Emotion and Cognition

by Michael de la Maza  David Benz

How our theory of the mind has changed over time

Agile values "

Understanding individuals and how they interact takes an understanding of how and why people make decisions. As it turns out, our understanding of how people think is often off the mark.

Throughout history, people have used the most complex piece of technology we've created to date to describe how our minds work. Over the last thousand years we have gone from thinking of the mind as a hydraulic system to a mechanical system to an electrical system to a computer system.

The Greeks viewed the mind as a hydraulic system similar to an aqueduct. Hippocrates spoke of the four basic humours and their relationship to personality types and moods: sanguine, choleric, melancholic, and phlegmatic.
While Descartes believed the mind was ephemeral and the body mechanical (dualism), many mechanical metaphors also arose for the mind. Clocks were likely one of the first. You can still hear this thinking in metaphors we use today such as "you can see the wheels turning" or "she has a mind like a clock" or "like clockwork."

John Locke used the idea of the Gutenberg printing press in his view of memory as a tabula rasa, or blank piece of paper, upon which experience left an imprint. You can hear the impact of the Gutenberg printing press on Locke's thinking about memory other way of retention is, the power to revive again in our minds those ideas which, after imprinting, have disappeared, or have been as it were laid aside out of sight." Contrary to many before him, he believed we weren't born with innate ideas but rather that everything we know was shaped by our experience.

Freud spoke about the mind metaphorically as a steam engine. Desires could be suppressed or repressed, but like steam in a steam engine, psychological pressure would lead to an explosion unless it found an outlet.

In the 1790s, Italian scientist Luigi Galvani discovered that a spark caused the leg muscles of dead frogs to twitch. This discovery led to the idea of bioelectricity.

With Galvani's discovery, electrical impulses began to replace water or mechanical means as a metaphor for communication between the senses and the mind. In 1849, the German scientist Hermann von Helmholtz measured the speed at which electrical signals were carried through nerve fiber. At the time, people believe the signal was instantaneous.

The telegraph, invented in the 1830s, provided Helmholtz a conceptual model for understanding how sensory signals reached the brain. Other electrical components we've related to the human mind at one point or another throughout the 20th century include vacuum tubes, transistors, electrical switches, resistors, capacitors, amplifiers, relays, tape recorders, and memory banks.
The mind as a computer

Ask people today how they think the mind works and odds are good that they will describe a computer. They will talk about accessing memory or they will talk about processing data. They will talk about sending off a request and computing results. Or they will talk about acting on input to produce a specific output.

We think of our brains as having a separate processing unit and separate memory. Data is input, stored in memory, and when processed appropriately correct answers should appear. For example, if we understand the operation called multiplication and are given two different numbers such as 7 and 6 we should return a correct result, 42.

The concept of short-term memory and long-term memory is also very similar to the computer model of long-term disk drive storage and short-term cache/RAM memory.

Figure 3: Computer memory hierarchy.

John Daugman, Professor of Computer Vision and Pattern Recognition at Cambridge,

The mind doesn't work the way we think it does

Here's a simple puzzle

A number came to your mind: 10 cents. The puzzle evokes an appealing, intuitive answer that is, of course, quite wrong. If you work this out in a quick algebraic formula, you'll find the answer is 5 cents. On average, students tested at MIT, Harvard, and Princeton gave the intuitive answer 50% of the time. At less selective universities, the rate was much higher.

As much as we may sometimes think that our minds perform like computers and that we make rational decisions, science says otherwise. We're brash, we make snap judgments, we ignore what we don't want to see, and we have tendencies to like things that we like. Ask any salesman and they will tell you people don't make decisions rationally (though they'll often rationalize them after the fact!).

Example: The mere exposure effect
In 1969, Robert Zajonc, a psychologist at the University of Michigan conducted an experiment where he printed a silly sounding word on the front page of the student newspaper in Michigan every day for several weeks. He then sent questionnaires to readers and asked them to categorize the word as 'good' or 'bad'. Words that appeared in print many times were judged to be more positive than those that didn't or only appeared once or twice. The sheer appearance of these words in a trusted source on a number of occasions caused people to think more favorably of the words. He called this the mere exposure effect (sometimes referred to as the familiarity principle), a psychological trait where people develop a preference for something simply because they're familiar with it. 

The effect has been demonstrated across cultures and with multiple types of stimuli including: faces, Chinese characters, language, and sounds. It explains decisions by stock traders, distortions in academic journal rankings and quite likely much of the success of chain restaurants and hotels.

Zajonc argued that “affect,” his term for the unconscious mind, is always present as a companion to cognition where the opposite is not always true. Many decisions are made completely without the rational mind.

