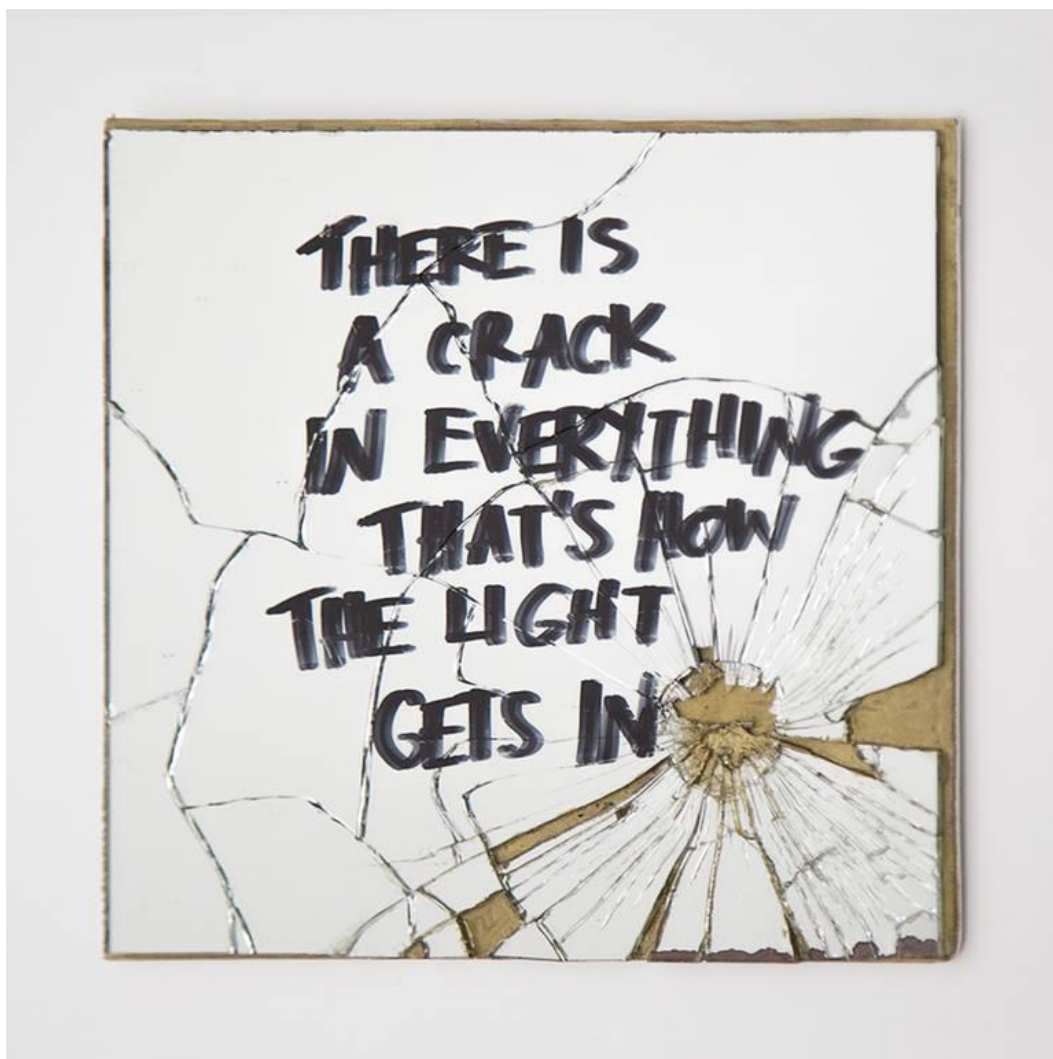


The Limits of Reason: Cognitive Psychology, The Epistemological Crisis, and Epistemic Humility

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(Palazzi, 2023)

There is a crack, a crack in everything
That's how the light gets in. (Cohen, 1992)

[H]ow would we feel if science came up against experimental and intellectual brick walls, so that after centuries of trying, man finally concluded that the world was constructed – if upon intelligible principles at all – upon principles so bizarre as to be perfectly undiscoverable or unfathomable by the human mind? What if [humankind] became totally convinced that the world simply could not be understood, that the world is and always must remain an intellectual surd? Science might then continue at it pertains to technology, but not as it pertains to theory. What if all hope of theoretical understanding were permanently lost? (Davis, 1987: 293)

Only those who stop at the right moment prosper in philosophy, those who accept the limit and the comfort of a reasonable level of worry. Every problem, if one touches the

bottom, leads to bankruptcy and leaves the intellect naked: No more questions and no more answers in a space without horizons. The questions turn against the mind which conceived them: It becomes their victim. Everything becomes hostile: [their] own solitude, [their] own audacity, absolute opacity, and the manifest nothingness. Woe to [that person] who, having reached a certain point of the essential, has not stopped! History shows that the thinkers who climbed to the limit of the ladder of questions, who laid their foot on the last rung, on that of the absurd, have given to posterity an example of sterility, whereas their peers, who stopped half-way, have fertilized the mind's flow; they have been **useful** to their fellows, they have passed down some well-crafted idol, a few polished superstitions, a few errors dressed up as principles, and a system of hopes. (Cioran, 1949: pp. 115-116)

1. Introduction

This essay is an introduction to a research project that aims to undertake an examination of various claims about epistemological crises existing in foundational disciplines such as mathematical logic, philosophy, theoretical physics, and psychology, outlining the philosophical significance of the widespread existence of "blackholes," or conceptual impasses in human thought.

These issues preoccupied my professional academic research, as pitiful as it is, since 1980, where I argued this in an Honours thesis at the then-Marxist dominated philosophy department at Flinders University, then in my PhD thesis, and later works (Smith, 1988a, 1988b). This 1,000 page Honours thesis was not well received by one supervisor, but liked by the external examiner, and my skin was only saved by the intervention of department head Marxist Professor Brian Medlin (1927-2004), who gave it a first class. Years later I became close friends with Brian until his death from cancer, convincing him of the dangers of the ecological crisis, which he turned to in his final years, moving beyond mechanistic Marxism. As a research fellow I shared an office with him, discussing a wide range of issues, including how he thought Gödel's First Incompleteness Theorem was incorrect, but he did not put his finger on the fallacy ("Some invalid jump from object language to metalanguage," he thought). This dialogue was done with work boots on the tabletop, and Brian, always dressed in black, drinking a beer. And all that now is but a memory.

