SOCIAL NEUROSCIENCE
2018, VOL. 13, NO. 5, 511–529
https://doi.org/10.1080/17470919.2017.1400462

Routledge
Taylor & Francis Group

REVIEW

A multilevel social neuroscience perspective on radicalization and terrorism

Jean Decety[a,b], Robert Pape[c] and Clifford I. Workman[a]

[a]Department of Psychology, University of Chicago, Chicago, IL, USA; [b]Department of Psychiatry and Behavioral Neuroscience, University of Chicago, Chicago, IL, USA; [c]Department of Political Science, University of Chicago, IL, USA

ABSTRACT

Why are some people capable of sympathizing with and/or committing acts of political violence, such as attacks aimed at innocent targets? Attempts to construct terrorist profiles based on individual and situational factors, such as clinical, psychological, ethnic, and socio-demographic variables, have largely failed. Although individual and situational factors must be at work, it is clear that they alone cannot explain how certain individuals are radicalized. In this paper, we propose that a comprehensive understanding of radicalization and of how it may lead to political violence requires the integration of information across multiple levels of analysis and interdisciplinary perspectives from evolutionary theory, social, personality and cognitive psychology, political science and neuroscience. Characterization of the structural-functional relationships between neural mechanisms and the cognitive and affective psychological processes that underpin group dynamics, interpersonal processes, values and narratives, as well as micro-sociological processes may reveal latent drivers of radicalization and explain why some people turn to extreme political violence. These drivers may not be observable within a single individual level of scientific enquiry. The integrative, multilevel approach that characterizes social neuroscience has the potential to provide theoretical and empirical clarity regarding the antecedents of radicalization and support for extreme violence.

ARTICLE HISTORY
Received 15 June 2017
Revised 29 September 2017
Published online 8 November 2017

KEYWORDS
Social neuroscience; political neuroscience; radicalization; extremism; political violence; group dynamics; microsociology; terrorism

Introduction

Political violence and terrorism are not new phenomena. The past decades have witnessed a dramatic transformation in the nature and use of terrorism, however, which has forced intelligence, psychological, and medical experts to re-evaluate their understanding of extremism and radicalization (McCauley, 2007). How can science help us to understand why certain people develop extreme opinions and beliefs that, in some cases, lead to violent extremism including acts of terrorism? This question has captured the interest of scholars from various disciplines, particularly the social sciences where the search for an elusive "terrorist personality" began in the 1970's. The resulting literature is replete with failures to construct terrorist profiles based on personality traits, psychopathology, religious orientation, or racial and/or economic background (Atran, 2003; Horgan, 2014; Kruglanski et al., 2014; Victoroff, 2005). There is no typical social and economic profile of the radicalized. For instance, individuals who perpetrated recent attacks in Europe are not inhabitants of the Gaza Strip, Libya or Afghanistan. They are not necessarily the poorest, the most humiliated or the least integrated. The fact that 25% of jihadis are converts shows that the link between radicals and their "people" is also largely an imaginary construct (Roy, 2017). If a "standard terrorist personality" does exist then it is likely obscured by the complex historical, political, and economic contexts into which terrorist acts are embedded (Horgan, 2014).

Disturbing as it may be, individuals who become radicalized and involve themselves with terrorist organizations are, by and large, ordinary people. These individuals have typically functioning brains; they are not mad but are fanatics. Most are not psychopaths and, with the exception of "lone wolf" terrorists are not especially likely to have psychiatric diagnoses (Horgan, 2014). Violent radicalization is not a consequence of religious radicalization, even if it often takes the same paths and borrows from the same paradigms. Religious fundamentalism exists, of course, and it poses considerable societal problems because it rejects values based on individual choice and personal freedom. But it does not necessarily lead to political violence (Roy, 2017). Thus, scholars generally agree that the origins of radicalization and terrorism are not necessarily caused by brain disorders. Rather, people who are otherwise psychologically typical may develop values and strong emotional ties to narratives and causes and become radicalized (McCauley, 2007). Many individuals who sympathize with and even join

CONTACT Jean Decety decety@uchicago.edu Department of Psychology, 5848 S. University Ave., Chicago, IL 60637 USA

This article was originally published with error. This version has been amended. Please see Corrigendum (http://dx.doi.org/10.1080/17470919.2018.1437883)

terrorist organizations are educated and seemingly rational (Bronner, 2016). If ordinary, rational people are capable of holding extreme views and of becoming radicalized, why then do extremists comprise only a small fraction of society? Moreover, are there characteristics that distinguish individuals who merely hold extreme views from those who act on those views by engaging in ideologically motivated violence?

A better understanding of the antecedents of extremism and political violence cannot be gleaned simply by reexamining the extant literatures on individual dispositions, interviews, situational variables, and their relation to political violence in healthy individuals. Burgeoning evidence (reviewed below) suggests a comprehensive understanding of sociopolitical attitudes must incorporate evidence from the biological sciences with cognitive science and sociology at multiple levels of analysis, and cannot rely solely on personality, survey, and other self-reports. Moving the field forward requires a transdisciplinary perspective that emphasizes the relationships between neural, cognitive, and social processes, including the intervening information-processing components and operations at both the neural and computational levels of analysis. This approach has characterized the social neuroscience perspective since its inception 25 years ago (Cacioppo & Berntson, 1992), and has significantly contributed to explaining complex social behaviors and brain–behavior relationships such as risk-taking behaviors (Steinberg, 2008), social hierarchies and status (Koski, Xie, & Olson, 2015), motivation for justice (Decety & Yoder, 2017), and social support (Taylor, 2011; Uchino, Smith, Birmingham, & Carlisle, 2011). A special issue of the journal Political Psychology published in 2003 advocated for the application of the social neuroscience perspective to enrich theorizing about political psychology (Cacioppo & Visser, 2003). Subsequent to this publication, psychological, physiological and neurobiological evidence has been synthesized to generate accounts of political phenomena that could not have been achieved through investigation of any of these levels in isolation (e.g., Hibbing, Smith, & Alford, 2014). The extant evidence strongly suggests a link between brain structure/function and the psychological mechanisms that mediate political attitudes. Individual differences in neurocognitive structure and functioning are in fact linked to a constellation of social and psychological processes that unfold over time and both reflect and give rise to the expression of political behavior (Jost, Nam, Amodio, & Van Bavel, 2014). In other words, the evidence favors a dynamic, recursive theoretical framework in which the connection between physiological and psychological functioning and political extremism is conceived of as bidirectional. Linking individual psychological dispositions and demographic variables that are expected to predict extremism to specific patterns of brain activity and functional connectivity during moral evaluations, for example, could shed light on the cognitive requirements, affective responses, and computational processes that underlie radicalization.

Despite the progress social neuroscience has afforded political science, this perspective has not yet been systematically applied to the study of radicalization and support for politically motivated violence. Pessimism towards psychological approaches to understanding the antecedents of radicalization and support for extreme violence is understandable given that psychological theorizing has not yet produced satisfactory working models despite 40 years of effort. Here we argue that this stagnation is partially attributable to a failure to capture the "big picture" across levels of analysis.

In this paper, we first describe the social neuroscience approach and briefly review theoretical advances in political science made possible by this perspective. Then, we sketch out a process model of radicalization informed by multiple biological and social science disciplines. According to this model, radicalization and support for ideologically motivated violence emerges through reciprocal interactions between 1) group dynamics, 2) interpersonal and 3) microsociological processes[1] (Figure 1). Next, we discuss neurobiological and behavioral evidence regarding the propensity to engage in violence. Throughout, we synthesize key findings from multiple disciplines to illustrate how social neuroscience can advance our understanding of radicalization and of support for ideologically motivated violence. We conclude by highlighting the significant scholarly advances it is likely to stimulate.

The social neuroscience perspective

The complexities of the relation between brain and behavior pose fundamental questions that cannot be answered by one discipline alone. Understanding social behavior requires integrative multidisciplinary approaches across disciplines and levels (i.e., scales) of analysis. Social neuroscience is an interdisciplinary field that investigates the biological mechanisms underpinning social structures, processes and behavior, as well as reciprocal interactions between the social and biological levels of organization (Cacioppo & Berntson, 1992; Cacioppo & Visser, 2003). In order to achieve a complete understanding of social phenomena, it is imperative to use integrative analyses that encompass different levels of organization, ranging from

[1]Microsociology is concerned with the nature of everyday human social interactions and agency on a small scale, in particular the reciprocal relationship between events/actions and the nature of the societal context in which they occur.

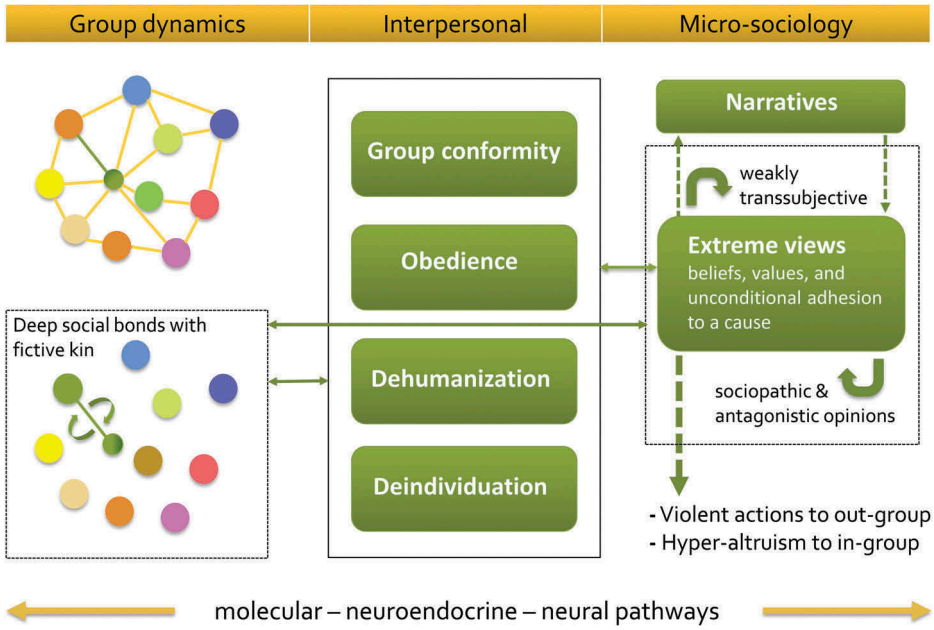

Figure 1. Flow chart of dynamic social and cognitive processes involved in radicalization. At the level of group dynamics, individuals disconnect gradually or abruptly from other formal and non-formal social groups that hold competing values (e.g., family, friends, neighbors, hobbies, etc.). Relatedly, isolated individuals may eagerly seek incorporation into a kinship-like group, which, in conjunction with the associated mechanisms of bonding and with the underlying psychology of desire, may enable a suicide terrorist to expect self-sacrifice to benefit their fictive kin post-mortem. Social forces operating at the interpersonal level may act to strengthen in-group connections (e.g., through group conformity, obedience to authority, and/or deindividuation) while increasing social distance to out-groups (e.g., through dehumanization). At the micro-sociological level, fewer connections to social groups with competing opinions and values results in less intra-individual competition between beliefs, values, and ideas. As individuals who become radicalized adhere more strictly to extremist ideologies, narratives, and increasingly limit their exposure to competing ideas, terrorist organizations are able to exert greater influence over the values and beliefs of their members. The most dangerous extremist ideologies are weakly trans-subjective, or insufficiently convincing to achieve widespread acceptance throughout a population, and sociopathic, or antagonistic towards different worldviews. Group dynamics, interpersonal factors, and micro-sociological factors interact reciprocally to create the conditions for hyper-altruism towards one's in-group as well as violent action directed at innocent out-group members. Individual differences in propensity to engage in violence operate at multiple levels (genetic, neuroendocrine) mediating cognition and behavior through specific neuroanatomic networks. Taken together, interdisciplinary synergy across academic disciplines and levels of analysis has the capacity to provide a clearer understanding of how radicalization occurs.

the genetic through to the social levels. Molar constructs used in social science, such as radicalization, persuasion, loneliness, empathy, or morality, provide a means of understanding highly complex processes without needing to specify each individual process by its simplest components (Cacioppo, Berntson, & Decety, 2010). However, such constructs are composed of processes and representations that work together to serve particular functions (Willingham & Dunn, 2003). Psychological models often use hypothetical representations and processes that operate on those representations. For instance, executive functioning, theory of mind, and empathy are all psychological constructs, but none of these constructs can be described as primitive (Decety & Jackson, 2004; Miyake et al., 2000). These higher-level constructs need to be decomposed into their constituent elements, component processes, representations, and computations that can then be mapped onto neural circuits using techniques including brain mapping, functional connectivity, and lesion studies (Cacioppo, Cacioppo, Dulawa, & Palmer, 2014; Decety & Cacioppo, 2010).

