BRAIN SCIENCE PODCAST

with Ginger Campbell, MD

Episode #42:

On Being Certain

Aired July 25, 2008

This is the Brain Science Podcast. The podcast for everyone who has a brain. And I'm your host, Dr. Ginger Campbell. On the Brain Science Podcast, we explore how recent discoveries in neuroscience are unraveling the mysteries of how our brains make us who we are. For more information, including show notes, links to previous episodes, and information about how to subscribe, please go to the website: brainsciencepodcast.com. We also have a discussion forum at brainscienceforum.com, and you can send me e-mail at docartemis@gmail.com.

[music]
Welcome back to the *Brain Science Podcast*. This is episode 42. Today's episode is a discussion of the book by Robert Burton, *On Certainty: Believing You Are Right Even When You're Not*. This is the first part of a two-part discussion. The next episode will be an interview with the author, Dr. Robert Burton.

As usual I'm saving most of my announcements for the end of the podcast, but I'd like to mention that there's a special promotion going on regarding the audience survey. As many of you know, my podcast is hosted on Wizzard Media, and the audience survey is important to getting advertising. Between July 15 and August 31, 2008, if you do this survey you will be eligible to win a free iPod Touch. Even if you don't want an iPod Touch I hope you'll do the survey. The address is wizzard.tv/survey/brainsciencepodcast. Wizzard is spelled w-i-z-z-a-r-d. There's also a link on the website if you'd rather just go and click on that link. And I want to thank everyone who has done the survey and hope that those of you who haven't will take the time to do so. It only takes about five minutes. It's boring, but it doesn't take very long. And your feedback is very much appreciated.

[music]
One of the subjects that we talked about quite a bit last year especially on the *Brain Science Podcast* is the role of unconscious decision-making. Things that go on in our brain that aren't accessible to our conscious awareness that involve our choices and decisions. In this episode we are going to be considering a new book by Robert Burton, MD called *On Being Certain:*

Believing You Are Right Even When You Aren't. Dr. Burton is a neurologist at the University of California in San Francisco, and he's also published three novels.

This book takes a slightly different look at the role of the unconscious, especially the focus is on what he calls "the feeling of knowing." In his preface Dr. Burton opens his book with this line: "Certainty is everywhere." After giving numerous examples, he says, "But modern biology is pointing in a different direction. First of all there's the myth that we know what we know by conscious deliberation." He spends the first part of this book explaining how unconscious parts of our brain create our sense of certainty. He says, "I have set out to provide a scientific basis for challenging our belief in certainty." He acknowledges that this will also show the limits of scientific knowledge. Dr. Burton says, "My goal is to strip away the power of certainty by exposing its involuntary neurological roots. If science can shame us into questioning the nature of conviction, we might develop some degree of tolerance and an increased willingness to consider alternative ideas."

The theme of this book is the feeling of knowing and where it comes from. We all know this feeling which Dr. Burton calls "the feeling of knowing." For example, when you know the answer to a question but you can't think of it right off but you know you know- that's the feeling of knowing. Or when you're trying to figure out something like an equation and suddenly it all makes perfect sense, that "aha" moment is the feeling of knowing. Of course, sometimes we recognize it more by its absence. To illustrate this, I'm going to read you a paragraph from page 5:

"A newspaper is better than a magazine. A seashore is a better place than the street. At first it is better to run than to walk. You may have to try several times. It takes some skill, but it is easy to learn. Even young children can learn it. Once successful, complications are minimal. Birds seldom get too close. Rain, however, soaks in very fast. Too many people doing the same thing can also cause problems. One needs lots of room. If there are no complications it can be very peaceful. A rock will serve as an anchor. If things break loose from it, however, you will not get a second chance."

What do you think he's talking about in this paragraph? Feel free to stop this podcast for a minute and think about this.

[music]

So now what if I tell you a single word? The word "kite?" Now go back and play that last bit again and see how much different it seems. For example, the sentence "At first it is better to

run that to walk" has an entirely different meaning when you know that we're talking about flying a kite. A key idea here is that the feeling of knowing makes contemplating alternatives difficult. Can you go back to hearing this paragraph as you did before I gave you the word kite? Burton's book *On Being Certain* explores the neural underpinnings of this feeling of knowing.

How do we know what we know? There can be a mismatch between what we consciously think we know and what we actually know. Burton starts exploring this principle by asking his readers to remember where they were either when President Kennedy was assassinated, when the Challenger exploded, or when the attacks of 9/11 happened. So you can think back on those three things. It may be that if you're young you'll only remember 9/11. The strange thing is that people will have very different memories about where they were on these events, even if they compare them to people that they were actually with at that time.

There's a study called the Challenger study that actually demonstrates this. This study was done by a scientists named Ulric Neisser, who was studying the kind of memories people have for highly dramatic events. So within a day of the Challenger explosion he interviewed 106 students and he had them write down exactly how they heard about it, where they were, what they were doing, and how they felt. Two and a half years later, he interviewed them again and he found that for 25% of them their second account was significantly different from their original journal entries. In fact, more than half the people had some degree of error and less than 10% gave all the details exactly the same as they had originally.