I came to see early in my PhD work that philosophy cannot adequately address its core problems, despite two thousand years of concentrated efforts. I turned my attention to the sociology of the environmental crisis, only to reach a starker conclusion: that human civilization is hurtling to self-destruction (Smith & Positano, 2010). David Ehrenfeld in *The Arrogance of Humanism*, a book which profoundly influenced my thought as first year undergraduate student reading it in 1978, defines the doctrine of Humanism, which he criticizes, as

a supreme faith in human reason—its ability to confront and solve the many problems that humans face, its ability to rearrange both the world of Nature and the affairs of men and women so that human life will prosper. (Ehrenfeld, 1978: p, 5)

Central to this doctrine is the idea that all problems are soluble, both intellectual ones and problems of life. Consequently, human civilization will survive (Ehrenfeld, 1978: 17; Ligotti, 2011). These are the ruling ideas of rationalism and scientism, and they will be challenged in this essay too, as I've also done in previous publications (see, e.g., Sauer-Thompson & Smith, 2021).

There appears to be a common thread to the various foundational claims made in an extensive literature to be reviewed below, that at the deepest theoretical level of the disciplines, there are incompatibilities between core concepts or theories, paradoxes, and antinomies, and/or, fundamental problems of interpretation of the basic meaning of the essential principles of the paradigm. The best-known illustration of this epistemological crisis—a perennial search for the justification and validation of knowledge claims—is philosophy, which has been subjected to perennial debate about the rationality of its foundations, and the refutation of skepticism, since its birth in ancient Greece. If philosophical questions turn out to be unsolvable, or in some way incoherent, it may be possible then that we cannot have a coherent world view. Thus we will continue to use, for example, numbers and sets, or physical theories such as quantum mechanics and the special and general theories of relativity, even though these pieces do not form a logically cogent whole (Davis, 1987: p. 293).

In this essay, I'll provide a very incomplete, broad-brush outline of some of the most challenging foundational issues in basic areas of knowledge, with a focus upon issues associated with cognitive psychology. Why? Because for no better reason than I am presently in a psychology department, am supposed to make some contribution to the field, and that is as good a place for me to start as anywhere. The answer to why there are a series of epistemological crises throughout many cognitive enterprises, is that the thesis of *epistemic humility* or *limitationism* is most likely to be correct: that the human mind is inherently limited, and the universe as we cognize it might well be unknowable in itself, as we “poor, bare, forked animal(s)” (*King Lear*: act 3, scene IV), try to make sense of what is causing the shadows on the walls of our perception (Plato, *Republic*: book VII, 514a-520a).

If there are fundamental cognitive limits, then what follows from this for the human project? Is it reasonable to suppose, as technological optimists do, that there is a solution to every, or even most problems confronting humanity? If there are unsolvable problems, what significance does this have for human survival in the light of the converging and compounding ecological threats facing the human race, such as climate change, species extinction, and rapid resource depletion, even if, at the end of the day, these issues have as much “reality” as anything else? If the philosophical thesis of epistemic humility is correct, then we should also accept clear limits to our technical capacity to solve all problems, and should aim for limits to growth and extreme caution with vast technological projects, such as transhumanism, all of which could blow up in our faces (Smith & Positano, 2010).

2. Background: The Cognitive Limits of Rationality

There has been considerable research published by psychologists and other scientists that has challenged, and indeed refuted, the view of human nature held by ancient Greek philosophers such as Aristotle, and reaffirmed by Enlightenment thinkers, of humans as essentially rational animals (Gray, 1995, 2002; Lloyd, 1995). Aristotle (384-322 BC), and even more relatively recent philosophers such as René Descartes (1596-1650), would be most likely astonished to learn that non-humans are not non-rational biomechanisms, but have some of the rational qualities that were thought to be exclusive to humans, such as mathematical, and even medical understanding. For example, domestic pigeons can spot cancer as well as human experts (Levenson, 2015), and unlike humans (even some mathematicians), pigeons performed optimally on the Monty Hall probability puzzle (Herbranson & Schroeder, 2010). The numerical competency of pigeons has been proposed to be on par with primates (Scarf et al., 2011). The humble honey bee understands the concept of zero as a number (Howard et al., 2018).

Nor are humans unique in having forward planning for the future, for ravens engage in future planning as well as apes and small children do (Kadadayi & Osvath, 2017). Canines are much less susceptible to over-imitation than human children, who are more likely follow bad advice; canines copy humans only to the extent it is necessary to achieve certain tasks (Johnston et al., 2017; Wujciak, 2017). Rats may have the power of imagination (Lai, et al., 2023). African elephants appear to understand human pointing cues to find food, a relatively complex cognitive skill (Smet & Byrnes, 2013). Asian elephants have complex personalities and a sense of selfhood, as do cows (Seltmann et al., 2017, 2018).

There are more cortical convolutions and a greater surface area in dolphins' and humpback whales' brains, than in human brains, raising the controversial question of whether the cetacean brain is "smarter" than the human brain (Marino, 1998; Marino et al., 2007). Whales and dolphins experience emotions and exhibit distinct personalities (Fox et al., 2017). Cuttlefish can pass the "marshmallow test" of future planning, to delay gratification if better food is forthcoming, by being trained to defer eating crab meat once they are shown that the more preferred shrimp meat was to come later (Schnellet et al., 2021). Rationality in the broadest sense as higher level cognitive information processing and problem-solving ability, is thus not exclusive to humans, contrary to past philosophers (Jensen, 2016; Veit, 2023).

Nor, for that matter, is complex problem solving. For example, to take a task beloved of behaviorist psychologists, maze solving, slime molds have shown the capacity to solve mazes (the "U-shaped trap problem") in the search for food, more effectively than many robots (Grabianowski, 2012). The species *Physarum polycephalum* moves by shifting cellular fluid in the form of exploratory tendrils. These tendrils leave a trail of slime chemicals that constitute a chemical memory. As a

consequence, the organism will not retrace paths that have not led to food, thus generating a relatively effective strategy of moving through a maze, without having a brain or central nervous system at all, purely relying on chemical signals (Reid et al., 2012).

Shore crabs (*Carcinus maenas*), having a brain about 10 times smaller than a bee in terms of the count of neurons, were trained to complete a complex maze (Davies et al., 2019). Hence, a brain, or even a central nervous system, or not much of one by mammal standards, is not necessary to complete a navigational task better than many AI systems.

