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## Book Review of Max S. Bennett (2024). *A Brief History of Intelligence: Why the Evolution of the Brain Holds the Key to the Future of AI.* William Collins.

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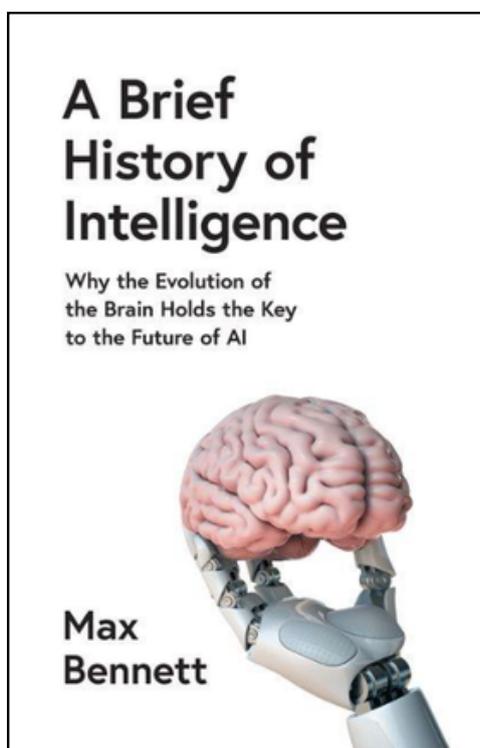


Figure 1: Book cover of *A Brief History of Intelligence*, Bennett (Ed., 2024)

The key to learning is the brain. *A Brief History of Intelligence* tells readers all that one needs to know about the evolution of the brain. The story is complex. Bennett tries to make it (almost) as simple as 1-2-3. Or, 1-2-3-4-5. First, the Earth existed before life. Then came life without intelligence. To make progress, the brain needed to enter the picture.

If the brain is key to learning and education, it would seem worthwhile to learn about it. But proceed with caution: This book is not an “easy read.” Nobel prize-winning economist Daniel Kahneman says he has read it twice- first quickly because it was so interesting, then again to capture the details. And I read pages twice because I couldn’t understand much during the first reading.

If this is not a book of tools which we educators can use tomorrow, why do I say to my colleagues, "You should read this." Because in the text, and also between the lines, there is important and sometimes surprising information. The inclusion of AI in the book title might be intended to catch today's hot topic. But no need: there is perhaps the best story one can find on human evolution in these pages, and that is enough. This is a history book, a history of the evolution of the brain, a solid, important story.

What is the main message? We, humans, are indeed gifted. Thanks to investigations by many scientists, we now know that the human brain has made all that we have accomplished possible. Only humans invented wheels. Some species seem to communicate, but only humans have conquered spoken language. As Bennett states, "every single group of humans ever discovered uses language" (Bennett, 2024, p. 298). I have seen three-year-old children around the world using language. Only humans do this. Sue Savage-Rumbaugh taught chimpanzee Kanzi to understand and use many "words", so the end of this story has not yet been written (Bennett, 2024, p. 300). But as of now, humans are the only species that truly have language. One cannot fathom learning and education without language.

Bennett gives a history of the brain and a history of life on Earth. Bennett reminds us that humans have been around for a long time, on a planet that has been around a really long time. "The first brain – the first collection of neurons in the head of an animal – appeared six hundred million years ago, in a worm the size of a grain of rice" (Bennett, 2024, p. 7). I have never felt comfortable with big numbers like a million. But this book has desensitized me a bit, numbers in the *millions* seem less formidable when the study of intelligence moves the conversations into *billions*. We move past millions when Bennett informs readers that "the human brain contains eighty-six billion neurons and over a hundred trillion connections" (Bennett, 2024, p.5). So, we set aside the hundred trillion connections and return to the planet Earth. If the first brain appeared six hundred million years ago, does that help us understand how old our planet is? Not exactly. This book is about the brain and intelligence, which came to be on Earth. The planet was lifeless for eons but then -

"about four billion years ago, deep in the volcanic oceans of a lifeless earth, just the right soup of molecules were bouncing around the microscopic nooks and crannies of an unremarkable hydrothermal vent. As boiling water burst from the seafloor it smashed naturally occurring nucleotides together and transformed them into long molecular chains that resembled today's DNA. This new DNA-like molecule wasn't alive per se..." (Bennett, 2024, p. 17)

But it duplicated itself, and that began life. A mere 4 to 3 and a half billion years ago.

Then brains emerge. "Life existed on earth for a long time – and I mean a *long* time, over three billion years – before the first brain made an appearance" (p. 17). Part of my problem is difficulty comprehending "*long*" time or, for that matter, any big numbers. As we learned on page 5, the human brain contains 86 billion neurons. Then on page 47, we learn that a nematode gets along just fine with 302 neurons "compared to a human's 85 billion."

