

Did Human Reality Denial Breach the Evolutionary Psychological Barrier of Mortality Salience? A Theory that Can Explain Unusual Features of the Origin and Fate of Our Species



Ajit Varki

“We now know that the human animal is characterized by two great fears that other animals are protected from: the fear of life and the fear of death.”

—Ernest Becker

“A being who knows that he will die arose from ancestors who did not know.”

—Theodosius Dobzhansky

“The human race is the only one that knows it must die, and it knows this only through its experience.”

—Voltaire

The yaksha asked: “What is the greatest surprise?” Yudhishthira replied: “People die every day, making us aware that men are mortal. Yet we live, work, play, plan, etc., as if assuming we are immortal. What is more surprising than that?”

—The Mahabharata

Abstract Some aspects of human cognition and behavior appear unusual or exaggerated relative to those of other intelligent, warm-blooded, long-lived social species—including certain mammals (cetaceans, elephants, and great apes) and birds (corvids and passerines). One collection of such related features is our remarkable ability for ignoring or denying reality in the face of clear facts, a high capacity for self-deception and false beliefs, overarching optimism bias, and irrational risk-taking behavior (herein collectively called “reality denial”). Such traits should be maladaptive for reproductive success when they first appear as consistent features in

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individuals of any species. Meanwhile, available data suggest that self-awareness (knowledge of one's own personhood) and basic theory of mind (ToM, also termed mind-reading, intentionality etc.) have evolved independently several times, particularly in the same kinds of species mentioned above. Despite a long-standing opportunity spanning tens of millions of years, only humans appear to have gone on to evolve an extended ToM (multilevel intentionality), a trait required for optimal expression of many other unusual cognitive attributes of our species, such as advanced linguistic communication and cumulative cooperative culture. The conventional view is that extended ToM emerged gradually in human ancestors, via stepwise positive selection of multiple traits that were each beneficial. A counterintuitive alternate possibility is that establishment of extended ToM has been repeatedly obstructed in all other species with the potential to achieve it, due to a "psychological evolutionary barrier," that would arise in isolated individuals of a given species that develop the genetic ability for extended ToM. Such individuals would observe deaths of conspecifics whose minds they fully understood, become aware of mortality, and translate that knowledge into mortality salience (understanding of personal mortality). The resulting conscious realization and exaggeration of an already existing intrinsic fear of death risk would have then reduced the reproductive fitness of such isolated individuals (by favoring personal survival over reproduction). This "psychological evolutionary barrier" would have thus persisted until hominin ancestors broke through, via a rare and unlikely combination of cognitive changes, in which two intrinsically maladaptive traits (reality denial and extended ToM) evolved in the minds of the same individuals, allowing a "mind over reality transition" (MORT) over the proposed barrier. Once some individuals broke through in this manner, conventional natural selection could take over, with further evolution of beneficial aspects of the initial changes. This theory also provides a unifying evolutionary explanation for other unusual features of humans, including our recent emergence as the dominant species on the planet, and replacement of all other closely related evolutionary cousins, with limited interbreeding and no remaining hybrid species. While not directly falsifiable by experiment, the MORT theory fits with numerous facts about humans and human origins, and no known fact appears to strongly militate against it. It is also consistent with most other currently viable theories on related subjects, including terror management theory. Importantly, it has major implications for the human condition, as well as for many serious current issues, ranging all the way from lack of personal health responsibility to ignoring anthropogenic global climate disruption, which now threatens the very existence of our species.

An Unusual Theory from an Unlikely Source. An expert reader might choose to skip this chapter in the volume *Evolutionary Perspectives on Death*, as it is written by a physician-scientist without a track record of publications in evolutionary psychology. However, regarding mortality salience (awareness by an individual that his/her death is inevitable) the author has had much real-world experience. I was once an oncologist giving chemotherapy to patients in the early days when it rarely worked, and thus witnessed first hand the remarkable human ability to suppress the harsh reality of personal mortality as well as the unrealistic optimism of all parties

involved. Many years of studying molecular differences between humans and our closest evolutionary relatives (including human-specific diseases) (Chou, Takematsu, Diaz, et al., 1998; Ghaderi, Springer, Ma, et al., 2011; Hayakawa et al., 2005; Hedlund, Padler-Karavani, Varki, & Varki, 2008; Varki, 2000, 2010; Varki, Strobert, Dick, Benirschke, & Varki, 2011; Wang, Mitra, Secundino, et al., 2012) and trans-disciplinary interactions with scholars of many stripes interested in explaining human origins (Enard, Khaitovich, Klose, et al., 2002; Gagneux, Moore, & Varki, 2005; Ghaderi et al., 2011; McConkey & Varki, 2000, 2005; O'Bleness, Searles, Varki, Gagneux, & Sikela, 2012; Olson & Varki, 2003, 2004; Varki, 2007; Varki, Geschwind, & Eichler, 2008) also prepared the author for a contrarian question posed to him in 2005 by the late Danny Brower of the University of Arizona: instead of asking what biological and cultural evolutionary processes generated the human mind, perhaps we should instead ask why we are not currently competing with other species with humanlike cognition. After all, warm-blooded, highly intelligent, socially complex species such as elephants, dolphins, whales, great apes, and corvids have been on this planet for tens of millions of years? So why are we not competing with other lineages with humanlike cognition, and have instead endangered them all by taking over the entire biosphere? Perhaps we should consider the possibility of a difficult cognitive barrier that only the lineage leading to humans was able to breach on a single occasion (Varki, 2009; Varki & Brower, 2013).

Some Unexplained Distinctive Features of Humans and Our Evolutionary Origins. Each living species has unusual or distinctive features that emerge from evolutionary interactions between biology and environment. The symposium addressing *Evolutionary Perspectives on Death* exemplified two unusual features of humans: first, our ability to consider and understand the thoughts of many others at once (as occurred during the lectures and discussions); and second, our ability to dispassionately discuss knowledge of our own mortality without being consumed by fear. I will argue that these two seemingly disparate human peculiarities were involved in a critical interplay in relation to the origin of our species, also then contributing to our subsequent replacement and/or limited genetic assimilation of our closest (now extinct) evolutionary cousins—and eventually to our domination of the entire planet, two additional distinctive features of humans. I will first consider each of these human peculiarities individually, and then attempt to synthesize them into a single overarching theory, which can also explain many other aspects of the human condition and the origin of our species. Note that this is not one of the oft-criticized “umbrella theories” (Langdon, 1997) that seek to explain everything about human origins and cognition. Rather, it is a theory about a *very finite* period of human evolution, and the proposed breaching of a “psychological evolutionary barrier,” which allowed our emergence as a cognitively distinct species. It is also a theory that appears to fit with all known relevant information, and is not apparently negated by any other facts, but also cannot be definitively falsified at this time by an experiment.

