5 Why terrorism terrifies us

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Introduction

Over the past decade, evolutionary scientists have provided many theoretical and practical insights to understanding the social dynamics and underlying motivations that foster terrorism. Several researchers have shown, for instance, that contrary to most criminological models of violent groups, such as gangs, the strongest predictors of terrorist recruitment are neither poverty nor lack of education (e.g. Atran, 2009; Hafez, 2009). Rather, would-be terrorists are often compelled by feelings of victimization and revenge on behalf of one's kin, motivations that are likely "instinctual" and evolved to deter intergroup violence (see McCullough, 2008). Evolutionary perspectives have also complemented rational choice models of political violence by showing that seemingly irrational violent-behaviors, such as suicide bombings, are parochially altruistic (Ginges et al., 2009; Qirko, 2009; Victoroff, 2009). This means that terrorists can elicit suicide bombings from otherwise normal (i.e. nonpsychotic) recruits by promising benefits to their kin and manipulating cues of genetic relatedness among group members (Atran, 2004; 2012; Azam, 2005). Additionally, evolutionary scholars have shown that terrorist organizations do not use religion simply to brainwash recruits (vs., Harris, 2004), but to provide systematic organization for group activity. For religion aids in forming coalition identities (Graham & Haidt, 2010), strengthening cooperative bonds (Sosis & Alcorta, 2008; Sosis et al., 2012), and strengthening group commitments to extreme acts, including violence (Atran, 2003; Norenzayan & Shariff, 2008).

Despite these insights, evolutionary scholars have rarely considered why terrorism terrifies us. At first glance, asking why we respond to terrorism as we do may seem like a trivial question, but it is not. Because exposure to violence influences reproductive decision-making (Wilson & Daly, 1997), migration (Knauft, 1987), and revenge (McCullough, 2008), terrorism must entail fitness consequences for survivors (Sharma, 2003). Furthermore, because exposure to terrorism results in approach and avoidance behaviors (e.g. increased anxieties, in-group identification, vigilance toward out-groups, etc.), which are evident in numerous communities after attacks (e.g. Fischer

et al., 2006; Rogers et al., 2007; Yehuda & Hyman, 2005), terrorism must exploit a psychological system dedicated to extreme threats and uncertainties. However, understanding those responses would be incomplete without the methods employed by evolutionary scientists for identifying the mental algorithms or behavioral strategies that undergird them. Likewise, no evolutionary approach to terrorism would be complete without considering the effects of terrorism itself.

In the U.S., pneumonia, infections, and even lightning strikes result in much higher fatality rates than terrorism, yet these and countless other causes of death do not elicit the fear and attention that terrorism does. And this response is not unique to U.S. citizens. Even at the height of the Second Palestinian Intifada, Israelis were more likely to die in an automobile accident than a terrorist attack (Stecklov & Goldstein, 2004). Yet while many Israelis exhibited caution when riding on buses and going about their business in public spaces, similar concerns were not elicited by driving a car (Klar et al., 2002; Sosis, 2007). Why do we have this apparently non-rational response to terror?

The main purpose of this chapter is to use insights from the evolutionary study of human behavior to answer this query and explain why terrorism terrifies us. In so doing, we bring together several disparate strands of research. *Terrorism responses* are understood rather broadly as the psychological and behavioral patterns that result from directly or indirectly witnessing a terrorist attack, and the outcomes of various coping practices thereafter (e.g. Sinclair & Antonius, 2012, pp. 4–30). We link the broad spectrum of terrorism responses to the threat-compensation strategies of an anxiety module comprised of the anterior cortex and septo-hippocampal circuit (SHC). We hypothesize that terrorism is terrifying because, among other things, it exploits a number of uncertainties that activate, amplify, and sustain the activity of this module.

Our discussion will proceed as follows. We begin by defining terrorism and briefly differentiating modern terrorism from other forms of political conflict throughout history. After that we review the spectrum of psychological and behavioral responses to terrorist attacks. We then consider the evolutionary significance of such responses and connect them to an anxiety module that underlies threat-compensation strategies. We locate the module that responds to terrorism among several other anxiety modules in the brain's precaution system. Hence, what we propose here is a synthesis of material and a proposed module that has not been previously discussed in evolutionary psychology.

Terrorism

Primoratz (2013, p. 24) defines terrorism as "the deliberate use of violence, or threat of its use, against innocent people, with the aim of intimidating some other people into a course of action they otherwise would not take." Indeed, as many scholars observe (e.g. Hudson, 1999), the keys to terrorism are

1 the spread of fear in a community by
2 targeting civilians with
3 shocking, unexpected, and unlawful violence in order to
4 intimidate or coerce a government or civilian population into political demands that are desirable for the terrorists.