Within the widely accepted evolutionary framework, this proposition that there is no sharp demarcation in terms of rationality between humans and other animals, although a challenge to many traditional rationalist philosophies, and religions, could be accepted as showing not that humans are limited in any way in the Enlightenment ideal of reasoning and logical capacity, but just that many animals participate in reasoning as well, so that the set of rational beings is much wider than either Aristotle and Descartes thought. So the considerations of animal cognitive science do not necessarily show any limits of human rationality. This argument is technically correct and shows only that certain philosophers and theologians have been too narrow in their categorization of rational thinkers or cognizers, holding to human chauvinism and exceptionalism (Sylvan & Plumwood, 1980). This literature does, however, have a deflationary effect upon the humanistic intellectual arrogance inherited from the Enlightenment.

Nevertheless, there is the further question of cognitive blindspots.

3. Cognitive Blindspots

A large body of work in 20th and 21st century psychology extends the critique of human rationality much further than merely demonstrating that animals share in rational capacity to various degrees. Briefly: humans frequently commit a range of cognitive errors such as base-rate neglect errors (Henrion & Fischhoff, 1986); framing errors (Rothman & Salovey, 1997); preference reversals and the prominence effect (Gilovich, 1991); omission biases (Gilovich, 1991, 97); the status quo bias (Ritov & Barron, 1992); availability bias (Tversky & Kahneman, 1974); hindsight bias (Fischhoff & Beyth, 1975); ordering effects (Schwartzgebel & Cushman, 2012); anchoring and adjustment (Wistrich et al., 2005), and probability errors (Bar-Hillel & Falk, 1982; Brilmayer, 1983; Bishop & Trout, 2005; Rosenhouse, 2009). Experts, as well as “ordinary people,” commit such errors (Brilmayer, 1983). Humans, from a behavioural economics perspective, have been viewed as “predictably irrational”:

we are pawns in a game whose forces we largely fail to comprehend. We usually think of ourselves as sitting in the driver’s seat, with ultimate control over the decisions we make and the direction our life takes; but alas, this perception has more to do with our desires – with how we want to view ourselves – than with reality. (Ariely, 2009: p. 321)

According to the historical study by Justin E. H. Smith of the waves of rationality and irrationality in human history, irrationality is an ineliminable part of the human condition, there being something of an historical seesaw between reason and unreason, in unending cycles (Smith, 2019).

Humans, outside of academic environments, usually have limited time, knowledge, access to information, as well as limited computational capacities, so probability and formal logic have a much more reduced role in daily life than found in scientific practice (Gigerenzer et al., 1999). Sound reasoning and decision-making in terms of the laws of probability requires unfeasibly large amounts of time, knowledge and computational capacity, so much human decision making makes use of fast and frugal heuristics, rather than the calculation of probabilities, utilities, and Bayesian models; rationality is “bounded” (Simon, 1982). The cognitive limits of the human mind, and the inability to calculate optimal strategies, “in the field,” means that sub-optimal decision-making using approximate methods must be done in the context of the structured environment (Simon, 1956; Elster, 1979).

Robert A. Burton, in *On Being Certain*, says that psychology as a discipline faces something of an existential crisis, in the light of research that indicates that much of cognition occurs outside of consciousness (Burton, 2008: pp. 146-147), without “direct access to the “adaptive unconscious,” thereby making human behavior a mystery: hence we’re strangers to ourselves (Wilson, 2002: p. 16). As such, Burton concludes, we do not know what we know by conscious rational deliberation and the careful balancing of reason, and

we are left challenging the common sense and folk psychology understanding of ourselves, including knowing the degree to which we are consciously responsible for our thoughts and actions. (Burton, 2008, 146)

Of course, philosophical defenders of rationality, intentional action, and free agency, will disagree, and can supply challenging counter-arguments (Hanna, 2006, 2018; Hanna & Maiese, 2009).

Gerd Gigerenzer in *Gut Feelings*, concludes from his review of the psychological literature that “much of our mental life [is] unconscious, based on processes alien to logic: gut feelings, or intuitions” (Gigerenzer, 2007, 1). The present paper will develop this idea, which can be called, “cognitive blindspots,” in more detail and fully embrace the paradoxical consequence, that if true, and accepted, the position is self-undermining, or perhaps “trans-rational,” but in an interesting way, showing yet another antinomy of reason and the self-undermining aspect of contemporary science, and inherent limitations of reason.

To devilishly complicate things even further, much of this research into cognitive errors and biases is based upon psychological studies using W.E.I.R.D (White, Educated, Industrialized, Rich and Democratic) subjects, and it has been

argued that the samples used by behavioral scientists to establish various claims about human behavior and psychology, including

visual perception, fairness, cooperation, spatial reasoning, categorization and inferential induction, moral reasoning, reasoning styles, self-concepts and related motivations, and the heritability of IQ" (Henrich et al., 2010: p. 1),

may not be universal at all, valid for the human race in general. In other words, research into biases could itself be biased in subtle ways, and perhaps self-undermining as well! We might be lost in the epistemological fog.

As one who is epistemically humble would expect, there is psychological literature challenging the idea that biases, errors and self-fulfilling prophecies at least in the area of social psychology, are as prevalent as social and cognitive psychologists think, to the extent of making human social life a maze of errors, if not deceptions, undermining the rationality and validity of social judgement and perception. Lee Jussim, in *Social Perception and Reality*, has put the opposing case that this position in cognitive and social psychology has exaggerated the importance, extent, and pervasiveness of cognitive errors, which while in many cases are real, by no means dominate human life (Jussim, 2014, 2017).

Jussim's position parallels that of L.J. Cohen, who argued in an iconic 1981 paper in *Behavioral and Brain Sciences*, against leading cognitive error theorists such as Kahneman and Tversky, that the admittedly widespread existence of cognitive errors and biases in human life and science, does not make the prospects of human rationality "bleak," for

[t]he presence of fallacies in reasoning is evaluated by referring to normative criteria which ultimately derive their own credentials from a systematisation of the intuitions that agree with them. These normative criteria cannot be taken, as some have suggested, to constitute a part of natural science, nor can they be established by metamathematical proof. Since a theory of competence has to predict the very same intuitions, it must ascribe rationality to ordinary people. (Cohen, 1981: p. 317)

In what follows, I'll be concerned primarily with putting the more general metaphysical case for anti-rationalism, and in particular being concerned with addressing the foundational, epistemological and metaphysical issues raised by Cohen, rather than simple addressing the debate between Kahneman and Tversky, on the one hand, and Jussim, on the other, that deals primarily with the rationality of ordinary life. Here, the rationality of science itself is the target, and that includes, of course, psychology itself; philosophy and formal logic will be dealt with in other essays.

