BRAIN SCIENCE PODCAST

With Ginger Campbell, MD

Episode #17: *The Wisdom Paradox*, by Dr. Elkhonon Goldberg, PhD

Aired July 26, 2007

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INTRODUCTION

Hi. I'm Dr. Ginger Campbell, and this is the *Brain Science Podcast* - the podcast for everyone who has a brain. In this podcast we explore how recent discoveries in neuroscience are unraveling the mysteries of how our brains make us who we are.

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Welcome back to the *Brain Science Podcast*. This is Episode 17. Today I'm going to be talking about the idea of wisdom, or more specifically, what happens to our brains as we get older. Do they just go downhill, or are there ways in which our brains actually get better as we age?

Before we start exploring today's question, here are a few brief announcements. First I want to welcome any new listeners to the *Brain Science Podcast*. This episode is going to be bringing together some subjects that have been talked about the past on the podcast, but you don't have to have listened to any of the other episodes to understand and enjoy this podcast. I hope that you will want to go back and listen to the episodes that I refer to, but feel free to go ahead and listen to this episode first.

I want to remind everybody that this is the month that I'm having the trial sponsorship with Audible.com, so I hope that you will go to brainsciencepodcast.com and click on the ad so you can get your free audiobook download. This is for anyone who isn't already a subscriber to Audible.com. They have a library of over 35,000 books, including quite a large number of books that I have talked about both on this podcast and on *Books and Ideas*.

Also, as I mentioned last time, the new Brain Science Discussion Forum is now up at brainscienceforum.com. Of course, it's a brand new forum and there haven't been that many posts yet, but I would like to encourage everyone to please join and start posting your comments there.

One thing that I wanted to mention is the fact that when you sign up if you go on into your profile and put in your email, that will be very helpful to me, even if you choose to hide your email from everyone else. Also, you'll notice that the way that the forum is organized, I've got some main discussion areas that I'm just guessing are good starting points, and then there's also a place for discussing specific episodes. Feel free to put your comments or posts in whatever area you think makes the most sense.

As always, I love getting feedback, and there are three ways that you can give me feedback. One is to send me email at docartemis@gmail.com. Or, you can go to brainsciencepodcast.com and leave comments with the Show Notes. And lastly there is the Brain Science Discussion Forum at brainscienceforum.com.

I want to thank Matthew Lofton, who pointed out to me that I misspoke in the last episode when I claimed that only humans and certain primates are able to recognize themselves in the mirror. He pointed out that it has been shown that elephants are able to do this, and he gave a reference, which I will link in the Show Notes, to the February 2007 issue of *Scientific American Mind*. There was an article entitled, "I, Elephant" by Kaspar Mossmanin, which you might want to check out if you're interested in this issue.

OK, so let's get into today's discussion.

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DISCUSSION

Today I am going to be discussing the book, *The Wisdom Paradox: How Your Mind Grows Stronger as Your Brain Grows Older*, by Elkhonon Goldberg. This book was published in 2006. Now, Dr. Goldberg also wrote the book, *The Executive Brain*, which we talked about in Episode 16. And I don't usually stay on the same author for two episodes in a row, but the reason that I did was that this book really expands on the discussion we started last time of the prefrontal lobes. And it reflects the fact that I read these books back-to-back. In fact, I actually started with this book—*The Wisdom Paradox*—and realized that he had written a book about the prefrontal lobes, went and read it, and then came back and finished this book.

So, this week we are going to have the opportunity to pull together important ideas, both from the last episode and also from ideas that we have discussed in previous episodes—in particular, ideas related to memory, which was discussed in Episode 12; emotions, which were discussed in Episode 11; and neuroplasticity, which was discussed in Episode 10. And then, of course, last time in Episode 16 we talked about the prefrontal lobes.

And, as I mentioned in the introduction, it's perfectly fine if this is the first episode you've heard or you haven't listened to these other episodes. I'm going to be referring to these episodes, but I'm going to be giving you the information you need to understand today's episode. I'm really giving you this reference so that if you want more detail you can go back and listen to these episodes.

