



To arrive at the edge of the world's knowledge, seek out the most complex and sophisticated minds, put them in a room together, and have them ask each other the questions they are asking themselves.

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[John Tooby](#)

Founder of field of Evolutionary Psychology; Co-director, Center for Evolutionary Psychology, Professor of Anthropology, UC Santa Barbara

I SEEM TO BE METADATA

Obliterating whole lineages — diatoms and dinosaurs, corals and crustaceans, ammonites and amphibians — shockwaves from the Yucatán impact 65 million years ago ripped through the intricate interdependencies of the planetary ecosystem, turning blankets of life into shrouds in one incandescent geological instant. Knocking out keystone species and toppling community structures, these shifts and extinctions opened up new opportunities, inviting avian and mammalian adaptive radiations and other bursts of innovation that transformed the living world — and eventually opening the way for our placenta-suckled, unprecedentedly luxuriant brains.

What with one thing and another, now here we are: The Internet and the World Wide Web that runs on it have struck our species' informational ecology with a similarly explosive impact, their shockwaves rippling through our cultural, social, economic, political, technological, scientific, and even cognitive landscapes.

To understand the nature and magnitude of what is to come, consider the effects of Gutenberg's ingenious marriage of the grape press, oil-based inks, and his method for inexpensively producing movable type. Before Gutenberg, books were scarce and expensive, requiring months or years of skilled individual effort to produce a single copy. Inevitably, they were primarily prestige goods for aristocrats and clerics, their content devoted to the narrow and largely useless status or ritual preoccupations of their owners. Slow-changing vessels bearing the distant echoes of ancient tradition, books were absent from the lives of all but a tiny fraction of humanity. Books then were travelers from the past rather than signals from the present, their cargo ignorance as often as knowledge. European awareness was parochial in the strict, original sense — limited to direct experience of the parish.

Yet a few decades after Gutenberg, there were millions of books flooding Europe, many written and owned by a new book-created middle class, full of new knowledge, art, disputation, and exploration. Mental horizons — once linked to the physical horizon just a few miles away — surged outward.

Formerly, knowledge of all kinds had been fixed by authority and embedded in hierarchy, and was by assumption and intention largely static. Yet the sharp drop in the price of reproducing books shattered this stagnant and immobilizing mentality. Printing rained new Renaissance texts and newly recovered classical works across Europe; printing catalyzed the scientific revolution; printing put technological and commercial innovation onto an upward arc still accelerating today. Printing ignited the previously wasted intellectual potential of huge segments of the population — people who, without printing would have died illiterate, uneducated, without voice or legacy.

Printing summoned into existence increasingly diversified bodies of new knowledge, multiplied productive divisions of labor, midwived new professions, and greatly expanded the middle class. It threw up voluntary, meritocratic new hierarchies of knowledge and productivity to rival traditional hierarchies of force and superstition. In short, the release of printing technology into human societies brought into being a vast new ecosystem of knowledge — dense, diverse, rapidly changing, rapidly growing, and beyond the ability of any one mind to encompass, or any government to control.

Over the previous millennium, heretics had appeared perennially, only to be crushed. Implicitly and explicitly, beyond all question, orthodoxy defined and embodied virtue. But when, after Gutenberg, heretics such as Luther gained access to printing presses, the rapid and broad dissemination of their writings allowed dissidents to muster enough socially coordinated recruits to militarily stalemate attempts by hierarchies to suppress them. Hence, the assumption of a single orthodoxy husbanded by a single system of sanctified authority was broken, beyond all recovery.

For the same reason that communist governments restricted access to Marx's and Engels' original writings, the Church had made it a death penalty offense (to be preceded by torture) to translate the Bible into the languages people spoke and understood. The radical change in attitude toward authority, and the revaluation of minds even at the bottom of society, can be seen in William Tyndale's defense of his plan to translate the Bible into English: "I defy the Pope, and all his laws; and if God spares my life, I will cause the boy that drives the plow to know more of the Scriptures than the Pope himself." (After his translation was printed, he was arrested, tied to the stake, and strangled.) Laymen, even plowboys, who now had access to Bibles (because they could both read and afford them) shockingly decided they could interpret sacred texts for themselves without the Church manipulatively interposing itself as intermediary between book and reader. Humans being what they are, religious wars followed, in struggles to make one or another doctrine (and elite) locally supreme.

Conflicts such as the Thirty Years War (with perhaps ten million dead and entire territories devastated) slowly awakened Europeans about the costs of violent intolerance, and starting among dissident Protestant communities, the recognized prerogatives of conscience and judgment devolved onto ever smaller units, eventually coming to rest in the individual (at least in some societies, and always disputed by rulers).