The Remarkable Human Propensity for “Reality Denial” in the Face of Facts or Realities. The human ability to understand and consider our own mortality without being consumed by fear seems natural to us. In fact, it appears to be just one

manifestation of a peculiar human ability to ignore, rationalize, or outright deny obvious realities, and even to believe in multiple or alternate realities at the same time. For example, advances of in science and medicine have made it clear that health and longevity are improved if we exercise regularly, eat a balanced and healthy diet, avoid tobacco and excessive alcohol, maintain an optimal body weight, detect and treat high blood pressure or sleep apnea, avoid excessive stress, and so on—but very few of us follow these simple and logical recommendations (physicians are often among the worst offenders) (Freeman and Spiegelhalter 2018; Spiegelhalter, 2012). Even when we do acknowledge such realities, we tend to indulge in magical thinking, behaving as if these statistics apply to everyone else, but not to ourselves. Many humans also ignore or even deny scientific and societal realities such as biological evolution, anthropogenic climate change, human “overshoot” with nonrenewable resource depletion, gross degradation of our environment, massive expansion of national debt, ballooning healthcare costs, covert or overt racism, and so on. Instead, many continue to believe in UFOs, literal biblical creationism, magical cures, claims that vaccines do not work (or cause autism), irrational fear of all genetically modified organisms (GMOs), and so on. We also insist on rebuilding our dwellings in the places where the worst natural disasters have repeatedly occurred. On the political front, distortion or denial of obvious realities is prominent in all parties and belief systems, depending on the circumstances. Of course, scientists are also not immune to denying obvious realities, and phenomena like a heliocentric solar system (Copernicus), evolution (Darwin), plate tectonics (Wegener), blood circulation (Harvey), and antisepsis (Semmelweis) were strongly resisted at the time by learned colleagues in the face of facts, and some of these frustrated proponents did not even live long enough to be personally vindicated.

Absent a single entry in the dictionary to denote these and other related phenomena, I have taken the liberty of coining the term “reality denial” defining it as a *subconscious defense mechanism characterized by refusal to acknowledge (or rationalization of) unwanted unpleasant facts, realities, thoughts, and feelings*. There are many other ways to consider about this overall cognitive peculiarity, including “denialism” (Specter, 2009), “corruption of reality” (Schumaker, 1995), “cognitive dissonance” (Harmon-Jones, 2019), “predictable irrationality” (Ariely, 2008), “the believing brain” (Shermer, 2012), various views of “optimism bias” (Gilbert, 2007; Sharot, 2011a, 2011b; Sharot, Korn, & Dolan, 2011; Sharot, Riccardi, Raio, & Phelps, 2007; Weinstein, 1980), and so on. Whichever way we choose to define this broad phenotype, it is a common feature of humans, and (as far as we know) not common in other animals. Thus, it needs to be added to a list of our many unusually exaggerated cognitive characteristics (see Table 1 for a partial list). However, unlike most other features listed in Table 1 that should have had net benefits for positive adaptive selection during evolution when they first appeared, this capacity for persistent and sometimes extreme reality denial *should have been a maladaptation when it first appeared in our lineage*. Indeed, any individual who routinely practiced reality denial and took excessive risks would likely be removed from the gene pool of that species, and there would have been a failure to fix the genotype responsible for this phenotype. The questions then are the following:

Table 1 Some unusual or exaggerated cognitive features of humans

Acting (mime or spoken)	Caring for the sick	Planning ahead
Bargaining	Hospitality	Reality denial^a
Beliefs about death	Inheritance rules	Religiosity
Blushing	Intentional deception	Representational art
Bravery and courage	Language (complex)	Reputation (concern for)
Care of infirm and elderly	Laws and justice	Risk-taking (excessive)
Comedy	Lecturing	Rites of passage
Control of fire	Medicines for others	Romantic infatuation
Cooking	Magical thinking	Social control of paternity
Cooperation	Multi-instrumental music	Suicide (intentional)
Cumulative culture	Nonreciprocal altruism	Teaching (explicit)
Domestication of Animals	Organized sports	Theory of mind (extended)*a
Food preparation for others	Optimism bias	Torture (deliberate)
Funerary practices	Overconfidence	Trade

^aDeleting extended theory of mind and/or reality denial from the human cognitive repertoire would eliminate or diminish many of the other features in this table

How and why did excessive reality denial and risk-taking evolve in humans, and what benefits outweighed the obvious negative consequences, *at the time when this propensity first emerged?*

Extended Theory of Mind as Another Distinct Feature of Humans. Many warm-blooded species appear to have independently evolved self-awareness as defined by various criteria, including the mirror self-recognition test (Anderson & Gallup, 2015; Candland, 1995; Gallup, 1977; Parker, Mitchell, & Boccia, 1994; Ross et al., 2017; Suddendorf & Butler, 2013), which has been passed by individual members of various species including chimpanzees (Anderson & Gallup, 2015; Eddy, Gallup, & Povinelli, 1996; Gallup, 1977; Kitchen, Denton, & Brent, 1996; Povinelli, Eddy, Hobson, & Tomasello, 1996; Rajala, Reininger, Lancaster, & Populin, 2010), elephants (Dale & Plotnik, 2017; Plotnik, de Waal, & Reiss, 2006), dolphins (Morrison & Reiss, 2018; Reiss, 2011; Reiss & Marino, 2001), corvid birds (Clary & Kelly, 2016; Prior, Schwarz, & Güntürkün, 2008), and possibly even trained monkeys (Huttunen, Adams, & Platt, 2017; Rajala et al., 2010; Toda & Platt, 2015). The question arises whether such individuals with awareness of their own self are also fully aware of the self-awareness of others, a state that is often referred to as “theory of mind” (Apperly, 2010; Baron-Cohen, Leslie, & Frith, 1985; Bedny, Pascual-Leone, & Saxe, 2009; Crockford, Wittig, Mundry, & Zuberbühler, 2012; Dumontheil, Apperly, & Blakemore, 2010; Emery & Clayton, 2009; Gentner & Goldin-Meadow, 2003; Kappeler & Silk, 2010; Krupenye, Kano, Hirata, Call, & Tomasello, 2016; Meltzoff, 1999; Moll & Meltzoff, 2011; Moll & Tomasello, 2012; Patel, Sestieri, & Corbetta, 2019; Povinelli et al., 1996; Premack & Woodruff, 1978; Schaafsma, Pfaff, Spunt, & Adolphs, 2015; Young, Dodell-Feder, & Saxe, 2010), or “intentionality” (Dennett, 1987, 1996; Tomasello, 2018) (i.e., the ability to not only attribute mental beliefs, desires, and perspectives to oneself, but also to understand that others have beliefs, desires, intentions, or perspectives similar or different from