I know many of you have told me you don't have time to read the books that I discuss, and I hope you can tell I try to put this podcast out in a form that doesn't require any reading on your part. However, I recommend this particular book as one to read if you only have time for an occasional book on the subject. And I recommend this particular book for several reasons. One, it's very readable, and it sums up a lot of the ideas we've talked about over the last several months. Plus it presents material that's of a practical use in terms of keeping our brains healthy. Needless to say, this episode isn't just about reviewing what we've talked about in the past. We are going to be talking about some important new ideas.

Some of these are how the difference between the right and left lobes relate to how our mind changes as we go through life. The second question is what is wisdom, and how does it relate to the prefrontal lobes. In this context we're going to be talking about both cognitive and emotional aspects of wisdom. And finally, a key question that we're going to confront in this episode is what happens to our brains as we age and what can we do about it. It turns out that there are three protective mechanisms that we can take advantage of. And I will describe these in this podcast.

First I want to review a few of the key ideas from Episode 16, which was about the prefrontal lobes. For those of you who didn't get to listen to Episode 16, the prefrontal lobes are the very frontmost part of the brain that is approximately that area that's right behind your forehead. They're connected to practically every other part of the brain, and they are in charge of making plans and carrying them out. The prefrontal lobes call on the other parts of the brain to perform their executive functions. That's the reason why Dr. Goldberg called the frontal lobes the "executive brain" in his first book that we talked about last time.

Dr. Goldberg has offered evidence that the old idea of the difference between the hemispheres being based just on language—with the left hemisphere being the language hemisphere and the right hemisphere being associated with spatial and other non-verbal tasks—that this way of looking at the brain is really obsolete. And he gives more evidence about that in this book. I'm not going to get into all that evidence, but I'll remind you that one of the most straightforward clues that the difference between the right and left hemisphere isn't just about language is the fact that this difference is seen in many different animals, even fairly low-level animals. And he did give a surprising new example in this book, that someone has actually found that there are some fruit flies that have a difference between their hemispheres, and these fruit flies show an increased ability to have long-term memory.

So, in connection with this idea about looking at the right and left hemispheres in a different way, Dr. Goldberg proposed two important ideas. One was that the right lobe is the novelty lobe, while the left contains the patterns of what we have already learned. The second idea was that the neocortex is not modular. Instead there are a large number of interconnections that mean that the neurons can overlap and belong to multiple functional units. Now, this is in contrast to older parts of the brain—I mean older in terms of evolution. These are both modular and relatively hard-wired.

This approach is important because it gives us a way to look at the brain that allows for the fact that it's got a combined structure. The older parts are modular and relatively hard-wired, while the newer parts have a more continuous—what he calls gradiential— structure that allows ongoing learning. And he expands on both of these ideas in this book, which is one reason why I brought it up. However, I'm not going to get into this in a great deal of detail today because I did talk about it in the last episode.

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The major theme of *The Wisdom Paradox* is that while our brains change in normal aging the process is not all downhill, because there are abilities that we gain with experience that offset some of the loses. We're going to discuss the neurobiology behind how our brains change, and we're also going to talk about what we can do to ensure that we obtain and maintain cognitive wisdom. Dr. Goldberg argues that pattern recognition is the key. He says, "Problem solving shifts from the effortful creation of new mental constructs to the form of pattern recognition. Many researchers believe that pattern recognition is the most powerful mechanism of successful cognition."

In terms of understanding how pattern recognition might work at the level of the neurons he gives the definition of an attractor, which he defines as a cognitive template that enables pattern recognition. And all this means is that you have a set of neurons that are strongly interconnected among themselves. Now, the unique property of an attractor is that a very broad range of inputs can activate the same set of neurons, and this is thought to be the mechanism of pattern recognition.

It's like when you hear the first few notes of a song and you know the rest of the song because your brain takes the clue of the first few notes and plugs it into that pattern recognition. That's kind of the idea. This was discussed also in Jeff Hawkins' book, *On Intelligence*, which I've mentioned several times in the past. One of the advantages of having this pattern recognition mechanism is that it leads to less effort and less use of resources. And you'll be able to see more why this is important in a few minutes.

Let's briefly consider how our brain changes as we grow older. And I'm going to be talking about normal changes of aging, not diseases. First of all we know a lot about what happens in a normal brain with aging. We know that the weight and volume shrink by about 2% per decade, and that as we age we have fewer synapses and less abundant blood flow. Small focal lesions are also very common.