Freedom of thought and speech — where they exist — were unforeseen offspring of the printing press, and they change how we think. Political assumptions that had endured for millennia became inverted, making it thinkable that political legitimacy should arise from the sanction of the governed, rather than it being a natural entitlement of rulers. And science was the most radical of printing's many offspring.

Formerly, the social validation of correct opinion had been the prerogative of local force-based hierarchies, based on tradition, and intended to serve the powerful. Even disputes in natural philosophy had been settled by appeals to the textual authority of venerated

ancients such as Aristotle. What alternative could there be? Yet, when the unified front of religious and secular authority began to fragment, logic and evidence could begin to play a role. What makes science distinct is that it is the human activity in which logic and evidence (suspect, because potentially subversive of authority) are allowed to play at least some role in evaluating claims.

Galileo — arguably the founder of modern science — was threatened with torture and placed under house arrest not for his scientific beliefs but rather for his deeper heresies about what validates knowledge: He argued that alongside scripture — which could be misinterpreted — God had written another book — the book of nature — written in mathematics, but open for all to see. Claims about the book of nature could be investigated using experiments, logic, and mathematics — a radical proposal that left no role for authority in the evaluation of (non-scriptural) truth. (Paralleling Tyndale's focus on the literate lay public, Galileo wrote almost all of his books in Italian rather than in Latin.) The Royal Society, founded two decades after Galileo's death, chose as their motto *nullius in verba*: on the authority of no one — a principle strikingly at variance with the pre-Gutenberg world.

The assumptions (e.g., I should be free to think about and question anything), methods (experimentation, statistical inference, modeling building), and content (evolutionary biology, quantum mechanics, the computational theory of mind) of modern thought are unimaginably different from those held by our ancestors living before Gutenberg. All this — to simplify slightly — because of a drop in the cost of producing books.

So what is happening to us, now that the Internet has engulfed us? The Internet and its cybernetic creatures have dropped, by many more orders of magnitude, the cost (in money, effort, and time) of acquiring and publishing information. The knowledge (and disinformation) of the species is migrating online, a click away.

To take just first order consequences, we see all around us transformations in the making that will rival or exceed the printing revolution — for example, heating up the chain reactions of scientific, technical, and economic innovation by pulling out the moderating rods of distance and delay). Quantity, Stalin said, has a quality all its own. The Internet also unleashes monsters from the id — our evolved mental programs are far more easily triggered by images than by propositions, a reality jihadi Websites are exploiting in our new round of religious wars.

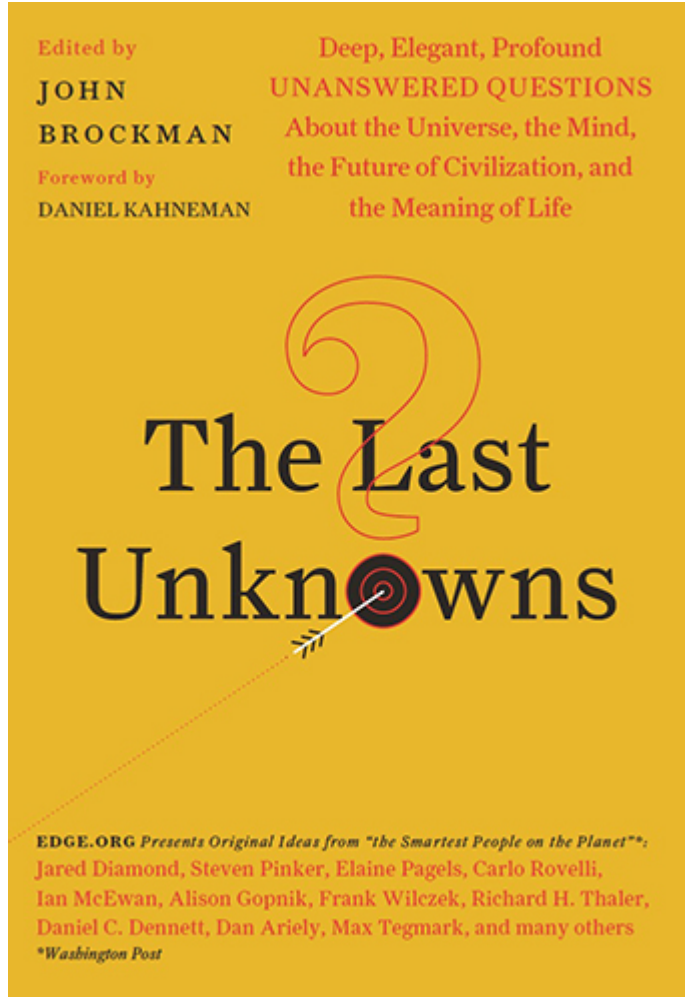
Our generation is living through this transformation, so although our cognitive unconscious is hidden from awareness, we can at least report on our direct experience on how our thinking has shifted before and after. I vividly remember my first day of browsing — firing link after link after link, suspended in an endless elation as I surveyed possibility after possibility for twenty hours straight — something I still feel.