Zajonc's research, controversial for the day because it challenged the prevailing view that rationality guides our decisions, helped found the field of social cognition and opened up studies into emotion and cognition.

Example: Mirror neurons

In 1995, the mirror neuron was discovered in the primate brain. Giacomo Rizzolati at the University of Parma discovered that mirror neurons in the brain light up when we see other people do things on purpose; neurons in your brain light up. This was, finally, the anatomy of empathy.

Soon, new mirror-neuron studies were underway, and they led to new insights. A key insight was that the mirror neurons not only pick up on intentional actions like grasping a pencil, they also pick up on emotional actions such as facial expressions.
If empathy had an anatomical location in the brain—a place where specific nerves were dedicated to empathic connection with another—then what about other aspects of social connection? What about like and dislike? What about respect, inclusion, and ostracism? Where were they located?

As an Agile coach or manager, you can see why it's important to model the behavior desired of your team.

Rizzolati's discovery of the mirror neuron has had a profound impact on the field of social cognition and ignited an explosion of research. Not only do certain potential neurons in our brain fire when we perform tasks, they fire when others perform similar tasks. Though we've still only conducted research in primates, we may have found the biological roots of empathy.

How does the mind actually work?

Recent research into the mind and discoveries in the field of artificial neural networks suggest that the metaphor of the mind as a computer is just as flawed as the metaphor of the mind as a steam engine.

From medical research, we know our brain consists of millions of biological neurons. How do these neurons function together to produce thought? How do these neurons work together as a single unit, the human brain?

The field of artificial neural networks offers some insights into how these millions of neurons turn input into decisions. As a relatively new science, it's important (and fairly easy) to understand this model metaphorically.

Figure 5: A simple artificial neural network, a back-propagation network, consisting of an input layer (sensors), any number of hidden layers (where the “thinking” occurs through the weighted connections \( w_{ij} \) and \( w_{jk} \)), and an output layer (representing the decision).

Artificial neural networks (ANNs), like the above, contain a learning rule, which modifies the weights of the connections according to the input and desired recognition of that input.

During this “learning” or training algorithm, information is stored in the weights and connections that allows the network to respond to a given set of inputs.

If you wanted to train an ANN to recognize the number 1, you would present it with a series of numbers over and over again while you're training the neural network. Each time a number is presented, the network makes a guess whether it is a 1 or not. You provide the network with positive or negative (right or wrong) feedback about its guess and this feedback is used to adjust the levels in the hidden layer of neurons.
In this manner, the ANN “learns” to recognize the number 1 (or another number or image that the ANN has been trained to recognize). One of the important things to note for ANNs is that you typically have to expose them to thousands of training runs with feedback before the hidden layer weights adjust. Simulated on a computer, depending on the complexity of the ANN, this can take a bit of time.

Though we still don’t know how all the associations in our mind exactly work, an associative network of neurons makes a much better metaphor for thinking about the mind than a computer. When we think of a concept—a car, for example—car is defined by its associations: driving, vehicle, motor, wheels, passengers, speed, roads, traffic, wheels, dashboard, transmission, etc.

Two systems of thinking

If you think of our minds as having evolved over thousands of years, the mind can be viewed as different layers of neural networks in different areas of the brain like the prefrontal cortex (responsible for higher-level reasoning) and older, more primitive areas of the brain, such as the limbic system (responsible for emotion).

Daniel Kahneman, winner of the Nobel Prize in economics for his groundbreaking research on the mind, conceptualizes this as System 1 (“fast”) and System 2 (“slow”).

System 1 operates automatically and quickly with very little effort. System 1 governs our rapid pre-flight or fight emotional responses. Some activities driven by System 1: Driving a car on an empty highway, answering 2+2 = ?, doing the dishes, orienting to a sudden sound, snap judgments based on appearance, and detecting hostility in a voice.

System 2 is responsible for our slower, more conscious cognitive processes. System 2 is responsible for what we often think of as efforts that require more concentration. Some activities driven by System 2: Counting the occurrence of the letter ‘T’ in this document.
writing a term paper, making a social appearance, identifying all the women with white hair, preparing for a speech, and validating a logical argument.

It's important to note that the two systems are not functionally separate. In many circumstances, System 1's emotional response may drive the direction of System 2. They are also not physically separate in the brain as there are many connections and relationships we simply don't understand yet from a biological perspective. However, it helps to think of these systems as System 1 ("fast, emotional") and System 2 ("slow, cognitive").

Emotions

Most people have a general idea that emotional thinking is different from rational thinking. We talk about people making emotional decisions, decisions that are influenced by anger or sadness, for example.

But where do our emotions come from? Are they learned, ingrained, or both?