This fourfold combination of terrorism is itself terrifying because it violates established norms more than any previous form of political conflict, even those witnessed in civil wars, making it truly one of the scourges of modernity (Cooley, 2000). Given the combination of the four, many scholars (e.g. Iviansky, 2009) agree that modern terrorism is a rather unprecedented form of violence in world history, employing divergent methods from previously known political conflicts.

To illustrate, unlike previous political conflicts and social struggles, such as nationalist movements, which generally struck at regimes somewhat narrowly by eliminating leading figures, contemporary terrorists frequently employ new tactics to strike at governments or communities in unpredictable ways. This is one of the reasons why terrorism is so terrifying—it is virtually unlimited in terms of what or whom it can target (Crenshaw, 2000, p. 412). Evolutionarily speaking, this lack of constraint also gives terrorism a high mutation rate: like an evolving virus, it can perpetually change to strike its target, namely, governments or communities, in new ways. Such mutability has entailed that potential targets develop, in turn, an immune system, which eliminates threats or prevents them from reoccurring.

Despite this, two mechanisms have facilitated the intensification of terrorism over the last decade. The first is the modern media: the media magnifies the effects of terrorism by exposing millions to attacks, and thus amplifying perceived threats and exacerbating traumatic impacts (Sinclair & Antonius, 2012, pp. 89–91). The second is religion: albeit not the cause of terrorism, religion facilitates improbable behaviors, such as suicide bombings, by framing conflicts as ultimate struggles, justifying terrorist acts, and imbuing terrorism with emotional and moral significance (Sosis & Alcorta, 2008, pp. 106–108). Given the media's capacity to spread images of terrorist attacks worldwide and religion's ability to turn political struggles into cosmic wars (Juergensmeyer, 2003), it is no wonder that terrorism is increasing and becoming more lethal (Pape, 2005).

The effects of terrorism

Although evolutionary approaches to terrorism have converged on the causes and motives of terrorists, they have not examined the psychological and behavioral effects of terrorism on targets. It remains an open question, then, as to why we respond to terrorism as we do (e.g. Bleich et al., 2003; Sinclair, 2010; Sinclair & Antonius, 2012). To illustrate another angle at why this matters, consider that our ancestors were not exposed to indiscriminate suicide

bombings, barrages of terrorist images in the media, and globalized settings where terrorist attacks were even possible. Furthermore, terrorist attacks everywhere evoke panic, existential anxiety, prolonged stress, and psychopathological symptoms. Understanding why people respond in this manner, especially the "mental powers" and "capacities" that enable these responses, demands an evolutionary analysis (Darwin, 1859, p. 449). Specifically, one that analyzes the selective pressures that have shaped the underlying neuropsychology that elicits our responses to terror.

To be sure, studies indicate that people are as fearful of terrorism as they are of snakes, spiders, and public speaking—in fact, terrorism outranks all other fears for America's youth (see Gallup Poll, 2005). Given that fear circuits are conserved in mammalian brains (LeDoux, 2012), terrorism must trigger a circuit designed to detect and respond to fearful stimuli (Tritt et al., 2012). Although neglected by evolutionists, this potential circuit, along with terrorism responses, has received a good deal of attention from psychologists since 9/11. While we obviously cannot review all of those studies, we can highlight the most prominent discoveries. Accordingly, we synthesize four areas of research (viz., studies on PTSD (post-traumatic stress disorder), existential anxiety, vicarious stress, and resilience) and organize terrorism responses along a theoretical spectrum.

In a review of disaster costs, Bonanno et al. (2010) proposed that responses to terrorism fall into one of three categories, from most to least traumatic:

- Elevated stress and anxieties that do not dissipate, often resulting in psychopathological symptoms, such as catastrophizing and overgeneralizing or even PTSD.
- A delayed response, where the person initially shows few signs of distress but then develops potentially long-standing anxieties, especially about violence and death.
- Heightened levels of distress immediately after the attack, which may lead to ruminations about violence and death, but the person eventually experiences full recovery.

These effects can be summarized as an elevation in stress (viz. fast-acting epinephrine) and/or anxiety (viz. slow-acting corticotropin) that, depending on the individual and environment, lead to prolonged anxiety (e.g. hippocampal changes, immune system suppression, inhibition of reproductive functions, growth hormone inhibition, and gastrointestinal shutdown; see Sapolsky, 2003). These effects translate into forms of avoidance coping (depression, panic, withdrawal) and/or threat-compensation strategies (e.g. agoraphobia, vigilance, out-grouping), and sometimes even extreme distress (e.g. isolation, violence or suicide; see Madux & Winstead, 2005). Most remarkably, a single terrorist attack can bring about these effects and traumatize any individual, regardless of whether he or she experienced the attack directly or indirectly through media coverage (Sinclair & Antonius, 2012, p. 134).

