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BOOK REVIEW

The Hidden Spring: A Journey to the Source of Consciousness by Mark Solms, W.W. Norton, 2021, 432 pp., $28.95

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Emotions are perhaps the most important topic to understand in relation to the brain. Not just because they are so personal, so self-involving, but also because they are the source of much human suffering. The World Health Organization has said that mental health is currently a global crisis, and emotional disorders are a central part of the problem.

This is not due to a lack of research on emotion. Emotions have been extensively studied, both psychologically and neurobiologically. But the question is, what have we learned? The answer depends on a far deeper question. What is an emotion? Until we answer that question, knowing what we have learned will remain out of reach, since we have to know what we are looking for in order to find it.

One answer was provided in the 19th century by Darwin, according to whom, emotions are mental states that we have inherited from our animal ancestors by virtue of having inherited some feature of their nervous system. He in fact often described animal behavior in human emotional terms: cheerful, proud, scornful, content, jealous, contemptuous. A reporter once asked him why he talked this way: He replied that it was kinder, and that the public was more likely to accept animals being like humans than humans being like animals. Another kind of answer came from Williams James, who argued that emotions are conscious experiences that result when the signals from body responses feed back to the brain. A third view is that emotions are cognitive interpretations of situations, which in some ways also goes back to James. All three positions have active adherents today.

Mark Solms' book, *The Hidden Spring*, is squarely in the Darwinian tradition with regards to emotions, but with a very strong Freudian slant to both the topic, and to the history of psychology. Solms is an excellent writer, and his book tells an engaging story about his scientific career. Before reading it, I was aware of his general approach to the mind but enjoyed learning more about his justification for his views and, in general, about his scientific story. Though I disagree with the thrust of some of his conclusions, I enjoyed the book as a reader.

The History of Psychology

I'm no expert on Freud, but I do know a bit about the history of psychology. And I think that Solms's take is not quite right. For one thing, behaviorists would not agree with the description of behaviorism as an approach that began "to apply the experimental method to the mind." Behaviorism was about explaining behavior without calling upon the mind, rather than about understanding it. Also, Solms overstates the case when he says that behaviorism was mainly a reaction to Freud. Clearly, John Watson, who founded behaviorism in the early 20th century, was not a fan of Freud's views, but there was much else going on.

My understanding of this history is that behaviorism was more directly a response to factors within mainstream academic psychology in the United States than to Freud. One was psychologists' free-wheeling use of conscious explanations of human behavior, without evidence of conscious causation of these behaviors, in the late 19th and early 20th centuries. The other was rampant anthropomorphism that dominated animal psychology at the time. These two factors were related, since human-like mental states were being used to explain animal behavior. A leading anthropomorphist was Darwin's disciple, Gorges Romanes, who, like Darwin, viewed animal emotions in human terms. William McDougall's views on motivation were a third factor. In contrast to Watson's emphasis on learning and environment, MacDougall's "hormic" or "dynamic" psychology assumed that innate instincts underlie human motivation. Hundreds of such instincts were proposed. While there are some similarities between Freud and McDougall's "dynamic" approach, including their emphasis on instincts, they differed on other points and feuded.

To be clear, I am not defending behaviorism so much as history. Behaviorism gave psychology some good methods and a much-needed methodological kick in the butt. Yet, a psychology without mind is not really a psychology. And psychologists eventually figured that out.

Behaviorism was run by American psychologists who studied animal behavior. But in Europe, the mind was never really abandoned. In academic psychology, the Gestalt School, which explicitly opposed American stimulus–response psychology, emphasized how organisms, including people, create meaning by organizing and interpreting their world. But there were also naysayers among human psychological researchers in the U.S. and even some animal researchers, like Edward Tolman and Karl Lashley, objected. When computer scientists began to talk about the similarities between mind and information processing by machines, this provided an opening that eventually led to cognitive psychology, which was a more viable approach to psychology than behaviorism offered.

Solms described "cognitive neuroscience" as a "seamless transition from learning theory." I am puzzled by why he focuses on cognitive neuroscience. Cognitive psychology, the field from which cognitive neuroscience emerged, had been around for almost 2 decades before cognitive neuroscience entered the picture. Cognitive psychology, rather than cognitive neuroscience, was the discipline within which the transition from neobehaviorist learning theory to cognition first took place.