But not all parts of the brain are affected to the same degree. It seems that the newest parts—in terms of evolution—are affected the most, and the oldest parts the least. So, this means that areas receiving the raw sensory input and the motor cortex are the least affected. In contrast the prefrontal cortex, which is in charge of complex planning and organization of complex behaviors in time, is the most affected. It's the last to develop and the first to deteriorate. This includes deterioration of white matter, which is the connections, the myelin; gray matter, the actual neurons; and depletion of neurotransmitters.

Now, what about other parts of the brain besides the cortex? Well, the hippocampus and the amygdala, which we have talked about in the past—and I'll come back to telling you more about that if they're new to you, don't worry—the hippocampus and the amygdala seem to be much less affected than the frontal lobes. There is evidence that in other mammals the hippocampus is not affected at all.

Now, remember that the hippocampus is important for forming long-term memories. And I said the hippocampus isn't much affected. Now, that's in healthy aging. Unfortunately the hippocampus is one of the first areas to deteriorate in diseases like Alzheimer's disease. The basal ganglia, the cerebellum, and the midbrain are parts of the brain that are only moderately affected by normal aging.

So, here are some of the overall effects of normal aging. First the overall speed of mental operations declines, and so do sensory functions. Functions that are dependent on the frontal lobes are also the most likely to falter. So, for example, let's think about mental inhibitions. If you know any really elderly people you probably have noticed that they are much more likely to say things that you can be pretty sure they wouldn't have said when they were younger.

At a more practical level this means also that working memory is affected, which means the ability to hold a lot of information in your head while you're doing something. And the example that comes to my mind for this is computer programming, because you often have heard it said that it's difficult to do high-level computer programming as one ages. Now, I haven't done any computer programming since I was in college, so I don't have any personal experience with this. But Steve Wozniak, who is one of the inventors of the original Apple computer and well known to be a very good programmer, has said that he doesn't feel he can program as well as he did when he was younger, because he says he can't keep as much stuff in his head. So, that's one reason why computer programming seems to be more of a young persons' field.

Another thing related to the prefrontal lobes and normal aging is mental flexibility, which includes the ability to shift quickly between tasks. As one ages this becomes more difficult. Also, the ability to learn new facts and remember specific events declines. So, an older person is more likely to come back from an event and describe to you the general gist of what happened, rather than all the specific details that a younger person might describe.

So, you might say, 'Well, what's left?' Well, people remain surprisingly competent, including those in very demanding professions. And I'm going to explore why this is in a little while, but it seems to relate to the ideas of competence and wisdom, which I'm going to define shortly. But one of the goals of this podcast is to think about competence and wisdom in terms that correlate with actual brain function.

One important point that Dr. Goldberg makes in *The Wisdom Paradox* is that even a partial loss of mental powers does not spell cognitive doom. For one thing, most dementias develop very slowly and not all mild cognitive impairments progress to full-blown dementia. The key idea which he gives on page 55 is this: He says, "A mind equipped with a wide range of previously-formed pattern recognition devices can withstand the effects of neuroerosion for a long time." In the book there are a lot of historic examples that he uses to demonstrate this principle of how there have been many leaders of state in control despite some problems, and he thinks that this relates to Herbert Simon's claim that pattern recognition is the most powerful cognitive tool at our disposal.

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We've considered a little bit about what happens when we age, so now let's get back to the subject of pattern recognition and explore exactly what we mean. I mentioned the terms 'competence' and 'wisdom'. Dr. Goldberg defines competence as the ability to relate the old to the new; that is, to be able to recognize the similarities between a new problem and one that you've already solved in the past. In this book he defines wisdom as an enhanced capacity for problem solving, so in a way he's talking about cognitive wisdom. And he chooses to narrow it down this way because this is the aspect of wisdom that can be explored by neuroscience. So, in this context he's really describing wisdom as an extreme form of competence.

Both wisdom and competence are related in his mind to the idea of pattern recognition. Humans aren't the only ones that are capable of pattern recognition, but we are the only ones that can transmit patterns from generation to generation. And language is an example of this. Language is kind of odd, because not only is it an example of a tool of pattern recognition, but it's a means by which we transmit other patterns from generation to generation. In fact, he argues that our ability to form mental models of the future is the combined result of the development of our frontal lobes and of language.

