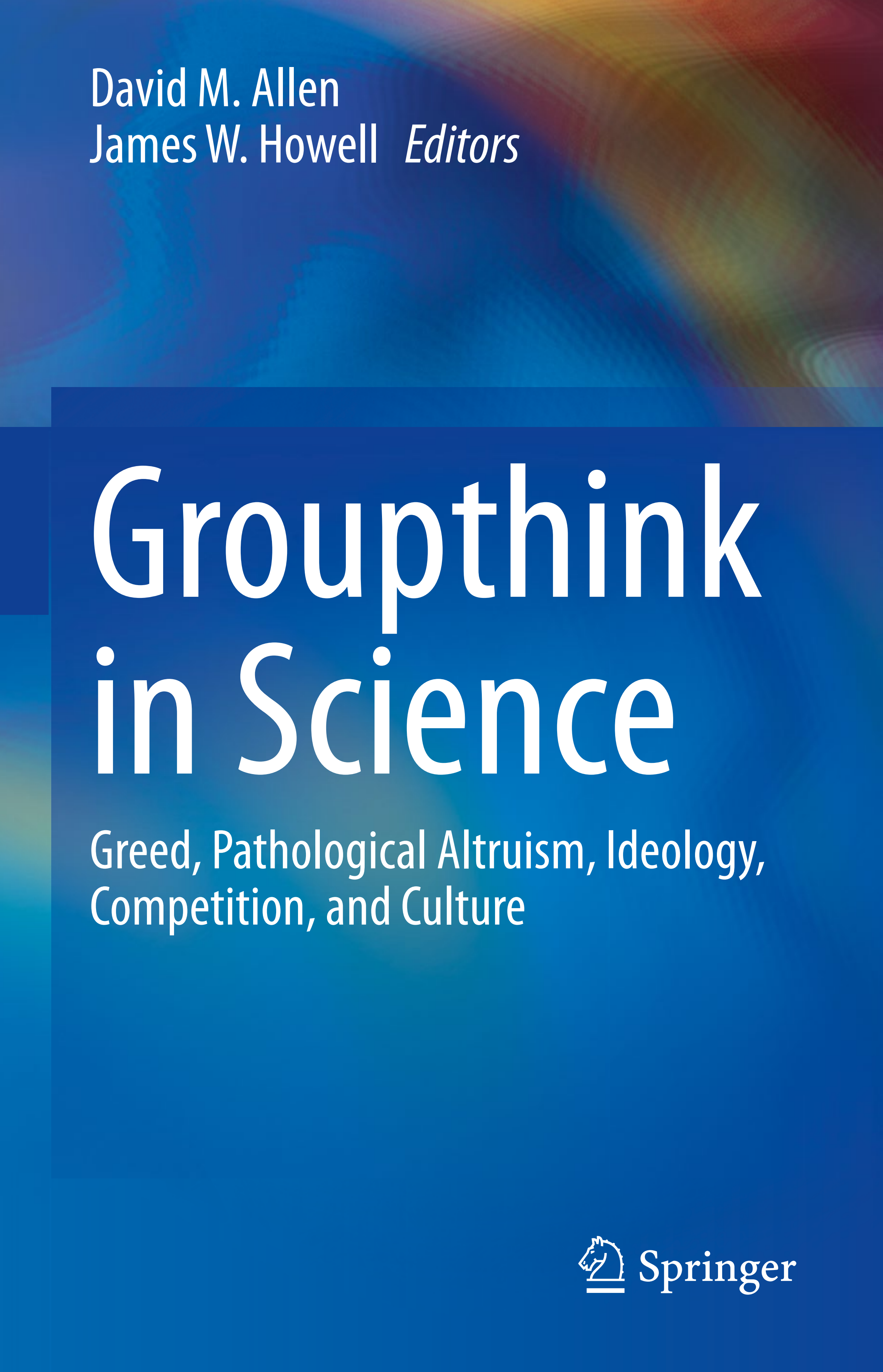

David M. Allen
James W. Howell *Editors*

Groupthink in Science

Greed, Pathological Altruism, Ideology, Competition, and Culture

Springer

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S. Hossein Fatemi, MD, PHD,
a true scientist, physician, and friend.
Professor, Department of Psychiatry
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Abbreviations

AAVE	African-American Vernacular English
AML	Appropriate Management Level
BIT	Behavioral Investment Theory
BLM	Bureau of Land Management
CMS	Centers for Medicare & Medicaid Services
DNC	Maryland Department of Natural Resources
DOI	Digital Object Identifier
EPA	Environmental Protection Agency
FIIS	Fire Island National Seashore
HEI	Higher Education Institutions
HMA	Herd Management Areas
JH	Justification Hypothesis
KOL	Key Opinion Leader
NIST	National Institute of Standards and Technology
NPS	National Park Service
RSVI	Relational Value/Social Influence
USDA	United States Department of Agriculture