Multilevel analyses require a range of expertise that is unlikely to be available to any one investigator, suggesting the need for teams of scholars spanning multiple disciplines, including evolutionary biology, neuroscience, psychology, anthropology, economics, and political science. In contrast to multidisciplinary research, where expertise is aggregated but not synthesized, interdisciplinary research is not simply the sum of its individual parts but instead results in synergistic outcomes (Cacioppo et al., 2007). Social neuroscience is not a substitute for the behavioral or social sciences but rather is an interdisciplinary field that draws on these disciplines as well as neuroscience to provide a single, integrative paradigm with which to investigate complex human behaviors across levels of organization (Cacioppo & Decety, 2011). Importantly, the

best-designed experiments aiming to bridge the psychological and neurobiological levels are those with clear hypotheses based on pre-existing psychological research and with known or proposed candidate processes. In addition, explanations of results at the neural level are almost entirely contingent on higher-level vocabulary and concepts derived from behavioral work (Krakauer, Ghazanfar, Gomez-Marin, MacIver, & Poeppel, 2017).

Multilevel interdisciplinary approaches have already gained traction elsewhere in political psychology, where scholars are merging information about brain functioning, individual dispositions (e.g., beliefs, values, motivations, emotions), and group dynamics to inform theories of political thought (Jost et al., 2014). While political beliefs have long been associated with broader underlying cognitive, motivational and personality traits, work that combines psychology and neuroscience methods and theorizing indicates that some ideologies are adopted in part because they serve the more general purpose of reducing uncertainty, ambiguity and threat (Jost, Glaser, Kruglanski, & Sulloway, 2003). There is evidence, for example, that liberals are more tolerant of uncertainty and complexity, whereas conservatives exhibit less cognitive flexibility and less openness to new experiences (e.g., Gerber, Huber, Doherty, Dowling, & Ha, 2010). These findings are taken to suggest that political attitudes emerge from general psychological processes, particularly those involved in motivation and self-regulation, and are deeply connected to basic biological mechanisms that serve to defend against environmental challenges (Jost & Amodio, 2012; K. B. Smith, Oxley, Hibbing, Alford, & Hibbing, 2011). Functional neuroimaging studies support this interpretation by showing, for instance, that conflict-related activity in the anterior cingulate cortex (ACC), a region critical for conflict monitoring, is negatively associated with political conservatism (Amodio, Jost, Master, & Yee, 2007). Similarly, conservatives and liberals could be distinguished by neural responses to disgusting non-political images in regions that are implicated in negative affective valence and interoception of disgust[2] and that serve basic aspects of attentive sensory processing (Ahn et al., 2014). Another study investigated whether activity in the neural circuits that support risk-taking behaviors differs as a function of political identity (Schreiber et al., 2013). Although no behavioral differences were observed, liberals demonstrated greater activity in the insula whereas conservatives demonstrated greater activity in the amygdala. These regions have previously been implicated in studies of affective processing and emotional saliency (Cacioppo, Cacioppo, & Petty, 2017; Kaplan, Gimbel, & Harris, 2016). In particular, the amygdala is a critical hub that prioritizes the affective relevance of sensory inputs for the goals and motivations of the perceiver (Cunningham, Van Bavel, & Johnsen, 2008). A study using neuroanatomical measures found that conservatism was negatively associated with gray matter volumes in the ACC and positively associated with right amygdala volume (Kanai, Feilden, Firth, & Rees, 2011). A recent study reported increased activity in the insula and amygdala in participants who resisted changing their political beliefs when those beliefs were challenged (Kaplan et al., 2016). Taken together, psychological processes underpinned by specific neural circuits recruited when facing environmental challenges appear to converge in discriminating political orientation. Activation in these regions seems to distinguish participants' political orientation even when behavioral differences are not observed. Interestingly, individual differences in gray matter density in insula and cingulate cortex predict individual differences in affective and cognitive empathy, respectively (Eres, Decety, Louis, & Molenberghs, 2015), suggesting that these regions perform domain general functions that are not specific to processing political information. Naturally, these neurophysiological data cannot determine whether any of these brain regions play a causal role in the formation of political attitudes and beliefs. They do suggest, however, that social neuroscience provides a richer perspective on political attitudes by incorporating information about the biological mechanisms associated with cognitions, attitudes, values and beliefs.

Process model of radicalization and support for violence

Theories explaining radicalization to terrorism abound but are limited by a dearth of solid experimental evidence, which is understandable given the complexity of the phenomenon and the difficulty of obtaining empirical data. Furthermore, numerous studies have relied on anecdotal rather than empirical evidence or on interviews that are susceptible to biases such as confirmation bias. This constrains theorizing about terrorist psychology (Horgan, 2014). If we accept the view that most terrorists are ordinary people, how can we reconcile this with the reality that most ordinary people are unwilling to sacrifice innocent lives to support the causes they hold dear? In other words, a comprehensive theory of terrorist psychology must be sensitive to the features common to extremists yet specific enough

[2]Interoceptive awareness is the sensitivity to stimuli originating within the body.

to distinguish between extremists who will and will not go on to commit acts of political violence and from other ordinary people.

Although socioeconomic status, ethnic background, education, relative deprivation, religious affiliation, poverty, and the desire for personal significance, for example, may contribute in varying degrees to individual pathways towards radicalization and terrorism, they are neither specific enough nor necessary, let alone sufficient to be categorized as root causes (Roy, 2017; Victoroff, 2005). In order to provide a theoretical scaffolding upon which to organize relevant data from multiple scales of analyses and academic disciplines, as well as help to move the field forward, we build on current knowledge from group dynamics, interpersonal processes and micro-sociology to propose that radicalization emerges from complex interactions across these levels (see Figure 1). In the following sections, we synthesize key findings from psychology and neuroscience in relation to each level with a view towards providing preliminary descriptions of the neurocognitive mechanisms that may underpin radicalization and support for ideologically motivated violence and, where applicable, we point to outstanding gaps in the literature that future research should address.

Group dynamics leads to both cooperation and competition

Homo sapiens is an ultra-social species. We are interdependent, obtain the majority of our resources through cooperation (e.g., hunting, building shelters, protection against predators, child rearing), and cooperate to an extraordinary degree. Humans engage in highly complex coordinated group activities with people that are not their kin (Tomasello, 2009). They may rush to defend absolute strangers one day, or join forces with unrelated individuals to wage merciless wars against their competitors the next. Sociality can benefit individuals because it provides greater protection from predators, enhances success in locating or maintaining access to resources, creates mating opportunities, and reduces vulnerability to infanticide. Sociality can also be costly, however, by increasing competition for access to resources and mating opportunities, increasing exposure to infection, and potentially increasing conspicuousness to predators (Marean, 2015). Mathematical modeling of social evolution combined with archaeological evidence on causes of death during the late Pleistocene shows that an optimal condition under which genetically encoded hyperprosociality can propagate is, paradoxically, when groups are in conflict. Groups that have higher numbers of prosocial people will work together more effectively and thus outcompete others and pass their genes for this behavior onto the next generation, resulting in the spread of hyperprosociality. Furthermore, such cooperative behavior spreads best when it begins in a subpopulation, competition between groups is intense and when overall population sizes are small, like the original population of *Homo sapiens* in Africa from which all modern-day people are descended (Boyd & Richerson, 2009). Additionally, there is strong empirical evidence that humans are helpful or hurtful towards others based on perceived similarity to themselves (Hare, 2017). This like-me psychology manifests itself in a high degree of tolerance toward in-group members that facilitates unique forms of collaboration and conformity (Burton-Chellew & West, 2012; Kurzban, Burton-Chellew, & West, 2015). In contrast, ostracism and lethal aggression among hunter-gatherers primarily targets nonconformist or out-group members (Boehm et al., 1993). Violent propensities like intraspecific killing occur in a variety of species and have been selected among male chimpanzees and humans. Likewise, propensities for particular types of altruistic and cooperative behavior have probably also evolved through selection, and are neither more nor less important biologically than violence (Wrangham, 1999). This type of antisocial or agonistic response is facilitated by the readiness of humans to dehumanize out-group members (Kteily, Hodson, & Bruneau, 2016). Thus, humans are the most ultra-social species on earth but also the most ruthless. Overall, evolutionary theory supports the view that any intensification of out-group aggression could be a by-product of selection for intragroup prosociality late in human evolution (Hare, 2017). In-group favoritism in combination with out-group hostility seems to have emerged simultaneously as highly successful strategies (Choi & Bowles, 2007).

As a species, group living has had the consequence of fostering obligatory interdependence – that is, long-term survival is predicated on the willingness to share information, resources, and help with others. At a fundamental level, humans experience the strong need to create and foster social bonds (Baumeister & Leary, 1995). Our cognitive, emotional, and motivational faculties have been shaped by the demands of this social interdependence. Indeed, humans have hardwired capacities for in-group favoritism, enhanced self-esteem, enhanced group boundaries, group norms, scripts, schemas, conformity, symbolic immortality, and distinct empathic and helping behaviors for in-group compared to out-group members (Mesoudi, 2009). Human beings have a natural proclivity to make distinctions between "us" and "them", which has a clear survival value, but is also a source of bias and prejudice (Diesendruck, 2013). These group biases manifest early in development and carry with them

expectations of behavior and constrain the possible actions individuals believe others will engage in, such as whether two people will be friends or foes, will cooperate or compete, or will help or harm others (Rhodes & Chalik, 2013). For instance, preschoolers reliably expect agents from one group to harm members of the other group (rather than members of their own) but expect agents to help members of both groups equally often (Rhodes, 2012). Strongly held biases typically emerge around groups intimately tied to societally reinforced stereotypes, making them particularly susceptible to individual differences in life experiences (Hirschfeld, 2013).

A sense of kinship may drive individuals to take great risks and even to sacrifice themselves in order to increase the fitness of their family members, tribes, cliques, ethnic communities, and national groups (Trivers, 1985). The fundamental need to establish social bonds that is experienced from birth may encourage human beings to seek "fictive kin,[3]" and even to sacrifice for them (Tobeña, 2009). Through the process of radicalization, individuals establish kinship-like relationships with extremist organizations and may even engage in self-sacrificial behaviors, such as acts of martyrdom, that are expected to enhance the fitness of the community and collective cause it claims to support. Indeed, the Islamic State and many of the world's deadliest terrorist groups organize around kin-like causes. Fictive kinship is one of many social forces that emerge during the process of radicalization. As such social bonds deepen, isolation from groups with competing values and the development of extreme beliefs facilitate interpersonal processes such as obedience, conformity, deindividuation, and dehumanization which, taken together, may set the stage for violence towards innocent individuals (Table 1 for definitions).