I think that he would probably argue that our prefrontal lobes are just as important to our humanness as language, even though language in the past has pretty much gotten all the credit. So, I'm going to spend a little bit of time talking about language in this context. Language shapes our cognition by imposing certain patterns on the world. In other words, it makes pattern recognition easier. Also, it gives us a mechanism for storing our collective knowledge. That's the reason why he regards language as an example of a pattern recognition device. It helps classify things; it helps us to know how to act with respect to them.

He also argues that the wisdom of the species inherent in language is neither genetic nor hard-wired, because it's flexible and it's still changing. Dr. Goldberg doesn't buy the arguments that the similarity of languages proves that they're hard-wired, and in this book he gives counter examples. Basically he argues that languages tend to be similar because they arise in similar environments. And if you're interested in the details of this argument you can find some of them at approximately around page 94 in the book.

With respect to Steven Pinker's argument that the rapid acquisition of language in young children implies a language instinct—that's the name of Dr. Pinker's famous book, *The Language Instinct*—Dr. Goldberg argues that the rapid learning in youth and the loss of this ability is not unique to language. Now, you remember in the past I had presented Dr. Pinker's view, which was that we have a window for learning language and it kind of passes us by. Well, basically what Dr. Goldberg is saying is that we have this enhanced ability to learn new things when we're very young, and it's not just language that it applies to.

We discussed in the last episode the evidence that language is distributed throughout the neocortex, so it really seems to be more emergent than hard-wired. Dr. Goldberg argues that language is a product of very complex but relatively general-purpose neuronal networks in the human brain. And this viewpoint seems to be becoming more common, it seems to me, based on the books that I've been reading recently. He's not saying that the brain structure doesn't have any impact on language, but he's saying that it sets limits on complexity rather than the specific content. On a practical level language is very important with regards to intelligence. It is sometimes said your intelligence is only as good as your language.

Coming back to the whole question of pre-wiring, it really appears that the brain is pre-wired for certain kinds of knowledge and not others. And so, there are older parts of the brain that really are pretty much pre-wired; like certain neurons in the visual cortex that will respond only to certain angles, for example. But the newer, more complex cortical structures have very little pre-wired knowledge, but they also have a great capacity for learning. And so, basically he's arguing that language is an example of this sort of process rather than a pre-wired process.

I think there's still controversy on this issue. But in terms of learning, one way to look at it is that it's like having a computer than can add new software. So, he says we can think of the ability to form increasingly complex attractors for pattern recognition as the ability to add new software with an open-ended capacity that allows us to deal with complexity of any nature.

Dr. Goldberg argues that the pattern recognition capability of the most advanced regions of the cortex is emergent, because this capability emerges from the brain. This idea of emergence is one that you're probably going to be hearing more about in the future. From Dr. Goldberg's point of view the key idea is that the brain has become less hard-wired and more open-ended and open-minded, and that this corresponds to its transition from a modular structure to one of continuous distributions, or gradients—again, what he called the gradiential principle.

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Welcome back to the *Brain Science Podcast*. I'm your host, Dr. Ginger Campbell. We're talking about the book, *The Wisdom Paradox*, by Dr. Elkhonon Goldberg. I've introduced the idea of pattern recognition, so now I want to talk about how this relates to memory, because this is another key idea in this book because he is arguing that pattern recognition results in a different kind of memory that is less vulnerable to aging and disease. He calls this generic memory, which just means a memory for patterns. A key idea is that wisdom is intricately linked to this generic memory.

Let's review a little bit about what we know about memory. We know that most, if not all, memories are stored in the younger neocortex. Some depend on subcortical structures, and these are more vulnerable. Remember that forgetting is normal. Most unimportant things are forgotten very quickly. Now, when people have damage that causes amnesias these usually reflect damage to the memory-forming parts of the brain rather than the places where the memories are stored, because the memories are stored in the same structures that originally processed the information. So, the perception of a thing and the memory of it share the same neurons.