AI tool "Claude" volunteered a way to grasp the concept of a billion.

The jump from a million to a billion is enormous - a million seconds is about 11.5 days, but a billion seconds is nearly 32 years.

The reason for spending so much time on numbers is that the history of the brain and the history of our planet, as described by Bennett, involves numbers in the millions and billions.

Bennett uses a story to reinforce the notion that humans are newcomers.

"If we were to scrunch the six hundred million years of evolutionary time – from which the first brains emerged until today – into a single calendar year, then we would now find ourselves perched at Christmas Eve, the final seven days of December. Over the next "seven days" our ancestors will go from foraging fruits to flying Falcon 9 rockets" (Bennett, 2024, p. 291).

A quadrillion years, four billion years, 600 million years, none of the numbers really sink in. I do know that it is a really long time between the day the Christmas tree goes up and the day the kids can finally open the wrapped presents under the tree. That is a *really* long time.

How might this tie to the current topic of artificial intelligence? Bennett quotes Geoffrey Hinton: "...the only way to get artificial intelligence to work is to do the computation in a way similar to the human brain" (Bennett, 2024, p. 6). Making artificial intelligence work would be significant. But what we need is to better understand how *humans* think and learn. Fortunately, we can benefit from the work of "scientists... [who] use the fossilized skulls of ancient creatures to reverse-engineer the structure of their brains... we can begin to trace acquirement of each mental power by gradation" (Bennett, 2024, p.8).

Although it is difficult to chronicle the history of intelligence and of humanity in one book, Bennett does an admirable job. Readers learn about "our four-billion-year evolutionary story"... and "the emergence of the modern human brain in our ancestors around one hundred thousand years ago" (Bennett, 2024, p.358). A series of breakthroughs had to occur before we could reach today's amazingly capable brain. Bennett gives five such turning points.

First, after life developed "bilateral bodies," creatures with a front and a back and a right side and a left side, things learned to *steer*. Left looks good, right looks like painful, GO LEFT. Bennett's second breakthrough was *reinforcing*. If that worked, REPEAT. Reinforcement learning helped brains catch the notions of "time perception, curiosity, fear, excitement, disappointment, and relief" (p. 360). "Breakthrough number 3 was *simulating*..." which, in my mind, overlaps with number 4 mentalizing. But number 5 was the big one: *speaking*. I might call number 5 "language" instead of *speaking*, but Bennett shows how speech matters. Sue Savage-

Rumbaugh taught Kanzi to understand and even sign many "words" (p. 300), but only humans have the necessary equipment (vocal cords, etc.) to *speak*. I can imagine learning and education without *speaking* (recall the Anne Sullivan and Helen Keller story), but not without language. Breakthrough number 6? Not yet. Read the book for hints.

Many studies reported by Bennett are fascinating and unexpected. Caroline Delong watched as her fish learned to navigate the tricky maze and find food. One amazing twist to this story is what happened *a year later*. Delong put the fish back in the same tank and *bingo!* The fish remembered exactly how to get to the reward. This makes me think that my giving tiny packs of M&Ms to the first team with the correct answer might be more than just fun; it may be assisting *learning*. Amazingly, there is more to the story: Several other scientists found that it is not the reward that causes the dopamine release, which puts a smile on the face of the fish or monkey; it is the "surprise, aha, I did it" feeling, the reward itself seems not to matter much! This book is full of hundreds of such tidbits, for which I felt rewarded upon discovering (Bennett, 2024, p. 111, p. 139).

Here we humans are in what we call the 21st century, with remarkable brains. Bennett has done his homework and shares his findings. We can with confidence describe how the human brain evolved. The brief history of the evolution of intelligence makes the book worthwhile. But there are also important takeaways hidden *between the lines*. Consider two interesting-but-unwritten messages from this book, 1-2: first, the work of many scientists. Second, things change.

### **1. First, we must acknowledge the research that has gotten us this far.**

Scientists have helped piece together the very complex story of the evolution of humans and the human brain. It took many brains to discover the pieces in this puzzle, which Bennett distills into this brief 400-page history of intelligence. Here are the names of scientists whose work is mentioned in the first 200 pages of the book:

George de Mestral [appears on page 4], Geoffrey Hinton, Theodosius Dobzhansky, Charles Darwin, Paul MacLean, Yann Lecun, Edgar Adrian, Santiago Ramon y Cajal, Charles Sherrington, Henry Dale, John Eccles, Rodney Brooks, Kent Berridge, Robert Heath, Ivan Pavlov, Edward Thorndike, B. F. Skinner, Marvin Minsky, Alan Turing, Richard Sutton, Andrew Barto, Gerald Tesauro, Ken Jennings, Petr Dayan, Read Montague, Wolfram Schultz, David Rumelhart, Ronald Williams, Neal Cohen, Michael McCloskey, David Hubel, Torsten Wiesel, Kunihiro Fukushima, Ca-

