

## Is Love an Emotion?

How prairie voles almost broke the Harvard EWHC Class of 2022

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Humans have been writing love stories for thousands of years. Though our tools have evolved from clay tablets to electronic screens, the urge to make sense of the joy and tragedy of falling in love still consumes us. It's no surprise, then, that neuroscientists who work to map pathways of emotions have struggled to explain exactly how love arises from the circuitry of the brain. Two models proposed by researchers Joseph LeDoux and Antonio Damasio and Gill Carvalho make a compelling case for the emergence of drives, like hunger and thirst, and emotions, like joy and fear, but their models fall short of demystifying and classifying love. In fact, they struggle, as we all do, to even define it. LeDoux writes that the purpose of emotions is to help organisms stay alive, remain healthy, and propagate their species (206). He identifies animal models where fear can be studied and describes a plausible explanation of fear as an emotion. However, he grapples with finding a way to study love and ultimately decides to investigate attachment to mates in an animal model. By substituting attachment for love, he concludes that love, too, is an unconscious emotion, driven by hormones, though we experience it additionally as a feeling. Building on LeDoux's work, Damasio and Carvalho similarly classify attachment as an unconscious response—a drive—though they do not explicitly mention love in the body of their paper. These conclusions about love are difficult to accept, however, based on the two models presented. While fear reliably fits the researchers' stated purpose of emotions (protection and propagation), love can prompt us to engage in impulsive, even self-destructive behaviors. Perhaps it is because love is not a single emotion or feeling, as fear or pain is, but a complex bundle of different drives and emotions all enhancing or dampening the effects of one other. What we experience is difficult to predict or explain, something far more than the sum of its parts, something that falls outside the realm of these models of hard-wired emotions.

In "Synaptic Self," LeDoux defines *emotion* as the way in which the brain takes the vast amount of sensory input from its environment and determines which of that information is important to survival. Emotions, therefore, help the organism stay alive, remain healthy, and propagate its species (206). In his model, the brain processes this sensory information through circuits, using different circuits to process different kinds of information: a defense circuit, a food-seeking circuit, and a sex circuit, for example. Incoming sensory information activates the relevant circuit, which processes the information and generates a reaction—a change in physiology. This process occurs automatically and does not reach consciousness unless the physiologic response triggers generation of a *feeling*—the conscious experience of an emotion. Feelings emerge when the activated circuit sends its information into working memory, which integrates it with current sensory information (images or smells, for example) and stored memories of the same stimulus to create an emotional experience—a feeling of joy, anger, fear, dread, or even love.

In "The Nature of Feelings," Damasio and Carvalho similarly describe emotions as one link in a chain of the complex process of survival. In their model, the central nervous system continuously monitors our internal and external environments so it can quickly detect and correct any threat to homeostasis. The brain delegates this task to two monitoring systems: the interoceptive system, which monitors the interior environment for changes in parameters like heart rate and blood glucose levels, and the exteroceptive system, which gathers data from the outside environment through the five senses. All data reported from both monitoring systems trigger unconscious

physiologic responses that the authors call *action programs*. Action programs that respond to changes in the interior environment are called *drives* (hunger, thirst), and those that respond to changes in the exterior environment are called *emotions* (fear, anger). The interoceptive system then detects physiologic changes made by these action programs and will occasionally trigger a conscious *feeling*, defined as a mental experience that accompanies a change in body state. Feelings force us to pay attention to the conditions that triggered a change and allow us to learn so we can avoid or embrace future exposure.

Both models distinguish drives and emotions (unconscious responses) from feelings (conscious experiences), though with our limited vocabulary, we often use the same words to describe both drives/emotions and feelings. Using an example from “The Nature of Feelings,” the sight of a grizzly bear on a trail triggers a freeze or flight response, increases the heart rate, stimulates cortisol secretion, and configures facial muscles in an expression of fear (144). This is fear, the emotion—the unconscious responses. These physiologic changes then produce a feeling—the conscious mental experience—of fear. These models suggest that emotions like fear, arising from these circuits or action programs, should be predictable and reproducible: the same stimulus should produce the same response each time it is encountered.

Though these two models give us a satisfying explanation of why our heart rate quickens when we stumble upon a bear or why we seek food when hungry, it’s difficult to apply them to our understanding of love. LeDoux concluded that his model can be applied to love by considering love in terms of attachment to mates. He found a monogamous animal model in prairie voles and researched their behavior to try to map the circuitry of love (230). He illuminated the role of the hormones oxytocin and vasopressin in the process of forming attachment to mates and used this to justify his classification of love as an emotion (231-232). He then theorized how working memory blends the input of the attachment circuit with recalled memories and visual input to create the *feeling* of love, concluding that love is both an emotion and a feeling (233). Damasio and Carvalho didn’t mention love in their paper other than a teaser in the abstract, though they did list several components of what we might think of as love in both the unconscious *drives/emotions* categories—libido, care of progeny, attachment to mates, compassion, admiration—and in the conscious *feelings* category—compassion, admiration. But they never explicitly discussed love. Thus, as we start to consider classifying love as drive, emotion, or feeling, the problem becomes clear: love, in its complexity and variability, is difficult to define.

Thirst, hunger, and fear as both drives/emotions and feelings are easy concepts to understand: they are consistent from day to day and from person to person, are easily defined, and are tied directly to survival. Love is more complex and calls to mind the myth about the 100 Inuit words for snow. There is love of a partner or spouse, which may best fit LeDoux’s model of attachment and generally includes but is not limited to the emotions/drives attachment, libido, and sex, plus the feeling of love. But when we consider the powerful love a parent has for a child, we would not include the same emotions/drives; we would substitute attachment and care of progeny, plus the feeling of love, which many would argue is different from the feeling of love of a spouse. There is the kind of love that we have for our best friends, which would not encompass libido, sex, or care of progeny but would likely include the emotion admiration. And what about love of a pet? There are people who love their cats as they do family members and pay thousands of dollars for treatments like kidney transplants. This love for a cat does not benefit human survival now that we have other ways to control rodents who carry disease. In fact, this love diverts resources that could be spent on other life-prolonging or pleasurable experiences for the cat lover. Finally, what about love

demonstrated by a soldier who sacrifices herself for the survival of another member of her unit or even for civilians whom she has never met? Love does not always follow the stated purpose of emotions as self-preservation and reproduction. Half of marriages in this country end in divorce; love can fade away. The models are incomplete.

I would argue that love is too general a term and that it inaccurately lumps together several drives, emotions, and feelings acting in concert—a bundle with different components each time we feel a different kind of love. LeDoux's and Damasio and Carvalho's models describe emotions and feelings in isolation of one another and do not fully explore how different circuits or action programs and feelings influence one another. LeDoux mentions love as an emotion only in terms of attachment and love as a feeling in terms of working memory with attachment as the circuit supplying information to create the feeling of love (233-234), but surely there are other circuits at work here, too. Future models should address how circuits or action programs might interact with one another to enhance or mitigate each other's effects to produce the complex and variable emotions and feelings we label, incompletely, as love.

#### References

1. LeDoux J. Synaptic self: how our brains become who we are. New York: Penguin Books; 2002.
2. Damasio A, Carvalho GB. The nature of feelings: evolutionary and neurobiological origins. *Nat Rev Neurosci*. 2013 Feb;14:143-5.