It's usually damage to the hippocampus, which is related to the laying down of long-term memories, that causes the amnesias that we have talked about in the past. And it is the hippocampus that is particularly vulnerable to dementia, even though that's not where the memories are actually stored. Ironically, since the hippocampus is not required for maintaining long-term memories, we see the classic appearance of dementia in which the person has severe short-term memory difficulties while still retaining good memory of the distant past.

Now, how does this relate to the idea of generic memories? Generic memories—or memories of patterns—are thought to have an increased chance of survival because they're constantly being stimulated—perhaps by reverberating loops. Their constant reuse is one of the things that makes them more robust. Now, how does this happen? Well, let's think about when we're learning something new. Isn't it true that you can learn the shared properties of similar situations more easily than the differences? Sometimes we have to really put our mind to thinking about what's different; the similarities tend to catch us immediately. This is where pattern recognition comes in.

Now, I'll give you an example of this principle. Take a small child, say a toddler, who's just learning how to talk. They commonly will lump cats and dogs together, and depending upon which word they learned first they might call everything dogs, they might call everything puppies. And then later on they learn how to tell the difference between cats and dogs, but they might call all dogs puppies, for example. And then eventually they learn how to tell the difference between cats and kittens, cats and dogs, and dogs and puppies. So, the pattern for what a dog is, for example, gets developed. So, that's an example of a generic memory. The basic idea is that the more generic a memory is, the better it's going to withstand decay, because these generic memories are thought to be the most stable type of memory.

Another aspect of memory that we've talked about in the past is the fact that there's a difference between the memory for how and the memory for what, and also a difference between episodic memory and semantic memory. And this relates to the context of learning. For example, you might know something like Paris is the capital of France—that's a semantic memory. You don't have any specific episode in your life that gives you that piece of information.

Obviously one person's episodic memory might be another person's semantic memory. For example, I was a little girl when John F. Kennedy was assassinated, and so for me the memory of his assassination and the weekend of his funeral, including seeing Jack Ruby shoot Lee Harvey Oswald—which was actually on TV

—all of that is part of my episodic memory. However, those of you that were born after that event, or perhaps live in a country where that was not an important event, for you that would be a semantic memory.

At the same time let's consider 9/11, a more recent event and therefore one that belongs to the episodic memory of a lot of people who weren't alive at the time of JFK's assassination. Yet, there are going to still be those of you who were unaware of the events at the time of 9/11. For you even 9/11 would be a semantic memory. So, semantic memories are stuff that you know but that you didn't actually experience in any way.

One way that Dr. Goldberg began to appreciate the role of generic memories happened because he was taking care of a patient, who he calls Steve, who suffered a severe head injury and he had severe retrograde amnesia for the events of his life. Now, in general in these situations you don't really expect to have much of a loss of semantic memory. But he actually did have a pretty severe semantic memory loss, but his generic memories were intact. The studying of his case really showed up that these were different and that this kind of difference was not uncommon.

I need to give you an example—and this is really from the book—of a singular memory. The kind of thing that would be something he would have lost would have been like Paris is the capital of France. That's a single memory, but it's still semantic. Whereas he remembered stuff like tomatoes are usually red. That's a generic semantic memory. This suggests that maybe we need to look at memory in a slightly different way than we have in the past.

The usual way of breaking down memory is to break it down into procedural—how to do stuff—and declarative, which is things you could put into words. And then you take the declarative memories and you break those down into semantic and episodic. Now, if we're going to take into account the existence of generic memories—or patterns—then we have two main classifications. We have generic memory and we have singular memories.

Within generic memories, now, we're going to have procedural—which is how to do stuff—and we're going to have generic semantic. And that's going to be stuff like tomatoes are usually red. Then under singular we'll have episodic—which is stuff that happened to you—and singular semantic, like Paris is the capital of France.

Don't worry if you can't keep all that straight. The main thing to remember is that the generic memories are the ones that are relatively invulnerable to loss. And that's the key idea, that generic memories are more stable and less vulnerable.

Now, an example is the meanings of words, which would be a generic semantic type memory. This is important, obviously, because the meanings of words is the basis of our linguistic competence. Well, that, like I said, is an example of generic memory. And it's also an example of the kind of memory that is usually preserved.

Both language and higher perception appear to be based on generic memories. In order for them to be lost there needs to be direct cortical damage. They are not going to be affected by damage at the subcortical levels. Most important for our discussion, these are the types of memories that are resistant to the effects of normal aging. They're even somewhat resistant to dementia.