Now my browsing operates out of two states of mind: the first is broad, rapid, intuitive scanning, where I feel free to click without goals, in order to maintain some kind of general scientific and cultural awareness without drowning in the endless sea. The second is a disciplined, focused exploration, where I am careful to ignore partisan pulls and ad hominem distractions, to dispense with my own sympathies or annoyance, to strip everything away except information about causation, and paths to potential falsification or critical tests.

Like a good Kuhnian, I attempt to pay special attention to anomalies in my favored theories, which are easier to identify now that I can scan more broadly. More generally, it seems like the scope of my research has become both broader and deeper, because both

cost less. Finally, my mind seems to be increasingly interwoven into the Internet — what I store locally in my own brain seems more and more to be metadata for the parts of my understanding that are stored on the Internet.

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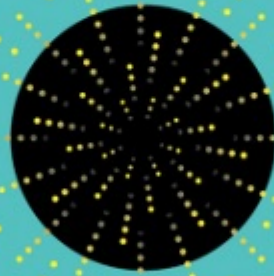


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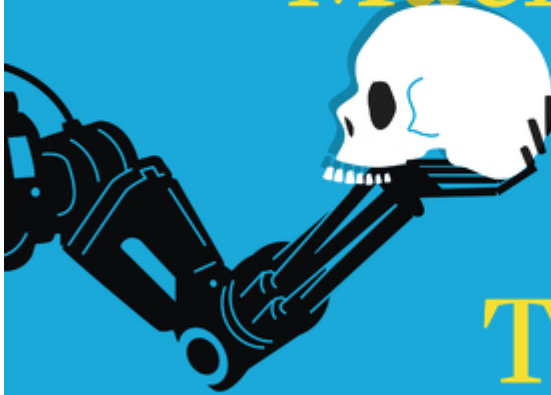
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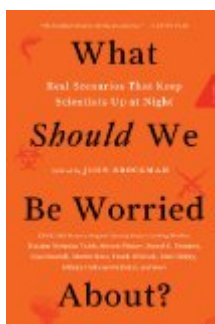
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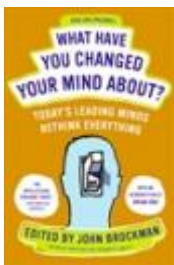
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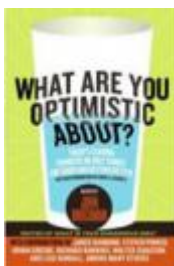
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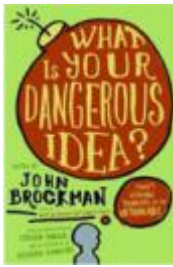


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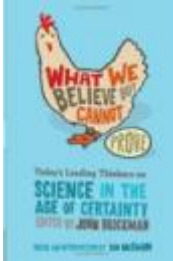


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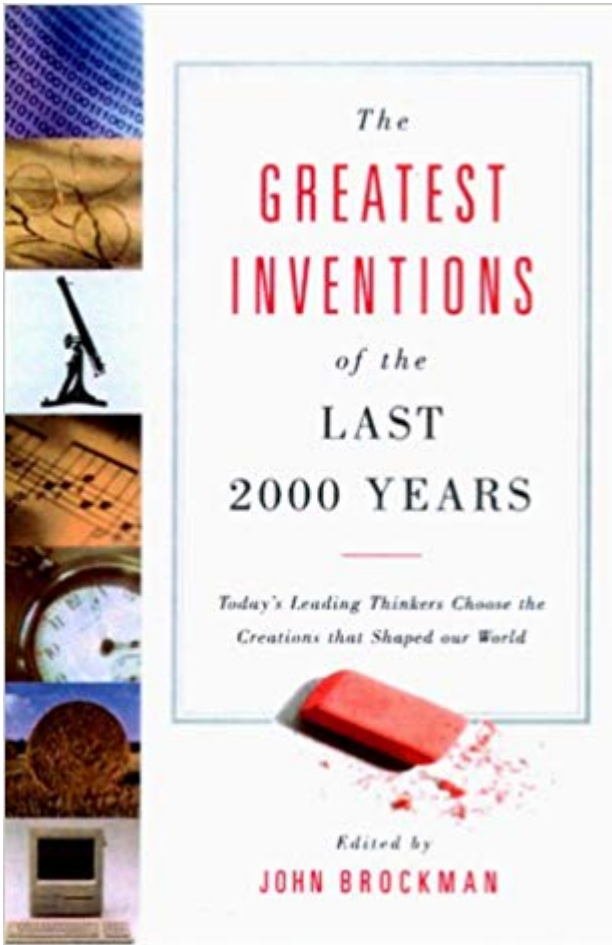
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