Interpersonal processes

Human behavior is influenced, directly and indirectly, by the presence and/or behavior of others. This is manifested in many phenomena studied by social psychology such as social influence, conformity, obedience, or compliance. As demonstrated in now classical work on obedience to authority conducted by Milgram and Zimbardo, almost anyone can be led to perpetrate acts of violence or abuse under the right circumstances and social pressures. Two-thirds of participants administered what they believed were lethal electric shocks to someone who failed a memory test when asked to do so by a researcher in a lab coat (Milgram, 1963). These levels of obedience and of disobedience have remained stable in the 50 years since Milgram's original study (Doliński et al., 2017). A third of college students assigned to play prison guards humiliated and abused students playing prisoners in a simulation (Haney, Banks, & Zimbardo, 1973). These findings make clear the importance of situational factors and group dynamics in creating the circumstances under which ordinary people may carry out acts of violence. Importantly, however, the unwillingness of some participants to act violently or abusively despite their circumstances suggests dispositional factors should not be ignored.

Consistent with this view, recent studies report that a variety of individual dispositions predict the willingness of individuals to administer high-intensity electrical shocks in adapted versions of the Milgram obedience paradigm (Bègue et al., 2015). In one study, obedience was positively associated with trait conscientiousness and agreeableness, which reflect self-discipline and sense of duty as well as the desire to avoid violating social norms, respectively. Obedience was further influenced by political orientation, which is consistent with previous research linking conscientiousness and agreeableness to political ideology (Hirsh, DeYoung, Xu, & Peterson, 2010; Mondak & Halperin, 2008). Relatedly, another study using a similar paradigm found that obedience was associated with authoritarianism and hostility (Dambrun & Vatiné, 2009). Taken together with meta-analytic results showing participants in Milgram disobedience experiments are most likely to disobey (36.88%) when the individual receiving shocks requests release (Packer, 2008), behavioral research clearly indicates that both situational and dispositional factors are indispensable for understanding what drives acts of extreme violence.

Functional neuroimaging research points to empathy as an additional disposition mediating obedience to authority. Individuals who underwent scanning while completing a virtual reality adaptation of the Milgram experiment demonstrated increased activation in regions including the ventrolateral prefrontal cortex and amygdala while viewing virtual avatars in pain (Cheetham, 2009). This pattern of activation was further associated with trait personal distress, which is the emotional component of empathy and indexes sensitivity to discomfort or anxiety when observing the negative experiences of others. Another study reported that individuals who reacted to self-relevant moral statements with blunted activation of the medial prefrontal cortex were more likely to harm outgroup members when competing on a team (Cikara, Jenkins, Dufour, & Saxe, 2014). Relatedly, individuals who

[3]The notion of fictive kin refers to people who are regarded as being part of a family even though they are not related by either blood or marriage bonds. Fictive kinship may bind people together in ties of affection, concern, obligation and responsibility.

Table 1. Interpersonal processes influence and alter individual perceptions, motivations, attitudes, and social behavior.

Social influence	Description
Conformity	Adopting the opinions, attitudes, and/or behaviors of members of a group to which one belongs or wishes to belong
Dehumanization	Denying a person dignity, individuality, and autonomy, ensuring that one's moral standards are not applied
Deindividuation	Refers to loss of identity and its automatic link to irresponsible and antisocial behaviors
Depersonalization	Occurs when one views oneself as an archetypal member of a social group rather than as a unique individual within that group
Diffusion of responsibility	When one feels less responsible for taking an action while in the presence of other people
Essentializing	Attributing natural, essential characteristics to members of specifically defined groups
Obedience to authority	Complying with commands given by an authority figure

responded to moral dilemmas indicating they were willing to sacrifice the lives of out-group members (e.g., the homeless) to benefit the in-group activated medial prefrontal cortex as well as orbitofrontal cortex and dorsolateral prefrontal cortex (Cikara, Farnsworth, Harris, & Fiske, 2010). The medial prefrontal cortex is part of a network including the superior temporal sulcus (pSTS/TPJ) which plays a fundamental role in the attribution of intentions, beliefs, and emotions to oneself and others (see Figure 2).

Socially connected individuals have been shown to dehumanize out-group members and are more willing to endorse harms against dehumanized others (Waytz & Epley, 2012). Individuals who were shown stimuli depicting dehumanized outgroup members responded with increased activation of amygdala and insula, consistent with disgust, as well as blunted ventromedial prefrontal cortex activation (Harris & Fiske, 2006). The cortical network involved in the attribution of mental states allows individuals to compare their own thoughts and feelings to those of others and is central to generating both caring and dehumanizing responses. Perceiving videos depicting drug addicts experiencing physical pain is associated with significantly less neural response than videos depicting control subjects, although the level of pain expressed in the videos is exactly the same (Decety, Echols, & Correll, 2010). When other humans are perceived as having good intentions (being warm) and having the capability to carry them out (being competent), the medial prefrontal cortex modulates empathic responses.

When subjects were allowed to punish in-group and out-group members for norm violations, punishment of in-group members was less likely and was associated with heightened activity and connectivity between the medial

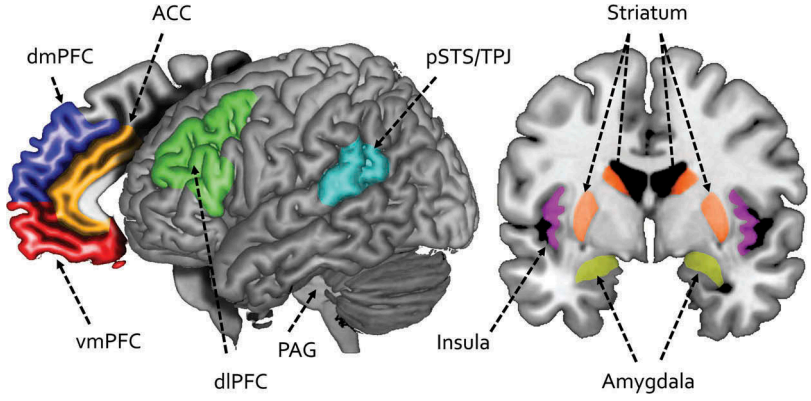

Figure 2. Brain regions implicated in social cognition and decision-making. Converging evidence from social neuroscience indicates that brain regions associated with social cognition are widely distributed and share computational resources with circuits controlling other capacities such as emotional saliency, mental state understanding, valuation of rewards, and decision-making. These regions include the ventromedial prefrontal cortex (vmPFC), dorsolateral prefrontal cortex (dlPFC), dorsomedial prefrontal cortex (dmPFC), anterior cingulate cortex (ACC), posterior superior temporal sulcus (pSTS)/temporoparietal junction (TPJ), amygdala, anterior insula (aINS), striatum, and periaqueductal gray (PAG). The vmPFC plays a critical role in social decision-making. Its connectivity with PAG, hypothalamus, striatum, amygdala, pSTS, allows for the encoding of value and modulation of affective responses. The dlPFC has consistently been implicated in executive functioning, working memory, and response selection, whereas the dmPFC is involved in evaluating social information about relevant mental states, social norms, and contextual factors. The ACC is a broad swath of medial cortex that is thought to perform various functions ranging from conflict monitoring (dorsal ACC) to representing self-conscious and affiliative emotion (pre- and subgenual ACC). The pSTS/TPJ are concerned with representing the bodily states, intentions and beliefs of others. The amygdala prioritizes the affective (positive and negative) relevance of social stimuli. The insula is associated with emotional awareness and empathy, and the striatum is known to play a role in reward and pleasure processes. The PAG is the site of integrated autonomic, behavioral, and antinociceptive stress responses.

prefrontal cortex and pSTS/TPJ. Theory of mind regions become more active, suggesting that people were justifying their groupmates' infractions; the same regions were not as active when out-group members made the same transgressions (Baumgartner, Schiller, Rieskamp, Gianotti, & Knoch, 2014). When there is decreased activity in this mentalizing network, people are more easily able to dehumanize others and are less likely to show empathy, tolerance, or prosociality (Cikara et al., 2014; Harris & Fiske, 2006; Waytz & Epley, 2012). Interestingly, recent work suggests dehumanization may enable morally objectionable acts of violence when these are motivated by a desire to obtain instrumental benefits (Rai, Valdesolo, & Graham, 2017).

Empathy is a powerful motivational force that fosters bonds and caring between conspecifics, and inhibits aggression towards in-group members (Decety, Norman, Berntson, & Cacioppo, 2012). It has a dark side too. People often feel less empathy and motivation to act prosocially towards individuals that belong to different ethnic, political, or social groups (Decety & Cowell, 2014). Longitudinal increases to empathy in Muslim immigrant youths who underwent resilience training aimed at strengthening self-esteem, agency, and empathy were associated with increased negative attitudes towards ideology-based violence (Feddes, Mann, & Doosje, 2015). Conversely, lower trait cognitive empathy (i.e., perspective taking) was positively associated with dogmatism, or an unwavering steadfastness in one's beliefs that is resistant to updating with new information, according to a recent study (J. P. Friedman & Jack, 2017). This same study found that dogmatism was negatively associated with analytic thinking. Activity within a network of brain regions including the ACC, anterior insula (aINS), and periaqueductal gray (PAG) was significantly decreased when healthy volunteers saw physical pain in strangers compared to loved-ones (Cheng, Chen, Lin, Chou, & Decety, 2010). Relatedly, activity within the ACC was blunted in both Caucasian and Chinese participants when viewing racial out-group members in pain compared to racial in-group members (Xu, Zuo, Wang, & Han, 2009). Activity within this network was significantly lower in participants who viewed clips of pained facial expressions in people who had contracted AIDs from illicit drug use rather than from a tainted blood transfusion, even though the clips were carefully matched on facial expression intensity, indicating that *a priori* implicit attitudes toward conspecifics modulate responses to perceptions of distress (Decety et al., 2010). Another study found that greater rival-specific aggression was associated with elevated activity in the ventral striatum, a brain region implicated in reward and pleasure, when watching rivals fail, even against a third party (Cikara, Botvinick, & Fiske, 2011).

Oxytocin, a neuropeptide with widespread targets in both the brain (including the anterior cingulate cortex and amygdala) and periphery, is a silent driver of flexible empathic responding and the lack thereof. Oxytocin has been implicated in the regulation of various behaviors ranging from bonding and attachment to ally selection and intergroup cooperation by making social information more salient (Bartz & Hollander, 2006). Oxytocin increases eye contact, trust and social bonding but also amplifies in-group favoritism. For instance, individuals administered intranasal oxytocin are more likely to humanize in-group rather than out-group members by attributing human-unique emotions to the in-group members and showing increased positive evaluations of them (De Dreu, Greer, Van Kleef, Shalvi, & Handgraaf, 2011). In behavioral economic games, oxytocin reduces the likelihood that male participants will cooperate with out-group members when they are perceived as a threat to in-group members (De Dreu et al., 2011; De Dreu & Kret, 2016). Importantly, individual differences in dispositional empathy as well as sympathetic nervous system responses are predicted by variants of the oxytocin receptor gene (Smith, Porges, Norman, Connelly, & Decety, 2014). Taken together, ordinary people exhibit in-group favoritism coupled with a blunted or diminished empathic responses to out-group members, a tendency that is partly driven by individual differences at the molecular level, that appears to operate outside of conscious control and that may even motivate harm towards rivals.

Micro-sociological processes

Narratives, sacred values, and the quest for significance

In everyday life, humans construct rich narratives that represent causal connections between different events and so imbue these connections with meaning or purpose. Indeed, one of the ways in which humans understand themselves is by generating autobiographical stories, or narrative identities, that represent the self in past, present, and imagined future contexts (McAdams, 2013). Coherent self-identities emerge gradually through adulthood from the integration of such narratives, which may themselves change over time, with social roles, psychological dispositions, motivations, and values (McAdams & McLean, 2013). With the right psychological ingredients in place, narratives can make bad ideas appear attractive and good ideas wholly unappealing. Of particular relevance to the study of radicalization are victimization narratives, or narratives that frame

individuals or social groups as the victims of intentional harm(s) (Pemberton & Aarten, 2017). Attempts to understand experiences of victimization, to assign these experiences meaning, and to reconcile these experiences with one's pre-existing identity may lead to the emergence of new narrative identities (Crossley, 2000). In Palestinian and Dutch Muslim youths, for example, perceiving oneself or one's group as the victim of injustices was associated with greater support for violence and radicalism (Doosje, Loseman, & van den Bos, 2013; Victoroff et al., 2011). It is thus not surprising that propaganda materials produced and distributed by violent extremist organizations in an effort to garner support and to mobilize recruits routinely employ such victimization narratives. They are a powerful means for transmitting emotions and values.