So, how do you get these generic memories? Well, he says, "Frequent exposure to a particular kind of mental task speeds up the formation of a robust long-term representation of the task." Repetition and using those memories really seems to be a big part of getting them into the generic and resistant-to-decay category.

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Generic memory is our first line of defense against the ravages of aging on our brain. What are the other protective mechanisms? There are two other mechanisms that have been uncovered by means of neuroimaging. He calls these 'pattern expansion' and 'effortless experts.' Pattern expansion just relates the fact that with practice and experience and repeated use, brain areas dedicated to a particular function get bigger. They expand into the adjacent cortical areas. Remember we already talked about how a violin player gets an increased representation in the cortex for the fingers on the left hand. So, this phenomenon of pattern expansion has been proven for motor functions, and it probably applies to cognitive functions.

Now, obviously the bigger the cortical areas devoted to a particular function, then the more resistant it's going to be to decay or damage. This might be the explanation for the mental clarity that was seen in the famous nuns from Notre Dame—the ones that seemed to be very mentally sharp, even though on autopsy they had signs of pretty severe Alzheimer's disease. This principle of pattern expansion may also partly explain the professional competence of aging doctors, lawyers, and engineers. They've used a large part of their brain for their profession and so that area is relatively resistant to damage because it's bigger.

Related to this is what he calls the effortless experts. And that relates to the fact that with practice and experience the neural tissue performing a particular task has lower metabolic demands. Have you ever noticed the fact that when you're really tired you can still do stuff that's familiar, but if you try to do a new task it can be very hard or almost impossible. And this change is also reflected in the changes in blood flow seen on neuroimaging. In fact, that's kind of the basis of the whole idea.

I think I mentioned in the past that this is also something of a barrier in doing studies because when somebody is doing something that is really familiar to them it may not show up as much blood flow on a scan. However, this is an important principle in aging because, remember that in aging the blood flow goes down. So, anything you can do to reduce the metabolic demands of the brain is going to help it to function better, even though there's less blood.

So, we have these three protective mechanisms: generic memories, pattern expansion, and effortless experts. And they can counteract the effects of degenerative and vascular brain disease for a long time, sometimes even up to a decade or two.

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One way of looking at wisdom is to think of it as being a condensation of years of experience to the point that some decision-making becomes almost automatic. As our repertoire of patterns grows as we age this helps to compensate for the diminished ability to solve problems the hard way. What about our prefrontal lobes? We know that this is where the knowledge of how to do things and how to solve problems tends to be stored, and that our prescriptive knowledge, i.e., what to do, is very dependent on the prefrontal lobes.

Well, what about aging? We've talked about the fact that the prefrontal lobes are the most susceptible to the effects of aging. Fortunately it turns out that although this is true, the executive generic memories are relatively invulnerable. These memories allow us to find solutions based on similarities to previously solved problems using rapid pattern recognition. Even so, it seems obvious that the healthier one's frontal lobes are, the better one's mental functioning will be as one gets older.

One thing that we will notice is that when decay does happen in the prefrontal lobes it's more likely to affect the ability to solve truly novel situations. What's novel or familiar varies from person to person. One of the things we're going to talk about last in this podcast is the fact that there is evidence that mental activity and mental exertion will actually help to strengthen these underlying neural tissues to help preserve them.

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First I need to talk about the significance of the right-to-left shift that we introduced in the last episode. Basically the hypothesis is that throughout life there's a shift of cognitive control from the right hemisphere toward the left as novel experiences are converted into familiar patterns. I'm not going to go back over the supporting evidence for this. Instead what I'm going to do is concentrate on the emotional component of this right-to-left shift, because this is the aspect we haven't talked about yet.

Remember that we said that the right hemisphere has a role in novelty. Well, what does this mean from an emotional perspective? What drives the search for a novel solution? Isn't it being dissatisfied with what you've got, or the current solution? It turns out that we know that this actually has a biochemical basis.

The right hemisphere is dominated by different neurotransmitters compared to the left. It tends to be dominated by norepinephrine, whereas the left is dominated by dopamine, the neurotransmitter associated with reward and pleasure. And in contrast, norepinephrine has been shown to drive restless exploration in lab animals. So, norepinephrine appears to mediate both negative emotions and exploratory behavior.