Terrorism, therefore, can result in a kind of trauma and, as such, requires time and social support for recovery. Recovery is understood as returning to pre-trauma levels of functioning (p. 134). Resiliency, on the other hand, is the ability to endure stress and make quick transitions from trauma to normal life (p. 135). With these distinctions in mind, we wish to examine the above spectrum, giving special attention to the outcomes of psychopathological symptoms and long-standing anxieties about violence and death.

Psychopathological symptoms

At its most extreme, terrorism traumatizes individuals and therein causes psychopathological symptoms, such as anxiety, depression, and even PTSD. This is perhaps not surprising when it comes to survivors who directly experience an attack and thus face intense confusion, insecurity, and disillusionment for months to years afterward (e.g. Shalev & Freedman, 2005). Perhaps more surprising, however, are the number of persons who show signs of psychopathology and PTSD after simply witnessing an attack or experiencing it indirectly through media coverage. For example, the lifetime prevalence rate of PTSD across the United States is 8 percent (see DSM-IV). However, a survey by Schlenger et al. (2002) found that PTSD symptoms, such as violent ideations, public avoidances, and anxieties about death, spiked across the U.S. to 18 percent after the 9/11 terrorist attacks. In Spain, too, roughly 20 percent of persons sampled in Madrid after the 2004 train bombings showed signs of PTSD, despite not being direct survivors of the bombings (Miguel-Tobal et al., 2005). Likewise, after the 2005 attacks on the London underground, 31% of surveyed Londoners reported experiencing elevated fears and stress that lasted for months after the attacks (Rubin et al., 2007). Accordingly, it is safe to say that terrorism, albeit limited in terms of the number of persons it affects directly, inflicts a widespread trauma on communities that is akin to full-fledged PTSD.

As surprising as it may be, then, few studies have investigated the long-term effects of PTSD on attacked communities. However, we can infer from other studies what the long-term effects are. Building on the studies of Bessel Van der Kolk (1987, 1996), researchers consistently find that persons with PTSD show two major neurological changes over time. Within weeks after the event, persons excrete lower levels of serotonin and cortisol, resulting in dramatic changes to neurotransmitter systems and long-term depression or anxiety, which in turn can trigger additional stress responses (e.g. Strickland et al., 2002). Months after the event, however, persons develop smaller hippocampal volume, leaving them more pathologically vulnerable to psychological trauma and stress-related psychopathologies (e.g. Gilbertson et al., 2002). Due to the seriousness of these possibilities, Rubin and Wessely (2013) recently resurveyed Londoners about the 2005 London bombings. While only 11 percent still reported PTSD-like symptoms—a 20 percent drop since 2007—those who required clinical interventions for such symptoms

never received them. Thus post-terrorist attack communities require the same level of outreach as victims of natural disasters to provide effective psychiatric care for PTSD (Rubin & Wessely, 2013).

Another psychological syndrome prevalent after terrorist attacks is catastrophizing: the incessant fear that another terrorist attack will occur or that similar violence is imminent (e.g. Beck, 1995; Fremont, 2004). According to Sinclair and Antonius (2012), catastrophizing often entails persistent feelings of vulnerability, changes in beliefs about out-groups, and ideations about death. Respectively, it leads to long-standing magnifications of environmental risks, ruminations about would-be attackers, and overall feelings of helplessness (p. 95). Yet catastrophizing goes beyond mere shifts in cognitive style and constitutes a manifestation of psychopathology. This is due to the fact that catastrophizing often persists even when individuals are confronted with evidence to the contrary (Beck, 1995). For instance, the most common forms of catastrophizing are agoraphobia, vigilance toward out-groups, and trusting solely with one's immediate in-group (e.g. Hirschberger et al., 2009). As a result, catastrophizing persons are similar to people with PTSD insofar as they get locked into a state of recalling the experienced trauma attempting, consciously or unconsciously, to prevent similar traumas from reoccurring (e.g. Holbrook et al., 2011).

Before going further, we pause here to note that despite the similarities in responses to terrorism, there are nevertheless variations in responses among individuals and communities. For instance, internal factors that influence responses to trauma or social stress of any kind include genetics, temperament, and social skills (Yehuda & Hyman, 2005). Environmental factors that increase the impact of terrorism on anxiety, depression, and social phobias include the frequency of experiencing aversive social experiences in early development, and negative life events in adulthood (Rapee & Spence, 2004). Furthermore, anxiety levels vary according to place, revealing that regions with histories of conflict and injustices have higher anxieties than others, including Zimbabwe, Central African Republic, and the Gaza Strip (Bateson et al., 2011).