oneself). Many other terms describe aspects of such mental states, including “inter-subjectivity” (Vogeley, 2017), “mind reading” (Apperly, 2010; Emery & Clayton, 2009; Heyes & Frith, 2014; Samson, 2009), “perspective taking” (Carter, 2002; Hodges, Denning, & Lieber, 2018; Moll & Meltzoff, 2011), and “other-regarding impulses” (Hrdy, 2009).

Of course such cognitive abilities are part of a continuum seen in the postnatal development of humans (Baron-Cohen et al., 1985; Baron-Cohen, O’Riordan, Stone, Jones, & Plaisted, 1999; Bering & Parker, 2006; Corriveau, Kim, Schwalen, & Harris, 2009; Dumontheil et al., 2010; Hofmann, Doan, Sprung, et al., 2016; Luu, Rosnay, & Harris, 2013; Meltzoff, 1999; Moll & Meltzoff, 2011; Moll & Tomasello, 2012; Parker et al., 1994; Piazza, Bering, & Ingram, 2011; Povinelli et al., 1996; Ronfard, Bartz, Cheng, Chen, & Harris, 2018; Ronfard, Chen, & Harris, 2018; Wellman & Brandone, 2009) (Fig. 1), with a 2-year-old recognizing herself in the mirror, the emergence of a rudimentary theory of mind or “collective intentionality” of a 3- or 4-year-old, and what one might call a full theory of mind or “multilevel intentionality” in a 5- or 6-year-old who can tell excellent lies (the ability to understand and deceive other minds). And in adult humans we have an “extended theory of mind,” which can now encompass a billion minds across the Internet, simultaneously understanding the beliefs of others (whether or not they are true!).

Why Are We Humans Alone in Dominating the Planet? The continent of Africa was the source of a diverse and complex assemblage of hominin lineages that spread across the Old World beginning about two million years ago (Wood & Boyle E, 2016), and evolved into multiple lineages of behaviorally sophisticated species, only a few which have been defined to date, such as Neanderthals, Denisovans, and “Hobbits” (Culotta, 2016; Hajdinjak, Fu, Hübner, et al., 2018; Meyer, Kircher, Gansauge, et al., 2012; Prufer, de Filippo, Grote, et al., 2017; Prufer, Racimo, Patterson, et al., 2014; Reich, Green, Kircher, et al., 2010). But once our own species emerged in Africa >200,000 years ago (Hublin, Ben-Ncer, Bailey, et al., 2017; Wood, 2017), and later spread across the planet (Clarkson, Jacobs, Marwick, et al., 2017; Galway-Witham & Stringer, 2018), we quickly

Fig. 1 A continuum in the cognitive development of self-awareness, theory of mind (ToM), and intentionality



became (in evolutionary time) the “Lone Survivors” (Stringer, 2012) and “Masters of the Planet” (Tattersall, 2012). To a large extent, our success has been based on a constellation of unusual cognitive features, such as those listed in Table 1. However, if we “delete” our extended theory of mind, many of the other cognitive attributes become less effective (consider a group of individuals with autism spectrum disorder, who may each have special cognitive attributes, but are much less capable of cumulative, rapidly developing culture).

The cognitive benefits of extended theory of mind are many, and may have been necessary for the spread of humans all across the planet, and the development of our varied and complex cultures. Given the obvious benefits to fitness, the counterintuitive question posed to me by the late Danny Brower (Varki, 2009) was why are such abilities are so well developed in adult humans—yet apparently not in otherwise highly intelligent, large-brained, warm-blooded, social, tool-using species ranging from chimpanzees, elephants, dolphins, and other cetaceans, corvids, and the like—lineages that have been on the planet for tens of millions of years of vertebrate evolution? Instead of the conventional assumption that something unusual happened in the course of human brain evolution, what if there was instead a difficult-to-surmount barrier that repeatedly blocked the cognitive progression of all other species? In other words, just as a *physiological evolutionary barrier* held back adaptation of vertebrate species from aquatic to terrestrial life for a very long time, what if there is a “*psychological evolutionary barrier*” (Fig. 2) that has repeatedly thwarted progression of cognitive evolution to the full state of multilevel intentionality?

When and How Did Humans Evolve Tolerance of Knowledge of Personal Mortality? It is reasonable to assume that most or all species with a nervous system have an automated reaction to death risk that has been honed by natural selection,