Even so, before they saw their original journals, most of them were certain that their memories were absolutely correct. In fact many of them, when confronted with what they had originally wrote down, still had a high degree of confidence in their false recollections- even when faced with journals in their own handwriting, because they just felt that their current memories were correct. In fact, there was one student who said, "That's my handwriting but that's not what happened." And lest you think that this was an isolated incident, there have been plenty of other documented cases. You can do it yourself, as Burton did, when he asked several of his medical school classmates where they were on the day Kennedy was killed, which apparently was when he was in medical school. And he got a similar sort of reaction. As this Challenger study shows, it's one of the many example of people consciously choosing a false belief because it feels correct.

This is an example of what is called *cognitive dissonance*, which was a term coined back in 1957 by Stanford professor Leon Festinger. He defined cognitive dissonance as a distressing mental state where people find themselves doing things that don't fit with what they know, or

holding opinions that don't fit with other opinions that they hold. The key idea is that the more committed we are to a belief, the harder it is to relinquish it, even in the face of overwhelming evidence. We tend to go with what *feels* right, no matter what the evidence. And I'm sure if you think about it you could think of an example of this from your own life.

So what causes the feeling of certainty? And what could be the advantage of an unjustified feeling of knowing? Where does this feeling of certainty come from? There's pretty good evidence that it must be coming from someplace in the brain, because there are some medical conditions where the feeling of knowing gets distorted, like in the condition where the person feels that his loved one has been replaced by an impostor. And that's because they have lost the feeling of knowing that person, even though they can logically say, "Yeah, it looks exactly like them." Or it sometimes involves something like a piece of furniture that they think has been replaced and they'll say, "Yeah, it has all the exact qualities but it's just not the same piece of furniture." Now this has been seen in several different patients and they didn't have the same brain lesion. But what they did have in common was that they all tended to choose in favor of what they felt and they would come up with tortured logic in order to do so.

This leads to the question: why does our physiology seem to be weighted in favor of feeling over logic? Apparently, conviction isn't really a choice. As Burton points out in his book, studies of blind-sight demonstrate that knowledge and the awareness of knowledge arise from different regions in the brain. In the case of blind-sight, people have damaged the part of the visual that allows them to see or have conscious awareness of vision, but visual information goes to other parts of their brain and they are able to act in ways that show that this visual information is actually reaching other parts of their brain even though they have no conscious awareness of being able to see. In the book he considers some other examples such as the physiology behind mystical experiences and the effects of certain drugs.

What about the emotional element of certainty? This seems to be rooted in older parts of the brain, including the cingulate gyrus, amygdala, hippocampus, hypothalamus, and basal forebrain structures. These are the areas that have, in the past, been called the limbic system. Joseph LeDoux is the one that's best known for figuring out the role of the amygdala in fear. He did experiments with rats where he pairs a sound and a shock. And he showed in these experiments that there is an acoustic pathway that actually by-passes the auditory cortex.

The way that he did this was that he showed that if you cut the acoustic nerve, there will be no fear response. But if you remove the auditory cortex itself, it doesn't have any effect on the fear response. In other words, the rat doesn't have to be aware of the sound to feel fear. This establishes that the amygdala has a role in the fear response that does not require any

conscious awareness or recognition of the stimulus. In another experiment they showed that if the amygdala is destroyed, the animals are totally fearless, showing that the fear response really does not require conscious awareness.

Antonio Damasio has done a lot of work with emotions in human patients, and he has had similar results, basically, from studying patients with brain damage to certain areas that show that even in people the amygdala is necessary for the expression of fear. In fact, people that have damage to their amygdalas are fearless to the extent that they often will be observed to act in very foolish ways- because we actually need fear to help us to make good decisions in certain situations.

Similarly, it's been discovered that seizures that involve some of these so-called limbic structures can cause things like a sense of something familiar or deja vu, or the sensation that things are totally unreal so that they feel like a dream. Burton points out that he is not claiming that the limbic system is the source of our sense of knowing. His point is that our sense that something is familiar or real is not a conscious conclusion, because it's coming from lower parts of the brain that we do not have conscious access or control over.

Does that mean that the feeling of knowing is an emotion? Well, Burton quotes Antonio Damasio as saying that deciding what constitutes an emotion is no easy task. Something like fear might seem to be straightforward, but if we look at something like gratitude- which we would generally consider an emotion- we don't really observe that gratitude disappears with any particular known brain lesion, nor can gratitude be elicited by stimulating a certain part of the brain. Another example is surprise, which is not easily elicited by stimulating the brain.

So how should we approach this feeling of knowing? Burton concludes that we should regard mental states as sensations. He says this reflects the physiological truth that they come from the relatively discrete output of local neural structures, just like vision comes from the sensory output from the eye.

