

An introduction to evolutionary psychology and its application to suicide terrorism

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This article introduces evolutionary psychology to a general readership, with the purpose of applying evolutionary psychology to suicide terrorism. Some of the key concepts related to evolutionary psychology are discussed, as well as several misconceptions associated with this approach to psychology. We argue that one of the primary, but insufficient, motivating factors for suicide terrorism is strong religious belief. Evolutionary psychological theories related to religious belief, and supporting empirical work, are described, laying a foundation for examining suicide terrorism. Several promising directions for future research on suicide terrorism from an evolutionary psychological perspective are highlighted, particularly within the theoretical framework of kin selection, and the implications of applying evolutionary psychology to suicide terrorism are discussed.

Keywords: evolutionary psychology; suicide terrorism; religion; kin selection

Introduction

Suicide terrorist acts, and the fatalities associated with such acts, have increased dramatically throughout the world over the last decade (Hronick, 2006). It is vital for researchers to redouble their efforts to understand why this behavior occurs, because with greater understanding comes the potential means to curtail its occurrence. Already several attempts have been made to identify systematic psychological features of suicide terrorists or to identify the psychological factors that give rise to acts of suicide terrorism (see Borum, 2004; Hoffman, 1999; Ross, 1996), but it is ultimately the architecture of our minds that makes such behavior a possibility. Our minds must be vulnerable to being convinced to put one's ideals – often the most powerful being religious ideals – above one's own life (Dennett, 2006).

Psychologists often attempt to explain mental phenomena through proximate causes; that is, through the immediate, salient reasons for a given phenomenon (see Workman & Reader, 2008). For instance, most of us find painful experiences highly unpleasant and go out of our way to avoid them. On the other hand, we tend to pursue enjoyable experiences, such as sex, with great zeal. We can account for such behaviors through physiological means, by describing how the nervous system responds to the respective phenomena of painful stimuli and sex. Or we can ask people why they avoid pain and pursue sex, reaching an obvious conclusion: sex feels good, and pain does not. Although such (admittedly oversimplified) proximate explanations are of interest and contribute to our understanding of human nature, they do not provide a

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full explanation. In other words, they do not account for why such behaviors exist in the first place. Why do we feel pain at all? Why are we so motivated to pursue sex?

The answer lies in that blind, unconscious, omnipresent driving force behind biological diversity on earth: natural selection. Only by looking at the mind as a product of natural selection can we arrive at a full explanation, and once we do, we can gain a greater understanding of human behavior. The pleasure derived from sexual behavior, as well as the pain derived from various harmful stimuli, is a result of specific pieces of cognitive architecture that we have inherited from our ancestors. Our ancestors are those individuals who responded to stimuli in a way that made them more likely to survive and reproduce than their conspecifics, on average. The cognitive architecture that made those responses possible, whether it be responding to sex with pleasure or to harmful stimuli with pain and avoidance, were then selected for and eventually became 'universal' characteristics of the species. An evolutionary approach to psychology can thus do much more than merely catalog psychological phenomena and describe which conditions give rise to particular mental states; it can account for why such mental states and behavioral proclivities exist in the first place.

There is no reason in principle why this approach cannot be extended to the topic of suicide terrorism, and even terrorism in general. Whatever the proximate causes of such behavior, there must be underlying evolved mechanisms that open these behaviors up to the realm of human possibility. The purpose of this article is to explore just this possibility by introducing evolutionary psychology to a general readership and explaining how such an approach is valuable to understanding suicide terrorism.

We argue that one of the primary, if not the most important, motivating factors underlying the occurrence of suicide terrorism is religious belief. Although we are not suggesting that *all* suicide terrorism is necessarily religiously motivated, there is significant overlap between suicide terrorism and religion, in that the vast majority of those who commit suicide terrorism espouse strong religious beliefs (see Pedahzur, Perliger, & Weinberg, 2003; Weinberg, Pedahzur, & Canetti-Nisim, 2003), often of a fundamentalist or extremist nature, most notably Islamic (Harris, 2004). This overlap suggests that understanding the evolutionary psychology of religion can provide a useful foundation for exploring the evolutionary psychology of suicide terrorism. Therefore, after describing the fundamentals of evolutionary psychology and redressing several of the misconceptions that have hampered its appeal, the second half of this article explores how evolutionary psychology is beginning to penetrate the root causes of religion and tentatively extends the current theories on religion to the phenomena of suicide terrorism. Lastly, this article will discuss several promising directions for studying suicide terrorism from an evolutionary psychological perspective.

A primer on evolution

An understanding of evolutionary psychology requires familiarity with the basics of evolutionary theory. Many excellent introductions to evolution exist to which the reader may refer (see Coyne, 2009; Dawkins, 2009; Dennett, 1995; Mayr, 2001). Nonetheless, it is helpful to give a brief overview that will lead us into the subject of this article.

There are three conditions that need to be met for evolution to give rise to the complexity and variety of organisms we see today: in a given population of reproducing organisms, so long as there is variation of traits, heritability of these variations and

a non-random impact of these variations on survival and reproduction, evolution by natural selection will occur (Darwin, 2006/1859).

The first component is variation. If we consider any population of sexually reproducing organisms, we will note that not every member of that species is identical; differences in coloration, size and a plethora of other traits that may or may not be easily perceived are always present. These differences result from the recombination of parent DNA in offspring, and from the occasional mutation of DNA. The key point is that, without variation, there would be nothing available for natural selection to 'select'.

The second component is heritability. Even with variation in a population, if these variations are not passed down from parents to offspring with relatively high fidelity, natural selection cannot operate. Fortunately, the 'recipe' for most of an organism's characteristics is supplied by the DNA inherited from its parents, and the replication of DNA during meiosis is a process marked by exceptionally high fidelity.

The third component of biological evolution is differential survival. There is a struggle for existence, and not every organism is successful at surviving and reproducing. Heritable variation acts as a non-random determinant of which organisms will succeed. Over thousands of generations, inherited traits that promote greater survival and reproductive success will accumulate, whereas alternative traits that are less favorable vanish from the gene pool. This is natural selection, the primary mechanism by which evolution occurs.

