What are the limits of attentional capacity?

You can predict it with almost 100 percent certainty. The driver in front of you speeds up, then slows down, speeds up, then slows down again. Occasionally, the car veers over one of the lines that define the lane, only to get jerked back abruptly into place. Finally, you have had enough and decide to pass. As you go past the car, you shoot a quick look at the driver. Is the driver drunk? Nope, worse. He is talking on a cell phone.

Is driving while talking on a cell phone really similar to drunk driving? Some researchers think so. They believe that a driver's capability to safely operate a motor vehicle is severely impaired while talking on a cell phone, just as it is when intoxicated on alcohol. Others suggest that it is only a problem if the driver is using a handheld cell phone—that a hands-free phone eliminates the problem. These and other issues have been the objects of legal discussion worldwide since cell phones became an indispensable part of our culture, and have resulted in a wide assortment of laws, debates, and experimental studies.

The problem concerns the issue of attention, which, as I have discussed in the other stories in this chapter, is a rather diverse and complex topic. The issue of cell phone use while driving is about divided attention. Specifically, the question is this: How much, or in how many ways, can we divide our attention before performance starts to suffer?

The answer is not a simple one. And in fact, it is not just a matter of how many ways attention can be divided. For example, I can tap my right index finger rhythmically by itself, together with the index finger of my left hand, or together with my left hand and both feet; dividing attention among all four effectors produces a rhythmic performance that is as good as the rhythmic tapping of one finger by itself. In fact, research suggests that rhythmic timing performance actually improves when multiple effectors are tapping together (Helmuth & Ivry, 1996). When all four of the parts converge to achieve a common goal, then the attention devoted to each one is no greater than the attention paid to the collective whole.

The problem of divided attention occurs when each of the parts has an action goal that is separate and unique from that of the others. For example, instead of tapping both hands, try rubbing your head and patting your tummy at the same time (see "Party Tricks" in chapter 7). This task is difficult because the two parts have no common action goal. Instead, each limb has its own unique action, with differing movement commands and

sensory feedback that must be monitored during performance to achieve its distinct goal. Each part requires individualized attention to achieve accurate performance.

When researchers talk about the division of attention, they often refer to the concept of capacity—the fact that we have an absolute limit to the amount of attention we can devote to the processes involved in thinking and doing. Presumably, everyone has an absolute limit, or amount, of capacity to allocate flexibly to the performance of certain tasks. An analogy might work well here to illustrate these points.

Let's say that a large pot can hold up to 10 liters of gumbo. If the recipe calls for a combined 6 liters of water and rice, then only 4 liters of space remain for the other ingredients. I have a total volume of 6 liters of chicken, sausage, shrimp, and vegetables to add to the pot. I can fit more of these ingredients in the pot if I reduce the amount of water and rice. But, doing so changes the nature and essence of the recipe. Alternatively, I could maintain the amount of rice and water (6 liters) and add all of my other ingredients too (6 liters). If I do that, however, then some of the water and rice is going to spill onto the stove, leaving a mess to clean up.

By analogy, the attention needed for safely driving a car will occupy a large portion of my available capacity. I can add other things to the mix, such as listening to the radio, carrying on a conversation with someone else in the car, drinking a cup of coffee, thinking about work to be done at the office, and so on. And the degree to which these can be safely added to the driving task will depend on the attentional capacity required by each. The potential for problems begins once the total of the attention required by all of the tasks exceeds the limited amount of attentional capacity. To reduce the potential for problems, I must reduce the total attention demanded by the tasks being performed so that they do not exceed my available capacity. In other words, everything must fit in the gumbo pot. This could involve eliminating one or more of the extra tasks or reducing the attention devoted to each. I could also reduce the attention devoted to driving. However, like the gumbo analogy, reducing the main ingredients has the potential to ruin the recipe and produce disastrous results.