Then there's a practical reason, which is that regarding mental states as sensations recognizes that they are subject to the same principles as other sensations. For example, if you cut a nerve to your finger, you can't will it not to feel numb. A person who has obsessive compulsive disorder, for example, can't will the feelings that drive his compulsion to disappear. We can't will ourselves to have the feeling of knowing or to get rid of it when the feeling contradicts what appears to be logical. This is basically saying that just like sensations like vision really aren't under our conscious control, neither are many mental states.

This approach to mental sensations also recognizes that the most elemental ones are those feelings and emotions that are universal and deeply embedded into our neural circuitry like fear. There are others that are more complex and include inputs from higher centers, just like, for example, the emotion gratitude is a more complex emotion than the emotion of fear. So then you would put some thoughts into a more complex group. He's arguing that when it comes to the feeling of knowing, this is one that is universal and it's deeply embedded in our neural circuitry, as shown by the fact that we have no conscious control over it.

On page 40, he makes this bold but important claim: "By using these criteria of universality, relatively discrete anatomical localization, and easy reproducibility without conscious cognitive input, the feeling of knowing and its kindred feelings should be considered as primary as the states of fear and anger. At this point we may not be able to figure out exactly where in the brain the feeling of knowing is generated, but we definitely have overwhelming evidence that it is not under conscious control."

[music]

To sum up where we are so far: we've reached the conclusion, based on the evidence, the feeling of knowing is a primary mental state. It's not dependent on any underlying state of conscious knowledge. This conclusion is important because it determines how we might try to model the role of certainty in the hierarchical organization of the brain. If we're going to look at the hierarchical organization of the brain and regard it similar to a neural network, then we have to also understand the key elements that govern the brain's hierarchical structure. Then if we understand where the contradictory aspects of thought collide, we'll be able to see why Dr. Burton says, "Certainty is contrary to basic biological principles."

So looking at the brain from the point of view of neural networks, he points out some basic facts first. 1) at the level of the neurons, the action is at the synapse, which we have talked about many times in the past. At a synapse, there are at least thirty different neurotransmitters that are involved in neuronal activation. The dendrites receive inputs and they participate also in feedback loops. In the end, a neuron fires or it doesn't. A key idea here is that at the point that it fires, you lose all the information that was added up to decide whether or not it fires.

This brings us to an important concept that he talks about in the book, which is the idea that there's a hidden layer that's inaccessible to our consciousness, and why this inaccessibility cannot be overcome. To give an example of a hidden layer, okay, say you buy a book on Amazon.com. If you've ever done this, you know that it automatically- the website

automatically tells you, "Well maybe you'd like these other books." Okay, it has some algorithm that it uses to generate its suggestions about what other books you might like. But you don't have any access to how it did that. That's an example of a hidden layer. In the case of consciousness, the irony is that even though we don't know how consciousness occurs, we know from a conceptual standpoint that it has to arise from a hidden layer of neurons. The thing is you cannot tell from the output what happened in the hidden layer. This is important and I will come back to it.

This brings us to the principles of modularity and emergence. Burton defines a module as a cluster of highly individualized neurons specific to a specific function. For example, there are at least thirty discrete modules devoted to vision. Some of these have been discovered just because of what happens when they're damaged. And these modules are anatomically discrete. On the other hand, if you look at individual neurons, they're pretty similar no matter what part of the brain you look at. There's a few different kinds, but there are no such thing as "super neurons." So we need the concept of emergence, which he describes as follows: "Consciousness, intentionality, purpose, and meaning all emerge from the interconnections between billions of neurons that do not contain these elements." This is from page 59. He concludes, "Modularity combined with a schematic hierarchical arrangement of increasingly complex layers of neural networks and the concept of emergence serves as an excellent working model for how the brain builds up complex perceptions, thoughts, and behaviors."

I guess the easiest way to think of emergence is the old saying, "The whole is more than the sum of its parts." But when it comes to the idea of modularity, Burton warns that if you try to apply it to behavior it can lead to excessive reductionism, because there aren't really well-defined, discrete collections of neurons that are committed to behavior like there are for things like vision. With behavior what we're looking at is widely separated but interconnected neurons. So I guess that would make them more like functional modules in some sense, but not necessarily discrete modules.

For example, when we talked about what happens when we learn to read- this involves a number of different cortical centers that probably first evolved for other types of visual recognition. Also we've talked about in the past that no universal grammar module has been identified.

Dr. Burton concludes that the feeling of knowing is universal and probably generated by a local region in the brain, because it can be generated by direct stimulation or chemical manipulation. And we've already demonstrated that we don't have conscious control over it. However, in an e-mail he did acknowledge that the precise localization of where this comes

from has not yet been accomplished.