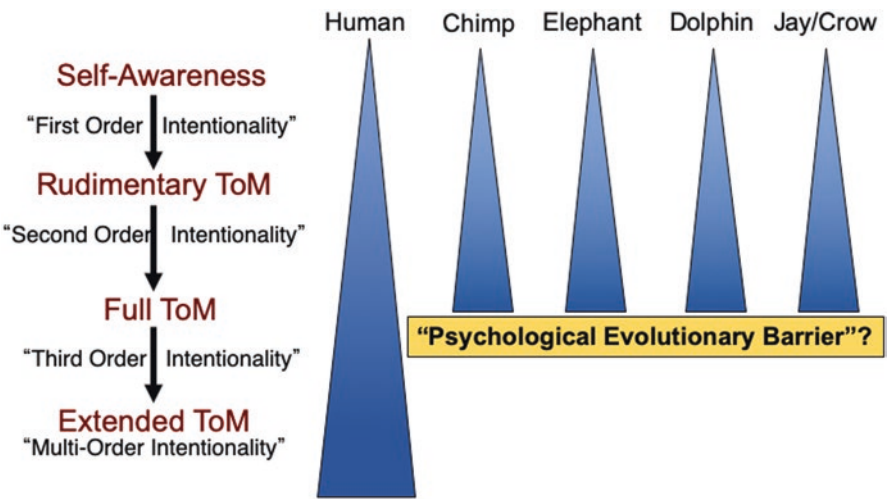


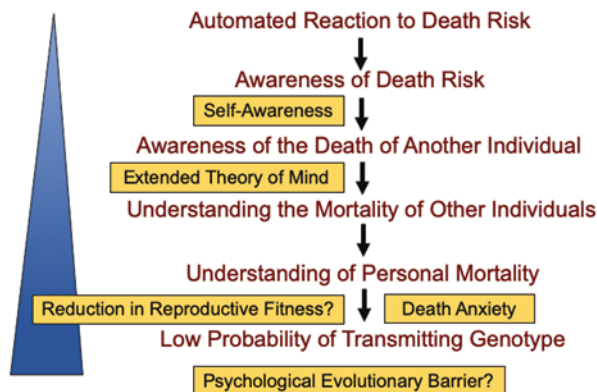
Fig. 2 A psychological evolutionary barrier to acquiring extended theory of mind

and it is likely that all animals have genetically wired reaction responses to death risk. But only a small subset of animals (once again, including elephants, chimpanzees, cetaceans, and corvids) seem to show awareness of the death of a conspecific (Anderson, Gillies, & Lock, 2010; Bearzi et al., 2018; Biro et al., 2010; Goncalves & Biro, 2018; Goncalves & Carvalho, 2019; Marzluff & Angell, 2012; Porter, Eckardt, Vecellio, et al., 2019; Stewart, Piel, & O'Malley, 2012), some descriptions of which can be found in another chapter of this volume (Brosnan & Vonk). Of course, many behaviors and emotions we associate with humans are also present in other species to varying degrees (Safina, 2015, 2019; Waal, 2019).

Regardless, the question remains open as to whether members of such species also experience true mortality salience (i.e., a full understanding of the reality of their own personal mortality) as humans do—as opposed to simply recognizing the death of another individual they were close to and reacting negatively. It is reasonable to suppose that *fully* understanding the death and mortality of other individuals is a prerequisite to *fully* understanding one's own personal mortality. If so, the emergence of a full theory of mind would eventually result in full understanding of the death of another individual, i.e., the permanent extinction of another mind, not unlike oneself. This understanding should translate to stark realization of one's own personal mortality. Severe death anxiety should affect the few individuals who develop this ability at any given time, and this may have sufficiently reduce their fitness to negate the possibility of passing on the genotype to offspring (Fig. 3). Perhaps this is the psychological evolutionary barrier that has held back all other species to date.

Did Two Rare Evolutionary Maladaptations Coincide to Breach the Evolutionary Psychological Barrier of Mortality Salience? As discussed earlier, excessive reality denial and risk-taking should have been maladaptive each time that they first emerged in individuals of a species with advanced cognition. And we have just argued that although an extended theory of mind can have fitness value in the right circumstances (as it does in today's humans), the initial negative impact of the resulting mortality salience should be maladaptive, because of the resulting mortality salience and death anxiety. But if both of these very rare maladaptations *happened*

Fig. 3 A continuum in awareness of death risk and understanding of mortality. Potential consequences for evolutionary selection



to evolve in the minds of the same individuals at the same time, they could combine to allow tolerance of death anxiety, and this unlikely combination could be genetically established in the progeny of these individuals (Fig. 4). In the more expanded view of this proposed “mind over reality transition” shown in Fig. 5, a species with a complex social organization, a long life, a preexisting maternal instinct, and helpless young could evolve (Froehle et al., 2019; Hrdy, 2009; Konner, 2010), such as occurs in some of the other mammals mentioned earlier. Such a species might also

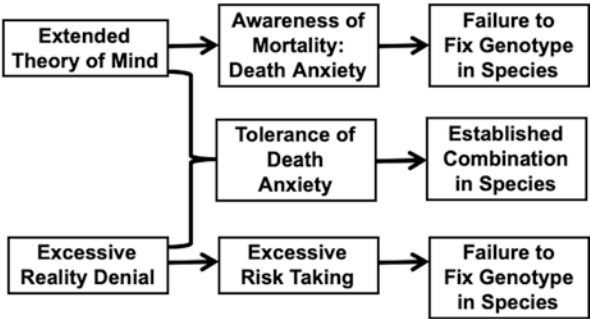


Fig. 4 “Mortality salience” barrier to establishment of an extended theory of mind in a species. A proposed mind over reality transition is based on unlikely coincidental combination of two maladaptive factors during human cognitive evolution

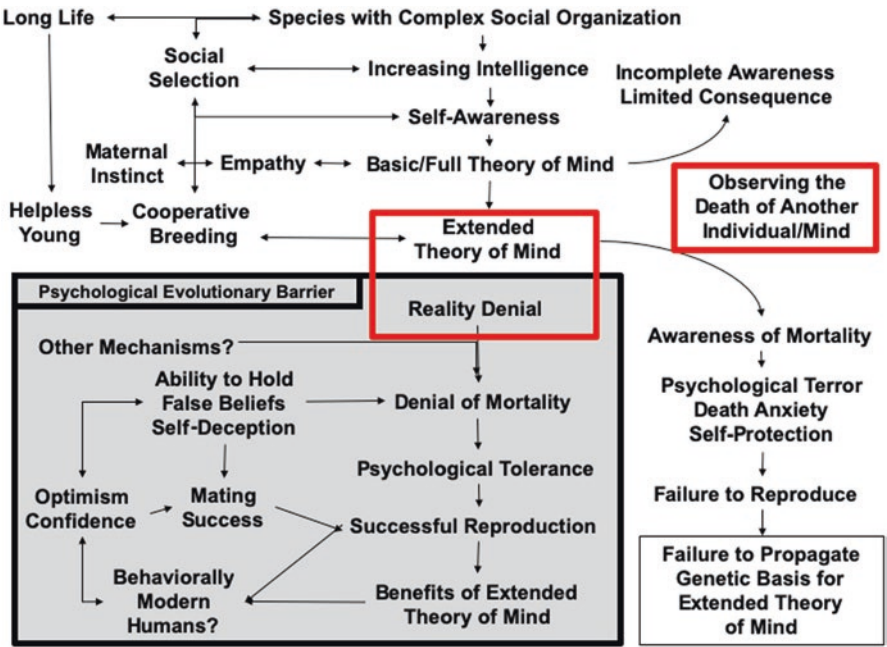


Fig. 5 Extended view of some factors involved in the proposed mind over reality transition

be more likely to develop some level of self-awareness and basic theory of mind, especially in the context of cooperative caring for helpless young (Hrdy, 2009).