Groupthink in Science: An Introduction

One of the hottest topics in science today is concern over certain problematic practices within the scientific enterprise. Richard Horton (2015), editor of the respected medical journal *The Lancet*, recently summarized some of the issues involved: studies with small sample sizes, tiny effects, invalid exploratory analyses, and flagrant conflicts of interest, together with an obsession for pursuing fashionable trends of dubious importance. *Groupthink in Science* will elucidate in depth a widespread phenomenon that is often at the heart of this—problematic aspects of the psychology and behavior of people in groups.

Now of course, the fact that this book acknowledges that science can be done in problematic ways is not in any way an indictment of science per se. When it works well, science is by far the best way to discover accurate information about how the universe works and to gain objective knowledge. We are huge proponents of the scientific method. However, we do not buy in to the proposition that scientists are beyond reproach. In fact, this book is meant to *advance* the cause of science, not to attack science.

Groupthink is when a group of people, in an effort to demonstrate harmony and unity, fail to consider alternative perspectives and ultimately engage in deeply problematic decision-making. Haidt (2012) points out that if we focus on behavior in groups of people who know each other and share goals and values, "our ability to work together, divide labor, help each other, and function as a team is so all-pervasive that we don't even notice it" (p.198). He adds that "Words are inadequate to describe the emotion aroused by prolonged movement in unison that drilling involved" (p.221). "It doesn't mean that we are mindless or unconditional team players; it means [we] are selective" (p.223). However, groupthink may lead to a great deal of bias when the psychological drive for consensus is so strong that any divergence from that consensus is ignored or rejected.

In scientific research, groupthink may lead researchers to reject innovative or controversial ideas, hypotheses, or methodologies that challenge the status quo. Philosophers, historians, and sociologists have observed that scientists often resist new ideas, despite their reputation for open-mindedness (Barber, 1961; Kuhn, 1962). The great quantum physicist Max Planck has been quoted as saying: "A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it" (Planck, 1962:33–34).

In his seminal work on the history of science, *The Structure of Scientific Revolutions*, Kuhn described the role of conformity and close-mindedness in scientific advancement. According to Kuhn (1962), science progresses through different stages. In the first stage, known as normal science, scientists conduct their research within a paradigm that defines the field. A paradigm is a way of doing science that includes basic assumptions, beliefs, principles, theories, methods, and epistemic values that establish how one solves problems within the normal science tradition; normal science involves consensus within a scientific community. For example, Newtonian physics was a normal science tradition that established ways of solving problems related to motion and electromagnetic radiation (Kuhn, 1962).

During the normal science stage, scientists attempt to apply the paradigm to problems they can solve and resist certain theories, methods, and ideas that challenge the paradigm. At this stage, scientists tend to think within the theoretical limits of the paradigm, limiting novel ideas. However, as problems emerge that cannot be solved within the paradigm, scientists start to consider new ideas, theories, and methods that form the basis of a new and emerging paradigm. A scientific revolution occurs when the new paradigm replaces the old. For example, during the early twentieth century, Newtonian physics succumbed to quantum mechanics and relativity theory (Kuhn, 1962). However, a paradigm shift is not a purely rational process driven by logical argumentation and empirical evidence; rather, it involves a change in perception or a willingness to see the world in a different way (Kuhn, 1962). After the revolution, a new paradigm takes hold and the process once again starts to repeat itself.

Some philosophers have argued that a certain amount of closed-mindedness, known as epistemological conservatism, is justified in scientific research. The rationale for this epistemological stance is that change in a network of beliefs should be based on substantial empirical evidence. Since changes in beliefs can consume a considerable amount of time and effort and our cognitive resources are limited, we should not change our beliefs, especially ones that play a central role in our worldview, without compelling evidence (Lycan, 1988; Quine, 1961; Resnik, 1994; Sklar, 1975). For example, because Einstein's general theory of relativity contradicted the fundamental principle of Newtonian physics that space and time are immutable, it took an extraordinary proof—i.e., that observation of the sun's gravity bending light from a star during a solar eclipse in 1919—to confirm the theory (Buchen, 2009). While it seems clear that a certain amount of conservatism makes sense in research, scientists should be careful to avoid dogmatism. Although scientists should practice a degree a skepticism pertaining to hypotheses and theories that challenge the status quo, they should be open to new ideas (Resnik, 1994).