But Solms also introduces the term "cognitive neuropsychology," saying that in the 1980s, it might as well have been called

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"neurobehaviorism." Had he said that neuroscientific studies of brain and behavior in animals was essentially "behavioral neuroscience", I would have agreed, as animal researchers were slower getting to the cognitive party, and some still resist acknowledging the significance of mental states in our lives. But he was referring to human neuropsychology, which, at the time, was very cognitive in its orientation. For example, I did my PhD research in the late 1970s studying the role of narrations in the cognitive construction of consciousness, including emotional consciousness, in split-brain patients (Gazzaniga & LeDoux, 1978). Moreover, research on patients with memory disorders was distinguishing two kinds of cognitive memories (semantic and episodic) that contrasted with noncognitive procedural memory. And patients with unilateral neglect gave clues about mechanisms of attention. It was also known at the time that damage to the frontal impaired executive functions such as attention and short-term memory.

Cognitive psychology succeeded in supplanting behaviorism in part by focusing on the mind as information processing, without much concern for whether conscious states resulted or not. What was explicitly excluded from early cognitive psychology was the topic of emotion. It was thought to be too subjective and not amenable to the computer-inspired model of the mind. These days, though, psychology and cognitive psychology are more or less the same, and this field even includes consciousness and emotions as research topics. That's good, but there's a problem.

With behaviorism a dim image in the rearview mirror of psychology, cognitive scientists, including cognitive neuroscientists, now freely use terms that refer to conscious states to explain behavior, without much concern for demonstrating whether consciousness is involved. In other words, we are, in some ways, back to where we were before the behaviorists arrived. And Solms' views about emotions are, in my opinion, part of that trend. Psychology needs mental states, but psychologists also need to be more judicious about when to call upon these.

Subcortical and Cortical Contributions to Emotions

Solms is an ardent supporter of the idea that consciousness, including emotional consciousness, depends on subcortical brain areas. He draws from basic neuroscience, Freudian theory, and clinical cases with brain damage, to make his case. Much of Solms' theoretical inspiration regarding emotions comes from his scientific hero, friend, and book dedicatee, the late Jaak Panksepp. According to Solms, Panksepp believed that nonhuman mammals feel emotions similar to those we call fear, lust, sorrow, and grief. While Panksepp himself did advance this view much of the time, he also adopted a less publicized position at times, one that may shock some of his adherents.

For starters, in *Affective Neuroscience*, Panksepp noted that "the mechanisms of affective experience and emotional behavior are intimately intertwined in comparatively ancient areas of the mammalian brain" (Panksepp, 1998, p. 34). He went on to say that subcortical circuits in mammals, including humans, underlie "raw affective experiences—primal manifestations of the 'mind'." Going further, he proposed that these are "perhaps truly unconscious," and that in humans, these primal subcortical states are seldom actually experienced because they are overshadowed by higher cognitive emotional states involving the prefrontal cortex and other areas.

This is a very different depiction than the one that Solms presents. As I wrote recently in the journal *Current Biology* (LeDoux, 2021), Panksepp's primal states are not the kinds of emotional experiences we think of ourselves as having, and that we talk about when we share our emotions with others, or read about in novels or poetry, as when Jane Austin, in *Persuasion*, wrote, "you pierce my soul. I am half agony, half hope … I have loved none but you."

Many emotion neuroscientists believe that complex experiences require complex circuits in the cerebral cortex. Solms is strongly opposed to that idea. Perhaps this is because of his commitment to a neuroscientific rehabilitation of certain aspects of Freudian theory. For example, he and Panksepp wrote a paper titled, "The 'Id' knows more than the 'Ego' Admits" (Solms & Panksepp, 2012, p. 147). In it, they explored primal subcortical states in relation to emotion. They write:

> subcortical energies provided a foundation that could be used for the epigenetic construction of perceptual and other higher forms of consciousness. From this perspective, perceptual experiences were initially affective at the primary-process brainstem level, but capable of being elaborated by secondary learning and memory processes into tertiary-cognitive forms of consciousness. Within this view … all individual neural activities are unconscious.

Solms frequently supports his subcortical model by citing the case of hydranencephalic girl who has little or no cortex. A picture of her responding in an "emotional" way is shown in Figure 8 of his book. The girl cannot verbally report her states. Consequently, all we have to go on is her behavior. But why can't we trust her behavior? Fear research helps understand why we can't ever trust our intuitions about the so-called emotional behaviors of other humans.