[music]

So far we have claimed that the feeling of knowing is generated in a hidden layer of the brain in the sense that it is not accessible to our consciousness or to our control. So that brings us to the question of: when does a thought begin? Now when it comes to the feeling of knowing, what is its relationship to thought? Dr. Burton talks about several different scenarios. One scenario would be when you have the feeling of knowing without an accompanying thought, such as during a mystical experience. Another scenario would be when the feeling of knowing and the thought reach conscious awareness simultaneously, as in the "aha" moment. And then there's the situation where you encounter an idea and objectively determine it to be correct, such as when you're looking for your friend's house and he answers the door so you know for sure that you're at the right house. Whether or not we should unconditionally trust our feeling of knowing really depends on which scenario has occurred.

Why do we get the feeling of knowing without it being proven? There are a lot of situations where we have to act without sufficient information. Take, for example, if you're hitting a fastball, or returning a tennis serve. It's been proven that the player has to start his swing before he can actually pick up the path of the ball. Yet players feel absolutely sure that they saw the ball, even though it is physiologically impossible.

Burton says, "If the brain did not somehow compensate and project the image of the approaching ball back in time, you would see the ball approach *after* you hit it." He says that the window of time required to process sensory data before it's perceived is what allows the brain to create a seamless world of now. Research indicates that these backward projections can be as long as 120 milliseconds. On page 75 he says, "The basic neurophysiological principle is that the need for immediate response time reduces the accuracy of perception of incoming information."

And he mentions that even though most people don't engage in high-speed sports, we do the same sort of thing every day when we engage in everyday speech. We really pretty much, to a certain extent, are anticipating what people are going to say before they say it. So we fill in little gaps and stuff, which is one of the reasons why it's so hard to create accurate speech recognition with computers.

With an example such as the baseball player thinking he saw the ball that he could not have seen, we can see how the subjective backward referral of the feeling of knowing can lead to

erroneous conclusions. A key idea in this book is that these sorts of temporal illusions can occur over much longer time spans. When we ask the question, "When does a thought begin?" Well, the basic fact is that thoughts are inaccessible to standard scientific measures until they reach consciousness. So it might not be that easy to determine the relationship between the feeling of knowing and our thoughts. The key idea here is that our internal brain time may not be an accurate reflection of external time.

This is an area I definitely want to explore further next time when I interview Dr. Burton. But I'll give you another practical example of this. I like to play tennis, and one of the ongoing controversies in tennis is lines calls. When you're playing a recreational level match, you don't have any lines judges and your opponent basically calls the lines on your shots to his side. One of the problems is that in reality, you can't see the ball bounce. Basically what your brain has to do is it has to take the information about the speed of the ball and its trajectory, and sort of create the impression in your mind that you have seen it bounce. I mean, you really think you have seen it bounce, even you experiments repeatedly show that it is physiologically impossible to see something of this sort of a duration. The thing is, the feeling that you saw the ball bounce is entirely convincing. And that's the whole point. Our brain makes us believe that it knows things that it can't really know.

Let's return for a few minutes back to the issue of people having different memories of shared events. You may recall way back when we first talked about memory, I think actually this was in episode 12, we talked about the difference between episodic and semantic memory. Semantic memory is the memory for facts, and episodic memory is the memory for events that one experiences. And we talked about how those episodic memories are very dynamic. They change over time according to what else we experience. And the thing is, even though we know this- or at least those of us who've read about this know that- we don't really believe that our memories are as fragile as they really are. As Burton says, he says, "We cling to our belief that our pasts approximately correspond to our memory." And if you're interested in learning more about how our memories can be so inaccurate, you might want to look at the work of Daniel Schacter, including his book *The Seven Sins of Memory*. I'll link to that in the show notes.

Burton suggests that we note a distinction between semantic thoughts- the kind that require memorization of facts- and those thoughts that arise from the complex computations of hidden layers of neurons, which means like episodic memory. Those kinds of thoughts are constantly changing. He calls these "perceptual thoughts," because he says that he thinks that trying to call them "episodic thoughts" would be cumbersome.

In his terminology, the term "perceptual thoughts" refers to the thoughts that result from complex computations outside of our conscious awareness. And one of the things about using the word "perceptual" is it does bring in the fact that there can be illusions. I mean, we know that we can have illusions of our visual perception that can be caused by various things. And really that's kind of the point he's trying to make, I think, with this term "perceptual"- is to realize that the stuff that's going on outside of our conscious awareness not only can change the thoughts, but it can cause us to be misled.

[music]

I want to take a moment to remind you about my ongoing sponsorship from Audible.com. You can get a free trial of audible.com by going to audiblepodcast.com/brainscience. I looked and Dr. Burton's book is not on Audible yet, although a lot of the titles that we have talked about on previous episodes *are* available as audiobook. Right now I'm listening to a book called *Fooled by Randomness* by Nassim Nicholas Taleb. This book actually complements some of the ideas of Dr. Burton's book. If you're interesting at all in using Audible.com, I hope you will go through my page link. I've been using Audible since 2003 and I definitely think it's worth it if you like listening to audiobooks.