A key product of natural selection is adaptation – a characteristic reliably inherited from parents that aids an organism in survival and reproduction. However, organisms do not comprise entirely adaptations. In addition to adaptations, organisms may have features that are considered byproducts or noise (Buss, Haselton, Shackelford, Bleske, & Wakefield, 1998). A byproduct is a characteristic that exists because it is an incidental consequence of an adaptation. Researchers have noted many examples of byproducts. The whiteness of bones, for instance, is not an adaptation but a byproduct of the build-up of calcium, an adaptation designed to produce bones that are not easily broken (Buss et al., 1998; Symons, 1992). Noise, on the other hand, is not an adaptation or a byproduct of an adaptation, but refers instead to random changes in gene frequency that have no survival or reproductive impact on an organism.

These three products of natural selection are important to keep in mind when considering human psychology from an evolutionary perspective. However, before discussing the application of evolutionary psychology to religion and suicide terrorism, it is vital to have a solid understanding of what evolutionary psychology is, and what it is not.

Defining evolutionary psychology

Most of us are familiar with an overview similar to the preceding account, but the full implications of natural selection are often overlooked. It is not simply the case that arms and legs and eyes and ears were shaped by natural selection as tools for survival. Behavior is no less important to an organism's reproductive success, and its behavior must be suited to its environment. It is no coincidence that a tiger has a mind built for hunting prey and a deer has the mind of an herbivore. However, behavior is not like eyes or ears. The question arises as to how natural selection could select for variations in behavior when, after all, genes are recipes for building a body, and a behavior is not a physical structure you can build with the right combination of proteins.

The answer to this question lies in the evolution of the brain, the organ that produces behavior. It is readily apparent how natural selection can favor genetic variants that have a direct impact on the structure of an organism's bones or the color of its skin, but some adaptations are indirect. For instance, Gaulin and McBurney (2001, p. 26) note that, 'selection can improve the efficiency of blood circulation only by improving the design of the circulatory organs such as the heart, arteries, and veins'. Natural selection likewise selects for behavior indirectly, by selecting for variation in the information-processing mechanisms of the brain.

Evolutionary psychology represents this application of evolutionary principles to the study of the human mind. Evolutionary psychology is not a particular subdiscipline or field of study within psychology, but an approach that can be applied to all areas of psychological research (Gaulin & McBurney, 2008; Tooby & Cosmides, 1992). For example, an evolutionary psychological approach has been used to investigate adaptations related to social behavior (Cosmides, 1989), learning (MacDonald, 2007; Weber & Depew, 2003), memory (McBurney, Gaulin, Devineni, & Adams, 1997) and perception (Rhodes, 2006). Thus, the application of evolutionary principles to the study of the mind is not limited to a specific subject; all aspects of human cognition are potentially explained by the structure and function of the evolved mechanisms of the mind.

Two key concepts that guide an evolutionary approach to psychology are the environment of evolutionary adaptedness (EEA) and evolved psychological mechanisms (EPMs). The implications of these key concepts – which are discussed below – grate against what has been dubbed the 'standard social science model', or SSSM (Tooby & Cosmides, 1992). It is instructive to briefly highlight this shift in approach to the mind inspired by evolutionary science before tackling the key concepts that distinguish an evolutionary psychological approach from other psychological perspectives.

A new paradigm

Pinker (2002) notes that the mind has long been regarded as a sort of blank slate, void of content prior to its first experiences. According to this view, it is experience that molds and shapes the mind to suit its environment. With the advent of computer technology, this blank slate model evolved into a conception of the mind as a sort of general-purpose computer (Tooby & Cosmides, 1992). The mind was regarded as a device with a few basic processing principles that guided it in sorting out the content of experience. According to this perspective, the ways we process information about the world, whether it is language or morals, customs or relationships, all draw on the same content-independent, domain-general cognitive mechanisms.

Evolutionary psychologists have abandoned the SSSM. Over the past few decades, the confluence of data streaming in from cognitive science, biology and neuroscience has given way to a new paradigm in psychology (Pinker, 2002; Tooby & Cosmides, 1992). Evolutionary psychologists have adopted a modular view of the mind, seeing the mind as possessing distinct modules, or information-processing mechanisms, selected for processing particular types of input and generating particular types of output (Fodor, 1983). Rather than viewing the mind as a single, general-purpose organ, the mind is more accurately described as a set of organs, each with its own evolutionary history and its own specialized function. Different selection pressures caused the evolution of distinct cognitive solutions to adaptive problems, a principle known as functional specialization.

Evolved psychological mechanisms

Evolutionary psychologists maintain that the mind comprises primarily domain-specific mechanisms, although a few scholars have argued that one or a few relatively more domain-general mechanisms also might exist (see MacDonald, 1991). Whatever the extent to which modularity applies to the human mind, we can note several characteristics to describe most evolved mechanisms that comprise human nature. Buss (2004) sums up the features of an evolved psychological mechanism (EPM):

- (1) An EPM exists in the form that it does because it solved a specific problem of survival or reproduction recurrently over evolutionary history
- (2) An EPM is designed to take in only a narrow slice of information
- (3) The input of an EPM tells an organism the particular adaptive problem it is facing
- (4) The input of an EPM is transformed through decision rules into output
- (5) The output of an EPM can be physiological activity, information to other psychological mechanisms, or manifest behaviors
- (6) The output of an EPM is directed toward the solution to a specific adaptive problem. (pp. 50–52)

For example, consider how a specific module for detecting and inducing fear of snakes would fit the above criteria. First, such an adaptation would clearly solve a specific problem of survival: avoiding dangerous environmental stimuli. Second, a module for detecting dangerous organisms may indeed take in only a limited type of information – it may induce us to pay special attention to serpentine forms and to motivate a fear response only towards a specific type of phenomena: perception of snakes. The third and fourth criteria are also met, in that the input – sensory processing of a snake or something snake-like – provides the organism with the information to produce a response appropriate to that particular input based on the adaptive problem that mechanism evolved to solve, which in turn activates a particular decision rule: fear and increased attention to the stimuli. The outcome of detecting a snake meets the final criteria, as the evolved mechanism for fear of snakes induces us to take action to remove ourselves from the danger, clearly a physiological response evolved to preventing bodily harm.