4. The Myth of the All-Seeing Eye: The Limits of Perception

It is also worth noting that the position of the leading critics of the unbounded rationality position, Herbert Simon (Simon, 1979) and Daniel Kahneman (Kahneman, 2011), have come in for criticism for containing metaphysical and methodological biases of their own, namely for accepting an idea of an “all-seeing eye” (Hoffman & Prakash, 2014; Koenderink, 2014; Felin et al., 2017). Felin et al. make the criticism that while rejecting the idea of unbounded rationality of agents (i.e. perfect information, no uncertainty, and optimal decision-making), the Simon-Kahneman school have replaced “economic omniscience” with “perceptual omniscience, with the metaphor of an ‘all-seeing eye’” (Felin et al., 2017: p. 1040), a type of God’s eye view of the universe, embodied in the thesis of metaphysical realism. Metaphysical realism, roughly stated, says that objects of the world exist independent of thought/cognition, and their natures are ontologically independent of conceptions of them (Khilentsos, 2021). The critique of the all-seeing eye metaphor can be seen as a close philosophical relative of Richard Rorty’s earlier argument in *Philosophy and the Mirror of Nature*, that the attempt to find some sort of essence to reality (“our glassy essence”), whereby language mirrors reality via a representational theory of perception and a correspondence theory of truth, is inherently flawed (Rorty, 1979).

The “all-seeing eye” metaphor, Felin et al. believe, runs through a large number of theories in the social sciences, as well as theories of cognition, including: (1) Bayesian models of rationality and cognition, (2) various approaches to decision-making and classical decision theory, (3) a number of philosophies of mind, (4) rational expectation theory in neo-classical economics, (5) ideal versus naïve observer analysis, (6) adaptive control and cognitive architecture theories, and (7) various models of optimal foraging and general models of “computational rationality and intelligence” (Felin, et al., 2017: p. 1041). The all-seeing eye metaphor is manifest in various ways in many contemporary theories of rationality, for example, in assertions about global rationality of some systems of thought, or

in the form of a scientist who imputes illusion, bias, or other forms of error or veridically to subjects—when they fall short of omniscience. (Felin et al., 2017, 1041)

Theories of rationality typically assume that someone, such as the knowing subject, the scientists, or more abstractly, “the system as a whole,” is capable, through veridical perception, to ascertain the objective facts of the matter, and determine the best actions for an agent to take, in order to achieve various ends (Felin et al., 2017: p. 1041).

Nevertheless, there are a number of objections to the replacement of economic omniscience with perceptual omniscience, as described by Felin et al. Perception does not map “truth” in the way of “ideal observer” theories of perception, based on a hypothetical observer who has optimal perception on a set task. For humans, there is a closer match between perceptual performance and practical utility, linked to evolutionary fitness and survival, than between perceptual performance and

acquiring so-called objective truths about “reality” (Felin et al., 2017: p. 1043). Organisms, including humans, do not exist in an objective perceptual environment; instead, perception is conditioned by what they are: perception is organism-specific and the nature of the organism determines what is perceived, and what can be perceived (Felin et al., 2017: p. 1043).

More fundamentally, perception does not involve a world-to-mind mapping in a camera-like fashion of representation of the “true” external world to “true” internal conceptions of the world, which is a common foundational assumption of the cognitive sciences (Koenderink et al., 2014). Felin et al., note that the visual illusions, such as the Ponzo illusion, have been interpreted by cognitive psychologists as showing the fallibility, limits, and biases of human perception (Gregory, 2005), and are “an artefact of the problem of singularity and exhaustively representing objective reality in the first place” (Felin et al., 2017: p. 1046).

Indeed, some visual illusions show not merely bias in human perception, but present a “reality” which is scientifically false, if not impossible, such as the seeming incompatibility between the observable world and the world of quantum mechanics, as presented in the “two tables” problem of Eddington, where the table of physics is mostly empty space, and what is not empty space, is filled with particles that have properties that large-scale objects do not have (Eddington, 1927; Bub, 1999).

The neural mechanics involved in a number of optical illusions, such as the “hypnotic vibes,” various patterns that fool the brain into perceiving motion, are not yet known (Sarcone, 2013). Likewise, for the even more philosophically and mathematically interesting perception of impossible objects, and the perception of motion as inconsistent (Mortensen, 2014). For example, impossible images were devised by Oscar Reutersvärd (1915-2002), M.C. Escher (1898-1972) and Roger Penrose (1931-). A famous example is Escher’s lithograph print *Relativity* (1953), which depicts a world in which not only does the law of gravity not hold, but also there’s an impossible situation whereby moving up the stairway leads to moving down the stairway, simultaneously. This impossibility is also depicted in the lithographs, *Ascending and Descending* (1960), and *Waterfall* (1961). The latter depicts a perpetual motion machine, as water flowing down, also flows simultaneously up as well. These impossible pictures have been analysed within a framework of a paraconsistent geometry (Mortensen, 2010).

It is common enough for cognitive psychologists to conclude from the study of illusions and the fallibility of the human perceptual system, that human perception does not operate as a video reproduction of reality, but rather is an interpretative process influenced by a range of factors such as prior beliefs and knowledge, experience and expectations even with respect to simple perceptual properties such as color, shape, and size (Gregory & Heard, 1979; Pronin et al., 2002). However, the more interesting philosophical thesis has been put forward by Brian Rogers, namely, that we are deluded about the nature of illusions because there is no epistemologically

satisfactory way of distinguishing between perceptual experiences regarded as veridical, and those regarded as illusions (Rogers, 2014). The problem is that illusions are widely regarded as “departures from reality” (Gregory, 2009: p. 9), but we do not know what reality is, outside of the working of our perceptual system, which raises the classical epistemological skepticism problem of the justification of the existence of the external world. If there is no single objective reality “out there” by which perceptions can be compared to in some pre-theoretical way, and hence no “all seeing eye,” as metaphysical realists suppose, and no way the world actually is (Koenderink, 2014), then how can anything at all exist beyond sensory perceptions? As Koenderink puts it:

The very notion of veridicality itself, so often invoked in vision studies, is void. Strictly speaking, veridicality applies to the description of an external observer (Watcher, say) who watches both the subject-agent and its environment. The Watcher has to approximate the All Seeing Eye sufficiently for the purposes of the experiment. This implies that the Watcher knows more of the environment than the agent possibly can. This often implies pointer readings: for instance, electrical measurements in the study of electroreception in sharks, caliper gauges in the study of human acuity, and so forth. Then perception may sometimes be called ‘veridical’ relative to the knowledge of the Watcher. This is a very tricky business, because human Watchers lack the All Seeing Eye. They too are only directly aware of their user interfaces—even when using instruments. This offers interesting opportunities for infinite regress. Who Watches the Watcher? Only Big Brother has the All Seeing Eye. (Koenderink, 2014, 5)

However, one of the consequences of this anti-realist turn is precisely noted by Rogers:

the distinction between the veridical and the illusory becomes meaningless and we are forced to regard either all our perceptions as illusions or none of them, which is hardly helpful or informative. (Rogers, 2014: p. 844)

This problem confronts other cognitive psychologists such as Donald Hoffman (Hoffman, 2019a, 2019b), who explicitly argues that human perception is non-veridical and did not evolve to reveal the truth about reality, and that what we deal with is an interface with reality. This is the Interface Theory of Perception (ITP). Hoffman compares our senses to the desktop interface on say a laptop computer, where the interface does not reveal the hidden truth about the inner electronics of the system, but enables tasks to be completed. Likewise, for humans, evolution has shaped human senses so that there can be an interaction with reality to preserve fitness and survival. According to Hoffman “fitness beats truth,” with the perceptual system being designed for fitness, not truth. As he says:

Spacetime is your 3-D desktop. It is not the ancient stage for a reality play in which we are recent bit players. You create spacetime when you look. You are the scenic designer that creates spacetime, stars, planets, mountains, and oceans with a glance, and then erases them with a blink. There is a reality that exists even if you do not look, but it is unlike the spacetime and objects that you create when you interact with reality.

Why is it that when I see a bus, others usually do too? Because, as members of a species, we have a similar interface. Why is it that the bus can kill me, even if I do not see it? Because there is a reality that is objective, that exists even if I do not perceive it. That reality can affect me, whether I perceive it or not. But that reality has no buses in it. Buses are my interface icons, created as I interact with that reality. (Hoffman, 2019a: p. 66)

The problem here, which Hoffman has addressed, is that this position is arguably self-undermining and that he self-implicates his own core evidence, namely, that from evolutionary theory. As Hoffman says in an interview with David Gruber:

Now, the rejoinder then is, well, evolution by natural selection, as standardly formulated, assumes that physical objects like DNA exist and have definite properties. And I'm saying that even space itself doesn't exist. Space itself is just a data structure that we create if our senses evolved. And so, why is it the case that I'm not refuting myself? I've used evolution to prove that evolution is false. And it turns out, I've used — when I use evolutionary game theory, I don't use all of the evolutionary theory. I used what's called "the algorithmic core," what Dennett and Dawkins call Universal Darwinism.... Variation, collection, retention — that program which is at the heart of evolution. And evolutionary game theory is the mathematics that captures that heart of evolutionary theory. Now, evolutionary game theory makes no ontological assumptions. It doesn't assume anything about space and time and matter and so forth. It's an algorithm. It says anything that can vary and have retention and selection is subject to evolution. And so, Dennett and Dawkins, for example, are happy to talk about memes, ideas that evolve, and scientific theories themselves as all subject to evolution, right? So what I have done in my theorem with Chetan Prakash, my collaborator who proved the theorem, and my graduate students, Justin Mark and Brian Marion—what we found is that the algorithmic core of evolution by natural selection is incompatible with the side assumptions that are made in standard evolutionary biology; namely, that physical space exists and that physical organisms with physical DNA exist. These are all symbols that we're using, pointing to a deeper reality. (Gruber, 2021: pp. 174-175)

The "deeper reality" will consist of a mathematically precise dynamic system of conscious agents, which are fundamental.

Now, that could well be so, and there is frontier philosophical and metaphysical work by neo-Kantian philosopher Robert Hanna which could have helped Hoffman, if Hoffman had taken the road of metaphysics, and transcendental idealism, rather than evolutionary algorithms, however trendy that may be (Hanna & Maiese, 2009; Hanna, 2021, 2022a). Given Hoffman's own philosophical framework, evolutionary arguments, based upon an "algorithmic core," allegedly show that evolution by natural selection is incompatible with the assumption that physical space exists and that physical organisms will exist. But that cannot be right, since whatever evolution is, it involves at a minimum a change in material things, such as organisms. If not, what could possibly be the subject of evolution? A mere abstract mathematical core will not deliver the world he wants. And, beyond that, if the existence of space-time and material objects such as organisms can be called into

question by Hoffman, why should we assume that evolution exists as well? Why suppose that algorithms exist? Perhaps whatever there is, was created by God, or an evil demon, or even a computer simulation by incomprehensible cosmic computer programmers? Perhaps nothing really exists at all? Less exotically, from the perspective of evolution, consciousness itself is still in need of explanation, since if what counts are survival strategies, then why should consciousness exist, since organisms, if they existed could do just as well without it (Chalmers, 1995: p. 202)?

One possible reply to this criticism is to argue that this sort of circularity faces most foundational questions. The logocentric predicament, as defined by Harry Sheffer is that in “order to give an account of logic, we must presuppose and employ logic” (Sheffer, 1926: p. 228). Hanna has generalized the logocentric predicament to apply more widely to rationality, and philosophical systems building, to the effect that every attempt to either justify or criticize rationality presupposes rationality, which he calls *the ratiocentric predicament* (Hanna, 2006, 2023). Be that as it may, at least as regards Hoffman’s system, positing evolutionary theory, as he views it, is not a fundamental aspect of reality, in the same sense that logic and reason are, because we can conceive of a world in which evolutionary forces are only one factor among many others, or do not exist at all, or are simply different in nature to Hoffman’s conception of them.

This does restate one of the classical skeptical arguments against the existence of the external world, since if all that is present to us are perceptual representations, we seemingly lack any rationally justified belief that the cause of those representations is an external world, or even whether there is a cause at all (Slote, 1970). But, if this is so, then why accept the information that was used to establish this argument in the first place, for there seems to be an implicit realism that creeps into the anti-realism argument even though it ultimately undermines itself? What is the epistemic status of the perceptual data used to get this argument off the ground, and if it is merely “relative” too, then can we even trust the argument from relativity of perception (Smith, 1985)? In other words, cognitive psychology generates a “limit paradox.”