[music]

Earlier on I asked the question, what would be the possible benefit of a feeling of knowing that is actually false. This brings us to a consideration of our brain's reward systems and how they interact and influence our thoughts. We know that there are extensive connections between the pleasure reward systems, emotions, and the opioid peptides in the brain. We- I think- have talked about in the past the mesolimbic dopamine system, which is a key component of the brain reward circuitry that originates in the upper brainstem. It, not surprisingly, seems to use dopamine as its key neurotransmitter. This mesolimbic dopamine system connects to parts of the brain that are involved in emotion and cognition, including parts of the frontal lobes and the nucleus accumbens, which is thought to be involved in addition. It's been shown that brain-mediated rewards cause behaviors to persist, including addictions.

So you have to wonder, how does this relate to the feeling of knowing? Dr. Burton gives the example in the book of a person faced with a charging lion who climbs up in a tree and survives. After the person escapes, he has the feeling that he's learned something. And if you make these sorts of decisions repeatedly, you will probably have a positive feeling of correctness that becomes linked to that behavior. Dr. Burton argues that the feeling of knowing and feelings of familiarity and integral to learning.

Think about it- when we look at the world around us, what is the first thing we notice? We notice if anything is changed, which means that we're comparing it to what we expect things to look like. Dr. Burton sees the feeling of knowing as what he calls "thought's original yes-man." But the thing is, this feeling of being right that was associated with simple choices- now we have thoughts that are much more complex and we often face questions that have no clear-cut answers. In fact, often we can't ever know for sure if the choice was the right one. Yet our brain reward system still requires a signal- we have to feel that the thought is worth pursuing before we have any supporting evidence or justification. If we were focused on the uncertainty, we'd be stuck or paralyzed.
It seems reasonable to assume that our brain reward system, including the part that relates the feeling of knowing, represents the result of evolutionary adaptations. Burton warns that these sorts of explanations may be overly simplistic since we really don't have any way of knowing what the original adaptation must have been. But it seems obvious that somewhere along the line, our brains, as he puts it, "stumbled" across the potential for abstract thought. And in order to do this there had to have been some sort of appropriate reward system.

I mean think about it- what keeps you going when you're working on a long-term project? We have to have some sort of conviction that our efforts are worthwhile. However, whatever psychological motive we invoke, it doesn't really address the underlying physiology of how our brains reward this kind of behavior. Burton proposes that the feeling of knowing was already part of the feedback reward system for learning. He says, "An unwarranted feeling of knowing might serve a positive evolutionary role." Note that he says "might"- he's not really making any unprovable claim.

Obviously the reward has to be strong enough to keep us going until our thoughts are verified. So that means that the feeling of knowing has to feel very similar to how we feel when we really do know something for sure. Burton suggests that there's a spectrum of bridging motivations, ranging from hunches, gut feelings, faith, belief, and profound certainty, and that these all contribute to the feeling of knowing. Bottom line is that we need some sort of reward so that the neural connections binding the thought and the sensation of being correct is gradually strengthened.

This strengthening happens with repetition and once the connections are formed, we know that they're difficult to undo. For example, Joseph LeDoux has shown with rats how persistent both fear responses and addictions can be. As Dr. Burton observes, once-established emotional habits and patterns of expectation and rewards are difficult to eradicate. He also argues that the same principle applies to thought, so that once we have a thought connected to

a feeling of correctness, it's hard to undo. He speculates on whether an insistence on being right might be similar physiologically to other sorts of addictions. He says, "Might the know-it-all personality trait be seen as an addiction to the pleasure of the feeling of knowing?"

Another idea that's hard to avoid in light of what we know about brain plasticity is the question of whether black and white thinking, such as the way schools emphasize the right answer, could mold the brain's reward system to prefer certainty over open-mindedness. Another element is the fact that just like people experience different levels of pleasure from things like alcohol, we might also experience differing levels of pleasure from the feeling of knowing. Our ability to accept uncertainty may reflect both our experience and our genetic makeup. Dr. Burton's conclusion is, "Any present day understanding of how we know what we know must take into consideration the contradictory nature of thought's reward systems. The feeling of knowing the reward for both proven and unproved thoughts is learning's best friend and mental flexibility's worst enemy.

I'm going to say that last line again- The feeling of knowing is learning's best friend and mental flexibility's worst enemy.

So what about the genetic component of the feeling of knowing? One of the points that Dr. Burton is really trying to make in this book is to dispel the misconception that since we each have what he calls an "innate sense of reason," we should be able to overcome our perceptual differences and see problems from some sort of optimal perspective. For example, twin studies have shown that genes appear to affect our interest in religion and spirituality. But of course as he reminds us, human behavior is exceedingly complex and you can't look at it as just a product of genes, as I have often said in the past. But in terms of the genetic component of behavior, the amygdala seems like a reasonable place to start.