It turns out that we do appear to possess an innate predisposition for noticing and fearing snakes, but we do not seem to possess a similar aversion to other dangerous stimuli, such as cars or guns (Hagen, 2005; Öhman & Mineka, 2001). The apparent incongruity that arises from this fact is that modern hazards pose a more serious threat to many of us than do snakes. The solution to this dilemma is that snakes were a part of our ancestral environment for a long enough time to exert sufficient selection pressures to produce such a fear module, whereas relatively novel aspects of our environment, such as cars, simply have not had sufficient time or selective impact to drive natural selection to build a module for fearing and avoiding them. This solution is clarified by describing a second key concept of evolutionary psychology, the environment of evolutionary adaptedness.

The environment of evolutionary adaptedness

The importance of identifying the relevant features of the environment of evolutionary adaptedness (EEA) for humans cannot be overstated. To generate testable hypotheses

about what mental tools we should expect humans to have, we must know something about the conditions under which our ancestors evolved. However, the EEA does not refer to one specific habitat or time period. Rather, it represents, ‘a statistical composite of the adaptation-relevant properties of the ancestral environments encountered by members of ancestral populations, weighted by their frequency and their fitness-consequences’ (Tooby & Cosmides, 1990, pp. 386–387; see also Cosmides & Tooby, 1994; Daly & Wilson, 1999). For any given adaptation, there was a particular set of selection pressures to which that adaptation arose as a solution. The conditions that gave rise to one adaptation will differ from those that gave rise to another, and thus the EEA of each adaptation will differ. For instance, an organism having both a shell and an acute sense of smell would likely have evolved these adaptations under different circumstances and for different reasons. Its ancestors may have evolved a keen sense of smell to locate food, but evolved their shells to protect them from predators. Mental modules arose in the same way. A mental module for preferring specific foods would evolve under different circumstances and solve a different adaptive problem than a mental module for detecting whether someone is cheating in a social context.

Hagen (2005) points out that, ‘[E]nvironments change, so the causal structure of the environment an adaptation finds itself in may not correspond to the causal structure the adaptation evolved in, and therefore the adaptation may not work as designed’ (p. 8). This leads us to an important observation: given the plodding pace of evolution by natural selection, the mechanisms our minds possess took a crushingly long time to evolve, and for the vast majority of this time, we lived in small tribes of nomadic hunter-gatherers (Pinker, 2002; Tooby & Cosmides, 1992). Several evolutionary psychologists (e.g. Pinker, 2002) have described modern humans as being stuck with a Stone Age mind which underwent much of its evolution in hunter-gatherer tribes under conditions that persisted over many millions of years, but which in many respects differ from our modern environment (Hagen, 2008). However, despite the slow pace of natural selection, we should not jump to the conclusion that the EEA for most human adaptations differs dramatically from the contemporary environment (Hagen, 2005). Although some aspects of our modern environments do differ from features of our ancestral environments, most of the adaptations we possess are likely to be operating as they were designed to operate. If they did not, and were our environments to have changed dramatically and rapidly from our ancestors, Hagen (2008) points out that we would probably be headed towards extinction:

The human species is clearly not going extinct; hence the common belief that [evolutionary psychology] claims humans currently live in an entirely novel environment is incorrect. Most aspects of the modern environment closely resemble our EEA. Hearts, lungs, eyes, language, pain, locomotion, memory, the immune system, pregnancy, and the psychologies underlying mating, parenting, friendship, and status all work as advertised – excellent evidence that the modern environment does not radically diverge from the EEA. (p. 154)

Evolutionary psychologists do not maintain that current environments are ‘entirely novel’, and Hagen (2005) notes the many functional similarities between the ancestral past and the present. However, it does appear that until a few thousand years ago, our ancestors lived similarly to modern day hunter-gatherer tribes. Modern life in developed countries may be similar to the environments of our ancestors in many fundamental ways, but we cannot ignore the differences that exist. Modern technology, for

example, now provides many humans with environmental input that did not exist for the majority of our history as a species. Because the information-processing mechanisms of the brain function by responding to environmental input, it is important to consider contemporary environments and the novel ways in which they may interact with evolved psychological mechanisms.

The concepts of EPMs and EEAs, although fundamental to evolutionary psychology, represent only a portion of the major tenets related to this approach to human behavior. However, rather than simply continue to describe what evolutionary psychology *is*, we believe it is useful to round out our description of evolutionary psychology by describing what it *is not*, particularly by highlighting and correcting some of the major misconceptions associated with an evolutionary psychological approach to human behavior.

Myths, misconceptions, and misrepresentations of evolutionary psychology

Despite phenomenal growth in evolutionary psychology, this perspective has continued to be plagued by misconceptions and misrepresentations. An exhaustive response to these criticisms is beyond the scope of the present article, and there are already numerous responses that address the majority of these criticisms (see Buss, 2004; Geher, 2006; Hagen, 2005; Kurzban, 2002; Liddle & Shackelford, 2009; Sell, Hagen, Cosmides & Tooby, 2003; Workman & Reader, 2008). However, an audience new to an evolutionary approach to psychology might be put off by many of these common misunderstandings, and a brief overview will serve to put such misunderstandings aside.

Misconception 1: evolutionary psychology is panadaptationist

One charge leveled against evolutionary psychologists is that they regard every aspect of behavior as an adaptation, and have failed to acknowledge the importance of other sources of genetic change (Gould, 2000). This claim is false. Evolutionary psychologists have made a point of explicitly noting that evolution does not only lead to the production of adaptations, but also results in the accumulation of byproducts and noise (Kurzban, 2002 provides a copious list of evolutionary psychologists stating this).

However, what makes this claim so obviously mistaken is that there are so many examples of evolutionary psychologists explicitly proposing and testing byproduct hypotheses. Symons (1979) speculated 30 years ago that the human female orgasm is a byproduct of an adaptation (namely, male orgasm). Other examples include Thornhill and Palmer (2000) arguing that the predisposition for rape is a byproduct of the male sex drive, Pinker (1994) maintaining that music is a byproduct of language and that art is a byproduct of habitat selection, and Dawkins (2006) speculating that religion is a byproduct of evolved mechanisms that arose to solve adaptive problems unrelated to a religious predilection. Not only do evolutionary psychologists acknowledge the presence of byproducts, their published works are saturated with references to them (see Buss, 2005).