Eric Dietrich and Chris Fields hold that science itself generates these type of limit paradoxes, and their discussion, among other things, deals with the metaphysical challenges that quantum mechanics poses (Dietrich & Fields, 2015). For example, mainstream science presupposes that boundaries between systems can in principle be made, that the observer and the observed are separate entities, in the sense that at the very least, they’re spatially distinct. But quantum theory through quantum entanglement, challenges this mainstream scientific assumption:

By introducing entanglement as an inevitable physical consequence of dynamical interactions, quantum theory forecloses this possibility: a system could be *objectively* entangled with all other systems—... with all systems from the point of view of any competent observer—and hence objectively bounded only if it was isolated outside of the universe, a situation inconsistent with the standard definition of “the universe” as “everything,” as well as the assumption that quantum theory is complete. Hence

quantum theory disallows the very assumptions that make the idealization of fully public, repeatable observations possible. (Dietrich & Fields, 2015)

The core assumption here, almost universally accepted, is that reproducibility is the hallmark of scientificity, a thesis Hanna has challenged (Hanna, 2023). Nevertheless, other examples could be given, so Dietrich-&-Fields's conclusion is relevant by way of illustration:

If science is possible, it eventually produces results that undermine its assumptions and methods. ... Hence science is impossible. But the result is in our possession, and science is necessary for our knowledge of the result. (Dietrich & Fields, 2015).

They conclude that these types of limit paradoxes (Priest, 2002) indicate a cognitive limit to science: "Our science is telling us, with increasing urgency ... that the universe is not fully open to our comprehension" (Dietrich & Fields, 2015). And, they conclude, a key assumption of the Enlightenment was that human beings could obtain a God-like understanding of the universe, but this assumption is "overly optimistic," and should be abandoned (Dietrich & Fields, 2015), a conclusion which can be further supported by a consideration of the epistemological crises.

5. The Epistemological Crises

The concerns of this essay go beyond the above considerations about the scope and limits of human perception to look at a deeper, more challenging area of cognitive blind spots (Sorensen, 1988), if not blackholes, in our conceptual framework, and science, however fundamental (Smith, 1988b).

There is literature in most fields of study expressing concerns about the epistemological foundations of the respective disciplines. For example, psychology, has been said to have a crisis of reproducibility, with the frequent failure of replication of key research results (Ioannidis, 2008a; Simmons, 2011; Hartshorne et al., 2012; Everett & Earp, 2015; Freedman et al., 2015; Yong, 2015; Open Science Collaboration, 2015; Gilbert et al., 2016; Higginson & Munafò, 2016). As Pashler and Wagenmakers put it, there is

currently a crisis of confidence in psychological science reflecting an unprecedented level of doubt among practitioners about the reliability of research findings in the field. (Pashler & Wagenmakers, 2012: p. 528)

This problem, it has been argued, also exists in various areas of biological/biochemical research (Ioannidis & Trikalinos, 2005; Ioannidis, 2008b; Begley & Ellis, 2012; Button et al., 2013), including cancer science, where one research team was unable to replicate 47 of 53 "landmark" cancer publications (Begley & Ellis, 2012). Much of biomedical and other scientific research cannot be replicated (Baker, 2016).

The replication crisis has generated an enormous literature discussing the causes of the problem, and what can be done for improvements in scientific practice, so the issue cannot be lightly dismissed as being merely of technical academic interest, as argued by (Amrhein et al., 2019). However, while understanding the failure of replication is an important area of research for psychology and other sciences, behind this problem lies the issue of the justification of psychological methodology, especially statistical method, and misapplication, as well as the epistemological problem that:

a replicated phenomenon may not serve as a rigorous test of a theoretical hypothesis because identical operationalizations of variables in studies conducted at different times and with different subject populations might test different theoretical constructs. (Stroebe & Strack, 2014: p. 59)

It is a theoretical challenge to rescue such reference from indeterminacy. One recent proposal, already mentioned, has been made by Hanna, which is that what the reproducibility crisis has shown is that mainstream scientists and philosophers are mistaken in taking the idea of reproducibility as either a necessary or sufficient condition for the truth of empirical science (Hanna, 2023). Hanna argues that the large literature on irreproducibility is actually indicating that some type of Heisenberg Uncertainty Principle is at work, the *Hanna Uncertainty Principle*, whereby

the more precisely you measure an empirical scientific study's original set-up conditions, the less you're able to reproduce its original results, and conversely (Hanna, 2023).

This is a novel idea well worthy of debate by all concerned about the reproducibility issue across the empirical sciences, but given the methodological conservatism, if not prejudice, of this community, I expect that ideas like this, however brilliant, will be unlikely to be seriously considered or even widely noticed.

John Ioannidis published a now iconic paper, "Why Most Published Research Findings are False" (Ioannidis, 2005a, 2005b), in which he argued that there is a high rate of non-replication, and failure of confirmation in many sciences, due to methodological limitations, such as doing one study based upon the methodology of statistical significance, with a p -value less than 0.05, if the significance tests are interpreted correctly mathematically at all (Selvin, 1957; Nunnally, 1960; Rozeboom, 1960; Lykken, 1968; Bakan, 1966; Morrison & Henkel eds., 1970; Carver, 1978; Glass et al., 1981; Guttman, 1985). Other researchers have agreed that Ioannidis is correct in saying that most published research is false (Tabarrok, 2005; Moonesinghe et al., 2007; Diekmann, 2011; Freedman, 2010). Similar concerns were raised before Ioannidis by J.B. de Long and K. Lang regarding economic propositions (de Long & Lang, 1992). In any case, in view of these results, this situation shows us what an epistemological crisis actually is: namely, a discipline-wide basic concern about the reliability of knowledge of that discipline (MacIntyre, 1977, 2006; Strohman, 1997; Wong, 1998; Rediehs, 2016; Balcomb, 2014; Sorti & Kaufman, 2018).

The important issue regarding epistemological crises in various disciplines is to explain how and why this situation exists. It is not the principal role of this present work to discuss the replication crisis in all its needed detail, but it will be noted that if there is no satisfactory unified account of why this crisis exists across a number of disciplines, then it is reasonable to take the fact of continuous epistemological crisis to show, as Dietrich and Fields have suggested in the context of limit paradoxes, intrinsic limitations of our capacity to understand reality. Either thesis plays havoc with spirited defences of the Enlightenment project, such as that given by Steven Pinker in *Enlightenment Now*, (Pinker, 2018), whereby this literature is essentially a counter to the humanistic optimism of Pinker. Not only do we not know what we believe we know, but also we may well be heading towards the destruction of our species, or at least, of our civilization (McPherson & Schneider, 2019).