Scientists have learned how to create what they call "knockout" strains of mice. In a knockout strain they knock out a gene for a particular thing and see what happens. So they have this strain of mice that lacks the ability to make stathmin, which is a protein that's normally found in high levels in the amygdala. And what they found was that these knockout mice are very difficult to condition to fearful stimulus. It's kind of interesting to speculate how such an important adaptive response could be affected by just one gene.

But, as he points out, there's an important difference between innate tendencies and predicting actual behaviors. For example, in the twin studies, it was found that what they said they wanted to do and what they did were not the same. Or as he says in the book, "Desire and action are not synonymous." It also seems that our apparently deliberate reasons for making a

particular decision will be influenced by our innate risk tolerance. Dr. Burton doesn't really think we could ever sort out the genetic component of something as complex as the feeling of knowing.

And then there's the fact that the environment actually affects gene expression. For example, we know that our brains become biased to hear the sounds that we are exposed to when we are young. The auditory cortex actually gets tuned to those sounds. And Michael Merzenich has shown that with young rats that this actually starts from the very beginning of brain development. I think I've talked about this in the past- that it turns out that nurture affects nature, because experience actually affects gene expression. The real thing that we need to come away with is the fact that we should not expect that we can get others to think and believe as we do.

Now most of us have learned that this is true, but we keep thinking it should be otherwise. And the point here is that it's the way our brains are- it's physiologically impossible that we will all be thinking exactly the same. Or, as Dr. Burton says, that we shouldn't believe that we can get other people to think and believe as we do unless we also believe that we can overcome the innate differences that make our thought processes as unique as our own fingerprints. This is a very important idea. It fits in with one of Dr. Burton's main themes in this book, which is that understanding how our brains really work in this regard ought to encourage us to try to have more tolerance for different beliefs.

[music]

We've talked about how thoughts can have a perceptual quality to them that includes the fact that they are partially generated by things that we have no control over.

Next we're going to consider the idea of sensational thoughts. And what does this mean? It relates to the relationship between our thoughts and the fact that we are embodied. The way we have been thinking about thought and reason really challenges the concept that we've inherited from the ancient Greeks that there is some sort of objective thing called "reason." Dr. Burton quotes the famous linguist George Lakoff here as saying, "Reason is not disembodied as the tradition has largely held, but arises from the nature of our brains, bodies, and bodily experience. Reason is not a transcendent feature of the universe or a disembodied mind." This comes from a book by Lakoff and Mark Johnson called *Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought*.

Dr. Burton says on page 127 of his book, "Disembodied thought is not a physiological option.

Neither is a purely rational mind free from bodily and mental sensations and perceptions." He says, "You can't have a thought without sensation." For example, you have a sensation that you're inside your body or inside your head. That's created by your brain and your body. Now we can't localize where the sense of self comes from, but we do know that the right temporal lobe is important, because if you stimulate certain areas in the right temporal lobe you can cause a person to have an out-of-body experience, which tells us that our sense of being in our body *is* created by our brain.

Our awareness that we are thinking is also a sensation. Thoughts that don't reach awareness don't feel like they're being actively thought. For example, let's take the idea of sleeping on a problem. Let's say we have a problem and we say, "I'm going to sleep on it." We go to bed, we wake up the next morning with the answer. When we wake up, it *feels* like the answer just came to us, and somehow that feels different from a thought that we've gone through in a deliberate, conscious way. If we remember something this way, it also feels different, even though- and here's the key thing- it really *isn't* any different as far as our brain is concerned, okay? So this is where we have what's again called the cognitive dissonance, which is a disconnect between what we know and what we feel. A thought that comes to us after we've slept on it, as far as the brain is concerned, is no different but it *feels* different.

So that's a cognitive dissonance. This brings us to the subject of unconscious thoughts. We've talked about the role of unconscious decision-making in several previous episodes. But in this book, Burton challenges the idea that we should regard these unconscious decisions as necessarily correct or special. If you program a computer to solve a problem and you go off and do something else and you come back and the computer has generated an answer. You don't look at that as being some sort of miracle or product of intuition just because it came about outside of your awareness. Yet if you talk to, say, a writer who has let an idea percolate for a while while he's working on something else, when the solution comes into his consciousness, he's very likely to attribute it to something special like his muse or a higher power. This idea that creativity, for example, comes from some special mystical place is very common. The thing is that these ideas that pop into the head, they have that special sense of rightness or feeling of knowing that arises at the same time as the idea reaches our awareness.

Burton suggests that we have difficulty assigning intention to thoughts that occur outside of consciousness. It doesn't *feel* intentional without some sort of clear and immediate preceding effort. This is where we come back to the example of the computer. We don't need to think the computer has intention to solve the problem- that doesn't bother us. But when it comes to our own thinking, it says, he says on page 133, he says, "Any significant delay between a question and an answer tends to strip the thought of a sense of being intentional." This is probably

related to the fact that we seem to be wired to see cause as preceding effect. Just as in the example of the fact that we know that physics requires that the batter to swing before he actually sees that path of the ball, the neural mechanisms make him feel that he saw the ball before he began his swing. This cause and effect way of perceiving the world seems to be the way we are wired.