Justice motivation, the capacity for perceiving injustice towards oneself or others and preferences regarding whether to act to restore justice (Decety & Yoder, 2017), plays a central role in victimization narratives. The perception that one's group has been the victim of injustices, whether political, economic, or religious, is believed to play a critical role in motivating acts of terrorism. For instance, Palestinian youths who felt as though their group had received unjust treatment also reported greater support for religio-political aggression (Victoroff et al., 2011). Perceived injustice was also associated with societal disconnectedness and was a determinant of a radical belief system in young Dutch Muslims (Doosje et al., 2013). While concern for justice is a part of human nature and emerges early in ontogeny, some individuals are highly sensitive to injustice. Individuals that are particularly sensitive to injustices are motivated by justice principles rather than emotional contagion and personal distress (Decety & Yoder, 2016). Justice sensitivity has been associated with brain activation in regions thought to perform higher-order computational functions, such as mental state evaluation and goal understanding. Individual dispositions in justice sensitivity predicted neural response in dorsolateral prefrontal cortex (dlPFC), dorsomedial prefrontal cortex (dmPFC), and posterior superior temporal sulcus (pSTS) in participants who were asked to rate scenarios depicting of interpersonal assistance or harm as either morally good or bad (Decety & Yoder, 2017; Yoder & Decety, 2014). Neural activity in these regions predicted participants' praise and blame ratings when they were evaluating prosocial and antisocial behavior. Both empathy and justice motivation are topics of growing interest in social neuroscience, and validated behavioral measures of empathy and justice sensitivity as well as normative functional neuroimaging data describing their neural substrates are available for use in future studies of vulnerability to radicalization (Cheng et al., 2010; Cikara et al., 2011; Decety & Yoder, 2016, 2017; Decety et al., 2010; Xu et al., 2009; Yoder & Decety, 2014).

Experiences of victimization through injustice may occur when one feels as though their sacred values or their group's sacred values have been violated. Sacred values are distinguishable from instrumental or material values in that they incorporate moral and ethical principles and, as such, are insensitive to trade-offs with other values (Atran, Axelrod, & Davis, 2007; Atran & Ginges, 2012). Sacred values may interact with other aspects of individual and group identity to produce a willingness to make costly sacrifices in support of one's group or cause. For instance, in Moroccans living in neighborhoods associated with militant jihad, a willingness to engage in costly sacrifice for Sharia was especially pronounced in individuals who considered Sharia a sacred value (Atran, Sheikh, & Gomez, 2014). Sacred values may also complicate attempts at conflict resolution – Israelis and Palestinians who were presented with hypothetical Israeli-Palestinian peace deals were more strongly opposed when these deals included material incentives but opposition decreased when adversaries were willing to make symbolic concessions relating to their sacred values (Ginges, Atran, Medin, & Shikaki, 2007). A recent functional neuroimaging study reported that sacred values, operationalized as values participants were unwilling to sacrifice in exchange for material gain, were associated with activation in ventrolateral prefrontal cortex and left temporoparietal junction (Berns et al., 2012). Interestingly, activation was not observed in typical value encoding regions which might be expected if individuals process sacred values in terms of utility. The authors interpreted the neural response as reflecting the encoding and retrieval of deontic rules, which they argue suggests sacred values are concerned with what is right or wrong rather than with outcomes (Berns et al., 2012). Violations of sacred, moral values may trigger disgust and/or anger responses (Rozin, Lowery, Imada, & Haidt, 1999; Seidel & Prinz, 2013) that may set the stage for ideologically-motivated violence.

The "significance quest" model provides a framework through which some victimization narratives, such as those constructed around violations of sacred values, can be understood as risk factors for radicalization (Kruglanski et al., 2014; Pemberton & Aarten, 2017). The significance quest refers to the universal need to make a difference, to be noteworthy, and to find one's purpose. On this view, the radicalization process requires the desire for significance, the identification of ideologically-motivated violence as the most appropriate means by which to achieve significance, and the devaluation of competing goals and desires. Victimization narratives may dampen feelings of personal significance and consequently lead to

disconnections between individual narrative identities and "master" societal narratives (Pemberton & Aarten, 2017). Individuals who feel their life stories are at odds with societal narratives often seek understanding through interactions with individuals or groups that have had similar victimization experiences (Pemberton & Aarten, 2017). These people or groups provide alternative "master" narratives that may accord better with individuals' personal narratives. An individual with extreme views on religious fundamentalism, for example, might find the prospect of joining a violent extremist organization attractive if this organization shares their views, and if it can provide a means by which to achieve significance. How, though, do individuals go about developing the kinds of narratives that coincide with the "master" narratives offered up by such organizations? In order words, how do people develop extreme views?

Extreme views

It is critical is to examine how individuals develop extreme opinions and become radicalized, increasing the probability of political violence. Extreme views require unconditional adherence such that other aspects of one's life are made subordinate (Bronner, 2016). The process of radicalization requires strict adherence to extreme thoughts, beliefs, and worldviews (Horgan, 2014), and individuals who become radicalized may sacrifice things they once considered precious (e.g., career, family, friends, freedom), or even innocent lives, in support of their views. Contrary to folk wisdom, however, extremist ideologies are often perfectly rational. Extremists adhere uncompromisingly to their moral worldviews. This strict moral dualism, according to which the distinction between right and wrong is unambiguous, underpins extreme views and provides a rationale for using violence as a means of re-establishing the balance between good and evil. Ordinary people, on the other hand, may compromise their moral values when this suits their interests – that is, they are sufficiently mentally flexible to hold contradictory beliefs (Bronner, 2016). Importantly, the capacity for tolerance towards potential inconsistencies and ambiguities requires mental flexibility, which refers here to the ability to represent knowledge from different perspectives and to shift between sometimes mutually contradictory views. When individuals belong to many different groups, each of these groups influences its members' beliefs, values, and behaviors. Competition between the diverse values held by different groups reduces the power of any one group over its members.

Values are motivational constructs comprised of beliefs imbued with emotion that, when activated, may exert attractive or repulsive forces (Eccles & Wigfield, 2002). Social values have been shown to emerge from co-activation of neural structures that represent social concepts (right superior anterior temporal lobe) and emotional states (fronto-mesolimbic areas) (Zahn et al., 2009). There is a hedonic element to values, where approach and avoidance modulate motivations to engage in behaviors aimed at achieving desirable goals. Motivation includes a global energization factor that varies independently of control demands and behavior direction (Duffy, 1962). Computational neuroscience work indicates that reward-based energization of higher cognitive resources independent of cognitive demands and behavior direction is a central component of human motivation (Kouneiher, Charron, & Koechlin, 2009). This motivational function includes distinct incentive levels that are intimately related to cognitive stages of decision-making.

Functional neuroimaging studies consistently implicate the nucleus accumbens in motivational salience and reward processing across domains. Religious experience (i.e., "feeling the Spirit"), for example, was found to be associated with activation of the nucleus accumbens and ventromedial prefrontal cortex in a small sample of devout Mormons (Ferguson et al., 2016). Importantly, three distinct paradigms revealed nucleus accumbens activation that preceded peak spiritual feelings by several seconds, which suggests doctrinal concepts may become intrinsically rewarding and motivate behavior in individuals who value religious experience. Relatedly, individuals with genetic markers indicative of greater dopamine availability were more likely to hold unfounded beliefs (e.g., suspicious thoughts, belief in the paranormal) (Schmack et al., 2015). Dopamine neurotransmission is vital for pleasure and reward-related cognitive processes, with the dopaminergic projections that comprise the mesolimbic pathway terminating at the nucleus accumbens. Values, then, reflect reasonably stable attributions of worth assigned to sacred and non-sacred people, places, objects, and events, and all individuals hold numerous values with differing subjective rankings.

Individuals who become radicalized by violent organizations usually withdraw from or completely terminate social connections with formal and informal groups and social networks that hold competing values. They establish exclusive bonds with other members of the terrorist group whose ideas, experiences and identities are similar, and members may become tightly knit to the extent that the group serves as a surrogate family. As a consequence, terrorist groups wield enormous influence over the bonds and values of radicalized individuals (see Figure 1). Extremism in general, whether related to animal rights, aesthetic preferences, or political attitudes, is characterized by an unconditional relationship between values and beliefs (Bronner, 2015). The average person,

however, only adheres unconditionally to values that require minimal sacrifice – for example, opposition to child molestation. These values are "trans-subjective" in that they can be applied universally and without damage to the collective well-being (Bronner, 2016). On the contrary, extreme views are weakly trans-subjective, in that they are unlikely to be perceived as convincing enough to propagate throughout a population, and possibly sociopathic, in that they reject competing worldviews. Both of these characteristics are present in the most dangerous extreme views.

Thus, cognitive flexibility is a psychological trait that appears to play a key role in the radicalization process (Hogg, Kruglanski, & van den Bos, 2013). Individuals who are cognitively inflexible and intolerant of ambiguity may become captive audiences for ideological, political, or religious extremists whose simplistic worldviews gloss over nuance. Indeed, cognitive inflexibility has been positively associated with authoritarian aggression, racism, and ethnocentrism (Victoroff, 2005). The related motivational construct of need for cognitive closure, or the desire to reduce ambiguity and uncertainty (Webster & Kruglanski, 1994), has been linked to increased favoritism towards in-group members (Federico, Hunt, & Fisher, 2013) and hostility towards out-group members (De Zavala et al., 2010). Executive functions, of which cognitive flexibility is one aspect, facilitate the selection of actions in response to competing internal goals and are subserved by specific regions of the prefrontal cortex (Miyake et al., 2000). In particular, cognitive control and motivation are integrated via reciprocal connections between the lateral prefrontal cortex, where control signals are represented in a graded fashion along an anterior-posterior axis, and medial prefrontal cortex (Koechlin & Summerfield, 2007; Kouneiher et al., 2009). Interestingly, a recent study reported that lesions to the dorsolateral prefrontal cortex were associated with fundamentalist beliefs, and that this relationship was mediated by cognitive flexibility and trait openness (Zhong, Cristofori, Bulbulia, Krueger, & Grafman, 2017). Functional neuroimaging studies of cognitive inflexibility and other executive functions also consistently implicate the ACC (Shackman et al., 2011). Individuals who were given the opportunity to explain away threatening information about a favored political candidate, for example, demonstrated increased activation in ACC as well as ventral striatum (Westen, Blagov, Harenski, Kilts, & Hamann, 2006). The ACC is a key node in neurobiological models of aggression and violence (Siever, 2008) and error-related activity in this region predicts future antisocial behavior (Aharoni et al., 2013).

Although the neural underpinnings of extremism remain elusive, political neuroscience research suggests political engagement and radicalism are associated with distinctive patterns of neural activation. Politically engaged individuals perceived congruent political attitudes as more emotionally intense and positive compared to individuals who are not politically engaged (Gozzi, Zamboni, Krueger, & Grafman, 2010). Furthermore, interest in politics in that study was associated with greater activation in amygdala and ventral striatum when reading congruent political opinions, suggesting political engagement recruits emotion- and reward-related brain areas. Another neuroimaging experiment found that individuals presented with political statements structured complex political beliefs along three independent dimensions that were reflected in distinctive patterns of neural activation (Zamboni et al., 2009). Individualism, which reflects the spectrum from individualism to collectivism, was associated with activation of the medial prefrontal cortex and posterior superior temporal sulcus, whereas conservatism, which reflects the spectrum from conservatism to liberalism, was associated with activation of the dorsolateral prefrontal cortex. In contrast, the radicalism dimension, which included items such as "People should use violence to pursue political goals", was related to increased activation of the ventral striatum and posterior cingulate. Taken together, there exists a reciprocal relationship between small group dynamics, when ties to groups with competing values are severed, and individual dispositions, such as lack of mental flexibility or intolerance in response to ambiguity, in facilitating extreme beliefs and opinions. Preliminary empirical data further suggest extreme beliefs recruit brain areas implicated in emotion and reward-processing.