Another neurotransmitter that we've talked about in the past is serotonin, and it looks like decreased levels of serotonin cause both depression and cognitive inflexibility—difficulty with new situations. This reminds us that cognition and emotions are very closely linked. When we talked about emotion in Episode 12 we saw that the amygdala drives the rapid, or hard-wired, emotional response—like the immediate sense of fear you feel when you see a snake, or something you think is a snake—while the frontal lobes control the emotional response that's based on cognitive analysis; you realize it's not a snake, it's a stick.

This information can be related to the difference between individual cognitive styles. You might predict, based on what I've just told you, that a quest for exploration, novelty, or innovation ought to go along with dissatisfaction with the status quo. And that's pretty much the way it is. It's usually the people that just feel sort of restless where they are that go off to the new frontiers.

He named this chapter "Magellan on Prozac" to sort of highlight the idea, what if somebody like Magellan or Columbus had been taking Prozac or a similar drug. Would they have just been happy to stay home? We could really get into some interesting questions about the side effects of the drugs used for treating depression. And there have been people who have reported that one of the things that happens when they take antidepressants is that they just feel no drive to do anything anymore, even though they're not depressed.

Now, it doesn't affect everybody this way. In fact, people that are very, very severely depressed lose all their drive to do stuff, so for them antidepressants actually help them to restore their drive to do stuff. So, it's very complicated.

But lets' get back to what happens as we get older. Typically our emotional tone changes. It appears that the amygdala becomes less active in response to emotionally negative stimulus, but its response to positive stimulus stays the same, so that people tend to become more mellow and more at peace with themselves. So, an important point here is that geriatric depression is not normal.

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What I want you to remember is that the shift from the right to the left as we age involves both cognition and emotions, which again emphasizes that emotion and cognition are inseparable aspects of our mental life. In general, in youth we tend to be dissatisfied and driven by novelty and the need to change the world. Later on we mellow out, and hopefully we begin to appreciate what we do have. Obviously there is a trade-off between these two traits, and there are those that remain driven to innovation throughout their lives.

Now, how does this difference between the right and left hemispheres relate to aging in terms of what happens to the brain as we age? Is there a difference between the aging process on the two hemispheres? And what is the implication of this lifelong shift from the right to the left? At this point we have to return to the topic that we talked about in great detail in Episode 10, which is the idea of neurogenesis.

Until a few years ago it was believed that you could not get new neurons as an adult, but we now know that we do have new neurons forming throughout life. And it has been shown that activity very much influences where these new neurons end up. You may recall we talked about how rats in an enriched environment would get more new neurons in their hippocampus. So, this would imply that mental activity might influence where the new neurons that we get go. And it turns out that even people with Alzheimer's disease have new neurons forming.

So, you would think, does what I work on or practice affect where the new neurons go. And the current evidence seems to indicate that the left hemisphere is the key beneficiary of the positive effects of practice. And this has been demonstrated with activities as diverse as language, or, something completely different, juggling. It appears that not only does the right hemisphere decay more as we age, but the older we get the more the left hemisphere benefits from mental exercise.

I'm going to be interviewing Dr. Goldberg in a few days, and one of the questions I intend to ask him is, is there anything we can do to help build up or maintain our right hemisphere. But the key idea, of course, is that the areas that are built up by mental exercise should withstand the ravages of both aging and disease longer.

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The final question is what should we do, since I would assume that we all want to have the most healthy active brains for the longest part of our lives as we can. Well, first of all it's been well established that physical activity is beneficial, both to stimulating neurogenesis and general brain health. Another thing Dr. Goldberg points out is the benefit of art. He says that this provides an excellent way to exercise the mind in an open-ended way. So, think about that the next time you see a senior taking up a new hobby such as painting or playing a musical instrument. They're actually doing something that is going to be very good for their brains.