Now he's not suggesting that the feeling of knowing is present in the unconscious. In fact he says, "An unfelt feeling makes no sense." But what he is suggesting is that it is likely that there's some sort of unconscious pattern-recognition going on which contains a calculation of the probability of correctness. And when it reaches a certain level, we consciously experience a feeling of knowing. That is, the closer the fit is between, say a previously learned pattern and the pattern that comes in, the greater the feeling of correctness. You know how that thing you have when you say, "I don't remember the person's name but I'll know it when I hear it," it's like that kind of matching kind of thing.

We don't know how thoughts emerge from neurons, but I agree with Burton that both conscious and unconscious thoughts are likely to be rooted in the same mechanisms, which are basically neural networks processing information. This fits what we already know about how the cortex processes things like sight and sound. And basically we're saying that thoughts are happening in the same way. Otherwise, we would have to postulate a difference between conscious and unconscious thoughts. That would mean that the basic biology of cognition changes when a thought moves in and out of consciousness. Now that might make sense from some philosophical point-of-view, but it doesn't really make any sense based on what scientific knowledge we have about how the brain works.

[music]

So if we reject what he calls "the dubious premise" that unconscious thoughts represent a different *way* of thinking, instead he asks, "Well why not consider cognition as a single entity that isn't subdivided into various ways of being experienced?" After considering how this approach might be applied to popular psychology terms like *intuition* and *gut feelings*, Dr. Burton emphasizes that recognition and discussions of these sensations of a thought are integral to any theory of mind. As he points out, thoughts require sensory information. In fact, our brain even has sensory systems that selectively tell us when we're thinking a thought. This explains how we experience cause and effect, intentionality, and the feeling of knowing or its absence.

The key idea is that we know the nature and quality of our thoughts via feelings, not reason.

"Feelings such as certainty, conviction, rightness, wrongness, clarity, and faith arise out of involuntary mental sensory systems that are integral and inseparable components of the thoughts they qualify." That is a quote from page 139. This has some very important consequences. First of all, what we're observing is the fact that the findings of neuroscience really challenge our ideals of reason and objectivity. As he says on page 141, "Certainty is not a biologically justifiable state of mind. There is no isolated circuit in the brain that can engage in thought that is free from involuntary and undetectable influences."

I'm going to say that again. "Certainty is not a biologically justifiable state of mind, because there is no such thing as an isolated circuit in the brain that can engage in thought free from involuntary and undetectable influences." We cannot do objective thought.

[music]

So how do we find a way to portray the mind that's both emotionally satisfying yet reflects these limits? Can we move beyond what Burton calls "the myth of the autonomous, rational mind," which is the belief that we can step back from our thoughts in order to judge them? Trying to ignore the evidence is not the answer. Burton suggests that we need to ask a question about any idea whether its a personal opinion or something from pop culture or even a scientific hypothesis. And that is, "Is this idea consistent with how the mind works?"

He spends quite a bit of time talking about two recent bestsellers- *Emotional Intelligence* and *Blink*. He has some criticisms of some of the conclusions that these books reach. The biggest thing that he's challenging is the idea that we can get to these layers and therefore be able to judge when they're right and when they're leading us astray. Instead, he feels that we need to go back to the position of Timothy Wilson of the University of Virginia, who said, "Our minds have evolved to operate largely outside of consciousness." Wilson's position was we can't know our unconscious. If that's the case, we really can't make our unconscious smarter. And we can't regard our unconscious as having some part of it that is totally logical, because we really can't get to it to make those judgements.

Now, without unconscious cognition there would be no conscious decision-making. The point that he's really challenging is he's saying that we do not have any criteria for knowing when we can trust our split-second decisions. He points out that feeling satisfied later about a decision is not a valid criteria for deciding that it was definitely the right choice. The feeling that a decision is right is not the same thing as providing evidence that it is right.

Which brings us back to the myth of the autonomous, rational mind and objectivity. The point

is that neither one of these is possible. Think about the famous experiment where people were told to watch a video and count how many times a basketball was tossed back and forth. And a guy in a gorilla suit walks by and they don't even see him, maybe because they were so focused, and what they saw was determined by what they were looking for. Burton says it should be a red flag whenever anyone claims that they had no a priori assumptions. He concludes that complete objectivity is not possible. The best we can hope for is partial objectivity, which means acknowledging our biases and assumptions as accurately and honestly as we can. For example, when you look at a good scientific experiment, they tell you what their assumptions are. The key idea that relates to this is the fact that we cannot access the unconscious through introspection. We can only get a partial view of how our minds work. No matter how much you meditate or do things to develop more awareness, you cannot get to these unconscious layers.