Perhaps the best illustration of a cognitive enterprise in a continuous state of epistemological crisis is supplied by philosophy, although at the same time there is a wealth of literature indicating that there is also intense theoretical anxiety about the rational justification of foundations in other fields (Denzin, 1996; Schwartz et al., 1999; Dougherty, 2008; Silva & Wyer, 2009), such as sociology (Sztompka, 2013; Smith, 2014), and even theoretical physics, where there is a logical incompatibility between the special and general theories of relativity, and quantum mechanics, so that physics as a discipline is logically inconsistent (Sorli & Kaufmann, 2018). The attempt to escape the inconsistency via string theory has produced an even deeper crisis, whereby it might not be possible, even in principle, to test a theory of such mathematical complexity. Empirical tests of a 26-dimensional reality might not be possible in our 3-D (or counting time, 4-D) world (Smolin, 2006).

For philosophy, the problem relates to the lack of consensus about virtually everything in the discipline, and the extreme level of theoretical pluralism and lack of justification of fundamental principles. This problem is of the conflict of the schools of thought of philosophy, and the seeming inability to make any progress at all, and was well presented by David Hume (1711-1776):

For I have already shown that the understanding, when it acts alone, and according to its most general principles, entirely subverts itself, and leaves not the lowest degree of evidence in any proposition, either in philosophy or common life. . . . The intense view of these manifold contradictions and imperfections in human reason has so wrought upon me, and heated my brain, that I am ready to reject all belief and reasoning, and can look upon no opinion even as more probable or likely than another. Where am I, or what? From what causes do I derive my existence, and to what condition shall I return? Whose favour shall I court, and whose anger must I dread? What beings surround me? And on whom have I any influence? I am confronted with all these questions, and begin to fancy myself in the most deplorable condition imaginable, environ'd with the deepest darkness and utterly depriv'd of the use of every member and faculty. (Hume, 1978: p. 267-269).

A contemporary view of the theoretical bankruptcy of philosophy has been put by Brennan:

[The Argument against Philosophy.] The goal of philosophy is to uncover certain truths. Radical dissensus shows that philosophical methods are imprecise and inaccurate. Philosophy continually leads experts with the highest degree of epistemic virtue, doing the very best they can, to accept a wide array of incompatible doctrines. Therefore, philosophy is an unreliable instrument for finding truth. A person who enters the field is highly unlikely to arrive at true answers to philosophical questions (Brennan, 2010, 3).

This is well recognised as a problem for the entire discipline of philosophy that has not been solved, at least within the hyper-rational framework of Analytic philosophy (Chalmers, 2015). For example, in a way that's also directly relevant to cognitive psychology, Dietrich and Hardcastle argue that the problem of consciousness is intractable, given the arguable failure of naturalistic, and dualist attempts to explain consciousness, and that since many metaphysical and epistemological problems are necessarily connected with consciousness, these problems are not solvable either, due to the limits of our understanding of conscious cognizing (Dietrich & Hardcastle, 2005).

Indeed, Eric Dietrich has argued that apart from developments in formal/mathematical logic and linguistic philosophy, philosophy has made no progress since the time of ancient Greece (Dietrich, 2011). Philosophy as a discipline remains current, and up-to-date, and some terminological changes occur, or becomes more precise, but the classical problems all remain in one form or another. Philosophy does not approximate "truth," because perennial disagreements preclude any sort of consensus as allegedly found in the sciences such as physics (Smith, 1988a). What philosophical arguments do achieve, however, is the critical demolition of various positions, as philosophical arguments are primarily destructive, hence philosophers are the "Vandals and Visigoths of the intellectual world ... the in-coming, Everest-sized asteroid streaking toward all that descent people hold dear," so that

whatever you believe, no matter how obvious or fundamental, no matter who you are, or where, or when, there's a good philosophical argument that your belief is *false*. (Dietrich, 2011, 337)

And perhaps even *that* principle is subject to the same skepticism, thereby creating a situation of epistemological indeterminacy.

This situation calls for a fundamental reworking of mainstream Western philosophy, as exemplified by Anglo-American Analytic philosophy, which has abandoned the ancient quest of providing wisdom for life, dealing with the problems of the human condition, in favor of being a poor, second-best Lockean "under-labourer" to the sciences, usually with physics worship and a religious faith in mechanism (Hanna, 2021). An alternative paradigm for philosophy has been

proposed by Hanna, “life-shaping philosophy,” which embraces neo-organicism and anti-reductionism, and is also pluralistic in the sense of not seeing one big philosophical system as answering all questions about reality (Hanna, 2022b). From this perspective, disagreements, even fundamental ones, are no longer the bane of reason, but indications of the complexity of all that is, and perhaps, mysteries beyond the limits of thought (Smith, 1988b). But, more on this in another essay.

The epistemological crisis problem spills out into foundational disciplines such as mathematical logic, where there is contemporary debate about not only the proper philosophy of logic and mathematics, but whether ultimate principles such as the law of non-contradiction hold universally. In another essay, I’ve shown that one attempted consistency proof for Peano arithmetic, generates a proof theoretical paradox (Smith et al., 2023). It should also be mentioned that strengthened paradoxes, involving versions of Curry’s paradox, where any arbitrary proposition can be proven, remain unsolved, hence challenging the coherence of mathematical logic and mathematics (Carrara & Martino, 2011). This, and more, will be dealt with in another essay.

Another interesting illustration of concern about an epistemological crisis in a discipline is the present crisis of medicine, a concern that’s expressed both intellectually and in widespread practical terms, with the rise of alternative medicine and health approaches, exhibiting a general skepticism about pharmaceutical drugs. Thus, one recent critique has it that there have only been a few important drugs brought to market in recent times, and most others have been of questionable benefit (Angell, 2005; Le Fanu, 2018). Worse, according to even some mainstream respectable critics—there are many radical critics who say the same thing but are banished into the shadows, beyond the pale—the medical profession is “bought by the pharmaceutical industry,” and journal editors are often bribed to the tune of thousands of dollars (Relman & Angell, 2002; Liu et al., 2017). If that does not generate crisis anxiety, then nothing would.