Dr. Goldberg has also developed a cognitive enhancement program. And I'm going to talk to him about this in some detail when I interview him. Now, this program is both for people who do have some problems and for those that are healthy, wishing to maintain. There are different aspects to this program. One, it involves working on your weaknesses. And in the book he refers to the work of Dr. Edward Taub, who we've talked about in the past for his pioneering work with helping stroke patients by forcing them to use their affected limbs. On the other hand, sometimes we need to be reminded to focus on what we can do, instead of what we've lost. And so, another aspect of cognitive enhancement involves reconnecting people with their abilities.

[music]

The main theme of this episode is that as far as our minds go it's not all downhill. There are certain mental gains, and this book shows that they have a clear neurobiological basis. Dr. Goldberg argues convincingly that years of vigorous and rigorous mental activity help provide us with what he calls a "mighty coat of mental armor" for our later years.

But competence and wisdom are not automatic; they are the condensation of years of mental activities. So, it's very important that we continue to test our minds and to strive for new mental challenges, because as he says, "The mental comfort zone is the mental stagnation zone." This caused me to reflect on the fact that it is very tempting as we get older to stick to activities that are familiar. For example, if you're already really good at crossword puzzles, they're comfortable; they are not really as mentally stimulating as learning something new.

But I think, based on what Dr. Goldberg has taught us, we should all look for opportunities to learn new things, even if it means that we have to go through the discomfort of feeling stupid; and even, if we're a little bit older, the fact that we can't learn new stuff as fast as we used to. I think he has argued convincingly that it's worth the effort, because it's going to pay off for us years down the road. And I, for one, am really interested in learning even more about this.

On the other hand, he also says—and I agree with him—that mental laziness in youth endangers your brain in old age. Vigorous mental activity should not come to a halt at any age. Dr. Goldberg is advocating an approach to lifelong mental fitness. So, basically I think that he is saying that we need to start to think of our mental health as being similar to our physical health; as something that we need to exercise and build up so that we'll be able to withstand the ravages of aging when we do start to get older. Dr. Goldberg concludes on page 291, "Aging is the price of wisdom, but wisdom itself if priceless."

[music]

OK, so let's just briefly summarize what we have talked about today. Cognitive wisdom means being able to use our lifetime of stored patterns to solve problems faster and with less energy. While we become less able to learn and retain new material, it is probable that by continuing to push ourselves into new challenges we will protect our prefrontal lobes, and maybe even our right hemispheres, from some of the effects of aging.

One aspect of continued mental health is challenging our minds on a regular basis, and also learning to appreciate the skills we have acquired, instead of moaning about what we have lost. And hopefully as this area gets more research there will be more appreciation for the cognitive value of wisdom, and elders will be treated with more of the respect that they deserve.

[music]

I hope you found today's episode interesting. And I really think it's one that has information that we can use in our personal lives, especially when we're making decisions about what kind of mental challenges we want to undertake. It certainly has made me look at these issues in a different light. The next episode is probably going to be an interview with Dr. Elkhonon Goldberg, and that should be out in a couple of weeks.

As always, I invite your feedback. You can send me email at docartemis@gmail.com. You can also post comments at the website brainsciencepodcast.com and at the forum which is at brainscienceforum.com.

Don't forget, if you enjoy audiobooks, to go to the website brainsciencepodcast.com and click on the Audible.com ad on the upper right-hand side of the page, where you can get a free audiobook download.

And don't forget to check out the latest episode of *Books and Ideas*, my other podcast. If you aren't subscribed to this podcast you can find it at booksandideas.com. Last week I put up a discussion of the question of free will, and there is a discussion and response to this episode already started at brainscienceforum.com. So, I hope you'll listen to that episode and let me know what you think.

There will be a new episode of *Books and Ideas* coming up probably within the next two weeks. It's going to be a discussion of the latest Harry Potter book, which you'll be able to listen to even if you haven't read it. It will be spoiler-safe. And also I am planning to have a surprise guest on that podcast. So, I hope that you will check that out also.

Finally, if you're new to the podcast and you aren't a subscriber I hope you will consider subscribing to the *Brain Science Podcast*. You can subscribe via iTunes, or you can go to brainsciencepodcast.com where I have links for subscribing, not only via iTunes, but also via RSS reader, podcatchers, and even by email. And I hope you will also tell others about this podcast and encourage them to become listeners.

Thanks again for listening. I look forward to talking to you again soon.

[music]

Transcribed by Lori Wolfson
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