make it less likely that we will take adequate safety precautions [17]. What this means is that we believe ourselves immune to the risks of multitasking and thus may not take necessary precautions despite our knowledge.

### Applications in Electrical Work Environments

Let's return to Gary's scenario (Figure 1). Why did Gary seem to forget that he was working in a potentially hazardous situation? Why did he suddenly seem blind to the dangerous location of the guage? It is possible that Gary was so intently focused on the task of getting the guage unstuck that, like a driver who looks but does not see the oncoming car, he lost sight of the overall picture and no longer recognized the dangerous location of the guage. Not having one's mind properly focused on a situation could result in not recognizing surrounding information. Multitasking can play a role in creating such inattention blindness.

We live in an electrical world. We are dependent on electrical technologies for almost every aspect of business, commerce, and daily living. Along with this comes potential exposure to electrical hazards. Most psychological research, and thus most data on multitasking, has been conducted with driving scenarios [8], [12], not electrical tasks. Although research would need to be conducted specifically in electrical safety environments to hold scientific merit of the risks involved, it could be reckless to assume the risks and consequences are not similar.

Just like drivers, once workers learn procedures, they become comfortable with the tasks and safety protocol, and the tasks can become automatic. This is dangerous because it is at this point that attention is easily captured by stimuli outside of the task at hand, which includes mental distracters that are difficult to recognize like daydreaming, or suddenly becoming intent on a second task (e.g., getting a guage

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unstuck), which can result in errors within the task being missed (inattention blindness).

Worker safety is dependent on skill training, diligence in design and installation, and adherence to safe work practices. However, it will also require an understanding of our limitations as human beings. Certain interactions between people and the interfaces with electrical technology require alertness and the mental flexibility to recognize when one is distracted. These are cognitive skills learned separately from tasks like meter reading procedures and lockout protocol. Because these cognitive skills are subject to situational differences within the same

individual (consider the sudden distracting effect of having an intense argument with a loved one), it is not possible to learn them in the same way that one can learn something like a voltage-reading protocol. That is, the same person may be cognitively able to be alert one day and be stressed and easily distracted the next. Still, as in any hazard/risk situation, measures can be taken to eliminate or reduce potential for judgment errors, such as the errors made by Gary in Figure 1.

The first step in reducing the multitasking risk is to develop an understanding of the cognitive processes that are impacted by multitasking and the biases that cause us to believe we are immune to the risk (the processes and biases that have been described in this article). The next step is to identify work scenarios in which distractions or errors in judgment may have serious consequences.

An organization wishing to reduce multitasking distractions might consider the following actions:

- assess work scenarios to identify areas of concern having high consequences, for example,
  - working within the limited approach boundary [2]
  - performing any step in the process to achieve an electrically safe working condition
  - switching activity in critical power systems and control circuits
  - identifying isolation points and applying lockout/tagout devices on those points
  - moving mobile equipment, rolling stock, cranes, and the like when there is a potential for contacting overhead power lines
- establish expectations to prevent distractions in these scenarios
  - eliminate distraction: beeps, flashes, or vibrations from all electronic devices unrelated to the electrical equipment of the task (e.g., cell phones, personal digital assistants, and smart phones) by switching all sounds and vibrations off
  - train workers and supervisors on the risk and intervention measures

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- hold interactive seminars to help workers and supervisors understand our cognitive limitations and vulnerability to distraction
- train workers to recognize their potential to be distracting to other workers
- eliminate workers' potential to be distracting to other workers (e.g., no off-task discussions by third parties within earshot of the limited approach boundary)
- audit the effectiveness of this proactive approach; work toward ongoing improvement to prevent distractions to workers at risk in electrically hazardous environments.

## Conclusions

The nature of human attention means that we can be easily distracted by surrounding stimuli. Trying to concentrate on two things at once makes us more prone to error, less likely to notice that we are making errors, and slower to fix errors if we do notice them. This happens each time we switch our attention from one task to another, which means it happens each time we notice a beep, vibration, or another person's conversation, or whenever we are distracted by our own thought processes (e.g., being worried over an argument, looking forward to a vacation, and so on). Finally, we all possess cognitive biases that cause us to think we won't be error prone or vulnerable to the dangers of multitasking.

Suggestions: 1) the misunderstandings surrounding multitasking are pervasive in our culture and extend from our personal lives (driving in our cars) to our work environment (voltage testing). Because of the pervasiveness of the lay public's misunderstandings, it is important for those of us involved with electrical safety to understand the psychology behind why multitasking does not work and also why we think it will; 2) we should take efforts to minimize distraction during occupational tasks where focus and attention to detail are critical to safety of the individuals involved.

The definition given previously for a qualified person points out the importance of having skills, knowledge, and safety training to recognize and avoid hazards [2]. However, accompanying these physical hazards are the hazards within our own minds. As people, we are vulnerable to distraction, which is completely independent of how expert we are with the technical aspects of our jobs. A qualified person must also have an understanding of these limitations—we need to recognize that by nature we are prone to distraction and that, once distracted, we are vulnerable to not having our mind on the task. And most importantly, we need to understand that persons susceptible to this vulnerability include you and me.

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