So, despite idealization by some students and practitioners, scientists are of course human beings and as such are subject to anything that can adversely affect the thinking of all human beings. In particular, scientists are not immune from acting in the interests of the groups to which they belong, be they financial, bureaucratic, political, or ideological. They can lie to others and even to themselves, engage in fraudulent practices, design studies in ways that lead to predetermined and preordained outcomes, draw conclusions based on false a priori assumptions that are never acknowledged, act together as a mob, or shun other scientists who have evidence for viewpoints which are at odds with their own. They can be bought off by profiteering industries.

Human beings also are highly prone to forming hierarchies, as well as cults of personality, in which leaders can then be lionized and followed like sheep unthinkingly. This is particularly true in universities and organizations which fund research, where the funding of projects and the publication of data can be subject to the arbitrary whims of the department heads or of well-thought-of, fully tenured professors at the expense of those lower down on the academic totem pole. Academic politics is widely known to be a cutthroat competition in which members of a department jockey and maneuver for influence with the powers that be.

The tendency of human beings to form hierarchies has an evolutionary advantage as described by Loretta Breuning in Chap. 1. Unfortunately in some instances, it has an impactful downside. People at the top of the hierarchy may let the power of the position go to their heads in a sense, especially if they have narcissistic tendencies to begin with due to their own individual upbringing. David Robson, in his book *The Intelligence Trap: Why Smart People Make Dumb Mistakes* (2019), looks at the problem from the perspective of people with relatively high intelligence do stupid things. Two processes stand out:

Earned dogmatism: Our self-perception of expertise can lead to a feeling that we have gained the right to be closed-minded and to ignore other points of view. We see this too often among established professionals who think that their accepted success level gives a deserved weight to their words, ideas, and opinions. This is especially true if the person has made a lot of money (in any field) or is the recipient of accolades and awards.

Entrenchment: A high-ranking expert's ideas often become rigid and fixed. When accepted by others lower in status, as is often the case, such ideas can become the foundation of the group's ideology and, effectively, become a "fashion" in a particular field of science. This usually includes a belief held by many simply because they have reached a certain "level of expertise" within a community and the benefits of following the leader's beliefs become entrenched.

Robson also points out how the most effective leaders in science benefit from being at least somewhat humble. One needs this in order to best interact with and consider the opinions of other people. Considering alternative views helps us all to avoid dogmatic thinking. Too often, outside arguments against ideas held by groupthink and defended by blind bias can be stifling to anyone who has the effrontery to challenge those ideas. In fields like medicine, this can sometimes have a literally fatal effect.

One of the most deadly examples of this was the experience of Dr. Sunny Anand when he was in his last year in medical school at Oxford University (Paul, 2008). Dr. Anand's ambition was to work with premature babies. He worked with these preemies in the nursery at the hospital in his spare time. After a while, he noticed that when babies were taken away for surgery, some of them came back to the nursery blue and some did not come back at all.

Of course, he became concerned about this, but at the time, he was a mere senior medical student and he did not know if he could find out what caused this problem. Finally, he went to the head of the nursery and asked if he could go to the operating room with one or two of these babies to see what was happening. He found that the babies were being operated upon without the benefit of anesthesia.

The reason given was that there was a consensus, not only at this hospital but pretty much around the world, that newborns did not feel pain and thus they were not exposed to the possible negative effects of anesthesia. The babies were going into shock and many did not survive.

Another reason that academics can also reject important truths is due to political correctness concerns. This is easiest to see in the social sciences and humanities, where professors are thought to be far more progressive than the general public. Their conclusions are often labeled as “left-leaning.” Their approach to “free speech” on university campuses is ironically associated with repressive actions that actually suppress free speech (Beinhart, 2017). This process seems to have become more extreme in recent years on college campuses, where groups sometimes turn even on their own members for not exhibiting the proper orthodoxy (Lukianoff & Haidt, 2018).

The problem is not, however, limited to the social sciences and the humanities. In the hard sciences, scientific education may operate as a kind of indoctrination that privileges certain theories or methods and leads to selective perception and validation of evidence. A symposium at the Wellcome Trust in London in association with the Academy of Medical Sciences in 2015 reviewed a growing failure in the reliability and reproducibility of biomedical research suggestive of this sort of bias. The situation was attributed variously to “data dredging” to impose expectations on the data; the non-publication of negative results; the use of small, unreliable samples; underspecified methods; and weak research designs—all of which make it difficult to reject the null hypothesis (which means that there is no significant difference between two specific populations and that any observed difference is due to sampling or experimental error).

Another symposium—“Is Science Broken?”—was held at University College London by experimental psychologists and came to similar conclusions (Woolston, 2015). It acknowledged widespread “p-hacking” to arbitrarily rerun quantitative models in search of the statistical significance of pet theories and the cherry picking of conclusions favorable to the proponents’ perspective.