Paul Ekman, a University of California psychologist, studied emotions across cultures and what he found was that there is a common core set of emotions came to the emotional meaning of certain facial expressions. Anger, fear, disgust, surprise, happiness, and sadness were found to be universally recognized, even by a tribe in Papua, New Guinea who could not possibly have learned of their meaning through the influence of television or other cultural influences.

Figure 8: Anger, fear, disgust, surprise, happiness, sadness.

System 2's emotions can be thought of in terms of categories such as anger, sadness, fear, enjoyment, love, surprise, disgust, and shame.

Each category has various shades of grey. Sadness, for example, could be broken down further into: grief, melancholy, sorrow, loneliness, self-pity, gloom, and despair.

Ekman's research suggests some level of biological basis for emotions—with culture taken out of the equation, people still share many of the same emotions.

Fast often overrides slow

One of the most interesting questions in contemporary cognitive studies is: how is emotion related to cognition?
Joseph LeDoux's research on fear suggests that the amygdala may be in a position to emotionally hijack the brain. LeDoux tracked the signals in rat brains as they responded to a loud sound. First, the signals traveled from the eye or ear to the thalamus and then across a single synapse to the amygdala. A second signal from the senses was also routed to the neo-cortex, the thinking part of the brain. This allowed the amygdala to respond quickly while the neo-cortex pondered the information.

In crucial “right-or-left” situations, this dual wiring allowed the amygdala to respond quickly while the neo-cortex formulated a plan. LeDoux's research overturned the conventional thinking of the day that signals were sent to the neo-cortex for processing and recognition and then down to the limbic system. This explains why we can act in certain emergency situations seemingly without thinking.

The brain also uses a very ingenious method of making sure we remember these critical emotional experiences. Under stress or other intense emotion, our bodies secrete epinephrine and norepinephrine that prime the body for an emergency. These hormones activate receptors on the vagus nerve carrying messages from the brain to the heart and back. These signals trigger neurons in the amygdala that signal other regions of the brain to strengthen memory. This is why we tend to remember emotionally charged situations, such as a first date or where we were when we heard John Lennon was killed, better.

If you rear-end another car, your hippocampus will retain the context of the situation—where you were, how fast you were driving, and what the other car looked like. But it's the amygdala that triggers anxiety whenever you get too close to a car in similar circumstances. To paraphrase LeDoux, the hippocampus is key in recognizing a face of your co-worker, but it’s your amygdala that adds you don't really like him.

The emotional mind (System 1) is much quicker than the rational mind (System 2) and emotional decisions carry a particularly strong sense of certainty. In hindsight, we may find ourselves wondering why we bought that particular stock or got into that heated argument. Emotional intelligence

Historically, emotion and cognition have been viewed as separate entities with cognition supposedly in control. Research suggests, however, that System 1 may drive far more decisions than we typically think possible.

Linda Rising, a patterns and Agile expert, said that emotion and cognition are about 10 percent, and the unconscious was the 90 percent hidden from view. Now, she says, it's clear that the conscious mind is even tinier.

While there's much we still don't know about how the mind works, it's clear that emotions influence cognition. Perhaps even more than we think. Science tells us that we are more like Kirk, than Spock. To be smart, we need to be smart about our emotions.
In 1995, Daniel Goleman coined the phrase emotional intelligence a buzzword. The fundamental question Goleman was trying to answer though remains relevant: Why do people with average IQs outperform those with the highest IQs 70% of the time? Why doesn't IQ determine success more often? Goleman proved that it was emotional intelligence or EQ that was far more likely to determine success. His work has been subsequently confirmed and expanded on in numerous studies. For example, found EQ to be strongest predictor of performance, leading to 58% of success in a wide variety of jobs.

A few other stats from TalentSmart

Emotional intelligence skills relate to how effectively people work with others, specifically around:

Self-awareness is understanding your own emotions, skills, strengths, weaknesses, and capabilities while social awareness is the ability to empathize with others and understand their verbal and non-verbal signals. Self management is the ability to overcome our emotions, especially negative emotions such as frustration or anxiety. And relationship management brings together all three of these skills to lead, manage conflict, influence others, and build teams.

Agile depends on emotional intelligence

How do emotional intelligence skills relate to the Agile principles?

Self-awareness

are much more likely to seek out proactive help for the sake of developing the best architectures, requirements, and designs. Someone that is afraid to seek out help for fear of appearing "less intelligent" may wait too long.

Self management

commitments on time? If requirements change, are members of the team going to be frustrated or will they be able to negotiate through to a mutually desirable conclusion?

In order to work together and communicate effectively, business leaders and the software development team must have the awareness managers and Agile coaches. If someone seems frustrated and has not met a commitment, understanding how to best communicate with this person can be critical in resolving the situation.