Misconception 2: evolutionary psychology is unscientific

Another pair of criticisms frequently aimed at evolutionary psychology is that it consists of little more than *ad hoc* storytelling, and that it is based on untestable,

unfalsifiable speculation over unknown details of our evolutionary past. Both of these criticisms are based on the argument that we know too little about the relevant features of ‘the’ EEA to make verifiable claims about the evolved architecture of the mind. For instance, Gould (2000) has asked, ‘how can we possibly obtain the key information that would be required to show the validity of adaptive tales about the EEA ... we do not even know the original environment of our ancestors’ and goes on to insist that, ‘the key strategy proposed by evolutionary psychologists for identifying adaptation is untestable and therefore unscientific’ (p. 120; originally quoted in Kurzban, 2002; Kurzban also cites other examples of similar charges, such as Benton, 2000, p. 262).

There are several problems with these criticisms. First, Sell et al. (2003) note that the charge of generating *ad hoc* hypotheses is inconsistent with how evolutionary psychologists have actually conducted research. Rather than attempting to find suitable explanations for previously acknowledged facts, evolutionary psychologists have tended to generate hypotheses for the purpose of discovering new facts. For instance, evolutionary psychologists hypothesized that men would experience greater distress over a romantic partner’s sexual infidelity than emotional infidelity, whereas women would experience greater distress over a partner’s emotional infidelity than sexual infidelity (Daly, Wilson, & Weghorst, 1982; Symons, 1979). Rather than conjuring an explanation for an already recognized fact of human psychology, this research discovered the existence of a previously unknown sex difference in human psychology.

Second, the charge that we know too little about ‘the’ EEA (as noted above, there are as many EEAs as there are adaptations) to generate anything more than armchair theories seems to be based on the misconception that an EEA is substantially different from today’s environment and that it is more mysterious than the crucial historical assumptions that permeate other fields, such as physics, geology and biology (Sell et al., 2003). We may not know much about the specific details of the evolutionary history of humans, but the notion that we know too little to generate hypotheses is not defensible in light of the rather modest assumptions evolutionary psychologists actually make to generate and test hypotheses. Hagen (2005) notes that the physical and chemical laws which govern the universe were the same, the ecological and geographical features of the world were the same insofar as the landscape was dotted with trees, caves, hills and lakes, and populated with similar types of plants, animals and pathogens. Likewise, important sociological phenomena were similar insofar as there were men and women who lived in family groups that consisted of parents, siblings, offspring and people of varying ages and relatedness.

If these details seem insufficient to allow for the generation of defensible evolutionary hypotheses, Hagen (2005) comments: ‘We know that in ancestral environments women got pregnant and men did not. This single fact is the basis for perhaps three-quarters or more of all [evolutionary psychology] research’ (p. 156). In other words, women must heavily invest in individual offspring – they must carry a child to term and nurse it afterwards – whereas men do not, and this disparity alone has generated numerous hypotheses about how men and women interact with one another that have been tested and confirmed (Buss, Larsen, Westen, & Semmelroth, 1992; Buss et al., 1999; Camilleri & Quinsey, 2009; Goetz & Causey, 2009; Hughes, Harrison, & Gallup, 2004; Miller & Maner, 2008; Stieger, Eichinger, & Honeder, 2009; Stone, Goetz, & Shackelford, 2005; Wiederman & Kendall, 1999). The bottom line is that evolutionary psychology is no less capable of generating testable hypotheses than any

other scientific approach, and contrary to the claims of critics, we in fact know a great deal about the *relevant* aspects of our evolutionary past.

Misconception 3: evolutionary psychology implies determinism

One of the most frequent criticisms of evolutionary psychology is that it implies genetic determinism (Nelkin, 2000; Rose, 2000; Shakespeare & Erikson, 2000). Genetic determinism is the view that all behavior is determined by our genes, and that free will or the environment play little if any role (Buss, 2004). Evolutionary psychology implies no such thing. This misunderstanding is particularly worrisome because it continues to resurface in unexpected places, such as Jerry Coyne's book *Why evolution is true* (2009). Coyne's otherwise masterful marshalling of evidence for evolution is diminished by his critique of evolutionary psychology, which he opens by asking, 'So if our evolution as social apes has left its imprint on our brains, what sorts of human behavior might be "hardwired"?' (p. 226).

The misunderstanding Coyne displays is a simple but important one. Evolutionary psychologists do not claim that behavior is hardwired. Rather, they contend that natural selection has shaped numerous information-processing mechanisms which interact with input (e.g. the environment) to produce behavior (Liddle & Shackelford, 2009). Hagen (2005) notes that, even if the structure of these mechanisms was genetically determined, this would not imply that *behavior* is genetically determined. Evolutionary psychology takes an interactionist approach, which requires two criteria to be met to produce a particular behavioral output: (1) a module for processing particular kinds of input, and (2) appropriate environmental stimuli to activate that module (Buss, 2004).

Thus, contrary to the claim that evolution has shaped brains that produce fixed, rigid behaviors 'hardwired' by our genes, evolutionary psychologists maintain that we possess a set of richly context-dependent modules that produce behavior contingent on environmental variables. Indeed, not only does evolutionary psychology not imply genetic determinism, its most prominent proponents have repeatedly and explicitly rejected genetic determinism, insisting that by ignoring the necessary interaction between genes and the environment, genetic determinism is not only false but also nonsensical (Kurzban, 2002).

With these misconceptions of evolutionary psychology set aside, we can turn our attention to putting the evolutionary psychological approach into practice and examining religious belief and behavior. Because we argue that religion is an important motivating factor for suicide terrorism, it is important to illustrate how evolutionary psychology can enhance our understanding of religious belief and behavior in general, thus paving the way for an evolutionary examination of suicide terrorism.