Existential anxieties

A moderate yet common response to terrorism, especially for those who witness it indirectly, is showing no immediate distress but developing long-standing anxieties thereafter. In most cases these anxieties differ in magnitude from catastrophizing and involve slight ruminations about violence and death, including one's own. This phenomenon is a manifestation of what is known as mortality salience (MS) (Pyszcynski et al., 2003). At its simplest, MS is the distinctly human fear of death, which supersedes all other anxieties and underlies many human compulsions, such as the need for certainty, meaning, and control (Greenberg & Arndt, 2011). In its broadest sense, MS influences human beings to attach themselves to cultural worldviews,

self-esteem bolstering activities, and having children, which serve as buffers against the fear of death (Pyszcynski et al., 1999). The upshot is that defending one's worldview and contributing to meaningful activities allows one to culturally survive death, just as having children provides one with genetic immortality. However, there is a downside to these fear-of-death minimizers. When confronted with death, humans not only embrace and defend their worldviews but also derogate persons dissimilar to themselves (Harmon-Jones et al., 1997). According to Pyszcynski et al. (2003), this was evident after 9/11 when images of terror prompted fears of death and defenses against cultural worldviews, such as widespread patriotism and an unfortunate slew of prejudices and attacks against Muslims.

Such reactions are known as threat compensation behaviors: the affirmation of alternative goals in the face of some other threatened goal. To illustrate, a common threat compensation behavior is for someone to affirm control over X after his or her control for Y has been threatened (Proulx, 2012). With regard to terrorism, Pyszcynski et al. (2003) find that most people, when exposed to a terrorist attack, experience existential threats, such as the realization of mortality, the loss of social order, and challenges to life's meaning. Indeed, the indiscriminate and unpredictable violence of terrorism threatens the view that the world is imbued with order, stability, and permanence (p. 16). As a result, most people compensate by engaging in the following: investing in kith and kin (Du et al., 2013), defending cultural worldviews (Pyszcynski et al., 2003), and committing to the social goals of their own in-group (Florian & Mikulincer, 2004).

The theoretical framework for explaining the above phenomena is known as terror management theory (TMT). TMT posits that the cognitive process of being threatened by death and maintaining psychological equanimity is undertaken by a form of dual-processing, where thoughts of death are suppressed through conscious beliefs that affirm the social order and both unconscious motivations and behaviors that provide symbolic immortality (Pyszcynski et al., 1999). When it comes to terrorism, this dual-process consistently translates into an increased commitment to, identification with, and defense of one's in-group (Pyszcynski et al., 2003). Indeed, exposure to images of terror has been shown to correlate with extreme in-group commitments, such as: escalating military intervention in the Middle East (Pyszcynski et al. 2006), using violence to solve international problems (Hirschberger et al., 2009), seeing the in-group's values as absolute (Tremoliere et al., 2012), and defending the in-group itself (Yen & Lin, 2012). Likewise, exposure to terror has been shown to correlate with prejudices toward out-groups (Das et al., 2009) and vigilance against anyone who threatens the in-group (Hayes et al., 2010).

From an evolutionary standpoint, these reactions are significant, for they illustrate how the threat of violence or death serves as a proximate mechanism for in-group behaviors. Consider, for instance, the fact that exposure to terrorism increases concern for one's neighbors and especially one's kin—even to the point of desiring more offspring after witnessing violence or death (e.g.

Fritsche et al., 2007; Wisman & Goldenberg, 2005). Exposure to terrorism also prompts individuals to evaluate physically dissimilar people more negatively and familiar people more positively than otherwise (Greenberg et al., 1992). Along the same lines, images of terrorism increase vigilance toward cultural norms (Greenberg et al., 1995) and disapproval of out-group symbols (Cohen et al., 2013), and motivate persons to strengthen social networks (Schmeichel et al., 2009). Hence, the existential anxieties brought about by terror not only touch upon an internal drive to minimize the fear of death, as TMT posits, but also to engage in behaviors that are relevant to in-group commitments and fitness itself.

Of course, this is not to say that such reactions are good. For doing so would commit the naturalistic fallacy and overlook the latent problems of in-group favoritism, vigilance against out-groups, and so forth. What is more, the behaviors associated with existential anxieties may, in fact, be an impetus for terrorism. According to McBride (2011), "people support or engage in terrorism to alleviate existential anxiety but ultimately find this anxiety exacerbated in the wake of the violence they create or sanction" (p. 560). As a result, terrorist attacks perpetuate violence, leading to retribution and sanctions against the very communities they stand for, which intensify existential frustration (see also Cottee & Hayward, 2011). Consequentially, deterring terrorism may require policies that not only provide self-determination, but also aspire to mitigate existential anxiety, a point we shall revisit in a coming section.

