Welcome to Lesson 2 of Module 3 on focus and decision-making. In Lesson 1, we looked at attention and attention networks in the brain. In Lesson 2, we take a look at multi-tasking and some ways we can train our attention.
Multi-tasking is the attempt to do two or more tasks at the same time. However, the research shows that when multi-tasking, people make more mistakes or perform their tasks more slowly.

Much of the research on multi-tasking has looked at driving while performing another task, such as texting, eating, or speaking to passengers in the vehicle, or with a friend over a cellphone. This research reveals that the human attentional system has limits for what it can process: driving performance is worse while engaged in other tasks; drivers make more mistakes, brake harder and later, get into more accidents, veer into other lanes, and are less aware of their surroundings.

There has been little difference found between speaking on a hands-free cell phone or a hand-held cell phone which suggests that it is the strain of the attentional system that causes problems, rather than what the driver is doing with his or her hands. While speaking with a passenger is as cognitively demanding as speaking with a friend over the phone, passengers are able to change the conversation based upon the needs of the driver. For example, if traffic intensifies, a passenger may stop talking to allow the driver to navigate the increasingly difficult roadway; a conversation partner over a phone would not be aware of the change in environment.
Here's a 2013 study that looked at brain activations during distracted driving. In this study, young adults drove in a simulator along a straight road and turned at intersections. Sometimes there was oncoming traffic and other times not. And they also had to listen to simple general knowledge questions, such as a triangle has four sides) and respond with true or false. So the design of this study was similar to real driving conditions.

Here's what they found. I know this image looks daunting, but it only shows different slices of the brain, starting from the top of the brain on the right and descending the brain as you go left.

The rows show brain activations for different driving conditions. The top row shows activations for right turns. The middle row shows activations for left turns and the bottom row shows activations for left turns in oncoming traffic. And this image shows the activations for regular driving only, without the distraction of the true or false questions.

In regular driving, without distractions, they found increasing brain activations in the parietal and visual, or occipital, cortices as the driving conditions became more difficult. If you remember, the parietal and occipital lobes are toward the back or the posterior of the brain. So, you can clearly see that left turns (the second row of images) showed more activation than right turns (the first row of images), and left turns in traffic (the bottom row of images) showed even more activation than the other conditions. These are circled in green.

This image shows brain activations during distracted driving, when the participants also had to pay attention to the true or false knowledge questions. In this condition, even straight driving showed some activations in the frontal and auditory, or temporal, areas, circled here in green. But, there were also deactivations in the visual, or occipital cortex. It’s a bit difficult to see, but the deactivations are shown in blue, here, here, and here.

In the left turn with traffic condition, the frontal areas showed even more frontal activations that were not there when the knowledge questions distraction was not present, circled here in green.

What can we learn from this research into distracted driving?
In brain imaging studies the conditions of interest are compared to a baseline condition. The baseline condition is subtracted from the conditions of interest, and any remaining activations are specific to the condition. In this case, the baseline was straight driving, without the knowledge questions. So, what this research shows is that undistracted right turns (where there were no knowledge questions) are virtually as easy as straight driving. We know this because there are very minimal additional activations. Undistracted left turns are more difficult and recruit more of the parietal and visual, or occipital cortices, which makes sense because these areas are responsible for spatial and visual processing. Undistracted left turns in traffic recruit even more of the parietal and visual cortices. Left turns in traffic are the most difficult and where the most serious accidents occur so this too makes sense. In addition, in this last most difficult condition, the anterior cingulate cortex was also recruited which was not evident in the easier conditions. This area is responsible for cognitive-response selection and alertness. What can we learn from the distracted driving condition?
Compared to straight driving without distraction, in distracted straight driving, frontal areas were recruited when the participants had to listen and respond to the knowledge questions. In addition, parietal and visual areas that are important for competent driving showed deactivations.

In the most difficult condition, turning left in a busy intersection while listening and responding to the knowledge questions showed even more frontal activation. This area is responsible for executive functions including attention and working memory processes, and processing thoughts and decision-making critical for multitasking. In addition, making left turns in traffic while distracted showed less activation in the parietal and visual cortices than making left turns in traffic without distraction, areas that are important for driving. In effect, when turning left in traffic, distraction shifted brain recruitment from the crucial parietal and visual cortices to the frontal areas. Obviously, this is not a good thing. When we need our parietal and visual cortices the most, turning left into oncoming traffic, the frontal areas hijack some of our brain power to accomplish the knowledge distractor task.

Although this study looked specifically at multi-tasking while driving, there are many other studies that have looked at multi-tasking in other domains, and the results are comparable. They show that when trying to do two tasks at once, the cognitive resources available for both tasks are reduced. In fact, multi-tasking is really very fast task switching.
However, it is possible to do two things at once and it can even let us accomplish more with little extra effort. The key is that the brain can only make sense of one sensory signal at a time. So, for example, we can't listen to two podcasts at the same time or do two complex tasks, like driving and having a conversation, at the same time, because they occupy the same channel.

But, we can exercise or go for a walk or run and listen to audio books at the same time. We can listen to non-distracting music and work or drive at the same time.

And we’re poor at multi-tasking even when we think we’re good at it. A 2013 study found that those who believe they are good at multi-tasking are actually poor at it, using an objective measure of multi-tasking ability. In addition, this study found that multi-tasking activity was related to attentional impulsivity: those who engaged in more multi-tasking were also those who showed greater attentional impulsivity.

So how do you improve sustained attention?

Some of the ways that you can improve attention is through:

**Mindfulness:** undergraduate students who took a mindfulness class and meditated for 10 to 20 minutes four times a week for two weeks scored higher on memory tests. And it reduced the mind-wandering of students who were prone to distraction compared to those who changed their nutrition and focused on healthy eating as a way to boost brain power.

[http://pss.sagepub.com/content/24/5/776](http://pss.sagepub.com/content/24/5/776)

**Exercise:** After only 20 minutes of walking, children performed better on an attention switching task, and in reading comprehension.

Some ways to improve attention

**Hydration**: Even mild dehydration by as little as 2% can impair attention, psychomotor skills, immediate memory skills, and an assessment of one's subjective state.


Listening to classical music engages the areas of the brain involved with paying attention, making predictions, and updating memory.


**Tea**, because of its theanine concentration, has been shown to improve attention.


**Chewing gum** may also have a positive effect on alertness and attention.

And finally we saw in module 2 on neuroplasticity that some video games may help increase sustained attention, especially for older adults. and that music and chess training, especially for children, may help develop their sustained attention.