These problems can sometimes create setbacks for entire fields for significant periods of time. In psychology, for example, one of the biggest deceptions perpetrated on the American public has been the idea that “self-esteem” is the key to success and self-improvement (Lilienfeld, Lynn, Ruscio, & Beyerstein, 2010). We were told that if we just improved the self-esteem of students and other individuals in this country, everyone would be happier and more successful. This idea has been carried on to this day in many sectors of mental health and is still supported by a large number of professionals despite a multitude of studies exposing the concept as useless. There is a major difference between self-esteem and self-confidence. Psychology has also become increasingly aware of failures by independent experimentalists to replicate allegedly robust discoveries (Baker, 2015).

The reliability of much of the neuroscience literature is also questionable, usually because of the small sample sizes used. With some of her colleagues, Dr. Katherine S. Button, now of Bath University, reviewed the statistical power of a large spectrum of the neuroscience literature (Button et al., 2013). They found the statistical power to be quite low at approximately 20 %. This makes it almost impossible to make a statement about any effects being studied.

In 2010, Ivan Oransky and Adam Marcus created a web site, *retractionwatch.com*, to record the public repudiation and retraction of refereed publications, not only in social sciences but in every sort of refereed scientific publication. In both the London venues, the chief supposition of participants was that the crisis in contemporary science in these diverse areas is more the failure of unconscious biases and regrettable (but not deliberate) sloppy methods and procedures—the sorts of things predicted by Kuhn's normal science. This does not rule out cases of scientific misconduct based on outright fabrication of data for career advancement. This does occur and is more likely to be unearthed through whistle-blowers than through failures to replicate or the peer-review process (Stroebe, Postmes & Spears, 2012). However, this is not usually created by groupthink.

When researchers and academic administrators sacrifice any modicum of scientific objectivity, and perhaps even their own ethical standards, in their behavior in order to support a particular group's interests, or that of group's leaders, doing so not only impedes scientific progress for the rest of us but can backfire and adversely affect the interests of the group to which a scientist belongs. Problems with the science that are never addressed often begin to show up and become very intense, negatively affecting group processes. In addition, other scientists from competing groups who are pushing more accurate ideas tend to eventually prevail, and the first group can suffer a precipitous fall from grace.

Oakley (2012) deemed this aspect of the behavior of systems—the process in which individuals who sacrifice themselves for the good of a group eventually cause harm to their group—*pathological altruism*. Of course, such behavior is altruistic only toward their in-group, not toward outsiders. We are particularly interested in how established leaders in a field often block the work of challengers for real or proffered reasons of "doing the right thing" or "helping others."

Many of the problems in science created by processes that often occur during groupthink have been highly exacerbated in recent decades due to several developments:

1. The increasing industrialization of all academic endeavors.
2. Research quality has been slowly giving way to excessive quantity, as several peer-reviewed publications per year are required for promotion and tenure—and even continued employment—at universities and professional schools.
3. The increasing emphasis on production and on attracting funding that gives universities more and more the appearance of businesses and scientists more and more that of merchants.

4. The proliferation of professional journals that must attract research papers or perish.
5. The increasingly loud siren calls of travel around the world's resorts for the presentation of "new" scientific facts and theories by the same conferees two to five times in a single year.

Group allegiances can cause adverse effects on science at every stage of the scientific process. As mentioned, researchers pick statistical tests based on how they want their research to come out and in their journal articles do not write about the assumptions that they are making which, if clarified, might lead readers to be highly skeptical of their conclusions. Certain journals are ranked higher than others, often on the basis of a past history which may no longer be valid, and findings published in "lesser" journals can be ignored. Peer reviewers for both journal editorial panels and grant review panels may subconsciously favor papers and proposals which are in line with their theoretical and professional group prejudices. Editors of journals can reject articles even when well-reviewed. Newspapers and television news show may highlight findings that are sensational without balancing the implications of their headlines with important caveats.

An understanding of this process is a major contribution by those who advocate for *systems thinking* (Senge, 1990). Systems thinking is a holistic approach to analyzing how events and processes that are often distant in time and space interrelate with each other in ways that are not often obvious but lead to various outcomes. The constituent parts within any one "system" also function within the context of larger systems.

The objective of the book is to educate scientists, health professionals, political advocacy groups, and interested members of the general public about these issues and to suggest solutions to help minimize the propagation of questionable science.

The book starts with a discussion of the evolutionary and cultural origins of group processes and then looks in detail at a wide variety of manifestations in science today of "going along with the crowd" that are adopted at the expense of the truth. It describes the many techniques scientists can employ to bias their research in order to further the interests of an "in-group" and through which others are unwittingly induced to go along. In order for ourselves to avoid maladaptive groupthink, we include in this volume chapter authors who have a wide variety of differing and sometimes opposing political viewpoints.