Neurobehavioral bases of violent tendencies

One often overlooked aspect of the famous early social psychology experiments on obedience and authority described earlier is that a nontrivial proportion of participants refused to commit violent or abusive acts (Haney et al., 1973; Milgram, 1963). While group dynamics and situational factors undoubtedly facilitate the emergence of violence, vulnerability to these facilitators is likely contingent on individual dispositions. It is beyond the scope of this paper to provide a thorough review of all individual dispositions that may be useful in understanding radicalization and support for ideologically motivated violence. Preliminary evidence, however, points to a number of cognitive, emotional, and motivational factors that may reciprocally interact with group and situational factors to facilitate extremist values and beliefs and violent behavior. The extent to which emotional and motivational factors become interconnected with extreme beliefs may distinguish

those who merely experience sympathy for an extremist cause from those who become motivated to act on its behalf. It is likely that the emotional and motivational factors that drive radicalization, however, are heterogeneous and multifaceted. For example, the inherent risks or promise of exhilaration associated with terrorism may appeal primarily to individuals high in trait novelty seeking or impulsivity (Victoroff, 2005). Of note, three year old children who were "under-controlled" (e.g., impulsive, distractible) were more likely to be involved with crime at 21-years of age (Caspi, Moffitt, Newman, & Silva, 1996).

There exist many pathways to radicalization such that searching for a universal terrorist profile is unlikely to yield fruitful results. Hope is not lost, however – even if a single universal profile is unlikely to exist, there are undoubtedly clusters of recurrent dispositions that may predict vulnerability to different radicalization avenues and behavioral outcomes. A propensity to meet conflict with violence, for example, may reflect one such recurrent disposition. A growing body of research describes molecular, neurobiological, and behavioral predictors of future aggression and violence (Glenn & Raine, 2013). Aggressive behavior measured in children as young as two has been shown to predict future aggression (Cummings, Iannotti, & Zahn-Waxler, 1989; Huesmann, Eron, Lefkowitz, & Walder, 1984). Similar findings have been reported in samples both inside and outside the US and irrespective of demographic variables such as gender (Kokko, Pulkkinen, Huesmann, Dubow, & Boxer, 2009). This suggests aggression and violence are stable dispositions. Indeed, strong links between genetic markers and aggressive, antisocial behavior are well documented in the literature (Glenn & Raine, 2013; Raine, 2013). A large study of approximately 1.3 million adoptees and non-adoptees found that adoptees were more likely to commit violent crimes if their biological parents had a history of criminal violence (Hjalmarsson & Lindquist, 2013). Maltreated children who carry alleles associated with low monoamine oxidase A (MAOA) activity are more likely to develop antisocial behaviors later in life (Caspi et al., 2002). Crucially, this effect was not observed in children whose genotype is associated with high levels of MAOA, suggesting genetic risk factors for violence interact with environmental factors. This just one of over a hundred studies providing evidence for such interactions in giving rise to antisocial behavior (Raine, 2013). This literature underscores the point that, since risk factors for extreme violence may emerge through interactions across levels of organization, a multidisciplinary perspective is urgently needed to understand vulnerability to radicalization. An important direction for future research will be to investigate how a propensity to engage in violent, antisocial behavior interacts with other dispositions (e.g., cognitive inflexibility) and with other levels (e.g., neurochemical) to increase vulnerability to developing extreme views and to becoming radicalized.

Multiple neurochemical systems in addition to MAOA have been implicated in aggressive antisocial behavior (reviewed in Nelson & Trainor, 2007). Serotonergic hypofunction is perhaps one of the most reproducible correlates of aggression (Moore, Scarpa, & Raine, 2002). Acutely impairing serotonergic function with acute tryptophan depletion or by lowering platelet serotonin levels increased aggressive responding to unfair offers in the ultimatum game (Crockett, Clark, Lieberman, Tabibnia, & Robbins, 2010; Emanuele, Brondino, Bertona, Re, & Geroldi, 2008). Impairing serotonin functioning also increased impulsivity (Crockett, Clark, Lieberman et al., 2010). Conversely, serotonergic enhancement with an acute dose of a selective serotonin-reuptake inhibitor increased acceptance of unfair offers in healthy volunteers (Crockett, Clark, Hauser, & Robbins, 2010). Importantly, these same participants judged moral harms as less acceptable, suggesting that serotonin regulates the aversiveness of aggressive responding. The mechanisms by which serotonin modulates such cognitions and behaviors are not well understood but are seemingly contingent on individual differences in impulsivity, emotion regulation, and social abilities (Krakowski, 2003). Serotonin modulates factors at the individual psychological level that may have downstream consequences for group dynamics, and social factors influence serotonergic functioning (Krakowski, 2003). Again, a complete understanding of vulnerability to ideologically motivated violence will not be possible without considering each of these levels and interactions between them.

At the level of the brain, several studies have described neural circuits linked to observing and imagining acts of violence. In one study, for example, participants viewed a series of short visual scenarios depicting intentional harming or helping behaviors while undergoing functional neuroimaging (Decety & Porges, 2011). To examine the relationship of agency (which refers to the feeling of control over one's actions and their consequences) to the neural circuitry engaged in aggression, participants were asked to imagine themselves as either the perpetrator or recipient of these actions. Bilateral amygdala deactivation was detected when participants imagined harming others compared to being harmed. Decreased connectivity between amygdala and ventromedial prefrontal cortex was also observed, as well as increased activation of secondary visual cortex,

posterior thalamus, and striatum. This decrease in ventromedial prefrontal cortex activation is consistent with changes in patterns of responses reported in previous studies of imagined aggression (Pietrini, Guazzelli, Basso, Jaffe, & Grafman, 2000). The vmPFC is critical region for social, motivational and emotional processing (Grafman & Litvan, 1999) and decision-making (Levy & Glimcher, 2016). It is densely interconnected to emotion processing regions including amygdala, periaqueductal gray, temporal poles, and reward processing areas such as the striatum (Carmichael & Price, 1996; Kondo, Saleem, & Price, 2003). There is a large body of fMRI and electrophysiology evidence that the ventromedial prefrontal cortex carries information about the personal subjective value of stimuli or actions (Fellows, 2006). Interestingly, increased activation of thalamus and striatum and decreased ventromedial prefrontal cortex activation have been reported to reflect enjoyment of aggression coupled with a diminished capacity for controlling aggressive behavior (Decety, Michalska, Akitsuki, & Lahey, 2009; Decety & Porges, 2011; Murray, 2007).

A handful of neuroimaging studies have begun shedding light on how situational factors and group dynamics shape attitudes towards killing and how this is represented in the brain. Indeed, although harming conspecifics is morally prohibited, there are circumstances where these prohibitions may be relaxed, as in warfare where killing enemy soldiers is considered justified. Individuals who underwent fMRI scanning while imagining carrying out unjustified acts of killing (e.g., shooting civilians) compared to justified killing (e.g., shooting enemy soldiers) showed increased activation in the orbitofrontal cortex with increased coupling to the temporoparietal junction (Molenberghs et al., 2015). Furthermore, activation of the orbitofrontal cortex was positively associated with feelings of guilt about engaging in acts of unjustified killing. Relatedly, greater neuro-hemodynamic activity was detected in the orbitofrontal cortex, as well increased coupling between the orbitofrontal cortex and amygdala and insula, when individuals viewed harmful behaviors perpetrated by out-group members against in-group members (Molenberghs, Gapp, Wang, Louis, & Decety, 2016). Future studies should investigate whether activation of and connectivity to the orbitofrontal cortex captures individual differences in the processing of extreme violence. Beyond describing the neural correlates of observing or imagining violence, two recent studies have used neuroimaging measures in an attempt to predict future antisocial behavior. Error-related activity in the ACC detected with functional MRI was shown to predict future antisocial behavior in a high-risk population (Aharoni et al., 2013). Relatedly, increased aggression and violence in adult men was predicted by lower amygdala volumes as measured three years prior (Pardini, Raine, Erickson, & Loeber, 2014). An important avenue for future research, then, will be to investigate whether and which neural markers are capable of predicting vulnerability to radicalization.

Moving beyond metaphors

Social neuroscience is important for understanding the full range of collective social behaviors, whether positive (e.g., cooperation and altruism) or negative (e.g., conflict, war and violence). This perspective should appeal to any academic who wishes to better understand the workings of the terrorist mind, such as anthropologists, psychiatrists, economists, or political scientists. As conceptual clarify improves, so too will the design of interventions, the structuring of studies, the selection of future research questions, the specification of hypotheses, and the selection of suitable analytic techniques. Psychologists, intelligence experts, and law enforcement personnel in particular could capitalize on an improved understanding of the complex interplay between individual dispositions and group dynamics to refine prophylactic strategies, to inform counter-terrorism efforts, to encourage disengagement from terrorist organizations, and to improve rehabilitation strategies.

A comprehensive understanding of radicalization and of terrorist psychology more broadly will not be possible, however, without first integrating top-down approaches, according to which the causes of terrorism are political, social, and economic, with bottom-up approaches, according to which terrorism is best understood with reference to the characteristics of terrorist groups and of the individuals that comprise them. Although the literature is brimming with theories and models of radicalization and of terrorism, many of which are couched in catchy metaphors (e.g., the "Staircase to Terrorism"; Moghaddam, 2005), these were intended to provide general frameworks for organizing knowledge in terrorist psychology. In contrast, the comprehensive approach we are advocating may eventually produce working models capable of predicting behavior.

This endeavor is challenging. It is made no less so by the reality that, to understand how social, cognitive, emotional, and motivational processes interact, we will eventually need a computational account that acknowledges the adaptive nature of radicalization and of political violence. The resulting model may look entirely different to anything we might anticipate based on our intuitions or on the extant literature. If true, this

would not necessarily mean that the neural processes that give rise to social cognition and decision-making in the context of radicalization and terrorism are inherently more difficult to characterize than other aspects of cognition or perception. Rather, the problem lies with our "folk" psychology. On the one hand, our intuitive understanding of the world grounds psychological theorizing. The reason social neuroscience is at all understandable is because it uses concepts that are continuous with our common sense understanding of our minds and of the minds of others. On the other hand, our intuitions sometimes get it wrong. It is intuitive, for example, that psychopathy should be a prerequisite for carrying out terrorist attacks that target innocent people. How else could someone do such terrible things without expressing any remorse or guilt? As we have discussed, however, the psychopathy account of terrorism is limited at best.

Putting the pieces together

In this paper, we provide an overview of the putative processes involved in radicalization and extreme political violence, and introduce a new framework, which captures the most critical elements that contribute to research and theory concerning this challenging issue. One central idea developed herein is that most people who become radicalized and resort to extreme violence are rational and should not be considered psychiatric patients. That is, ordinary people can hold extremes views without becoming terrorists. Thus, there are intra-individual characteristics at the molecular and brain organization levels that must be taken into account in explaining why some individuals turn to violence. A second central idea is that no single level of analysis, be it molecular, developmental, or sociological, can alone account for radicalization and propensity to commit acts of terror. Future research needs to incorporate as many levels of enquiry as possible. The utilization of the complementary information provided by perspectives on individual differences, social science, and neuroscience will enhance the identification of determinants and facilitators of radicalization. These different theoretical levels and approaches to measurement can be compressed with mathematical models and computer algorithms. Such information compression has the advantage of reducing complexity of a large proportion of the interindividual variability across levels of analysis and allows for the examination of the extent to which radicalization is driven by a limited number of factors, as well as the relations between variables. Undoubtedly, individual differences across levels of organization moderate the efficacy of rehabilitation strategies. Identifying clusters of recurring factors linked to susceptibility to radicalization, then, will inform tailoring of rehabilitation strategies to the characteristics of radicalized individuals. Molecular, neuroendocrine, and neurocognitive markers will increase confidence in which strategies are likely to be efficacious.