Drivers who talk on their cell phones often exceed their available attentional capacity. Their pot overflows. Others who share the road hope that the driver prevents this overflow by reducing the amount of attention devoted to the phone conversation. That is, they hope that the driver prevents the attentional gumbo pot from overflowing by maximally attending to the demands of the driving task and reducing the attention paid to the phone conversation. But we all know that this decision is not always followed, and evidence overwhelmingly shows that talking on a cell phone while driving increases the probability of an accident, perhaps by as much as fourfold. All too often the driver responds to the overflow either by reducing the amount of attention devoted to driving (resulting in all kinds of bad driving behaviors) or by simply allowing the pot to overflow, leading to an accident.

From T.D. Lee, 2011, *Motor control in everyday actions* (Champaign, IL: Human Kinetics).

The issues and questions about distracted driving are far more complex than this, however. Consider the following questions.

1. *Are the attentional capacity demands for driving the same for all people?* Clearly not. The attention a novice driver needs in order to operate a motor vehicle in traffic is far greater than the attention a highly experienced driver needs. Therefore, in theory, the experienced driver should have more available capacity for a cell phone conversation than does the novice.

2. *Do all conversations require equal capacity?* Again, the answer to this is an obvious no. In your kitchen you can fix a sandwich while talking on the phone up to the point at which something very important in the conversation arises, at which time you stop the sandwich making and devote much more capacity to what the other person is saying.

3. *Do handheld cell phones require more capacity than hands-free units?* Again, the research has yielded a very clear answer: the attention demanded by the conversation is the critical issue, not the demands of holding a phone. Almost every study conducted on this topic showed no difference in the capacity demands of handheld and hands-free phones (despite what lawmakers believe).

4. *Does talking on a cell phone demand more attention than talking to other people in the car, or listening to the radio?* Remember that a cell phone conversation has no fixed amount of demanded capacity, and the same is true for conversations with people in a car, radio programs, e-mail, text messages, and attending to GPS maps. Depending on the nature of the task, all have the capability to demand a dangerous amount of attention while driving. But again, research is very clear on this issue: carrying on a conversation with a passenger in the car demands less attention than does a cell phone conversation.

So, is driving while talking on a cell phone equivalent to driving while intoxicated? Actually, the question is a not an appropriate one. The elevated attention demands of the cell phone call can be changed simply by making a conscious decision to pay more attention to driving or hanging up; the decrement due to intoxication cannot be dismissed by the will of the driver. On the other hand, the roads would be much safer without either type of driver.

SELF-DIRECTED LEARNING ACTIVITIES

1. Define *attentional capacity* in your own words.
2. I have used the gumbo pot as an analogy to explain attentional capacity and demands. Create a different analogy to explain these concepts.
3. Develop an experimental methodology to examine the attentional capacity of driving when combined with any two of the following

factors: (a) using a hands-free versus handheld cell phones, (b) having a conversation with a passenger, (c) reading a GPS display, (d) listening to the radio, and (e) text messaging.

4. Compose a letter to your legislative representative stating your position on the legality of cell phone use while driving.

Notes

- Why do people insist on using cheesy ring tones such as "Edelweiss"?
- An epidemiological study done in Toronto found that drivers were four times more likely to be involved in an accident when talking on a cell phone:

  Redelmeier, D.A., & Tibshirani, R.J. (1997). Association between cellular-telephone calls and motor vehicle collisions. *The New England Journal of Medicine, 336,* 453-458.

- This research suggests that conversations with passengers are both less attention demanding than cell phone conversations and different, often because the traffic becomes a topic of conversation:

  Drews, F.A., Pasupathi, M., & Strayer, D.L. (2008). Passenger and cell phone conversations in simulated driving. *Journal of Experimental Psychology: Applied, 14,* 392–400.

Suggested Readings

Helmuth, L.L., & Ivry, R.B. (1996). When two hands are better than one: Reduced timing variability during bimanual movement. *Journal of Experimental Psychology: Human Perception and Performance, 22,* 278-293.

McCartt, A.T., Hellinga, L.A., & Bratiman, K.A. (2006). Cell phones and driving: Review of research. *Traffic Injury Prevention, 7,* 89-106.

Schmidt, R.A., & Lee, T.D. (2011). Attention and performance. In *Motor control and learning: A behavioral emphasis* (5th ed., pp. 97-132) Champaign, IL: Human Kinetics.