Jacob Stegenga, in *Medical Nihilism*, (Stegenga, 2018), argues that most medical interventions are largely ineffective (outside of placebo effects). The argument is not that *every* medical treatment is ineffective—for example, setting broken bones (Harris, 2016)—but that numerous important expensive ones are indeed ineffective, such as antipsychotics, many antidepressants, and some blood pressure lowering drugs (Harris, 2016). While there is a large critical literature describing various limitations of many pharmaceuticals, Stegenga’s arguments are primarily methodological, criticizing the “malleability” of medical methods, whereby methodological choices are made about which constructs count as medical evidence, such that viewed with different methods, the same “data” can yield contradictory conclusions (Stegenga, 2018: p. 13). This medical nihilism, or more appropriately, named, medical skepticism, has been held by Ivan Illich (Illich, 1975) and Thomas McKeown (McKeown, 1976), who both held that the increase in human lifespan has not been primarily due to medical technology, but to better nutrition and public health measures. And then there is also Richard Horton, who wrote this lamentation of a scientific Job:

The case against science is straightforward: much of the scientific literature, perhaps half, may simply be untrue. Afflicted by 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, science has taken a turn towards darkness. As one participant put it, “poor methods get results.” The Academy of Medical Sciences, Medical Research Council, and Biotechnology and Biological Sciences Research Council have now put their reputational weight behind an investigation into these questionable research practices. The apparent endemicity of bad research behaviour is alarming. In their quest for telling a compelling story, scientists too often sculpt data to fit their preferred theory of the world. Or they retrofit hypotheses to fit their data. Journal editors deserve their fair share of criticism too. We aid and abet the worst behaviours. Our acquiescence to the impact factor fuels an unhealthy competition to win a place in a select few journals. Our love of “significance” pollutes the literature with many a statistical fairy-tale. We reject important confirmations. Journals are not the only miscreants. Universities are in a perpetual struggle for money and talent, endpoints that foster reductive metrics, such as high-impact publication. National assessment procedures, such as the Research Excellence Framework, incentivise bad practices. And individual scientists, including their most senior leaders, do little to alter a research culture that occasionally veers close to misconduct. (Horton, 2015: p. 1380).

Richard Smith has given a sympathetic review of *Medical Nihilism* (Smith, 2018a), as has Jeremy Howick, who is critical of some aspects of the Stegenga critique (namely, that meta-analyses are ranked at the top of the evidence hierarchy), but accepts the main point that the prior probability of medical treatments being effective is low (Howick, 2018). Howick adds his own twist of skepticism, that it may not necessarily be medical methodology which is at fault, but rather that many contemporary treatments simply do not work, noting that a *Cochrane Review* found that even a rather common sense observation to the effect that that aspirin effectively dealt with tension headaches, was questionable (Derry et al., 2017), and that “it is legitimate to ask how we can know anything about medical interventions?” (Howick, 2018).

Other “establishment” critics (i.e. critics who are medically qualified academics) of modern medicine, see medicine “destroying” itself (Callahan & Nuland, 2011; Smith, 2018b), with a particularly telling critique by Seamus O’Mahony, *Can Medicine be Cured? The Corruption of a Profession* (O’Mahony, 2019), leading the way. This literature indicates a challenging level of skepticism about a vitally important institution of modern society, and that is but scratching the surface (Foss, 1989; Djulbegovic, et al., 2009). While it is not the purpose of this essay to endorse say, the medical nihilist thesis, or any wide-ranging skepticism about the foundations of medicine, the point to be made is that these problems *do* exist, that this extensive literature *does* exist, and that these problems and this literature *do* illustrate the type of foundational problems that can call a discipline or field of research into question through an epistemological crisis. Further, the examples of these sorts of foundational debates in an area of fundamental social importance such as medicine shows that the

epistemological crises can be directly relevant to issues of human welfare, rather than mere matters of academic speculation and debate.

6. Conclusion

One of the main research hypotheses to be investigated in future essays, which is strongly suggested by the work about cognitive blind spots and errors, is that there exist cognitive/neurological limits to the human mind, that render it an imperfect instrument for the seeking of truth at the deepest level about reality. Colin McGinn has proposed, for example, that humans did not evolve for philosophical and scientific exploration, because there were no specific selective forces acting to favour these qualities (McGinn, 1993). Rather, these cognitive abilities arose as a broader spin off, and unintended consequence of survival and gene replication. Consequently, the human brain is good at navigating the physical world, and reproduction, but not so good at exploration of abstract realms, or for dealing with multi-dimensional, non-linear “wicked problems” such as the ecological crisis, let alone fundamental explorations of the nature of ultimate reality (Balcomb, 2014).

McGinn sees the intractability of foundational philosophically-based problems as arising from the limited cognitive capacity of the human mind, while other philosophers, such as Thomas Nagel see the intractability of such problems as arising from the clash between the subjective and objective points of view (Nagel, 1986, 2012). Eric Dietrich (Dietrich, 2011) has argued that the approaches of both McGinn and Nagel are based upon points of view, whereas McGinn argues that humans lack the appropriate cognitive point of view to solve philosophical problems. Nagel postulates *three* points of view, the subjective, objective, and a third view that sees the subjective and objective views as equally valid, with intractability arises from the inability to resolve this:

From Nagel’s point of view, the subjective/objective divide is unbridgeable, and is the font of all philosophy and its intractability. From McGinn’s point of view, there is a point of view from which the problems of philosophy are solvable, indeed solved. (Dietrich, 2011: p. 340)

Dietrich believes not only that we cannot know which of these positions is correct, if either (Dietrich, 2011: p. 340), but also that both positions show that philosophy cannot progress, because “crashing points of view are ineluctable, and their existence is the only truth (Dietrich, 2011, 341). But even this creates a self-referential problem, as Dietrich’s own account is a philosophical account, subject to the critical arguments of others, so even the claim may that philosophy does not progress will not be known.

The position taken here, from this review of literature, is that the limitations of human reason are more than just a conflict between subjective and objective perspectives, although this is one relevant factor. It is more likely that there are cognitive and neurological limits to the human mind, more widespread than relating to philosophical inquiry, as important as that is. As such, while that alone does not

lead to epistemological skepticism, it does support the position of *epistemic humility*, a position adopted in various forms by many philosophers from Socrates (“For I was conscious that I knew practically nothing ...” Plato, *Apology*, 22d) to Kant. Rae Langton in *Kantian Humility* says, regarding Kant’s idea that we can never have knowledge of mind-independent things-in-themselves, that this is a position of “epistemic humility,” the recognition that there “are inevitable constraints on what we can know, inevitable limits on what we can become acquainted with” (Langton, 2001: p. 2).

It has been shown in this essay that considerations from cognitive psychology, and the epistemological crises, strongly support this doctrine of epistemic humility, a matter which will be further discussed in future essays, examining other fields, including mathematic, statistics, and physics.

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