Vicarious stress

The most widespread effect of terrorism is vicarious stress: a mild form of distress brought about by images of terrorism conveyed through the media (Marshal et al., 2007). At its extreme vicarious stress can lead to avoidance behaviors, ruminations about the attack, and increased arousal symptoms, such as cortisol release (Sprang, 2001). More typically, however, vicarious stress simply leaves individuals fearful of other attacks and striving to avoid them. For instance, Pyszcynski et al. (2003) found that the majority of Americans experienced vicarious stress a year after 9/11, with roughly 74% of the country believing another attack was imminent and taking some kind of precaution to avoid it. According to Fremont (2004), while vicarious stress is often interpreted as being a common and somewhat innocuous response to terrorist attacks, it can nevertheless have profound effects on communities: if attacks are particularly destructive or frequent, they can lead to a continuous state of fear, where vicarious stress exacerbates anxieties in already distressed individuals. Hence, vicarious stress can easily give way to existential anxieties and psychopathological symptoms. For that reason, North and Pfefferbaum (2002) recommend that individuals limit media consumption after terrorist attacks, which prevents vicarious stress from giving way to full-fledged anxiety.

The evolutionary psychology of responses to terrorism

An evolutionary psychological perspective can make sense of the above response spectrum. To begin, each phase of the spectrum is an expression of fear, which is itself an adaptation but not always beneficial for the organism. As observed by Darwin in *The Expressions of the Emotions in Man and Animals* (1872), fear is a universal emotion and physiological experience brought about by external stimuli interacting with internal systems, often resulting in adaptive responses. However, as Darwin also observed, sustained fear often leads to mental exhaustion, a point at which the "mental powers fail" (p. 292). Nearly a century later, Selye (1956) postulated that organisms exposed to frightful stimuli go through three phases: alarm, resistance, and exhaustion. While alarm is responding by fight-or-flight, resistance is managing environmental threats and stress, which, if unmanaged, result in exhaustion. Following Selye, Sapolsky (1994) recognized that fear in humans, although adaptive, can result in stress, obsessive behaviors, and ultimately psychophysical illnesses, if triggered by extensive trauma or repeated stressors. Hence, fear is one of evolution's double-edged swords: it is an adaptation that is undoubtedly necessary for survival, but it often leads to adverse consequences, especially when it progresses from stress and resistance to psychophysical illness, such as PTSD.

In line with Darwin, we wish to inquire about the internal systems that interact with external stimuli, namely, exposure to terrorism, to produce the spectrum of responses. Specifically, we wish to consider whether the spectrum originates from an evolved psychological mechanism. That is to say, obviously not a mechanism designed for terrorism per se, but rather designed to respond to threatening stimuli, which terrorism exploits.

It should be noted that an evolutionary approach to anxiety is not new. Both Marks and Nesse (1994) and Cosmides and Tooby (1999) offered what are now classic expositions, showing that anxieties and fears are ultimately adaptive. Several evolutionists have recently developed these outlooks in what might be called the "evolutionary psychology of anxiety." Bateson, Brilot, and Nettle (2011) have shown the adaptive value of several anxious behaviors—for instance, that insomnia provides alertness, restlessness is the body prepared for action, and ambiguity aversion is the avoidance of threats (p. 711). Along these lines, Grinde (2012) has proposed that happiness itself may be the product of several mood modules, including a "low mood" module associated with anxiety and depression, which is activated during times of uncertainty to decrease activity and thus the likelihood of risks. There is an additional literature discussing the natural selection of various mood disorders and anxieties (e.g. Bateson et al., 2011; Hagen, 2011; Nesse, 2011). What is more, several theorists have proposed distinct anxiety modules for such things as social phobias (Rapee & Spence, 2004), snake-detection (Ohman et al., 2001), and more (for a review of evolved fear-circuitry see Bracha, 2006).

What we propose here is an additional module—a "terror module"—that has not been discussed in evolutionary psychology, namely one designed to detect and respond to extremely threatening stimuli, such as signs of death or violence. By identifying its circuitry, we show that the module embodies the neural connections responsible for responses to death and existential anxieties, as recently identified by Tritt, Inzlicht, and Harmon-Jones (2012). Moreover, by identifying its neighboring circuitry, we show that the module is one of several designed for uncertainty and part of the brain's precaution system, as proposed by Boyer and Lienard (2006).

Identifying the terror module

Because the core response to terrorism is existential anxiety, it is appropriate to consider first what TMT says about the matter. For most TMT theorists, the affective state and behaviors caused by terrorism are instances of MS, which are unique threat-defense mechanisms that develop within the lifespan of the individual (e.g. Greenberg & Arndt, 2011). In other words, because humans come to realize the inevitability of their own deaths, they come to invest in behaviors that render life meaningful (Pyszcynski et al., 1999). However, several theorists have recently qualified this outlook by associating MS with the broad spectrum of mammalian fear responses, which progress from fight-or-flight to exhaustion, as Selye (1956) observed. For instance, many suggest that MS is simply one mode in which the mind deals with fear and uncertainty, making it akin to cognitive dissonance, entropy management, and inconsistency compensation (e.g. Holbrook et al., 2011). Related to this view, Tritt, Inzlicht, and Harmon-Jones (2012) have observed that MS is the product of a specific "internal system," as Darwin would say, which deals with extreme uncertainties and threats.