-roline DeLong, Vernon Mountcastle, Hermann von Helmholtz, Edward Tolman, David Redish, Adam Johnson, Adam Steiner [on page 193]

Many brains. I was struck by the scarcity of female brains, female names, in that list of names in the first 200 pages. I double-checked, and yes, that list above has only one female. (The number of females mentioned after page 200 increases slightly.) As a parent with both sons and daughters, I would hope my children, whatever gender, would play roles that might merit attention in future books. As described above, the history of the brain could not have been written if it were not for the work of many scientists. And the fact is, in the 21st century, the folks whose work helps us understand this are mostly male.

## **2. A second unwritten but important message in Bennett's book is this: things change.**

This can be a hopeful thought or a frightening thought. Why hopeful? The fact is that today there are relatively fewer females than males in important future-oriented high-tech jobs. But it is also true that gender imbalance is lessening in many areas. Things do change. And "at the present rate of progress ... we may expect to see gender equality in 467 years" (Schnall, 2023, p.1). After reading Bennett's book, 467 years seems instantaneous, not at all troublesome. An unwritten but clear message in this book is that things change.

One example sticks in my mind. The first class I taught was an MBA class with around 30 participants. Not one female. All males? That would be unthinkable today. And since few females studied business back then, it should not be surprising that few women taught business. Around the 1970s, a popular source of information about universities was the Lovejoy College Guide. One front-and-back page was all one needed to know about any school, for example, the University of California Berkeley business school. The names of each faculty member were printed out. In a full page of names, there was one female (Karlene Roberts) and about 50 males. Along with the faculty names was a sales pitch for the school. The San Francisco Bay area had many advantages, including a vibrant economy that would "provide many job opportunities for students' wives." One can simply not imagine such a phrase appearing in print today. Thankfully things can change, sometimes for the better, and sometimes relatively fast. Bennett's book helps us take a long view.

Picture the following. A proud-looking young woman is wearing a graduation gown, and the cap with the tassel. She and her group of six are standing at what looks like a university. She is at the right end next to her boyfriend. As we look left in the picture, we next see her mother and father, numbers 3 and 4 in the picture. The mother's parents, our graduate's grandmother and grandfather, are numbers 1 and 2 in the picture. All are smiling. In this one "photo", one can see evidence that things change, sometimes very fast. The graduation "photo" suggests that some things change so fast we can see change in one lifetime, as illustrated in one photo taken at a moment of time on one day. Humans are getting taller. The shortest person might well be number 1, the grandmother of the graduate. Perhaps almost imperceptibly, the group ranges from the shortest at the far left to the tallest at the right end. In one moment- today, we can see what we already know: humans are getting taller. Now, in that one graduation photo, we can see how fast things can change.

But there is also a frightening, potentially terrifying, angle to consider. Sometimes things change for the worse. Bennett's book helps us see that. Imagine a battle between a Stegosaurus and a Tyrannosaurus Rex. Who would win? But there could not have been such a battle. The stegosaurus became extinct around 150 million years ago. The Tyrannosaurus Rex did not even exist until some 80 million years after the Stegosaurus had become extinct.

These extinction "events" were not the first. One "event" happened around 2.4 billion years ago, and it occurred so rapidly (in geological terms) that Bennett calls it the Great Oxygenation "Event." Over the course of one hundred million years, oxygen levels skyrocketed... the rise of oxygen was followed by one of the deadliest extinction events in human Earth's history..." (Bennett, 2024, p. 21). The one hundred million years long Oxygenation extinction "event" was followed by other great extinctions and such as the what Bennett calls "the Permian-Triassic extinction which killed "over 70 percent of land-living vertebrates" (Bennett, 2024, p. 238).

There is no reason to think that extinctions are a thing of the past. What will come next? Could it be a global warming "event" occurring over perhaps a hundred million years or a thermonuclear holocaust requiring perhaps a

decade to wipe out many species, perhaps including humans? Both are “extremely unlikely.” Analyses by experts are not much help in determining the “likelihood.” One typical expert opinion assessed the danger from a meteor hitting the Earth as between one in a million and one in a billion. Both species extinction by global warming and nuclear holocaust are unthinkable. However, being unthinkable does not guarantee impossibility.

Climate change, slow and inexorable, would be bad but it would not bring human extinction. And climate change is potentially controllable (Cadez & Czerny, 2016). One Yucatan-peninsula-size meteor on top of ongoing global warming, sea level rise, etc., might be a threat. It is not likely, but if one does hit, yes, it would mess things up.