The evolution of religion

Religion is by no means a new topic of study within psychology (see James, 1902), and applying evolutionary theory to religious belief and behavior can be traced to Darwin (2006/1871) himself, who proposed that, 'The same high mental faculties which first led man to believe in unseen spiritual agencies, then in fetishism, polytheism, and ultimately in monotheism, would infallibly lead him ... to various strange superstitions and customs' (p. 816). However, despite Darwin's laudable prescience of applying evolution to the 'mental faculties' of religious belief, an evolutionary

psychological approach to religion is relatively novel and has only begun to gain momentum over the last decade.

Although there is much empirical work left to be done, the current consensus among many evolutionary psychologists and other researchers approaching religion from this perspective is that religion originated as a byproduct resulting from the interaction of several evolved psychological mechanisms, and with that initial foundation interacting with cultural evolution, religion has become what it is today (Atran, 2002; Bering, 2005; Boyer, 2001). One such psychological mechanism is the ‘hypersensitive agent detection device’, or HADD, which was proposed in large part by Guthrie (1993), although the term was coined by Barrett (2000, 2004), who also expanded upon the idea.

Humans have a tendency to detect agency in the environment even when none exists, and Guthrie (1993) hypothesized that this behavioral predisposition could have an evolutionary basis. For the majority of human evolutionary history, predators were a real threat, and successfully detecting predators meant the difference between life and death. However, our ancestors probably had to interpret ambiguous environmental stimuli often (e.g. hearing a noise in the brush). Given ambiguous stimuli, those who made a false-positive error suffered a much smaller fitness cost compared with those who made a false-negative error. In other words, misinterpreting a harmless, natural noise in the brush for a predator would at most result in wasted energy escaping from an imaginary foe, whereas misinterpreting a real predator for a harmless noise could lead to severe injury or death. Therefore, a selection pressure probably existed for hypersensitive agency detection, because those who made false-positive errors were more likely to survive and reproduce than those who made false-negative errors.

Several researchers have demonstrated that adults have a strong tendency to detect agency, even when none exists (Berry, Misovich, Keen, & Baron, 1992; White and Milne, 1999; also see Boyer, 2001 and Scholl & Tremoulet, 2000 for a review), and there is an extensive developmental literature suggesting that this tendency emerges in infancy (Bering, 2005; Gergely & Csibra, 2003; Hamlin, Wynn, & Bloom, 2007; also see Atran, 2002, for a review). This psychological mechanism may have laid the foundation for religious belief, with people predisposed to posit supernatural agents (e.g. ghosts, spirits, gods) for certain classes of ambiguous stimuli. However, this mechanism by itself is not enough to explain the existence of complex religious beliefs.

Belief in supernatural agents may emerge as a byproduct of the HADD, but this does not explain the characteristics bestowed upon such agents by those who believe in them. In further support of the byproduct hypothesis of religious belief, it has been proposed that the design of our memory system plays an important role. More specifically, Boyer (2001) suggests that people are particularly susceptible to remembering what Barrett (2004) has labeled ‘minimally counterintuitive’ (MCI) concepts, and that supernatural agents are examples of such concepts. MCIs can be succinctly described as concepts in which a relatively small number of assumptions are violated, thus grabbing our attention (see Barrett, 2004, for a detailed description). However, not all MCIs are equally memorable. After conducting several experiments to determine the degree of recall among concepts of varying counterintuitiveness, Boyer (2001) explains:

Barrett and I also found that violations of *ontological* expectations – as found in the templates for supernatural concepts – are recalled better than what we called ‘mere

oddities.' For instance, 'a man who walked through a wall' (ontological violation) was generally better recalled than 'a man with six fingers' (violation of expectations, but not of those expectations that define the ontological category PERSON). (p. 80, italics and capitalizations in original)

Additionally, these experiments found that concepts with too many assumptions violated were not recalled as well as MCIs, a finding that was replicated by Barrett and Nyhof (2001). Boyer and Ramble (2001) have even provided cross-cultural support for these recall tendencies.

In summary, a condensed description of the byproduct account of religious belief focuses primarily on the HADD and MCIs. Supernatural agents arise as a byproduct of the HADD, and the specific characteristics of supernatural agents persist in a given society because they were the easiest to remember, because one byproduct of our memory systems is the susceptibility to MCIs. However, not all researchers studying religion from an evolutionary perspective agree with this byproduct account, and so it is only fair to provide a brief review of adaptationist hypotheses for religious belief.

Wilson (2002) has proposed that religion may be an adaptation because throughout our evolutionary history, religious beliefs allowed groups to function more successfully and 'out-compete' groups that did not hold religious beliefs. Wilson is an advocate of group-level selection, which suggests that, in addition to operating at the level of individuals, natural selection can operate at the level of groups. Group-level selection was powerfully, and many would argue decisively, refuted by Williams (1966), and the current consensus among evolutionary researchers is that group-level selection is highly unlikely except under very specific and rare circumstances. Also, Wilson provides little empirical support for his claims, and until such empirical support is provided by Wilson or others, group-level selection will probably remain a minority view.

Some researchers have proposed that religious belief, especially church attendance, may have a positive effect on one's health (Koenig & Vaillant, 2009; Koenig et al., 1999; McCullough & Larson, 1999; McCullough, Larson, Hoyt, Koenig, & Thoresen, 2000), which would seem to support the view that religion has adaptive qualities. However, despite the positive relationships that have been found, these researchers have properly acknowledged the possibility of alternative explanations, such as one's health benefiting from the feeling of belonging and acceptance in a tight-knit group, feelings which are not exclusive to religious organizations. For example, Park, Fenster, Suresh and Bliss (2006) have written about the importance of general social support in facilitating positive adjustment in chronic illness populations, and they have provided evidence that social support is a significant predictor of decreased feelings of depression for those suffering from congestive heart failure (CHF). Furthermore, Murberg and Bru (2001) have shown that the perceived social isolation of patients with CHF is a significant predictor of mortality. On the other hand, positive relationships between church attendance and health have been found even after controlling for social connection variables (Koenig et al., 1999). Nevertheless, this does not address whether people belonging to certain *non*-religious groups might benefit in similar ways. Although manipulating religiosity or church attendance is not feasible, additional research must be conducted to determine whether these health benefits result from factors that are exclusive to religiosity, or if these factors exist in other contexts.