Relationship management brings together all of these skills in the formation and ongoing performance of teams. Agile principles founded on
The good news is that research shows that not only can emotional intelligence skills be learned but they can be retained for many years, especially in the right environment where skills can be practiced on the job and reinforced.

The Hay Group found that after implementing an EQ training program with 100K+ employees, Starwood Hotels moved “from relying on scripted interactions to having associates who are able to make thoughtful decisions about how to most effectively respond to the needs and requests of our customers.”

Johnson & Johnson, Boeing, American Express, PSEG, Roche Pharmaceuticals, and L’Oreal are into their best practices.

FedEx has implemented an EQ training program.

Conclusion

The mind doesn’t work the way we think it does. It’s not a computer and emotion influences cognition—frequently from the driver’s seat.

We justify car purchases by saying we got a good deal when we really liked how the car made us feel. We make decisions at work based on gut feelings rather than detailed analyses because we simply don’t have time to do a cost-benefit analysis on every decision. Nothing would ever get done. These shortcuts that we’ve developed based on our experiences and emotional intuition have a great deal of value to us. However, sometimes they can steer us wrong.

Whether you manage people on Agile teams, are a team member, or interact with Agile team members, it’s important to understand that most decisions are made emotionally rather than rationally. This is why, to be successful, we need to be smart about our emotions and develop our emotional intelligence.

About the authors
References
1. Rene Descartes trans. Thomas Hall.
4. Daniel Kahneman.

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The paragraph: "The emotional mind (System 2) is much quicker than the rational mind (System 1) and emotional decisions carry a particularly strong sense of certainty. In hindsight, we may find ourselves wondering why we bought that particular stock or got into that heated argument."

Must be: "The emotional mind (System 1) is much quicker than the rational mind (System 2) and emotional decisions carry a particularly strong sense of certainty. In hindsight, we may find ourselves wondering why we bought that particular stock or got into that heated argument."

Thanks Paulo, you are correct. That must have been my emotional mind talking :). I asked the editors to make the correction.

A clearer way of conceiving this is through a couple of important distinctions. Here are some thoughts on the matter.

Brain-mind distinction - brain as in the physical system that supports the mind that we are aware of through introspection. The benefits of identifying the relationship between them appears to find a casual connection. We are wise to err on the side of not ascribing more causation to correlation than can be responsibly justified.

Emotion-reason (or emoting-reasoning) distinction - emotion is a psycho-somatic response to a perceived value. Most simply, it's attraction to a positive or aversion to a threat - as automatized through habit formation. Reasoning is a volitional process that a person can control to the extent they make that choice - as in solve THIS...
problem. Ask WHY about anything and then try to answer this. And I'm not assuming the question is logical, i.e. a reasonable question as is often the case in paradoxes where there is a flawed assumption. E.g. "When did you stop beating your spouse?"; What is the sound of one hand clapping?; etc.

Conscious-subconscious distinction - (I prefer subconscious to unconscious which is better reserved for the state where we are knocked out - or dead). The sub-conscious here is reactive while the conscious open to reason. Emotions are reactive based on prior conscious programming. This is essential to survival. Attraction and avoidance based on prior experience and the value we attach to that experience. For example, is the sight of a dog initially perceived as a danger or a source of pleasure? Is the sight of a person you know a source of joy or fear? Is a stranger initially perceived as a threat? This last example gets to the basic trust in ones fellow human being based on ones experience in society - or lack of it.

From these assumptions, we are responsible for programming our sub-conscious. In intellectual development of children, or teaching throughout a lifetime, we can make the student safe for ideas or the ideas safe for students. I prefer the former and avoid those who prefer the latter.

Popping this up to our society and politics and getting practical on a broad scale...

Our near-monopoly government controlled primary and secondary education system provides the foundational thinking skills for most people. Are they taught the reasoning skills to think through what is in their best interests? How do people choose their philosophy or religion? What thinking tools are provided to help with this?

In elections, how much reasoning vs emoting is going on? And why is that? Since politicians win popularity contests, what are they incented to do? How does that square with responsible thinking, honesty and integrity?

And finally, how important is this vs brain-mind interaction among the sane who need to make choices every minute? When reason and emotion are in conflict, which do we allow to win? Isn't that what character is about?

If we are sold on determinism vs a volitional, rational human being, there is no incentive to stop and think. Seeing things from the perspective of the brain-mind, bio-electro-chemistry is most sensible.

How much is our attention to answering the issues in principle? How much is our educational system based on the philosophy of John Dewy's pragmatism built on ideas from William James and Charles Sanders Pierce? What does that advocate? And what has that done to our culture? The recent election cycle is a dramatic example of popular thinking on all sides.

I hope readers find these thoughts useful.
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