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Part I

Introduction: Definition, Manifestations, and Theoretical Issues

Chapter 1
The Neurochemistry of Science Bias

Loretta Breuning

Dr. Ignaz Semmelweis was shunned by the nineteenth-century medical establishment for telling doctors to wash their hands. His belief in invisible disease-causing agents was ridiculed by his peers. We hope this could not happen today because the scientific method keeps us focused on replicable data. But Semmelweis's critics likewise perceived themselves as defenders of evidence-based science (Nuland, 2003). They invoked the greater good in their dismissal of his findings. How is it possible for people intent on objectivity to dismiss essential information?

Two familiar answers are *confirmation bias* and *paradigm shift,* but neither explains it entirely. Confirmation bias is incomplete because it typically omits the investigator's own bias. For example, Semmelweis's critics could accuse him of confirmation bias without acknowledging their own biases. Paradigm shift is incomplete because it does not explain how a brain actively rejects information without conscious awareness.

Brain chemistry offers a new way to understand information-processing biases. Brain chemicals cause positive feelings about one chunk of information and negative feelings about another (Damasio, 1994). Feelings are presumed irrelevant to empirical analysis, but they are highly relevant to the brain's constant extraction of meaning from an overload of inputs. The neurochemicals of emotion are easily overlooked because they do not report themselves to the verbal brain in words. Their absence from our verbal inner dialog leads to the presumption that we are not influenced by them. The impact of emotion on empirical inferences is often more observable in others. The ability to recognize our own neurochemical responses to information is a valuable scientific tool. This paper explains these responses in animals, which illuminate their nonverbal motivating power in humans. Some examples of this motivating power are drawn from modern social science.

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Nature's Operating System

The reward chemicals and threat chemicals in humans are inherited from earlier mammals. These chemicals evolved to promote survival, not to make a person feel good all the time. Each chemical has a specific survival job that is observable in animals. Here is a simple introduction to the natural function of three reward chemicals (dopamine, oxytocin, and serotonin) and the threat chemical, cortisol. (This discussion will be somewhat oversimplified for heuristic purposes, because the various neurotransmitters often regulate one another in various complex feedback loops, making the overall picture somewhat more complicated.)

The operating system we share with animals motivates survival behavior by releasing a chemical that feels good when it sees something good for its survival, and a chemical that feels bad when it sees something bad for its survival. The human brain differs from other animals of course. The differences get a lot of attention, particularly our large cortex, so it is useful to review the similarities. Our neurochemicals are controlled by brain structures common to all mammals, including the amygdala, hippocampus, hypothalamus, and pituitary. This core operating system does not process language, yet it has allowed mammals to make complex survival decisions for 200 million years. It works by tagging inputs as reward or pain, which motivates approach or avoidance. A pleasant-feeling chemical motivates an organism to go toward a reward, while an unpleasant-feeling chemical motivates withdrawal from potential threats (Ledoux, 1998).

Humans define survival with the aid of a large cortical capacity to store, retrieve, and match patterns in information inputs. But we make these patterns meaningful by responding to them with a chemical that says, "this is good for me" or "this is bad for me" (Gigerenzer, 2008).

Natural selection built a brain that defines survival in a quirky way. It cares about the survival of its genes, and it relies on neural pathways built in youth. Anything relevant to the survival of your genes triggers a big neurochemical response. Neurons connect when the chemicals flow, so old rewards and threats build the neural pathways that alert us to new potential rewards and threats. This happens throughout life, but the pathways connected in youth become myelinated, which allows electricity to flow through them almost effortlessly. This is why old responses feel reliable, even when they conflict with new knowledge. And it is why our positive and negative neurochemistry is so poorly explained by our conscious verbal thoughts about survival (Kahneman, 2013).

The electricity in the brain flows like water in a storm, finding the paths of least resistance. The cortex can define rewards and pain in complex ways with its huge reserve of neurons, but it can only process a limited amount of new information at a time. Thus, we are heavily influenced by the pathways we already have. We are not consciously aware of these pathways, so we tend to overlook their influence over our thought process and presume that our declarative reasoning is the whole story (Ledoux, 2002).

No one consciously sifts new inputs through an old filter, but this is how the brain is equipped to make sense of its information environment. We have 10 times more neurons going from the visual cortex to the eyes than we have in the other direction (Pinker, 1997). This means we are 10 times more prepared to tell our eyes what to look for than we are to process whatever happens to come along. Our ancestors survived because they could prompt their senses to find information relevant to their survival. Neurochemicals are central to the prompting mechanism. The mammalian brain evolved to honor its neurochemical signals as if its life depended on it, not to casually disregard them. Here is a closer look at some chemicals of reward (dopamine, oxytocin, and serotonin) and pain (cortisol) and their role in our inferences about the empirical world.