Arguably the most compelling adaptationist account of religion suggests that religious belief leads to a greater degree of prosocial, or cooperative, behavior within groups (Alcorta & Sosis, 2004; Bering, McLeod, & Shackelford, 2004; Bulbulia, 2004; Purzycki & Sosis, 2009). Although this could be interpreted as group-level selection, it could also apply to selection at the level of individuals, because individual members of a prosocial group will, on average, benefit from these prosocial tendencies. A review of the literature on religious belief and prosociality by Norenzayan and Shariff (2008) led the authors to conclude that religious belief does indeed increase prosocial behavior, but that this increase is highly context-sensitive. Specifically, religious individuals are more likely to exhibit prosociality toward other members of their group than to 'outsiders'. Also, the increase in prosocial behavior occurs primarily when the situation can affect one's social reputation in the group. Finally, increased prosociality is not reliably observed unless one's religious beliefs, particularly those regarding a morally concerned deity, are cognitively salient at the moment when prosocial behavior is possible. Taken together, these results suggest a possible adaptive role for religious belief, but they do not eliminate the possibility of religion as a byproduct. Perhaps religious belief can be best described as an exaptation (Gould, 1991; Buss et al., 1998), originally a byproduct of the HADD, our memory system and other psychological mechanisms, and eventually serving the adaptive function of facilitating cooperation among individuals in a group.

Finally, it is worth mentioning memetics, which is another evolutionary approach to understanding religious beliefs, but does not neatly fall into the category of byproduct or adaptation. Dawkins (1976) coined the term 'meme' and suggested that ideas, or memes, may 'evolve' in a way analogous to genes. Ideas can be thought of as competing with one another for residence in the minds of people, and those ideas that are most successful at being remembered will survive, get passed on and possibly change (i.e. evolve) over time. Since its inception in 1976, memetics has been expanded upon by several authors (Blackmore, 1999; Brodie, 2009), and has been discussed explicitly in reference to religion by Dennett (2006). However, at this stage memetics is still a speculative, and controversial, approach to understanding cultural evolution and the spread of ideas (see Aunger, 2001). Nevertheless, Fincher and Thornhill (2008) have provided some indirect support for the memetic perspective in their examination of the degree of religious diversity throughout the world as it relates to pathogen prevalence. Fincher and Thornhill hypothesized, and found, that pathogen prevalence is positively correlated with religious diversity. Although they were not conducting this research from a memetic perspective, their results make sense within a memetic framework. If high pathogen stress limits contact between groups, there is less direct competition between different religious beliefs, which means that these different beliefs will continue to survive. Conversely, low pathogen stress translates into greater cultural transmission, which leads to competition between beliefs, and only the 'fittest' beliefs survive.

As we have shown here, an evolutionary psychological perspective has generated many interesting hypotheses regarding religious belief, and these hypotheses will undoubtedly be refined as additional empirical work is done. We can now turn our attention to how such a perspective can be used to examine suicide terrorism.

Applying evolutionary psychology to suicide terrorism

Like religion, suicide terrorism has been studied extensively from a psychological perspective (see Bongar, Brown, Beutler, Breckenridge, & Zimbardo, 2007; Stern,

2003). However, the focus of this research has largely been to determine and understand the proximate causes of suicide terrorism. Although this research is important, we argue that the addition of an evolutionary psychological perspective has the potential to increase our understanding of terrorism, in general, and of suicide terrorism in particular, by explaining why the propensity for such behavior exists in the first place.

We argue that religious belief is a primary factor in the occurrence of suicide terrorism, yet it is necessary to clarify this argument before attempting to link evolutionary psychological theories of religion to suicide terrorism. We are *not* arguing that religiosity is a strong predictor of suicide terrorism, since the number of religious people in the world vastly outnumbers those willing to engage in suicide terrorism. However, there are certain religious beliefs that may facilitate such willingness (e.g. belief in the afterlife, endorsement of martyrdom, viewing one's in-group as 'the chosen people', the vilification of heretics and nonbelievers). Therefore, although religiosity may not positively predict one's willingness to engage in suicide terrorism, the *lack* of religiosity (i.e. the lack of certain specific religious beliefs) should predict one's *unwillingness* to engage in suicide terrorism.

We are not the first to propose a link between religious beliefs and terrorism (Dawkins, 2006; Harris, 2004; Stern, 2003), but there is a lack of strong empirical data supporting this link. At the same time, data provided to disconfirm this link (Ginges, Hansen, & Norenzayan, 2009) is, as of yet, unconvincing (Liddle, Machluf, & Shackelford, 2010). People may point to the Liberation Tigers of Tamil Eelam, or the Tamil Tigers, as a disconfirmation of the link between religion and suicide terrorism, since they are recognized as a secular organization. However, this label does not provide us with information about the specific beliefs of Tamil Tigers who are willing to commit acts of suicide terrorism. One can maintain supernatural beliefs without belonging to an organized religion (Zuckerman, 2008), and unless we can determine that the majority of Tamil Tigers willing to commit suicide terrorism lack the beliefs that are likely to facilitate such terrorism (e.g. belief in the afterlife), the secular identity of the organization as a whole is not a convincing argument.

As it stands, the direct link between specific religious beliefs and one's willingness to engage in suicide terrorism is open for debate, since there is no evidence strong enough to effectively confirm or disconfirm this hypothesis. Nevertheless, the theories of religion outlined earlier provide a useful illustration of the application of evolutionary psychology, and the same principles of evolutionary psychology that have begun to demystify religious belief can be applied to the issue of suicide terrorism.

As with religious belief, an evolutionary psychological perspective requires us to consider whether suicide terrorism is produced by specialized psychological adaptations or is a byproduct of other psychological mechanisms. Although at first glance such behavior would appear maladaptive, primarily because of the forfeit of one's life in the process, there are promising adaptationist hypotheses worth considering. Perhaps the most promising hypothesis is that such behavior can be maintained via kin selection.