Studies in animals have implicated the amygdala in the control of behavioral (freezing, fleeing) responses and physiological arousal. Human studies have confirmed the basic findings from the animal work. But a variety of studies in humans using subliminal presentation of threat stimuli show that the amygdala is activated and physiological responses elicited, but the person does not report fearful feelings. And patients with amygdala damage on the other hand report feeling fear. The amygdala seems necessary for controlling body responses but does not seem to be required to feel fear. Fear itself is, in my view, a culturally shaped, personal, schema-based, narrative-driven, subjective experience that occurs in a biologically or psychologically significant situation (LeDoux, 2015, 2019, 2020a, 2020b, 2021; LeDoux & Lau, 2020). And the cortical circuits that assemble the experience operate in parallel to those that control simultaneously occurring behavioral and physiological responses.

But let's get more subtle about this. One possibility is that the hydranencephalic girl was not feeling what we humans talk about when we use common emotion words, but instead the kind of raw primal emotional state that Panksepp said is rarely experienced by humans except when elicited by electrical brain stimulation.

Panksepp, in fact, relied heavily on findings from the 1960s involving electrical stimulation of subcortical areas of the human brain to support the idea that primal emotional feelings are encoded in these regions. For example, stimulation of the amygdala resulted in people reporting they felt fear. However, later research raised methodological questions about this work, and what counted as reports of emotional experience. Recent studies with modern methods showed that while amygdala stimulation elicited physiological arousal, it seldom elicited reports of fearful feelings.

Given these findings, it would seem that the hydranencephalic and brain stimulation findings are only tangentially relevant to the question of whether the kinds of emotional states humans typically experience originate cortically or subcortically. But why are they even tangentially relevant? Because the brain is hierarchically organized in such a way that cortical and subcortical areas continuously interact in most psychologically significant states. There are no pure cortical states of mind that occur independently of subcortical areas. This means that subcortical areas indirectly contribute to emotion experience but do not directly determine the content of the subjective experience of fear, which is assembled in the neocortex via a cascade of nonconscious cortical processes related to sensation, memory, and conceptual knowledge about the world and oneself.

Partitioning Consciousness

It will be helpful in discussing the role of cortex in consciousness to consider different kinds of consciousness. Solms separates consciousness into two kinds of states: those that reflect the condition of being alive and responsive to stimuli (this is sometimes referred to as creature consciousness), and others in which one has a conscious experience with explicit content (this is called mental state consciousness). But mental state consciousness can and I believe must be further divided to capture the essence of what mental state consciousness is.

Over the past decade or so, Panksepp (writing with Marie Vandekerckhove) (Vandekerckhove & Panksepp, 2011) used Endel Tulving's three-way partition of consciousness into autonoetic, noetic, and anoetic states (Tulving, 2005), a partition that I also have often used (LeDoux, 2015, 2019, 2020a, 2020b, 2021; LeDoux & Lau, 2020). Each kind of consciousness is said to depend on a different form of memory. Autonoetic consciousness is a state of reflective self-awareness and it depends on episodic memory. Noetic consciousness is a state of factual awareness which depends on semantic memory.

While autonoetic and noetic states thus both have explicit content, anoetic states depend on innate wiring or implicit memory and lack explicit content. They are related to what William James referred to as the fringe or penumbra of consciousness and are embedded in every autonoetic and noetic experience. This is what allows you to know that your experiences belong to you, without you having to explicitly acknowledge that they are yours. Such familiarity by acquaintance is so commonplace that it is not usually noticed but is thrown into relief by patients who, due to brain damage, feel their mental states are not theirs.

Solms has been critical of my views of emotion and the brain, preferring Panksepp's approach. But had he considered the perspective I just described, he might have realized that Panksepp's views are not so distinct from mine. We both assume that cognitive emotions (autonoetic and noetic emotions) are products of cortical circuits. We also agreed that these are the main kinds of emotions that humans experience in daily life. As Panksepp suggested, primal anoetic emotions are seldom experienced by humans except through electrical brain stimulation (and even that is debatable). What Panksepp and I differed on most was whether anoetic states are products of subcortical circuits alone. He said yes, while I argue that subcortical information has to be re-represented cortically, and cognitively, even for anoesis. That's the crux of the disagreement.

Bottom Line

In reviewing *The Hidden Spring*, I did so as a scientist who is engaged in some of the issues Solms discussed. As such, I focused on his treatment of those aspects of the emotional brain that I am knowledgeable about, and I stayed away from other topics that I am less versed in, such as his views on dreaming and his embrace of Friston's extremely complex free-energy principle. But there is a completely different way to read *The Hidden Spring*. As a scientific autobiography, I found it to be a highly enjoyable book, and I am certain that many readers will as well.

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