Dopamine

The brain releases dopamine when a reward is at hand. A person may think they are indifferent to rewards because they do not respond to rewards that others value. But each brain scans the world with pathways built from its own past dopamine experiences. When it sees an opportunity to meet a need, dopamine produces a great feeling. This motivates us to do things that trigger it, and to lose interest in things that do not trigger it (Schultz, 1998).

Dopamine releases the energy that propels a body toward rewards. We humans experience this as excitement, but the physical sensation makes more sense when viewed from an animal perspective. A lion cannot get excited about every gazelle that crosses its path because its energy would be used up before it found something it could actually catch. A lion survives by scanning the world for a reward it realistically expects based on past experience. When a lion sees a gazelle within its reach, dopamine! That releases the energy needed for the hunt. Most chases fail, so a lion's brain constantly reevaluates its course of action. If it succeeds at closing in on the gazelle, dopamine surges, which tells the body to release the reserve tank of energy.

We are designed to survive by reserving our energy for good prospects, and dopamine guides these decisions. Our hunter-gatherer ancestors scanned for evidence of food before investing energy in one path or another. A modern scientist meets needs in different ways, but the same operating system is at work.The good feeling of dopamine motivates us to approach rewards, as defined by the neural pathways we have.

Dopamine is metabolized in a few minutes, alas, and you have to do more to get more. This is why we keep scanning the world for new opportunities to meet our needs. The brain habituates quickly to old rewards, so it takes new reward cues to turn on the dopamine (Schultz, 2015). When berries are in season, they stop triggering dopamine in a short time because they no longer meet a need. Then, protein opportunities turn on the good feeling, until nuts are in season. Dopamine focuses our attention on unmet needs by making it feel good. Today's scientists seek new discoveries because they stimulate dopamine.

Social rewards are as relevant to a mammal's survival as material rewards. Once physical needs are met, social needs get the brain's attention. The brain makes predictions about which behaviors will bring social rewards in the same way that it predicts which path is likely to lead to a berry tree: by relying on the neural pathways built by past experience (Cheney & Seyfarth, 2008). One may believe they are indifferent to social rewards, but anything that brought social rewards in your past sends electricity to your dopamine, which motivates an approach.

The brain defines social rewards in ways that are not obvious to one's verbal inner dialog. Mammals are born helpless and vulnerable, and thus need reliable attachments to survive. They evolved a survival strategy based on safety in numbers. To the mammal brain, isolation is a survival threat and social alliances are a valuable reward. Alliances with kin are especially rewarding to the brain built by natural selection (Wilson, 1975). (More on this in the "Oxytocin" section below.)

Our mirror neurons activate when we see others get rewards (Iacoboni, 2009). This wires us to turn on the dopamine in ways we see work for others. Our brain promotes survival by observing the patterns of rewards and pain around us, which helps us create a better hunting tool or a better grant proposal.

Oxytocin

Social alliances promote survival, so natural selection built a brain that rewards you with a good feeling when you build social alliances. Oxytocin causes the feeling that humans call "trust" (Zak, 2013). Oxytocin is not meant to flow all the time because trusting every critter around you does not promote survival. The mammal brain evolved to make careful decisions about when to trust and when to withhold trust. It releases the good feeling of oxytocin when there is evidence of social support.

Safety in numbers is a mammalian innovation. Reptiles avoid their colleagues except during the act of mating, when they release an oxytocin-equivalent. Reptiles produce thousands of offspring and lose most of them to predators. Mammals can only produce a small number of offspring, so they must guard each one constantly in order to keep their genes alive. Oxytocin makes it feel good. It causes attachment in mother and child, and over time it builds pathways that transfer this attachment to a larger group.

A mammalian herd or pack or troop is an extended warning system. It allows each individual to relax a bit as the burden of vigilance is spread across many eyes and ears. This only works if you run when your herd mates run. Mammals who insisted on seeing a predator for themselves would have poor survival prospects. We are descended from individuals who trusted their herd mates. We humans are alert to the risks of herd behavior, of course. But when we distance ourselves from our social alliances, our oxytocin dips and we start to feel unsafe. Even predators feel unsafe without a pack: a lone lion's meal gets stolen by hyenas and a lone wolf cannot feed its children. We have inherited a brain that constantly monitors its social support.