Building on these observations, we suggest that the effects of terrorism are not only threat-compensation strategies but also fear responses designed to orient the individual's cognition to violent environmental threats. However, when these responses are amplified or prolonged, they give way to psychopathological symptoms. In what remains of this section, we spell out this idea in greater detail, defending the possibility of a distinct anxiety module—among other such modules in the precaution system of the brain—that responds to terrorism, as well as other threatening stimuli.

As evolutionary psychologists observe, the human mind is not a blank slate but rather an evolved organ with multiple innate modules, each designed for an adaptive problem, such as acquiring mates, finding resources, and so on (e.g. Cosmides & Tooby, 1992). These modules are domain-general processors that respond to different sets of phenomena and specific phenomenon therein (Karmiloff-Smith, 2000). For example, humans have a module designed for responding to animals that is flexible enough for any four-legged creature, such as a dog (Sperber, 1994). With regard to responses to terror, if any sign of violence or death elicits stress, anxiety, and MS, as many argue

(e.g. Greenberg & Arndt, 2011), then it is possible that an underlying module regulates all of these responses. Accordingly, the module would be flexible enough to respond to a broad range of threatening phenomena but specific enough to respond to the phenomenon of terrorism.

Several lines of evidence support this possibility. Logically, it is unlikely that humans are unique among species in terms of responding to violence or signs of death, since doing so is essential for survival. Moreover, given the fact that fear systems in the brain are conserved, that is, built from ancient systems (see LeDoux, 2012), it is unlikely that humans evolved a unique module dedicated exclusively to death anxiety, as TMT suggests (e.g. Greenberg et al., 1986). What is more likely is that humans inherit a primitive anxiety system that is designed to detect and respond to extreme threats (e.g. expectancy violations, uncertainties, and dangerous stimuli). After all, when confronted with extreme threats, children, monkeys, and rats, like adult humans, respond in a similar way: they evade the situation or stimuli; avoid unfamiliar objects, places, or conspecifics; and/or consort with familiar conspecifics (Tritt et al., 2012, p. 722). Equally as remarkable, when primates are confronted with dangerous stimuli, they show a spectrum of fear reactions that parallel those of terrorism responses, progressing from stress to PTSD-like symptoms (e.g. see Cohen et al., 2006).

Still, this raises an important question: why a module? In other words, why wouldn't a primitive brain system alone, such as the amygdala circuit, be enough to explain such responses? In addressing this inquiry, we arrive at four additional lines of evidence.

The first is that threat-compensation strategies are too complex for a single fear system, especially a primitive one. Many threat-compensation strategies, such as the fear of snakes or spiders, are not only regular and innate—and thus modular—but also complex insofar as they detect a single stimulus and respond with similar behavioral patterns. This is due to the fact that such threat-compensation strategies derive from modules comprised of distinct association areas in the brain and primitive brain systems. Ethical behaviors, for instance, stem from moral modules comprised of association areas, such as the prefrontal cortex, and primitive brain systems, such as the disgust mechanism of the insula (e.g. Olatunji et al., 2008). The threat-compensation strategies caused by terrorism are similar in that they involve association areas, such as the prefrontal cortex and temporal lobes, and primitive nuclei, such as the amygdala (McGregor et al., 2009). Given this complexity of brain circuits, it is very likely that terrorism responses stem from a module as opposed to a single primitive fear system.

The second line of evidence is that researchers (Tritt et al., 2012, pp. 722–723) have recently mapped out the physiology of a potential module that controls threat-compensation strategies. The starting point of that map is the SHC, which compares mental schemas about the world and its proper ordering with incoming sensory information about the environment. When extreme misrepresentations are detected, such as dangerous stimuli, the SHC

activates the anterior cingulate cortex (ACC), which in turn gives off a "cortical alarm" that triggers the sympathetic nervous system and orients cognition toward resolving higher-order inconsistencies in the environment. To resolve those inconsistencies, the SHC and ACC also activate the septal area and basal ganglia, which jointly control goal-oriented behaviors and actuate prefrontal systems and left cortical hemispheres. The prefrontal systems and left cortical hemispheres, in turn, control approach and avoidance behaviors. When this entire system is activated and sustained, as with the observance of violence or signs of death, the individual experiences heightened vigilance, increased goal-directed cognition, and amplified motivation to approach the familiar and avoid the unfamiliar. Because this process captures the psychological and behavioral patterns caused by extreme threats, such as terrorism, it underscores the likelihood of a distinct underlying anxiety module (p. 715).