In the absence of a full theory of mind, observing the death of another individual of the same species would not trigger full mortality salience and its negative consequences (Fig. 5). On the other hand, individuals who first develop a full theory of mind and observe the death of conspecific would then suffer from awareness of personal mortality, and the resulting psychological terror would result in a failure to establish the genotype in that lineage. If so, a *highly unlikely one-time combination* that includes reality denial of mortality salience would allow psychological tolerance, successful reproduction, and establishment of the benefits of extended theory of mind (Fig. 5). It is also noteworthy that the ability to hold false beliefs, self-deception, optimism, and confidence might support a successful mating strategy, especially for males. This suggestion is congruent with Trivers evolutionary theory of self-deception that includes denial of ongoing deception, self-inflation, ego-biased social theory, false narratives of intention, and a conscious mind that operates via denial and projection to create a self-serving world (Murphy, von Hippel, Dubbs, et al., 2015; Ramachandran, 1996; Trivers, 2000, 2011).

One can thus posit a *hypothetical singular phase in human evolution*, during which mortality salience and maladaptive death anxiety were triggered by acquiring extended theory of mind, but happened to be stabilized by *simultaneous* evolution of reality denial in the same minds. Returning to Table 1, and doing the thought experiment, it is noteworthy that the combined deletion of reality denial and extended theory of mind would blunt or eliminate many of the unusual cognitive features of humans. Thus, once this unusual combination was established in the lineage that gave rise to modern humans, it would have given such individuals a considerable advantage at the cognitive level.

Can This Theory Help Explain the Unusual Origin of Our Species? Although new findings keep changing the numbers, it currently appears that modern humans evolved from a population of 5000–10,000 individuals in Africa >2–300,000 years ago (Nielsen et al., 2017; Scheinfeldt, Soi, Lambert, et al., 2019), and spread across the planet over the last 70,000–100,000 years or so (Clarkson et al., 2017; Galway-Witham & Stringer, 2018), at about the time when the archeological record began to show symbolic art, complex toolmaking, personal ornamentation, and burials with grave goods—the kinds of features one might expect to see if a full theory of mind had emerged. It appears that these “behaviorally modern” humans then replaced all closely related species over a few thousand years, with limited interbreeding (Galway-Witham & Stringer, 2018; Jacobs, Hudjashov, Saag, et al., 2019; Petr, Pääbo, Kelso, & Vernot, 2019), leaving us as the only surviving hominin lineage, eventually gaining dominance over the entire biosphere. The fact that there are no persisting hybrids (Varki, 2016) suggests that a subset of anatomically modern humans may have gone through this “mind over reality transition” (Fig. 6), and then used extended theory of mind, reality denial, self-deception, false beliefs, an overarching optimism bias, and irrational risk-taking, to emerge as the dominant species. Of course, there is much evidence that Neanderthals shared many advanced cognitive features with humans (Finlayson, Brown, Blasco, et al., 2012;

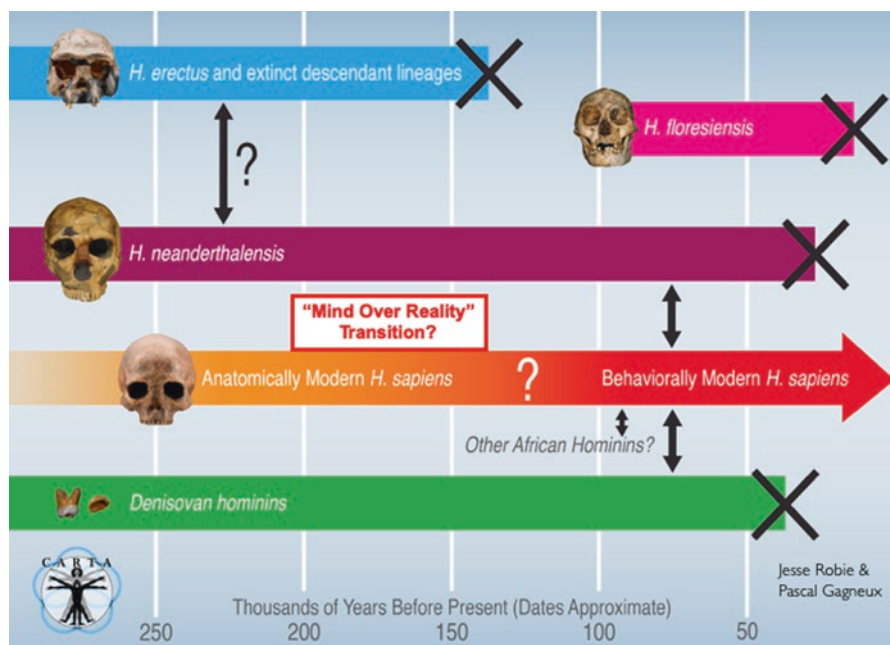


Fig. 6 Possible timing of the proposed mind over reality transition in relation to the origin of modern humans (modified from Varki A.: *The Scientist* 27:28–29, 2013)

Mithen, 2007; Nakahashi, 2017; Pettitt, 2010). Perhaps there they were also at the brink of the psychological evolutionary barrier, but then failed to attain the optimal combination of genes and culture to cross that Rubicon.