The value of any scientific undertaking hinges on its relevance to pressing social problems and mental health issues. Although social neuroscience alone is neither necessary nor sufficient to address radicalization and political violence, it represents a methodological and theoretical advance that creates an opportunity to address old questions in new ways and uncover new questions about brain function, cognition and behavior. When neuroimaging data are combined with fine-grain conceptual analyses, connectivity analyses, quantitative meta-analyses, lesion studies, and other sources of information (e.g., genetics, hormones, electrophysiology) across disciplines (e.g., anthropology, sociology, political science and behavioral economics), they can significantly advance theorizing about the human mind and social behavior (Decety & Cacioppo, 2010). Theory guides scientists when they select research questions, structure studies, specify hypotheses, choose analyses, and design interventions, and it connects the dots in order to reveal the bigger picture (Gray, 2017). Additional clarity can be achieved by complementing theorizing with unconstrained, bottom-up approaches according to which the latent drivers of radicalization emerge from interactions between basic psychological processes, representations and motivations. Mapping the complex cognitive, motivational and social processes onto brain mechanisms that mediate or drive radicalization and potential violent outcomes is an iterative way to make progress, bootstrapping our understanding with improvements occurring in each successive iteration.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by a grant from the US Department of Defense - Office of Naval Research (FP060231-01-PR).

References

Aharoni, E., Vincent, G. M., Harenski, C. L., Calhoun, V. D., Sinnott-Armstrong, W., Gazzaniga, M. S., & Kiehl, K. A. (2013). Neuroprediction of future rearrest. *Proceedings of the National Academy of Sciences*, *110*(15), 6223–6228. doi:10.1073/pnas.1219302110

Ahn, W. Y., Kishida, K. T., Gu, X., Lohrenz, T., Harvey, A., Alford, J. R., … Montague, P. R. (2014). Nonpolitical images evoke neural predictors of political ideology. *Current Biology*, *24* (22), 2693–2699. doi:10.1016/j.cub.2014.09.050

Amodio, D. M., Jost, J. T., Master, S. L., & Yee, C. M. (2007). Neurocognitive correlates of liberalism and conservatism. *Nature Neuroscience*, *10*(10), 1246–1247. doi:10.1038/nn1979

Atran, S. (2003). Genesis of suicide terrorism. *Science*, *299* (5612), 1534–1539. doi:10.1126/science.1078854

Atran, S., Axelrod, R., & Davis, R. (2007). Sacred barriers to conflict resolution. *Science*, *317*(5841), 1039–1040. doi:10.1126/science.1144241

Atran, S., & Ginges, J. (2012). Religious and sacred imperatives in human conflict. *Science*, *336*(6083), 855–857. doi:10.1126/science.1216902

Atran, S., Sheikh, H., & Gomez, A. (2014). For cause and comrade: Devoted actors and willingness to fight. *Cliodynamics: the Journal of Quantitative History and Cultural Evolution*, *5*, 1. doi:10.21237/C7CLIO5124900

Bartz, J. A., & Hollander, E. (2006). The neuroscience of affiliation: Forging links between basic and clinical research on neuropeptides and social behavior. *Hormones and Behavior*, *50*(4), 518–528. doi:10.1016/j.yhbeh.2006.06.018

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*(3), 497–529. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/7777651

Baumgartner, T., Schiller, B., Rieskamp, J., Gianotti, L. R. R., & Knoch, D. (2014). Diminishing parochialism in intergroup conflict by disrupting the right temporo-parietal junction. *Social Cognitive and Affective Neuroscience*, *9*(5), 653–660. doi:10.1093/scan/nst023

Bègue, L., Beauvois, J.-L., Courbet, D., Oberlé, D., Lepage, J., & Duke, A. A. (2015). Personality predicts obedience in a Milgram paradigm. *Journal of Personality*, *83*(3), 299–306. doi:10.1111/jopy.12104

Berns, G. S., Bell, E., Capra, C. M., Prietula, M. J., Moore, S., Anderson, B., … Atran, S. (2012). The price of your soul: Neural evidence for the non-utilitarian representation of sacred values. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *367*(1589), 754–762. doi:10.1098/rstb.2011.0262

Boehm, C., Barclay, H. B., Dentan, R. K., Dupre, M.-C., Hill, J. D., Kent, S., … Rayner, S. (1993). Egalitarian behavior and reverse dominance hierarchy [and comments and reply]. *Current Anthropology*, *34*(3), 227–254. doi:10.1086/204166

Boyd, R. T., & Richerson, P. J. (2009). Culture and the evolution of human cooperation. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1533), 3281–3288. doi:10.1098/rstb.2009.0134

Bronner, G. (2015). Terrorism and rationality. In G. Manzo (Ed.), *Theories and social mechanisms: Essays in honour of Mohamed Cherkaoui* (p. 858). Oxford, UK: The Bardwell Press.

Bronner, G. (2016). *La pensée extrême: Comment des hommes ordinaires deviennent des fanatiques* [Extreme thoughts: How ordinary people become fanatic]. Paris: Presses Universitaires de France.

Burton-Chellew, M. N., & West, S. A. (2012). Pseudocompetition among groups increases human cooperation in a public-goods game. *Animal Behaviour*, *84*(4), 947–952. doi:10.1016/j.anbehav.2012.07.019

Cacioppo, J. T., Amaral, D. G., Blanchard, J. J., Cameron, J. L., Carter, C. S., Crews, D., … Quinn, K. J. (2007). Social neuroscience: Progress and implications for mental health. *Perspectives on Psychological Science*, *2*(2), 99–123. doi:10.1111/j.1745-6916.2007.00032.x

Cacioppo, J. T., & Berntson, G. G. (1992). Social psychological contributions to the decade of the brain: Doctrine of multilevel analysis. *American Psychologist*, *47*(8), 1019–1028. doi:10.1037/0003-066X.47.8.1019

Cacioppo, J. T., Berntson, G. G., & Decety, J. (2010). Social neuroscience and its relationship to social psychology. *Social Cognition*, *28*(6), 675–685. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/24409007

Cacioppo, J. T., Cacioppo, S., Dulawa, S., & Palmer, A. A. (2014). Social neuroscience and its potential contribution to psychiatry. *World Psychiatry*, *13*(2), 131–139. doi:10.1002/wps.20118

Cacioppo, J. T., Cacioppo, S., & Petty, R. E. E. (2017). The neuroscience of persuasion: A review with an emphasis on issues and opportunities. *Social Neuroscience*, 1–44. doi:10.1080/17470919.2016.1273851

Cacioppo, J. T., & Decety, J. (2011). An introduction to social neuroscience. In J. Decety & J. T. Cacioppo (Eds.), *The Oxford handbook of social neuroscience* (p. 3–8). New York, NY: Oxford University Press.

Cacioppo, J. T., & Visser, P. S. (2003). Political psychology and social neuroscience: Strange bedfellows or comrades in arms? *Political Psychology*, *24*(4), 647–656. doi:10.1046/j.1467-9221.2003.00345.x

Carmichael, S. T., & Price, J. L. (1996). Connectional networks within the orbital and medial prefrontal cortex of macaque monkeys. *Journal of Comparative Neurology*, *371*(2), 179–207.

Caspi, A., McClay, J., Moffitt, T. E., Mill, J., Martin, J., Craig, I. W., … Poulton, R. (2002). Role of genotype in the cycle of violence in maltreated children. *Science*, *297*(5582), 851–854. doi:10.1126/science.1072290

Caspi, A., Moffitt, T. E., Newman, D. L., & Silva, P. A. (1996). Behavioral observations at age 3 years predict adult psychiatric disorders. *Archives of General Psychiatry*, *53*(11), 1033–1039. doi:10.1007/978-1-4419-0641-0

Cheetham, M. (2009). Virtual Milgram: Empathic concern or personal distress? Evidence from functional MRI and dispositional measures. *Frontiers in Human Neuroscience*, *3* (October), 29. doi:10.3389/neuro.09.029.2009

Cheng, Y., Chen, C., Lin, C.-P., Chou, K.-H., & Decety, J. (2010). Love hurts: An fMRI study. *NeuroImage*, *51*(2), 923–929. doi:10.1016/j.neuroimage.2010.02.047

Choi, J.-K., & Bowles, S. (2007). The coevolution of parochial altruism and war. *Science*, *318*(5850), 636–640. doi:10.1126/science.1144237

Cikara, M., Botvinick, M. M., & Fiske, S. T. (2011). Us versus them: Social identity shapes neural responses to intergroup competition and harm. *Psychological Science*, *22*(3), 306–313. doi:10.1177/0956797610397667

Cikara, M., Farnsworth, R. A., Harris, L. T., & Fiske, S. T. (2010). On the wrong side of the trolley track: Neural correlates of relative social valuation. *Social Cognitive and Affective Neuroscience*, *5*(4), 404–413. doi:10.1093/scan/nsq011

Cikara, M., Jenkins, A. C., Dufour, N., & Saxe, R. (2014). Reduced self-referential neural response during intergroup competition predicts competitor harm. *NeuroImage*, *96*(5), 36–43. doi:10.1016/j.neuroimage.2014.03.080

Crockett, M. J., Clark, L., Hauser, M. D., & Robbins, T. W. (2010). Serotonin selectively influences moral judgment and

behavior through effects on harm aversion. *Proceedings of the National Academy of Sciences*, *107*(40), 17433–17438. doi:10.1073/pnas.1009396107

Crockett, M. J., Clark, L., Lieberman, M. D., Tabibnia, G., & Robbins, T. W. (2010). Impulsive choice and altruistic punishment are correlated and increase in tandem with serotonin depletion. *Emotion (Washington, D.C.)*, *10*(6), 855–862. doi:10.1037/a0019861

Crossley, M. L. (2000). Narrative psychology, trauma, and the study of self/identity. *Theory & Psychology*, *10*(4), 527–546. doi:10.1177/0959354300104005

Cummings, E. M., Iannotti, R. J., & Zahn-Waxler, C. (1989). Aggression between peers in early childhood: Individual continuity and developmental change. *Child Development*, *60*(4), 887–895. doi:10.1111/1467-8624.ep9676167

Cunningham, W. A., Van Bavel, J. J., & Johnsen, I. R. (2008). Affective flexibility: Evaluative processing goals shape amygdala activity. *Psychological Science*, *19*(2), 152–160. doi:10.1111/j.1467-9280.2008.02061.x

Dambrun, M., & Vatiné, E. (2009). Reopening the study of extreme social behaviors: Obedience to authority within an immersive video environment. *European Journal of Social Psychology*, 94(1),n/a-n/a. doi:10.1002/ejsp.646

De Dreu, C. K. W., Greer, L. L., Van Kleef, G. A., Shalvi, S., & Handgraaf, M. J. J. (2011). Oxytocin promotes human ethnocentrism. *Proceedings of the National Academy of Sciences*, *108*(4), 1262–1266. doi:10.1073/pnas.1015316108

De Dreu, C. K. W., & Kret, M. E. (2016). Oxytocin conditions intergroup relations through upregulated in-group empathy, cooperation, conformity, and defense. *Biological Psychiatry*, *79*(3), 165–173. doi:10.1016/j.biopsych.2015.03.020

De Zavala, A. G., Cislak, A., Wesolowska, E., Golec de Zavala, A., Cislak, A., Wesolowska, E., … Wesolowska, E. (2010). Political conservatism, need for cognitive closure, and intergroup hostility. *Political Psychology*, *31*(4), 521–541. doi:10.1111/j.1467-9221.2010.00767.x

Decety, J., & Cacioppo, J. (2010). Frontiers in human neuroscience: The golden triangle and beyond. *Perspectives on Psychological Science*, *5*(6), 767–771. doi:10.1177/1745691610388780