But life with a pack is not all warm and fuzzy. Trust is hard to sustain in proximity to other brains focused on their own survival. And the social alliance that protects you today can embroil you in conflict tomorrow. Yet, mammals tend to stick to the group because the potential pain of external threats exceeds the potential pain of internal threats. Common enemies cement social bonds, and oxytocin makes it feel good. Each brain turns it on with the pathways of its unique individual oxytocin past. Each scientist recognizes the rewards of social alliances and potential threats to those alliances, whether they put it into words or not.

Serotonin

An uncomfortable fact of life is that stronger mammals tend to dominate weaker group-mates when food and mating opportunity are at stake. Violence is avoided because the brain anticipates pain and retreats when it sees itself in the weaker position. Yet, an organism must assert itself some of the time for its genes to survive. Serotonin makes it feel good. Serotonin is not aggression but the nice calm sense that you can meet your needs. When you see an opportunity to take the one-up position, your mammal brain rewards you with the good feeling of serotonin (Raleigh, McGuire, Brammer, Pollack, & Yuwiler, 1991). We can easily see this in others, even though we reframe it in ourselves.

The mammalian brain evolved to compare itself to others, and hold back if it is in the weaker position. Avoiding conflict with stronger individuals is more critical to survival than any one meal or mate. When a mammal sees itself in the stronger position, the safe feeling of serotonin is released. But it is metabolized in a few minutes, which is why the mammal brain keeps scanning for more opportunities to be in the one-up position (Palmer & Palmer, 2001). You may insist you do not compare yourself to others or enjoy a position of social importance. But if you filled a room with people who said that, they would soon form a hierarchy based on how much disinterest each person asserts. That is what mammals do, because each brain feels good when it advances its unique individual essence.

Cooperation is one way to gain a position of strength, and larger-brained mammals will cooperate when it meets their needs. They work together to advance their position in relation to common rivals, and serotonin is stimulated when they succeed (Breuning, 2015). The pursuit of social importance may threaten social alliances at times, but it strengthens social alliances at other times. Each brain is constantly weighing complex trade-offs in its path to survival.

Each serotonin spurt connects neurons that tell you how to get more in the future. The serotonin of your early years builds myelinated pathways that play a big role in your social navigation through life. These pathways generate expectations about which behaviors are likely to enhance social power and which behaviors might threaten it. Every researcher has expectations about which actions might bring respect or lose respect. One research outcome might trigger the expectation of social reward while another set of data might trigger social pain. It is easy to see why people go toward one slice of information and avoid another without conscious intent. And it is easy to ignore one's own efforts to compare favorably, even as we lament such efforts in others.

Cortisol

The mammalian brain releases the bad feeling of cortisol when it encounters a potential threat (Selye, 1956). Bad feelings promote survival by commanding attention. For example, a gazelle stops grazing when it smells a lion, even if it is still hungry. Cortisol motivates an organism to do what it takes to make the bad feeling stop (Sapolsky, 1994).

Cortisol is the brain's pain signal, but waiting until one is in pain is not a good survival strategy. That is why the brain is so good at learning from pain. Each cortisol surge connects neurons that prepare a body to respond quickly to any input similar to those experienced in a moment of pain. The brain evolved to anticipate pain because your prospects fall quickly once a lion's jaws are on your neck.

Social pain triggers cortisol. In the state of nature, social isolation is an urgent survival threat. Cortisol makes a gazelle feel bad when it wanders away from the herd, even when it is enjoying greener pastures. Cortisol creates alarm in a monkey who experiences a loss of social status because that is a threat to the monkey's genetic survival prospects. Conscious concern for one's genes or one's status is not needed to get the cortisol flowing. Natural selection built a brain that warns you with a bad feeling when your prospects encounter a setback. You may try to ignore it, but if you do not act to relieve the perceived threat, the alarm is likely to escalate.

A big brain brings more horsepower to the task of identifying potential warning signals. Cortisol turns on when we see anything similar to neurons activated by past cortisol moments. It is not surprising that people are so good at finding potential threats, and so eager to relieve them. And it is easy to see how social threats can get our attention as much as we presume to disregard them.

The Survival Urge in Science

Scientists are presumed to be indifferent to social rewards and threats as they comb the world for empirical truths. But like all mammals, scientists can easily see the potential for rewards and threats in their information environment; and like other mammals, they respond neurochemically to this information.

For example, dopamine is released when a scientist sees an opportunity to step toward a reward. Oxytocin is released when scientists cooperate with peers. Serotonin is released when an investigator gets respect. Cortisol is released when a scientist sees an obstacle to rewards, cooperation, or respect. These responses are shaped by neural pathways built from unique individual life experience, but the urge to do things that relieve cortisol and stimulate happy chemicals is common to all brains.