The theory of kin selection, originally proposed by Hamilton (1964), explains how traits that are not necessarily beneficial to an organism can nevertheless be selected for. This apparent contradiction is eliminated when one switches their focus from the *individual* to the *gene*. A trait that is harmful to an individual can be selected for if it is sufficiently beneficial to the individual's relatives, because from the gene's perspective, the harm is offset by the benefits to others who are likely to carry the

same gene. The use of this theory by evolutionary psychologists has been particularly helpful in providing a partial explanation for altruistic behavior (see Buss, 2004). Although altruistic behavior often entails a cost to the altruist, the psychological mechanisms that allow such behavior to occur can be selected for if the behavior is directed toward genetic relatives. The genes for altruism are likely to survive even if the altruist suffers, because those same genes are likely to be carried by the altruist's relatives who benefit from the behavior.

In terms of suicide terrorism, it is possible that such behavior persists because it provides benefits to the relatives of terrorists (Victoroff, 2009). Pedahzur et al. (2003), when examining the demographics of Palestinian suicide terrorists, concluded that these terrorists had few 'family ties' because 84.2% of their sample consisted of bachelors. However, 81% of these terrorists came from families with at least eight members (Blackwell, 2005). Therefore, even though the majority of these terrorists were seemingly unsuccessful in passing on their genes *directly*, their large families of genetic kin provided an ample opportunity for kin selection to take place, if their kin benefited from the act of suicide terrorism. In addition to the increased status and honor bestowed upon the families of these Palestinian suicide terrorists, these families have been paid between \$10,000 and \$25,000 by Hamas, spread out in monthly stipends of roughly \$1000 (Blackwell, 2005). Given the benefits bestowed upon the genetic kin of these suicide terrorists, and the large number of genetic kin in place to receive such benefits, the seemingly maladaptive act of suicide terrorism can prove to be adaptive through the action of kin selection. Although these data do not refer to *all* acts of suicide terrorism, they provide support for kin selection as a driving force behind Palestinian suicide terrorism, suggesting that a similar driving force may exist in other regions.

Whereas kin selection theory provides an adaptationist explanation for suicide terrorism, the same theory can also provide a useful foundation for considering byproduct explanations. One possibility is that, in cases in which genetic kin do not benefit from such terrorist acts, the same psychological mechanisms geared toward helping kin are 'hijacked'. In much the same way as altruism toward strangers may be produced by misfiring of mechanisms designed to benefit relatives, suicide terrorism may sometimes be triggered by feelings toward one's group (i.e. terrorist organization or religious sect), despite the lack of genetic relatedness. In other words, one's group may be considered 'fictive kin', leading to the unconscious activation of mechanisms that generate behavior normally geared toward benefitting genetically related kin.

Indeed, organizations that recruit individuals to carry out suicide terrorism promote feelings that are likely to lead to a misfiring of kin selection mechanisms. As Goetze and James (2004) describe:

The small, terrorist cell serves as a meaningful substitute to family and it is not surprising that members end up forming strong emotional bonds with each other as well as the typical sacrificial inclinations of close family. Leaders of terrorist organizations cultivate and manipulate these emotional bonds and steer their expression toward political goals of the terrorist organization. (p. 155)

Furthermore, data on 39 recruits to an organization allied with Al-Qaeda indicate that, 'All believed that by sacrificing themselves they would help secure the future of their "family" of fictive kin' (Atran, 2003, p. 1537). In addition to terrorist organizations, religious sects of would-be suicide terrorists are also prime suspects for the misfiring of kin selection mechanisms. Many religious belief systems, such as Judaism, Islam

and Christianity, rely heavily on terminology often reserved for genetic kin (Atran, 2002). In short, the idea of suicide terrorism resulting from the misfiring of psychological mechanisms deserves further empirical attention, because discovering the factors that contribute to these misfirings can help guide actions to prevent or reverse such effects.

For kin selection mechanisms to motivate suicide terrorism, whether these mechanisms are activated by expected benefits to genetic kin or fictive kin, the benefit to the survival and reproduction of one's kin must outweigh the costs to oneself. This provides another opportunity for religious beliefs to play a role in facilitating suicide terrorism. Without the belief that one's life continues after death (and the belief that martyrdom will be rewarded in the afterlife), the largely unconscious cost-benefit calculation that motivates kin selection-related behaviors would probably motivate the would-be terrorist to not follow through with a suicide act. Life after death, particularly a life of rewards in paradise for eternity, might play a large role in offsetting the costs associated with suicide terrorism, thereby 'tipping the scale' in favor of the expected benefits to one's kin. In short, even with expected kin benefits, specific religious beliefs may be a vital, but insufficient, motivating factor for suicide terrorism.

Speaking of beliefs, it is possible that, as with religion, memetics can shed light on the phenomenon of suicide terrorism. It may be the case that suicide terrorism persists because the ideas and beliefs that terrorist organizations and certain religious sects disseminate to their followers 'parasitize' the brain. As Pedahzur et al. (2003) describe, 'In a society where honor is among the highest virtues, there are indeed powerful social pressures lying behind the suicide bomber's decision' (p. 420). The 'virtues' of groups that foster terrorist activity can be considered memes, with the terrorist acts serving to benefit and propagate those memes. More specifically, the belief of everlasting life in paradise can be an extremely powerful meme, which is possibly one of the main reasons that suicide terrorism is so often performed by individuals with strong religious beliefs. It is clear that a terrorist's beliefs are a crucial component when attempting to explain their actions, and it is possible that these beliefs can be better understood within a memetic framework.