Decety, J., & Cowell, J. M. (2014). Friends or foes: Is empathy necessary for moral behavior? *Perspectives on Psychological Science*, *9*(5), 525–537. doi:10.1177/1745691614545130

Decety, J., Echols, S., & Correll, J. (2010). The blame game: The effect of responsibility and social stigma on empathy for pain. *Journal of Cognitive Neuroscience*, *22*(5), 985–997. doi:10.1162/jocn.2009.21266

Decety, J., & Jackson, P. L. (2004). The functional architecture of human empathy. *Behavioral and Cognitive Neuroscience Reviews*, *3*(2), 71–100. doi:10.1177/1534582304267187

Decety, J., Michalska, K. J., Akitsuki, Y., & Lahey, B. B. (2009). Atypical empathic responses in adolescents with aggressive conduct disorder: A functional MRI investigation. *Biological Psychology*, *80*(2), 203–211. doi:10.1016/j.biopsycho.2008.09.004

Decety, J., Norman, G. J., Berntson, G. G., & Cacioppo, J. T. (2012). A neurobehavioral evolutionary perspective on the mechanisms underlying empathy. *Progress in Neurobiology*, *98*(1), 38–48. doi:10.1016/j.pneurobio.2012.05.001

Decety, J., & Porges, E. C. (2011). Imagining being the agent of actions that carry different moral consequences: An fMRI study. *Neuropsychologia*, *49*(11), 2994–3001. doi:10.1016/j.neuropsychologia.2011.06.024

Decety, J., & Yoder, K. J. (2016). Empathy and motivation for justice: Cognitive empathy and concern, but not emotional empathy, predict sensitivity to injustice for others. *Social Neuroscience*, *11*(1), 1–14. doi:10.1080/17470919.2015.1029593

Decety, J., & Yoder, K. J. (2017). The emerging social neuroscience of justice motivation. *Trends in Cognitive Sciences*, *21*(1), 6–14. doi:10.1016/j.tics.2016.10.008

Diesendruck, G. (2013). Essentialism: The development of a simple, but potentially dangerous, idea. In M. Banaji & S. Gelman (Eds.), *Navigating the social world: What infants, children, and other species can teach us* (pp. 263–268). New York, NY: Oxford University Press.

Doliński, D., Grzyb, T., Folwarczny, M., Grzybała, P., Krzyszycha, K., Martynowska, K., & Trojanowski, J. (2017). Would you deliver an electric shock in 2015? Obedience in the experimental paradigm developed by Stanley Milgram in the 50 years following the original studies. *Social Psychological and Personality Science*, 194855061769306. doi:10.1177/1948550617693060

Doosje, B., Loseman, A., & van den Bos, K. (2013). Determinants of radicalization of Islamic youth in the Netherlands: Personal uncertainty, perceived injustice, and perceived group threat. *Journal of Social Issues*, *69*(3), 586–604. doi:10.1111/josi.12030

Duffy, E. (1962). *Activation and behavior*. New York, NY: Wiley.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, *53*(1), 109–132. doi:10.1146/annurev.psych.53.100901.135153

Emanuele, E., Brondino, N., Bertona, M., Re, S., & Geroldi, D. (2008). Relationship between platelet serotonin content and rejections of unfair offers in the ultimatum game. *Neuroscience Letters*, *437*(2), 158–161. doi:10.1016/j.neulet.2008.04.006

Eres, R., Decety, J., Louis, W. R., & Molenberghs, P. (2015). Individual differences in local gray matter density are associated with differences in affective and cognitive empathy. *NeuroImage*, *117*, 305–310. doi:10.1016/j.neuroimage.2015.05.038

Feddes, A. R., Mann, L., & Doosje, B. (2015). Increasing self-esteem and empathy to prevent violent radicalization: A longitudinal quantitative evaluation of a resilience training focused on adolescents with a dual identity. *Journal of Applied Social Psychology*, 400–411. doi:10.1111/jasp.12307

Federico, C. M., Hunt, C. V., & Fisher, E. L. (2013). Uncertainty and status-based asymmetries in the distinction between the "good" us and the "bad" them: Evidence that group status strengthens the relationship between the need for cognitive closure and extremity in intergroup differentiation. *Journal of Social Issues*, *69*(3), 473–494. doi:10.1111/josi.12025

Fellows, L. K. (2006). Deciding how to decide: Ventromedial frontal lobe damage affects information acquisition in multi-attribute decision making. *Brain*, *129*(4), 944–952. doi:10.1093/brain/awl017

Ferguson, M. A., Nielsen, J. A., King, J. B., Dai, L., Giangrasso, D. M., Holman, R., … Anderson, J. S. (2016). Reward, salience, and attentional networks are activated by religious experience in devout Mormons. *Social Neuroscience*, *0*(0), 1–13. doi:10.1080/17470919.2016.1257437

Friedman, J. P., & Jack, A. I. (2017). What makes you so sure? Dogmatism, fundamentalism, analytic thinking, perspective taking and moral concern in the religious and nonreligious. *Journal of Religion and Health*, 1–34. doi:10.1007/s10943-017-0433-x

Gerber, A. S., Huber, G. A., Doherty, D., Dowling, C. M., & Ha, S. E. (2010). Personality and political attitudes: Relationships

across issue domains and political contexts. *American Political Science Review*, *104*(1), 111–133. doi:10.1017/S0003055410000031

Ginges, J., Atran, S., Medin, D., & Shikaki, K. (2007). Sacred bounds on rational resolution of violent political conflict. *Proceedings of the National Academy of Sciences*, *104*(18), 7357–7360. doi:10.1073/pnas.0701768104

Glenn, A. L., & Raine, A. (2013). Neurocriminology: Implications for the punishment, prediction and prevention of criminal behaviour. *Nature Reviews Neuroscience*, *15*(1), 54–63. doi:10.1038/nrn3640

Gozzi, M., Zamboni, G., Krueger, F., & Grafman, J. (2010). Interest in politics modulates neural activity in the amygdala and ventral striatum. *Human Brain Mapping*, *31*(11), 1763–1771. doi:10.1002/hbm.20976

Grafman, J., & Litvan, I. (1999). Importance of deficits in executive functions. *The Lancet*, *354*(9194), 1921–1923. doi:10.1016/S0140-6736(99)90438-5

Gray, K. (2017). How to map theory. *Perspectives on Psychological Science*, *12* (5), 731 - 741.

Haney, C., Banks, C., & Zimbardo, P. (1973). A study of prisioners and guards in a simulated prison. *Naval Research Reviews*, *30*, 4–17. doi:10.1037/h0076835

Hare, B. (2017). Survival of the friendliest: Homo sapiens evolved via selection for prosociality. *Annual Review of Psychology*, 68(1), annurev-psych-010416-044201. doi:10.1146/annurev-psych-010416-044201

Harris, L. T., & Fiske, S. T. (2006). Dehumanizing the lowest of the low. *Psychological Science*, *17*(10), 847–853. doi:10.1111/j.1467-9280.2006.01793.x

Hibbing, J. R., Smith, K. B., & Alford, J. R. (2014). Differences in negativity bias underlie variations in political ideology. *Behavioral and Brain Sciences*, *37*(3), 297–307. doi:10.1017/S0140525X13001192

Hirschfeld, L. A. (2013). The myth of mentalizing and the primacy of folk sociology. In M. Banaji & S. Gelman (Eds.), *Navigating the social world: What infants, children, and other species can teach us* (pp. 101–106). New York, NY: Oxford University Press.

Hirsh, J. B., DeYoung, C. G., Xu, X., & Peterson, J. B. (2010). Compassionate liberals and polite conservatives: Associations of agreeableness with political ideology and moral values. *Personality and Social Psychology Bulletin*, *36* (5), 655–664. doi:10.1177/0146167210366854

Hjalmarsson, R., & Lindquist, M. J. (2013). The origins of intergenerational associations in crime: Lessons from Swedish adoption data. *Labour Economics*, *20*, 68–81. doi:10.1016/j.labeco.2012.11.001

Hogg, M. A., Kruglanski, A., & van den Bos, K. (2013). Uncertainty and the roots of extremism. *Journal of Social Issues*, *69*(3), 407–418. doi:10.1111/josi.12021

Horgan, J. (2014). *The psychology of terrorism* (2nd ed.). New York, NY: Routledge.

Huesmann, L. R., Eron, L. D., Lefkowitz, M. M., & Walder, L. O. (1984). Stability of aggression over time and generations. *Developmental Psychology*, *20*(6), 1120–1134. doi:10.1037/0012-1649.20.6.1120

Jost, J. T., & Amodio, D. M. (2012). Political ideology as motivated social cognition: Behavioral and neuroscientific evidence. *Motivation and Emotion*, *36*(1), 55–64. doi:10.1007/s11031-011-9260-7

Jost, J. T., Glaser, J., Kruglanski, A. W., & Sulloway, F. J. (2003). Exceptions that prove the rule–Using a theory of motivated social cognition to account for ideological incongruities and political anomalies: Reply to Greenberg and Jonas (2003). *Psychological Bulletin*, *129*(3), 383–393. doi:10.1037/0033-2909.129.3.383

Jost, J. T., Nam, H. H., Amodio, D. M., & Van Bavel, J. J. (2014). Political neuroscience: The beginning of a beautiful friendship. *Political Psychology*, *35*(SUPPL.1), 3–42. doi:10.1111/pops.12162

Kanai, R., Feilden, T., Firth, C., & Rees, G. (2011). Political orientations are correlated with brain structure in young adults. *Current Biology*, *21*(8), 677–680. doi:10.1016/j.cub.2011.03.017

Kaplan, J. T., Gimbel, S. I., & Harris, S. (2016). Neural correlates of maintaining one's political beliefs in the face of counterevidence. *Scientific Reports*, *6*(December), 39589. doi:10.1038/srep39589

Koechlin, E., & Summerfield, C. (2007). An information theoretical approach to prefrontal executive function. *Trends in Cognitive Sciences*, *11*(6), 229–235. doi:10.1016/j.tics.2007.04.005

Kokko, K., Pulkkinen, L., Huesmann, L. R., Dubow, E. F., & Boxer, P. (2009). Intensity of aggression in childhood as a predictor of different forms of adult aggression: A two-country (Finland and the United States) analysis. *Journal of Research on Adolescence*, *19*(1), 9–34. doi:10.1111/j.1532-7795.2009.00579.x

Kondo, H., Saleem, K. S., & Price, J. L. (2003). Differential connections of the temporal pole with the orbital and medial prefrontal networks in macaque monkeys. *Journal of Comparative Neurology*, *465*(4), 499–523. doi:10.1002/cne.10842

Koski, J. E., Xie, H., & Olson, I. R. (2015). Understanding social hierarchies: The neural and psychological foundations of status perception. *Social Neuroscience*, *10*(5), 527–550. doi:10.1080/17470919.2015.1013223

Kouneiher, F., Charron, S., & Koechlin, E. (2009). Motivation and cognitive control in the human prefrontal cortex. *Nature Neuroscience*, *12*(7), 939–945. doi:10.1038/nn.2321

Krakauer, J. W., Ghazanfar, A. A., Gomez-Marin, A., MacIver, M. A., & Poeppel, D. (2017). Neuroscience needs behavior: Correcting a reductionist bias. *Neuron*, *93*(3), 480–490. doi:10.1016/j.neuron.2016.12.041

Krakowski, M. (2003). Violence and serotonin: Influence of impulse control, affect regulation, and social functioning. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *15* (3), 294–305. doi:10.1176/jnp.15.3.294

Kruglanski, A. W., Gelfand, M. J., Bélanger, J. J., Sheveland, A., Hetiarachchi, M., & Gunaratna, R. (2014). The psychology of radicalization and deradicalization: How significance quest impacts violent extremism. *Political Psychology*, *35*(Suppl.1), 69–93. doi:10.1111/pops.12163

Kteily, N., Hodson, G., & Bruneau, E. (2016). They see us as less than human: Metadehumanization predicts intergroup conflict via reciprocal dehumanization. *Journal of Personality and Social Psychology*, *110*(3), 343–370. doi:10.1037/pspa0000044

Kurzban, R., Burton-Chellew, M. N., & West, S. A. (2015). The evolution of altruism in humans. *Annual Review of Psychology*, *66*(1), 575–599. doi:10.1146/annurev-psych-010814-015355

Levy, D., & Glimcher, P. W. (2016). Common value representation-a neuroeconomics perspective. In T. Brosch & D. Sander (Eds.), *Handbook of value: Perspective from economics, neuroscience, philosophy, psychology and sociology* (pp.