Why is it so difficult to let go of this myth of the autonomous, rational mind? Well one thing is that we generally tend to have a feeling that the mind is in a different category from the body. We accept our physical limitations, but we somehow think we should be able to overcome our mental limitations. I think that he puts it perfectly when he says, "Our mental limitations prevent us from accepting our mental limitations."

The last few chapters of the book are really a consideration of the implications of the truth of the fact that we can't get to what's going on in these unconscious layers. There's a great chapter about faith and how this knowledge has implications both in understanding why some people interpret the same evidence the exact opposite as other people. But the key idea that he tries to emphasize is that we need to let go of the belief that there's a rational mind that can reject irrational explanations, because this is not substantiated by current evidence. And he argues once again that this knowledge ought to encourage toleration on both sides. There's also a chapter that considers the implications of this knowledge on philosophical questions such as the mind-body problem and the issue of free will.

[music]

I want to summarize what we've talked about so far. First of all, I think everyone would agree that we need to have a feeling of knowing in order to be able to function. But an important principle to come away with here is that the brain creates some sensations that feel like thought but really aren't. In other words, the emotional components, the feeling of knowing for example. We can't really sort that out from pure thoughts. In fact I guess there's no such thing as a pure thought. So we can *think* that the feeling of knowing is a response to a thought when actually the feeling came before the thought. We just can't tell because of our brain's

ability to give us a distorted sort of sense of brain time.

Also, and this is very important, we can't dismiss the feeling of knowing, partly because we don't have any access to how it's created, and this is the most important thing that you need to remember from this episode- is that the feeling of knowing is coming from parts of the brain that we cannot access.

So how are we going to make practical use of this knowledge? Because the whole point of the *Brain Science Podcast* is not just to tell you stuff that's about the brain, but to tell you stuff about the brain that will make a difference. The first suggestion Dr. Burton makes is that we should try to replace the word "know" with "believe." For example, he suggests something like, "I believe that the theory of evolution is correct because of the overwhelming evidence." He says, "Substituting 'believe' for 'know' doesn't negate scientific knowledge. It only shifts it from being unequivocal to highly likely." Which is what science ought to be about anyway, right? Because we're supposed to be always open to new information.

Dr. Burton is optimistic that this knowledge about where the feeling of knowing comes from could restore our tolerance for conflicting opinions. He also says that we ought to take the point-of-view, and I agree with him, that any idea that isn't capable of being independently tested should be considered a personal vision. He wants psychology to let go of the idea of a perfectly rational unconscious and to let go of the idea that we can know when to trust our unconscious.

The bottom line is that certainty is biologically impossible. Dr. Burton believes that we can learn to tolerate the contradictory aspects of our biology, and that we can learn to tolerate the unpleasantness of uncertainty, and perhaps even teach this ability. After all, science gives us the tools since it provides us with the language and tools of probabilities. In real life, we constantly make decisions with incomplete information. But we also seem to have the tendency to feel certain about these choices.

[music]

Well hopefully this episode has given you some things to think about. I highly recommend Robert Burton's book *On Being Certain: Believing You Are Right Even When You're Not*, and in two weeks I'll be back with an interview with Dr. Burton where we can look at these ideas in a little bit more detail.

Since this has been a long episode, I'm going to try to keep my closing announcements pretty

short. First of all, I'd like to encourage you to visit the website at brainsciencepodcast.com. That's where you can find links to both show notes and other resources related to brain science. Also if you haven't had a chance yet to check out sciencepodcasters.org, please do that.

Speaking of that, both the *Brain Science Podcast* and sciencepodcasters.org have recently been moved off of Wordpress.com. The addresses that I always announce are still good, but you want to check your bookmarks to make sure that you're pointing at an address that starts with docartemis.com and not one containing "wordpress," because that would mean that you're not on the current website. I'm actually shutting down the old sciencepodcasters.org website, but the old *Brain Science Podcast* website will stay up because it contains a lot of show notes that people have linked to from other blogs, and I want to keep those links live.

I want to mention to you a podcast that I mentioned last time, which is the Psych Files. Michael Britt just had another great episode. I think it's entitled, "A Scientist Looks at Self-Help Books" and it's really good. In fact I'm going to go ahead and invite Michael to add his podcast to sciencepodcasters.org. Any field of science is eligible to be on the site. Please send in your suggestions.

Last but not least, in terms of feedback, the best place to go is the discussion forum at brainscienceforum.com, or you can send me e-mail at docartemis@gmail.com. If you would like to help support the *Brain Science Podcast*, I do accept donations via PayPal. There's information on the website brainsciencepodcast.com about how to make donations. You can make single donations or small monthly contributions, whichever works best for you. But your support is very important to the long-term success of this show. And I want to thank those who have donated since the last time we talked.

I want to thank everyone for listening and I look forward to being back with you again in a couple of weeks.

[music]

-transcribed by Jenine John