Does Human Psychological Ontogeny Recapitulate the Proposed Original Breaching of the Psychological Evolutionary Barrier? As shown in Fig. 7, this may also be an instance in which ontogeny does indeed recapitulate phylogeny (Clune, Pennock, Ofria, & Lenski, 2012; Gould, 1977), in that human postnatal psychological development seems to recapitulate the proposed evolutionary transition (Moll & Meltzoff, 2011). The proposed breaching of the psychological evolutionary barrier of mortality salience associated with the emergence of our species is perhaps being recapitulated in the death anxiety seen in young children (Barrett & Behne, 2005; Harris, 2018; Roche, Brooten, & Youngblut, 2019; Speece & Brent, 1984; Vázquez-Sánchez et al., 2018), especially in nonreligious families. Parents in such families are often concerned about such anxieties, but the transition to the “invincible” adolescent more prone to take risks usually takes care of the problem over time. Also consistent with the overall theory, children with autism spectrum disorders and limited theory of mind sometimes have difficulties in understanding the concept of God (Akechi, Kikuchi, Tojo, Hakarino, & Hasegawa, 2018; Jack, Friedman, Boyatzis, & Taylor, 2016; Norenzayan, Gervais, & Trzesniewski, 2012) or the deaths of others (Horowitz, Thurm, Farmer, et al., 2018).

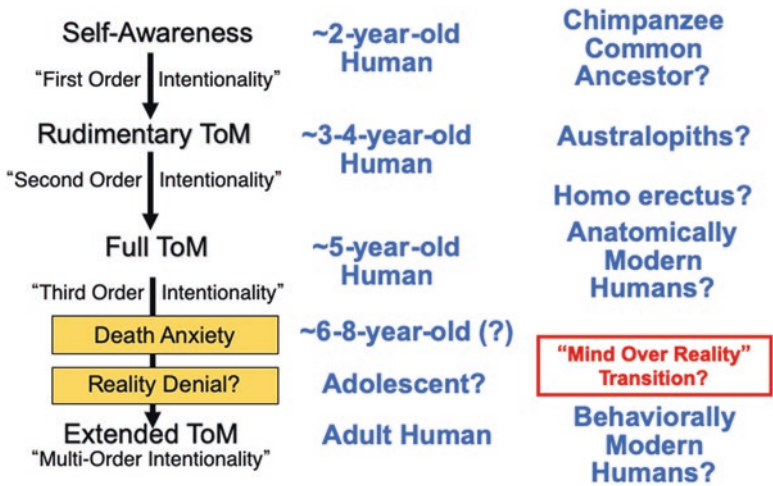


Fig. 7 Does human psychological ontogeny recapitulate our recent phylogeny?

Of course, autism spectrum disorders are not a proxy for our ancestral state, and ethical issues would constrain attempts to explore how well such individuals understand their personal mortality.

Other Examples of Potentially Supportive Evidence. As Dennett has suggested, “any theory that makes progress is bound to be initially counterintuitive” (Dennett, 1987). Any new theory is also more likely to be rejected if it originates from individuals without expertise in the relevant disciplines, and more especially if it cannot be immediately tested or falsified. But as is often done in fields like astronomy (or at the origins of the theory of evolution), one can assemble examples of potentially supportive evidence and also consider all possible “ugly facts” that might destroy the hypothesis.

The current hypothesis is consistent with “terror management theory” (Greenberg, Solomon, & Pyszczynski, 1997; Harmon-Jones et al., 1997; Lewis, 2014; Plusnin, Pepping, & Kashima, 2018; Pyszczynski, Greenberg, & Solomon, 1999; Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989; Solomon, Greenberg, & Pyszczynski, 1991, 2015; Vail et al., 2010) which seeks to explain defensive human thinking and behavior that arises from an awareness and fear of death, driving people to adopt worldviews that help protect their self-esteem, and making them believe that they play an important role in a meaningful world, despite the knowing of certain oblivion in the long run. Space does not allow a proper treatment of the extensive literature on Terror Management Theory (TMT) (see Pyszczynski in this volume). However, assuming that the proposed transition occurred in recent evolutionary time, human suppression of mortality salience is likely incomplete, and this partial suppression could explain the ongoing need for terror management in current-day humans. Perhaps one can suggest that MORT is to terror management theory (TMT) TMT as general relativity is to Newtonian

physics, the former being an improved model of reality, while the latter remaining useful for everyday predictions.¹

On the other hand, reality denial can be beneficial when it allows for optimism, perhaps explaining the evolutionary origins of the well-documented “optimism bias” in humans (Sharot, 2011a, 2011b; Sharot et al., 2007, 2011) which manifests itself in many human characteristics, such as the “Pollyanna hypothesis” (Iliev, Hoover, Dehghani, & Axelrod, 2016; Schlaghecken, Blagrove, Mantantzis, Maylor, & Watson, 2017) which addresses the apparent universal positivity bias of human language. It can also explain the human propensity for risk-taking and thrill-seeking behavior. Notably, evolutionary modeling shows that reacting in an overconfident manner can actually have fitness benefits, as long as the contested resources are sufficiently large, compared to the cost of competition (Johnson & Fowler, 2011). On the other hand, willfully ignoring negative information can lead to disasters such as unnecessary fatalities in mountain climbers who refuse to turn back against all odds (Krakauer, 1998),² major military losses in war (Brighton, 2004), and many other of history’s greatest disasters and mistakes (Cooke, 2013).

Reality denial could also contribute to the “end-of-history illusion” (Quoidbach, Gilbert, & Wilson, 2013), in which adults spanning a wide age range acknowledge that they have changed in many ways from how they were in the past, and yet find it hard to imagine that they will change much in the future. As the study authors put it, people seem to “regard the present as a watershed moment at which they have finally become the person they will be for the rest of their lives.” This obvious denial of future reality could also help with suppression of mortality salience. Ironically, some of the same individuals are still capable of a major concern for their own posthumous legacy, despite knowing that they will not be there to be personally affected by such a legacy.

Depending on the lens through which it is studied, one aspect of religion can also be considered as strong evidence in support of MORT. Most human behaviors exist in other species on a continuum of development, as one would expect from evolution. But religion appears to be a well-established near universal only in human cultures and there are many obvious fitness advantages that have been discussed by others (Bering, 2011; Boyer, 2001, 2008; Churchland, 2011; Dennett, 2006; Maser & Gallup, 1990; McCauley, 2011; Norenzayan & Shariff, 2008; Schloss & Murray, 2010; Shermer, 2012; Wade, 2009; Wilson, 2002). But most of these advantages should not require a belief in life after death. Nevertheless, almost all religions have at their core some form of such afterlife beliefs, which would serve as another mechanism to blunt the impact of mortality salience. Of course, atheists do not live

¹Analogy suggested by Rob Mielcarski, whose website Un-denial (<https://un-denial.com>) addresses many ways in which the MORT theory is consistent with the reality of the current human condition as well as the dismal fate of our species.