Following the last point, the third factor is that a modular account can explain the spectrum of terrorism responses in one fell swoop. As the work of Tritt, Inzlicht, and Harmon-Jones (2012) illustrates, the stress and anxiety caused by terrorism is obviously attributable to the SHC and ACC circuit. However, because the SHC and ACC regulate the limbic system, which is the central circuit for stress and anxiety in the brain, the SHC and ACC can cause psychopathologies, including PTSD. This happens when the circuit in question is amplified and sustained, usually due to an extensive trauma or repetitive exposure to traumatic events (e.g. Canteras et al., 2010). This of course explains how a module designed to respond to threats can nevertheless bring about mental exhaustion, as Darwin observed—put simply, when the SHC and ACC remain "turned on," the limbic system cannot be "turned off," resulting in a runaway stress response that leads to hippocampal cell loss and thus psychopathology (Sapolsky, 2003). Further, because the SHC and ACC wire to the prefrontal systems and left cortical hemisphere, they trigger goal oriented behaviors if moderately activated. This may explain why images of violence and death prompt the desires to sire kin (e.g. Fritsche et al., 2007), defend one's culture (e.g. Pyszcynski et al., 2004), and achieve personal goals (Kasser & Sheldon, 2000). Further still, recall that the SHC and ACC activate approach and avoidance behaviors, which demonstrates a conserved aspect of the mammalian fear response, but also accounts for the fact that threatening stimuli induce in-group loyalty and out-group exclusion (e.g. Das et al., 2009). Hence, the SHC and ACC circuit can account for each point in the spectrum of terrorism responses, rendering it a likely module for such responses.

The fourth point to consider is that a module along these lines makes evolutionary sense. While we cannot demonstrate that such a module indeed contributes to fitness, we can identify several facets that would render it potentially fitness enhancing. First, the spectrum of behaviors it produces—namely, approach and avoidance—would be adaptive in moments of threats and uncertainties (Tritt et al., 2012). Second, the fact that it heightens vigilance would be enough to minimize possible risks in times of distress (Slovic & Peters, 2006). Third, although it motivates in-group favoritism and out-group

prejudice, the former could marshal social support and encourage in-group cooperation in times of vulnerability (Navarrete et al., 2004), while the latter kept out-group threats at bay in ancestral environments. Finally, it should not be overlooked that episodic stress and anxiety are themselves adaptive defenses against threats (Vaillant, 2000).

Activating the terror module

The proposed terror module is activated by expectancy violations, uncertainties, and threatening stimuli (Tritt et al., 2012). Indeed, in slight cases, anything unfamiliar, unknown, or intimidating could activate the system (p. 723). However, the key here is not so much what activates it but rather what amplifies and sustains its activity. By amplification we mean the marked intensification in the neural activity of the SHC and ACC circuit, and by sustained we mean that which causes it to be prolonged for an extended period of time. According to Gray and McNaughton (2000), the SHC and ACC circuit is amplified by noxious stimuli, violence, and war, and is likewise sustained by traumatic events involving such stimuli, especially if exposure is repeated.

With this in mind, it is no wonder that terrorism activates the module. Terrorism is both the use of militaristic violence (e.g. mass shootings, bombings, gassings, etc.) against non-combatant targets and the attempt to bring war-like conditions to civilian environments. While violence and war are necessary for amplifying the SHC and ACC circuit, they are not sufficient for sustaining it. To sustain the SHC and ACC, terrorists maximize trauma by repeating belligerent attacks that consistently employ shocking, unpredictable, and indiscriminate violence. This not only violates mental schemas of peace and social order, but also exposes communities to seemingly incessant traumas. Of course, the impact of such trauma is further compounded by media coverage of terrorist attacks, which expose individuals to repetitive images of terrorist violence. Hence, terrorism is terrifying because it activates, amplifies and sustains an internal system—what we have identified as a module—that is designed to respond to extreme threats.

We pause here to consider a relevant inquiry: is the terror module akin to, say, a war module? We do not think so. For it is unlikely that humans have evolved a war module per se, since war is, in fact, a highly complex cultural activity. And though human beings frequently engage in aggressive behaviors, they are nevertheless ambivalent about war and express natural inhibitions against conspecific-killing, suggesting that war is not as innate as some evolutionists have presumed (Smith, 2007; van der Dennen, 2008). Furthermore, what we are proposing is rather modest compared to positing a complex behavioral module, such as one for warfare. Recognizing that the human brain is equipped with anxiety modules, we suggest that it includes one designed to respond to extreme threats, such as portents of death and violence, which terrorist attacks inadvertently exploit. This module may indeed contribute to impulses for out-grouping, which in turn contribute to

warfare, just as modules for aggression, resource acquisition, kin altruism and several others do; but the terror module would not be—nor would any other be—the sole module for war.