While our responses depend on our individual pathways, those pathways overlap to the extent that the experiences creating them overlap. Science training is a common set of experiences that help to wire individuals with common responses. For example, professional training prepares an individual to invest enormous effort in a long series of tasks in anticipation of distant rewards (social and/or material). It prepares an individual to collaborate within a particular theoretical framework. And it builds circuits that confer respect in specific ways and expect to receive respect accordingly. In short, science training builds specific expectations about how to gain rewards, social trust, and respect, and thus stimulate dopamine, oxytocin, and serotonin.

Expectations about threat and cortisol relief are likewise shaped by professional training. The credentialing process of each discipline prepares the mind to recognize potential threats to the discipline and respond in a way that promotes the well-being of the discipline. This need not be said in words because expectations are real physical pathways in the brain. Scientists surge with cortisol when they see a potential threat to their discipline and their place within it, and like any mammal, they are motivated to do what it takes to relieve that cortisol.

Fortunately for the state of knowledge, a scientist can gain rewards, cooperation, respect, and threat relief through objective empirical analysis. But even if this works in the long run, it does not always work in the short run. Thus, every scientist can recognize opportunities to stimulate immediate positive neurochemistry in ways that violate the scientific method.

It would be easy to point accusing fingers here, given the universality of these responses. But our brains are already skilled at seeing bias in others. The challenge is to recognize these mammalian motivations in one's self. In that spirit, I present two empirical biases I discovered in my own life. Before that, let us return to the Semmelweis story, where short-run motivations prevailed and in the long run we're all dead.

The Survival Brain's Potential for Bias

The hand-washing Dr. Semmelweis was of course interested in his own survival. The colleagues who disdained him were too. Each brain defined survival with networks of associations built from past experience. Those networks make it easy to process inputs that fit, and thus to respond in ways that worked before.

In the state of nature, objectivity promotes survival. To find food and procreate, an animal must interpret cues realistically. However, an animal that looked at the world with fresh eyes each morning instead of relying on old pathways would starve, and be socially ostracized. Old neural pathways equip us to scan the overload of detail that surrounds us and zero in on cues relevant to meeting our needs.

In the natural world, rewards fit old patterns so often that old neural networks are an efficient way to find new rewards. Scientists learn the value of relying on old pathways through lived experience and formal training. Yet, we expect scientists to reject old interpretations instantly when they bias interpretations of new data. Alas the brain did not evolve to instantly discard old circuits. They are real physical changes in neurons that speed electricity to the on switch of reward chemicals and pain chemicals. Hence, it is not too surprising that Semmelweis's peers filtered the new message through their old lenses.

It would be easy to accuse them of greedy preoccupation with their own survival needs at the expense of others. But the germ theory of disease had not been established yet, so Semmelweis's allusion to invisible disease carriers was superstitious nonsense in the science paradigm of his day. Leading doctors claimed that the public needed protection from such dangerous misinformation (Nuland, 2003).

Curing a major killer of the day, "childbed fever" (septicemia), may seem like a huge reward, but without a perceived link between hand-washing and health, there is no expectation of that reward. Doctors could easily anticipate a threat to their respect and social alliances as a result of Semmelweis's findings. The consequent bad feeling would not be offset by the expected good feeling of rewards, leaving doctors with antipathy that they could explain with verbiage unrelated to their own neurochemistry.

One may wonder why Semmelweis persisted in isolation. His biography is full of clues. First, his closest associate died from "childbed fever" after cutting his finger during surgery. This rewired Semmelweis's view of the disease. People often fail to rewire their views in response to new information, but the bigger neurochemical surge, the more the rewiring. Losing a best friend so quickly with such a clear chain of evidence would easily do that.

Second, Semmelweis was not wired to trust the safety of the herd in the way that his peers were. Some people attain professional credentials by cooperating with mentors in their discipline, while others satisfy credentialing requirements by going their own way. Semmelweis had been rejected numerous times by the community of science in his formative years, so he was already wired to rely on his own perceptions by the time the natural experiment with septicemia occurred in his hospital. When he observed that mothers attended to by midwives did not die of the disease the way postoperative doctors did, he was ready to rely on his own survival responses instead of trusting the survival responses of the herd.

If we are angered by his colleagues' indifference to the facts, we must hold ourselves to the same standards. We must be willing to invest our own energy in new information that conflicts with shared expectations, even when it threatens our social support. Often we do not. Often I did not. Here are two examples.

I was trained in International Management at a time when Japanese methods were celebrated and American methods were disparaged. I was wired to effortlessly process information about the glories of Japanese management and the misguidedness of American management. Then one day in 1995, while lecturing to 150 students, I suddenly realized that Japan had been in a deep depression for 5 years. US productivity was booming, and I had not adjusted my rhetoric one bit. Why? It