²“Unfortunately, the sort of individual who is programmed to ignore personal distress and keep pushing for the top is frequently programmed to disregard signs of grave and imminent danger as well. This forms the nub of a dilemma that every Everest climber eventually comes up against: in order to succeed you must be exceedingly driven, but if you’re too driven you’re likely to die.” Jon Krakauer, pg. 177

in constant fear of their mortality (Dawkins, 2008; Harris, 2005; Hitchens, 2009), so the underlying reality denial appears to be the primary mechanism.

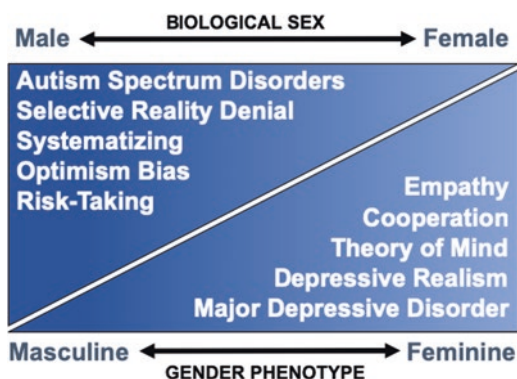
Meanwhile, the dark side of mortality salience is the ability to take a decision to commit suicide (Braun, Bschor, Franklin, & Baethge, 2016; Humphrey, 2018; Jamison, 1999; Preti, 2007; Soole, Kölves, & De Leo, 2015; Stoff & Mann, 1997). This uniquely human phenomenon varies in frequency in time and space in different cultures, but also occurs at a baseline rate in all populations, driven in part by major depressive disorder (Angst, Angst, & Stassen, 1999; Jamison, 1999), a common human psychiatric condition often characterized by “depressive realism” (Haaga & Beck, 1995; Moore & Fresco, 2012; Pacini, Muir, & Epstein, 1998), a concept that suggests that mildly depressed individuals are better at perceiving certain (largely negative) aspects of reality.

If at least some aspects of depression are related to a failure of reality denial, i.e., an inability to sustain the “optimism bias,” perhaps the dramatic effects of ketamine in major depressive disorder (Caddy, Amit, McCloud, et al., 2015; DeWilde, Levitch, Murrough, Mathew, & Iosifescu, 2015; Kraus, Rabl, Vanicek, et al., 2017; Machado-Vieira, Salvatore, Diazgranados, & Zarate, 2009; Parsaik, Singh, Khosh-Chashm, & Mascarenhas, 2015) partially constitute a sudden reset into altered reality. In this regard, could the well-known human craving for mind-altering substances also be partly due to the need to escape reality? Could the same be true of the positive value of meditation methods that focus on mindfulness of the present, or the shutting out of irksome reality? Conversely, could episodic panic attacks (Bighelli, Castellazzi, Cipriani, et al., 2018; Imai, Tajika, Chen, Pompoli, & Furukawa, 2016; Meuret, Kroll, & Ritz, 2017) represent a sudden failure of the neural mechanisms of reality denial? The reader may detect a tendency here toward an umbrella theory, but the fact remains that all the speculative suggestions above are consistent with the MORT theory.

Features of Human Sex and Gender Potentially Relevant to the Proposed Transition

Assuming that such an evolutionary transition did occur, what might have been the contributions of sex and gender? As illustrated in the very speculative Fig. 8, human males are at greater risk of autism spectrum disorders, more prone to selective reality denial, systematizing, optimism bias, and risk-taking behavior. Conversely, human females are more prone to empathy, cooperation, theory of mind, depressive realism, and major depressive disorder. Considering these sex and gender differences (which are of course on a continuum, and affected by many cultural and genetic factors), could it be that the original evolutionary transition involved mating of males with a complex genotype manifesting as maladaptive reality denial—with females having an equally complex genotype, suffering from mortality salience due to an enhanced theory of mind? Although we cannot know for certain, could such mating have generated an unusual collection of alleles, as an explanation for the

Fig. 8 Speculation regarding features of human sex and gender that are potentially relevant to the theory



origin of humans? Assuming that generating and stabilizing the optimal combination of such alleles were difficult, perhaps it took a very long time. Perhaps there was a prolonged interim state of recurrent cognitive instability, with ongoing dangers resulting from reality denial and/or existential angst, and possibly even high rates of suicide. Could this difficult transition explain the >100,000-year gap between the genetic origin of modern humans and archeological evidence suggesting our emergence in Africa and then elsewhere?

Issues Arising and Future Directions

Regardless of the sweeping speculations above, we have stated at the outset that the current theory is not falsifiable at this time. Thus, it is vital to search for “ugly facts” that might destroy the hypothesis. Although no such facts have yet emerged, there are many aspects of the earlier discussion that were oversimplified. For example, the mirror self-recognition test is not proof of self-awareness, the evidence for self-awareness in some nonhuman species is not definitive, and self-awareness in various distantly related species may not have necessarily evolved from the same neural processes. It is also true that theory of mind is not a clearly definable concept, that some other mammals and birds may have something approaching a full theory of mind, and that Neanderthals have left some evidence for an extended theory of mind, including burials and injured elderly individuals who must have been cared for (Ekshtain & Tryon, 2019; Morin & Laroulandie, 2012; Nakahashi, 2017; Pettitt, 2010; Staubwasser, Drăgușin, Onac, et al., 2018). Considering the archeological record, stone tool production must have required some degree of teaching, verbal communication, or at minimum active demonstration that was occurring prior to the appearance of modern humans (Asfaw, Gilbert, Beyene, et al., 2002), and the production of ochre pigment (Rosso, Pitarch Martí, & d’Errico, 2016), and long-range transport of obsidian toolmaking materials (Blegen, Jicha, & McBrearty, 2018) also predates evidence for modern humans.

Meanwhile, some would suggest that the biological sex drive should have superseded fear of mortality salience or that extended theory of mind and reality denial could have coevolved gradually. If so the question remains why only in one species? The argument that a rational human can deal with mortality fears with facts and statistics is not relevant to the suggested evolutionary scenario, as the initially maladaptive mortality salience would have emerged in just a few individuals, who would likely be without any facts or statistics to help rationalize the intense fear of death.