85–118). Oxford, UK: Oxford University Press. doi:10.1093/acprof:oso/9780198716600.003.0005

Marean, C. W. (2015). The most invasive species of all. *Scientific American*, *313*(August), 33–39. doi:10.1038/scientificamerican0815-32

McAdams, D. P. (2013). The psychological self as actor, agent, and author. *Perspectives on Psychological Science*, *8*(3), 272–295. doi:10.1177/1745691612464657

McAdams, D. P., & McLean, K. C. (2013). Narrative identity. *Current Directions in Psychological Science*, *22*(3), 233–238. doi:10.1177/0963721413475622

McCauley, C. (2007). Psychological issues in understanding terrorism ad the response to terrorism. In B. Bongar, L. M. Brown, L. E. Beutler, J. N. Breckenridge, & P. G. Zimbardo (Eds.), *Psychology of terrorism* (pp. 13–31). New York, NY: Oxford University Press.

Mesoudi, A. (2009). How cultural evolutionary theory can inform social psychology and vice versa. *Psychological Review*, *116*(4), 929–952. doi:10.1037/a0017062

Milgram, S. (1963). Behavioral study of obedience. *The Journal of Abnormal and Social Psychology*, *67*(4), 371–378. doi:10.1037/h0040525

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, *41*(1), 49–100. doi:10.1006/cogp.1999.0734

Moghaddam, F. M. (2005). The staircase to terrorism: A psychological exploration. *American Psychologist*, *60*(2), 161–169. doi:10.1037/0003-066X.60.2.161

Molenberghs, P., Gapp, J., Wang, B., Louis, W. R., & Decety, J. (2016). Increased moral sensitivity for outgroup perpetrators harming ingroup members. *Cerebral Cortex*, *26*(1), 225–233. doi:10.1093/cercor/bhu195

Molenberghs, P., Ogilvie, C., Louis, W. R., Decety, J., Bagnall, J., & Bain, P. G. (2015). The neural correlates of justified and unjustified killing: An fMRI study. *Social Cognitive and Affective Neuroscience*, *10*(10), 1397–1404. doi:10.1093/scan/nsv027

Mondak, J. J., & Halperin, K. D. (2008). A framework for the study of personality and political behaviour. *British Journal of Political Science*, *38*(2), 335–362. doi:10.1017/S0007123408000173

Moore, T. M., Scarpa, A., & Raine, A. (2002). A meta-analysis of serotonin metabolite 5-HIAA and antisocial behavior. *Aggressive Behavior*, *28*(4), 299–316. doi:10.1002/ab.90027

Murray, E. A. (2007). The amygdala, reward and emotion. *Trends in Cognitive Sciences*, *11*(11), 489–497. doi:10.1016/j.tics.2007.08.013

Nelson, R. J., & Trainor, B. C. (2007). Neural mechanisms of aggression. *Nature Reviews Neuroscience*, *8*(7), 536–546. doi:10.1038/nrn2174

Packer, D. J. (2008). Identifying systematic disobedience in Milgram's obedience experiments: A meta-analytic review. *Perspectives on Psychological Science*, *3*(4), 301–304. doi:10.1111/j.1745-6924.2008.00080.x

Pardini, D. A., Raine, A., Erickson, K., & Loeber, R. (2014). Lower amygdala volume in men is associated with childhood aggression, early psychopathic traits, and future violence. *Biological Psychiatry*, *75*(1), 73–80. doi:10.1016/j.biopsych.2013.04.003

Pemberton, A., & Aarten, P. G. M. (2017). Narrative in the study of victimological processes in terrorism and political violence: An initial exploration. *Studies in Conflict & Terrorism*, *0*(0), 1–16. doi:10.1080/1057610X.2017.1311110

Pietrini, P., Guazzelli, M., Basso, G., Jaffe, K., & Grafman, J. (2000). Neural correlates of imaginal aggressive behavior assessed by positron emission tomography in healthy subjects. *American Journal of Psychiatry*, *157*(11), 1772–1781. doi:10.1176/appi.ajp.157.11.1772

Rai, T. S., Valdesolo, P., & Graham, J. (2017). Dehumanization increases instrumental violence, but not moral violence. *Proceedings of the National Academy of Sciences*, *114*(32), 8511–8516. doi:10.1073/pnas.1705238114

Raine, A. (2013). *The anatomy of violence: The biological roots of crime*. New York, NY: Pantheon Books.

Rhodes, M. (2012). Naïve theories of social groups. *Child Development*, *83*(6), 1900–1916. doi:10.1111/j.1467-8624.2012.01835.x

Rhodes, M., & Chalik, L. (2013). Social categories as markers of intrinsic interpersonal obligations. *Psychological Science*, *24*(6), 999–1006. doi:10.1177/0956797612466267

Roy, O. (2017). *Jihad and death: The global appeal of Islamic State*. London: C. Hurst & Co.

Rozin, P., Lowery, L., Imada, S., & Haidt, J. (1999). The CAD triad hypothesis: A mapping between three moral emotions (contempt, anger, disgust) and three moral codes (community, autonomy, divinity). *Journal of Personality and Social Psychology*, *76*(4), 574–586. doi:10.1037/0022-3514.76.4.574

Schmack, K., Rössler, H., Sekutowicz, M., Brandl, E. J., Müller, D. J., Petrovic, P., & Sterzer, P. (2015). Linking unfounded beliefs to genetic dopamine availability. *Frontiers in Human Neuroscience*, *9*(September), 521. doi:10.3389/fnhum.2015.00521

Schreiber, D., Fonzo, G., Simmons, A. N., Dawes, C. T., Flagan, T., Fowler, J. H., & Paulus, M. P. (2013). Red brain, blue brain: Evaluative processes differ in Democrats and Republicans. *PLoS One*, *8*(2), e52970. doi:10.1371/journal.pone.0052970

Seidel, A., & Prinz, J. (2013). Sound morality: Irritating and icky noises amplify judgments in divergent moral domains. *Cognition*, *127*(1), 1–5. doi:10.1016/j.cognition.2012.11.004

Shackman, A. J., Salomons, T. V., Slagter, H. A., Fox, A. S., Winter, J. J., & Davidson, R. J. (2011). The integration of negative affect, pain and cognitive control in the cingulate cortex. *Nature Reviews Neuroscience*, *12*(3), 154–167. doi:10.1038/nrn2994

Siever, L. J. (2008). Neurobiology of aggression and violence. *American Journal of Psychiatry*, *165*(4), 429–442. doi:10.1176/appi.ajp.2008.07111774

Smith, K. B., Oxley, D., Hibbing, M. V., Alford, J. R., & Hibbing, J. R. (2011). Disgust sensitivity and the neurophysiology of left-right political orientations. *PLoS One*, *6*, 10. doi:10.1371/journal.pone.0025552

Smith, K. E., Porges, E. C., Norman, G. J., Connelly, J. J., & Decety, J. (2014). Oxytocin receptor gene variation predicts empathic concern and autonomic arousal while perceiving harm to others. *Social Neuroscience*, *9*(1), 1–9. doi:10.1080/17470919.2013.863223

Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. *Developmental Review*, *28*(1), 78–106. doi:10.1016/j.dr.2007.08.002

Taylor, S. E. (2011). Social support: A review. In H. S. Friedman (Ed.), *The handbook of health psychology* (pp. 189–214). New York, NY: Oxford University Press.

Tobeña, A. (2009). Lethal altruists: Itineraries along the dark outskirts of moralistic prosociality. *Annals of the New York Academy of Sciences*, *1167*, 5–15. doi:10.1111/j.1749-6632.2009.04542.x

Tomasello, M. (2009). *Why we cooperate*. Cambridge, MA: MIT Press.

Trivers, R. L. (1985). *Social evolution*. Menlo Park, CA: Benjamin/Cummings.

Uchino, B. N., Smith, T. W., Birmingham, W., & Carlisle, M. (2011). Social neuroscientific pathways linking social support to health. In J. Decety & J. T. Cacioppo (Eds.), *The Oxford handbook of social neuroscience* (pp. 804–813). New York, NY: Oxford University Press.

Victoroff, J. (2005). The mind of the terrorist: A review and critique of psychological approaches. *Journal of Conflict Resolution*, *49*(1), 3–42. doi:10.1177/0022002704272040

Victoroff, J., Quota, S., Adelman, J. R., Celinska, B., Stern, N., Wilcox, R., & Sapolsky, R. M. (2011). Support for religio-political aggression among teenaged boys in Gaza: Part II: Neuroendocrinological findings. *Aggressive Behavior*, *37*(2), 121–132. doi:10.1002/ab.20376

Waytz, A., & Epley, N. (2012). Social connection enables dehumanization. *Journal of Experimental Social Psychology*, *48*(1), 70–76. doi:10.1016/j.jesp.2011.07.012

Webster, D. M., & Kruglanski, A. W. (1994). Individual differences in need for cognitive closure. *Journal of Personality and Social Psychology*, *67*(6), 1049–1062. doi:10.1037/0022-3514.67.6.1049

Westen, D., Blagov, P. S., Harenski, K., Kilts, C., & Hamann, S. (2006). Neural bases of motivated reasoning: An fMRI study of emotional constraints on partisan political judgment in the 2004 U.S. Presidential election. *Journal of Cognitive Neuroscience*, *18*(11), 1947–1958. doi:10.1162/jocn.2006.18.11.1947

Willingham, D. T., & Dunn, E. W. (2003). What neuroimaging and brain localization can do, cannot do and should not do for social psychology. *Journal of Personality and Social Psychology*, *85*(4), 662–671. doi:10.1037/0022-3514.85.4.662

Wrangham, R. W. (1999). Evolution of coalitionary killing. *American Journal of Physical Anthropology, Suppl*, *29*, 1–30. doi:10.1002/(SICI)1096-8644(1999)110:29+<1::AID-AJPA2>3.0.CO;2-E

Xu, X., Zuo, X., Wang, X., & Han, S. (2009). Do you feel my pain? Racial group membership modulates empathic neural responses. *Journal of Neuroscience*, *29*(26), 8525–8529. doi:10.1523/JNEUROSCI.2418-09.2009

Yoder, K. J., & Decety, J. (2014). The good, the bad, and the just: Justice sensitivity predicts neural response during moral evaluation of actions performed by others. *Journal of Neuroscience*, *34*(12), 4161–4166. doi:10.1523/JNEUROSCI.4648-13.2014

Zahn, R., Moll, J., Paiva, M., Garrido, G., Krueger, F., Huey, E. D., & Grafman, J. (2009). The neural basis of human social values: Evidence from functional MRI. *Cerebral Cortex*, *19*(2), 276–283. doi:10.1093/cercor/bhn080

Zamboni, G., Gozzi, M., Krueger, F., Duhamel, J.-R., Sirigu, A., & Grafman, J. (2009). Individualism, conservatism, and radicalism as criteria for processing political beliefs: A parametric fMRI study. *Social Neuroscience*, *4*(5), 367–383. doi:10.1080/17470910902860308

Zhong, W., Cristofori, I., Bulbulia, J., Krueger, F., & Grafman, J. (2017). Biological and cognitive underpinnings of religious fundamentalism. *Neuropsychologia*, *100*(April), 18–25. doi:10.1016/j.neuropsychologia.2017.04.009