I had never thought about the possible extinction of humans until I read this book. But now I am forced to think. Extinction events of the past deserve attention. As Bennett writes, “perhaps we humans will end the grand four-billion-year experiment of life on Earth through ravaging the planet’s climate or blowing our world into oblivion with nuclear warfare” (Bennett, 2024, p. 364). Thermonuclear war would bring the collapse of the entire social structure. How would humans eat without the giant agribusinesses requiring electricity at innumerable points? Trucks could not transport food without a working highway system and fuel stations, which depend on a long supply chain from oil wells to refineries to trucks to refill the tanks of each station. What would a gasoline infrastructure collapse be like today? Or tomorrow? Might truckers wait for hours or days to refill their rigs at the few stations which have supplies of fuel?

One might envision fewer gasoline-powered vehicles in the future. In transportation, electrification is happening very rapidly. However, the idea of all cars and trucks being electric can terrify us. If all electric power failed, how would vehicles move? The “Great Northeast Power Outage” of 1965 in the USA should be reviewed (Hines & Talukdar, 2007). News accounts of that very localized yet very brief disruption hint at how bad it might have been if there were no end in sight. Health, societal order, food distribution, economy based on “jobs,” what would survive? What new systems, networks, customs would emerge? Would governments become local, even micro in nature? What about education?

The COVID-19 event has brought about an incredible societal response around the world. Thankfully, the events around 2020 never got as bad as the bubonic plague or even the “Spanish Flu” of around 1920. The Irish Potato Famine caused many deaths by starvation and resulted in millions more leaving the country, with the pre-famine population high of around 8 million in the 1840s dropping to around four million by 1900. Hitler killed six million Jews in the Holocaust (Bartov, 2022). Now, in the 21st century, famines still bring tragic loss of life. Wars take countless lives. If we were to face a breakdown of infrastructure which relies on electricity, what might happen? A “computer glitch” which hit one firm, CrowdStrike, on July 19th, 2024, caused air travel disruptions impacting millions. This one event caused more than eight million computer systems to crash (Santos-Reyes, 2025). Many people today are addicted to their mobile phones. What if all mobile networks stopped working as a result of a global EMP (Electro Magnetic Pulse) event, one element of a global thermonuclear disaster? (Gurevich, 2022). A hint can be seen when a mobile network collapses for whatever reason. Such disruptions to date have always been limited in scale and duration (Evans, 2024). What if my network ceased to exist? What disruptions might that bring to my safety, security, health, professional life and my university?

While there are certainly grounds for concern, as outlined above, things also change for the better. This book is basically optimistic, a story of the amazing growth of intelligence. Bennett reminds readers in every chapter that things change slowly, taking thousands, millions and even billions of years. The “graduation photo” suggests that things can sometimes change dramatically even within the short lifetime of one human. We are getting taller at a fast pace. We can see it in a wedding photo of an entire family standing or any graduation picture. Might this be significant in a story about the history of intelligence? Bennett plays with an interesting question, the size of the brain, in several parts of the book (Bennett, 2024, pages 239, 253, 254, 323, 330). Is brain size really important? Human brains have been getting larger. Bennett theorizes this growth in brain size.

Every roundabout of this cycle made our ancestors’ brains bigger and bigger. As social groups got bigger ... it created more pressure for bigger brains to keep track of all the social relationships. As more ideas accumulated across generations, it created more pressure for bigger brains to increase the storage capacity of ideas... (Bennett, 2024, p. 339).

Brain size is not directly related to intelligence. The chimpanzee has a brain of similar size compared to the human, but chimpanzees have not created driverless taxis (which can be seen daily in San Francisco in the mid-2020s). On the other hand, chimpanzees have never formed armies nor committed genocide. The accomplishments of homo sapiens outweigh the failures, so far. Bennett implies that the increased brain size has been a good thing for the species. If so, will some noteworthy increase in brain size occur over the next hundred million or so years, some "event" lasting a mere hundred million years? Or, will brain size grow over the next 33 years, one human generation? Look again at that imaginary graduation photo, which shows a small but perceptible increase in human height, one generation to the next. And note what Bennett says, "the size of the spaces inside their skulls (good proxy for the size of the brain) ..." (Bennett, 2024, p. 323). The spaces inside the skulls of today's grandchildren are bigger than the spaces inside the skulls of today's grandparents. This book will indelibly etch this fact into a reader's intelligence: things do change.

Bennett's book is a history of evolution, yes. But to me, it is more. A Brief History of Intelligence forces one to think. Bennett does not answer all my questions. But reading this book forces me and will force a reader to think. I recommend this book. Read it fast and think about it slowly (Kahneman, 2011).

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