Potential Neuroanatomic Correlates of the Theory

If this theory is correct, modern humans should have unique neural pathways that mediated the proposed evolutionary changes. Candidate brain regions include the amygdala (the brain's "danger hub" that activates natural "fight-or-flight" response to danger and death risk) (Barger, Stefanacci, Schumann, et al., 2012; Barger, Stefanacci, & Semendeferi, 2007; Carlo, Stefanacci, Semendeferi, & Stevens, 2010; Feinstein, Adolphs, Damasio, & Tranel, 2011; Johansen, Cain, Ostroff, & LeDoux, 2011; Kim, Dager, & Lyoo, 2012; Kliemann, Dziobek, Hatri, Baudewig, & Heekeren, 2012; Quirin, Loktyushin, Arndt, et al., 2012; Roozendaal, McEwen, & Chattarji, 2009; Weisholtz, Root, Butler, et al., 2015); the prefrontal cortex (involved in judgments, decision-making, problem-solving, and controlling the amygdala during stressful events) (Blakemore & Robbins, 2012; Fuster, 2008; Kuss et al., 2015; Mitchell, 2009; Tamir & Mitchell, 2010); and the anterior cingulate cortex (involved in responding to mistakes, motivation, staying focused on a task, and managing proper emotional reactions) (Ecker, Suckling, Deoni, et al., 2012; Quirin et al., 2012; Rilling et al., 2012; Sharot et al., 2007). These also happen to be some of the regions that have undergone major anatomical changes in humans compared with our closest living evolutionary cousins (Barger et al., 2007, 2012; Rilling et al., 2012; Sakai, Mikami, Tomonaga, et al., 2011), and in which fMRI studies of optimism bias show evidence of activity (Sharot et al., 2007). All these are obviously highly oversimplified views of very complex neural structures and pathways, but they are at least consistent with the theory.

A Potentially Unifying Explanation. Overall, this "mind over reality transition" theory provides a potentially unifying explanation for the *evolutionary* origins of several unusual or exaggerated features of human cognition, including:

- Extended "theory of mind" (required or beneficial for many other aspects of human cognition)
- The ability for reality denial, even when aware of facts
- A strong tendency for self-deception and false beliefs
- Overarching optimism bias
- Irrational risk-taking behavior
- Recent emergence as the dominant species on the planet (perhaps making use of the above attributes)

- Replacement of all other closely related evolutionary cousins, with limited interbreeding

The theory is also consistent with all known facts, compatible with all other related theories, and not negated by any currently known facts. On the other hand, it is not directly testable by experimental reproduction and not directly falsifiable by experimental approaches. Given also the counterintuitive nature and unusual origins of this theory, as well as the lack of expertise of the originators in many relevant disciplines, MORT is very likely to be attacked from many quarters, and resolution is unlikely during the lifetime of this author. Only the passage of time will tell if MORT is as important as plate tectonics or as completely fanciful as “phlogiston” (or something somewhere in between). Fortunately, concern for posthumous legacy is a largely meaningless exercise.³

Coda: Relevance to the Current Human Condition and the Future of Our Species. The 2007 draft of Danny Brower’s incomplete manuscript that I modified and expanded into a co-authored book (Varki & Brower, 2013) included the following prescient observations: “*We are polluting the earth and changing the climate in ways that we can’t predict, and likely at some point, can’t easily reverse. If we’re so smart, why do we continue to sow the seeds for our eventual destruction? Because we are saddled with a brain that is designed by selection to cope with the ultimate disaster (death) by denying that it will occur, and so we treat other impending disasters by denying that they will ever happen Indeed, it is arguable that we are destined ultimately to destroy ourselves as a species.*” Although many of our follies arising from reality denial can at least theoretically be eventually reversed, there are two that definitely cannot be turned back once they occur: global nuclear holocaust and anthropogenic climate change. Although not an expert on climate, discussions with such individuals lead me to the conclusion that the human-induced climate disruption is already occurring, and that absent major changes in current human behavior and/or human intervention there is a very high probability of *irreversible* global catastrophic climate disruption before mid-century (Gilding, 2012; Gore, 2007, 2013; Guterl, 2012; Hansen, Sato, & Ruedy, 2012; Mann, 2012; Wallace-Wells, 2019), i.e., a “climate holocaust.” In other words, we are putting our children on an airplane with a very high probability of a catastrophic crash (McKibben, 2019; Rich, 2019). If this theory regarding the evolutionary origins of human reality denial is true, the first step to reversing the situation would seem to be a full awareness of our genetic tendency to reality denial by the media, and by our scientific and political leaders. Sadly, it is unlikely that rational discussion or scientific details will be sufficient to sway the average human to do what is right for the future of our species, let alone leaders who are focused on near-term political and economic goals. The only solution then may be “legitimate fear-mongering”! It is notable that it was such fear-mongering that once brought all the nations of the world together during

³ “*I cannot possibly believe that a false theory would explain so many classes of facts as I think it certainly does explain.....on these grounds I drop my anchor, and believe that the difficulties will slowly disappear.*”—Charles Darwin, letter to Asa Gray, shortly after *Origin of Species* was published.

the Cold War, to minimize the risk of a nuclear holocaust (Caldicott, 2017). The only other hope may be to combine fear with shame and guilt, imposed upon adult humans by adolescent school children, who can better imagine the dire future we are leaving them to face (Kjeldahl & Hendricks, 2019). As the 15-year-old Greta Thunberg said to the elites at Davos: “I want you to feel the fear I feel every day. And act as if your house is on fire. Because it is.” Of course, even if we manage to avoid catastrophic climate disruption, there are the other existential threats to our species that reality denial makes us prone to, such as widespread and indiscriminate applications of artificial intelligence (Müller, 2016) to the generation of “deep fake videos” (Stover, 2018) and other gross distortions of reality at a population-wide level. If this theory turns out to be the correct explanation for the origin of the species, it might ironically also be now sowing the seeds of our demise.

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⁴This work draws from a vast range of areas of human knowledge, most of which the author has limited expertise in. Thus, the citations are undoubtedly incomplete and very likely not always the best choices. The author also apologizes for the likely errors of omission and commission in the selection of the citations.

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