Locating the terror module in the brain's precaution system

Given the circuitry outlined in the last section, we are now in a position to make connections with other anxiety modules. The most relevant is the precaution system and its relation to pathological and ritualized behaviors, as discussed by Boyer and Lienard (2006). When humans are confronted with uncertainties, such as vulnerable life-stages or the birthing process, they not only experience anxiety, but also produce action-ritualizations—that is, stereotyped and repetitive behaviors, such as obsessions about contaminations and contagions, and avoidance, behaviors that resemble psychopathologies. According to Boyer and Lienard (pp. 2–5), these obsessions and behaviors are the output of a psychological immune system or "precaution system" comprised of two underlying cognitive subsystems:

1 an "action parsing system" that divides incoming sensory information and outgoing behavior into meaningful units, and
2 a "motivational system" that detects and reacts to potential threats to fitness.

The latter subsystem, which is most pertinent to our discussion, is further divided into a variety of circuits that include the frontal cortices, striatum, globus pallidus, and ACC. The result of this vast circuitry is that the motivational system controls a rather broad set of habitual responses and motor habits, and an extensive set of cortical alarms.

Granted this much, we can locate our proposed module within the motivational system. Boyer and Lienard (2006) speculate that the motivational system is designed to detect environmental errors of many kinds, including highly salient conditions that would have been dangers in our evolutionary past: reproductive risks, predation, pathogens, social harm, and possibly more (p. 8). Critically, each of these would have evolved as its own module, detecting certain manifest-threats (e.g. signals about the source of danger) and inferred-threats (e.g. when potential danger is likely), thereby initiating different decision rules (e.g. IF x triggers disgust, THEN reject x as pathogen; e.g. see Fessler & Navarrette, 2003). Accordingly, Boyer and Lienard (2006, p. 9) suggest that each of these devices would have evolved slightly different circuitry within the motivational system in order to detect threats of different kinds (e.g. cheaters, predators, pathogens, and the like).

We thus speculate that the terror module is one of the various devices in the motivational system. For it embodies some of the motivational system's circuitry designed for responding to environmental uncertainties, yet it is unique enough to react to the specific uncertainties involving death. By

way of example, recall that humans are especially sensitive to any sign of death and violence, which trigger a spectrum of responses, from stress to PTSD. In line with Boyer and Lienard (2006), those signs are manifest and inferred-threats, and the responses are decision rules, thus underscoring that the underlying circuitry for them is part of the motivational system.

Conclusion

With increasing levels of destruction, terrorism continues to impact various communities and individuals across the globe. However, its alleged threat may not be as lethal as it seems. According to Mueller and Stewart (2011), despite the political rhetoric and news footage concerning terrorist attacks, terrorism poses a rather minimal risk for most persons and communities. In fact, compared to other threats, such as accidents or diseases, terrorist attacks are rather infrequent, and the majority of attempted attacks fail. Moreover, while terrorism inflicts millions of dollars in damages each year, the U.S. alone has spent over one trillion dollars since 9/11 to combat terrorism (p. 1). This discrepancy has led Mueller and Stewart to question why people overestimate the capacity of terrorists, inflate the vulnerability of targets, and neglect the probability of successful attacks. We suggest that it is due to the activation of a terror module, which, like the human reaction to spiders or snakes, responds strongly to extreme signs of death or violence, regardless of the actual threat posed by the stimuli. Indeed, such reactions, despite the reality of terrorism, underscore the importance of finding adaptive ways to cope with terrorist threats.

Even though communities have developed ways of coping with terrorist threats (e.g. Sosis, 2007; Sosis & Handwerker, 2011), the uncertainties of attacks, media coverage of terrorist carnage, and religious zeal of would-be attackers continue to cause distress among targeted individuals and witnesses. While this distress often results in vicarious stress and existential anxiety, it often produces psychopathological symptoms akin to PTSD. Thus any scholarly work that helps us get a handle on these responses is valuable for treatments in particular, and contributes to the ongoing conversation about dealing with terrorist threats in general. Along these lines, clinical psychology has developed rigorous means of identifying responses to terror, but by identifying the selective pressures that shape the neuropsychology of such responses we may be able to develop more efficacious coping strategies. Indeed, evolutionary psychology has extended approaches to clinical psychology by generating specific hypotheses about underlying modules, which have led to a more complex and interesting picture of human psychology over the last two decades. In this chapter, we have engaged in that ongoing conversation, hypothesizing that a distinct anxiety module in the brain's precautionary system, among others, operates over the spectrum of terror responses. The more we understand the evolutionary psychology of human anxiety, especially with regard to terrorism, the better we will be at managing

responses to terror, which will contribute to resolving the threat of terrorism in the twenty-first century.

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