For example, often when confronted with stories of Islamic suicide terrorism, Muslims are quick to explain these terrorists as twisting Islamic beliefs and misinterpreting the Quran. These explanations can take on a whole new meaning from a memetic perspective. The differential survival and replication of religious beliefs (memes) should be related to which beliefs are the most 'successful' in a given environment. Islamic beliefs that promote martyrdom, condemn heresy, apostasy and nonbelief, and highlight rewards in the afterlife for killing the 'enemies of Islam' will be emphasized by those who recruit, train, engage in or support suicide terrorism. Likewise, these beliefs will be de-emphasized by moderate Muslims, who will instead emphasize Islamic beliefs that promote peace and tolerance of those with different religious beliefs, and condemn acts of martyrdom. Both sets of beliefs can be found in the Quran (Harris, 2004), but moderate Muslims are right to distinguish 'their' Islam from the Islam promoted by terrorists. Asking whether Islam is a religion of peace or a religion of war is the wrong type of question to ask, and memetics can illustrate why: Islam, like other organized religions, is not a homogenous set of beliefs. It has evolved into several 'sub-species' of Islam, each with their own sets of core beliefs that can be traced back to a 'common ancestor' (i.e. the Quran). These sub-species are the result of different selection pressures, in that different groups

select, emphasize and transmit those beliefs that best suit their needs. By adopting a memetic perspective, we may gain a better understanding of how and why the Islam of suicide terrorists differs so widely from the Islam of moderates, and how the emphasis of different sets of core beliefs can influence the occurrence of suicide terrorism.

Directions for future research

We have provided the theoretical groundwork for thinking about suicide terrorism from an evolutionary psychological perspective, but such an endeavor is only useful if it can open up new avenues of empirical study. We now provide some examples of how an evolutionary psychological approach to suicide terrorism can be applied to future research.

As mentioned earlier, kin selection may be a motivational force in suicide terrorism. Given the data on Palestinian suicide terrorists and the benefits received by their genetic kin (Blackwell, 2005), a next step would be to investigate whether genetic kin receive similar benefits in other populations in which suicide terrorism takes place. Are the majority of suicide terrorists in other populations bachelors? Do these individuals come from large families? Do their kin receive monetary rewards or improved status after the terrorist act? If so, do the monetary rewards or increases in status correlate with the degree of relatedness (i.e. parents and siblings of suicide terrorists receiving greater benefits than cousins)? The accumulation of data related to these questions would go a long way in determining whether kin selection plays a role in motivating individuals to engage in suicide terrorism.

In addition to (or in lieu of) benefitting genetic kin, suicide terrorists may be motivated by affiliations with 'fictive kin', which causes kin selection mechanisms to misfire. One way to investigate this would be to question suicide terrorists directly, using surveys or interviews to determine the extent to which they view others in their organization, religious sect, society, etc. as kin, and to compare their responses to those from the population at large. However, this brings us to one of the greatest difficulties in attempts to study this population: researchers would be hard pressed to find a less amenable group to analyze than suicide terrorists, with the only ones available for questioning being those who are in training or those who were unsuccessful. Of that sub-group, those willing to respond to surveys or engage in systematic interviews may well be in the minority. Nevertheless, such interviews are possible (see Stern, 2003), but there are other options available as well.

One option is to measure the *support* for suicide terrorism among individuals who are not suicide terrorists themselves. Although people who support terrorism are not synonymous with people who *engage* in terrorism, there is likely to be some overlap in the psychology of these two groups. For example, Ginges, Hansen and Norenzayan (2009) found a positive relationship between religious service attendance and support for suicide attacks, which is consistent with the possibility of misfiring kin selection mechanisms, since attending religious services can strengthen one's feeling of being connected to the community (Zuckerman, 2008). Additional research should be conducted in this fashion, comparing support for suicide terrorism and perceptions of fictive kin. This can be done through surveys, as well as other methods, such as investigating whether priming concepts of kin influences one's level of support for suicide terrorism. Clearly, studying individuals who support suicide terrorism should not be viewed as a replacement for studying actual

suicide terrorists, but the former group can inform our understanding of the factors associated with suicide terrorism.

Another important avenue for future research is testing the hypothesized relationship between religiosity and suicide terrorism. Granted, there are difficulties associated with trying to empirically assess this relationship. As we stated earlier, religiosity is unlikely to have any strong predictive power because there are far more religious people than would-be suicide terrorists in the world. Nevertheless, investigating the relationship between religiosity and suicide terrorism is not a lost cause. One can generate hypotheses regarding which *specific* religious beliefs are likely to facilitate suicide terrorism. For example, belief in the afterlife is likely to have a strong impact on the (probably unconscious) cost–benefit analysis of engaging in suicide terrorism by minimizing the projected costs. Also, religious beliefs that strengthen the in-group bond and create a feeling of ‘fictive kin’, coupled with beliefs that strengthen out-group hostility, may activate psychological mechanisms related to kin selection and protecting one’s in-group (which consisted mostly of genetic kin throughout our evolutionary history), thus motivating behavior that is perceived to benefit the in-group and hurt the out-group, such as suicide terrorism.

A list of specific religious beliefs, like the ones mentioned above, allows us to generate more specific hypotheses. Within terrorist organizations, or among individuals who support suicide terrorism, there should be an emphasis on promoting these religious beliefs relative to other beliefs from the same religion. In other words, religious beliefs that likely facilitate suicide terrorism should be rated as more important than other beliefs within the same religion, but this pattern should not be found among those from the same population who are not supportive of, or willing to engage in, suicide terrorism. By considering specific religious beliefs, rather than religiosity in general, we may have a better chance of detecting the link between religiosity and suicide terrorism, if such a link exists.

Conclusion

Terrorism, in all its forms, is a phenomenon that we must try to understand as best we can, in the hopes that we can curtail its occurrence. This level of understanding can only be achieved by interdisciplinary efforts. We have reached a point at which proximate explanations of terrorism are becoming clearer, but ultimate, or evolutionary, explanations have yet to be pursued with similar enthusiasm. We believe that an evolutionary psychological perspective has the potential to provide such ultimate explanations.

For the purposes of this article, we restricted our analysis to suicide terrorism. The surge of evolutionary psychological research on religion in the last decade provides a powerful stepping off point for examining acts of terrorism that are seemingly motivated by certain religious beliefs. By reviewing the many ways in which an evolutionary perspective has influenced current research on religion, we sought to illustrate how evolution can be a useful framework for researching suicide terrorism. Applying the evolutionary principles of kin selection, and possibly memetics, to suicide terrorism has great potential, but researching terrorism from an evolutionary perspective is by no means limited to the ideas offered here. We encourage researchers to utilize the principles of evolutionary psychology when studying suicide terrorism, or terrorism in general, with the hope that such an approach will uncover valuable insights regarding such behavior.

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