



The neurobiology of war: A call for a new field of research

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“With humanity in its present cultural and technological situation, we have good reason to consider intra-specific aggression the greatest of all dangers. We shall not improve our chances of counteracting it if we accept it as something metaphysical and inevitable, but on the other hand, we shall perhaps succeed in finding remedies if we investigate the chain of its natural causation.” - **Konrad Lorenz, *On Aggression***

“To the militant, identity is everything” - **Susan Sontag, *Regarding the Pain of Others***

Intraspecific aggression, expressed as war between groups defined by tribe, nationality, religion, or worldview, has long defined human existence. The cost of war is immeasurable, and the damage it incurs ripples over geographies and generations. Tremendous efforts to tame intergroup conflict by politicians, philosophers, psychologists, sociologists and others have proved largely ineffective, and war has come to feel intractable to the human condition. This essay presents a conceptual framework that considers war from a social neuroscience perspective and argues that neurobiological explanations can integrate various war-related phenomena from the fields of empathy, aggression, and intergroup dynamics research.

I propose that the complex cultural and economic factors leading to warfare have masked from view one of its' crucial defining characteristics. During war, socially transmitted threat arousal initiates a neurobiological state shift that is evolutionarily programmed to promote group survival by altering behavior in several important ways. From a sociobiological perspective, “war” is a systemic social reconfiguration that optimizes coordinated defense and attack responses to a perceived existential threat. Intergroup aggression and social reorganization in response to threat is observed across taxa, including different species of insects, birds, and mammals. Darwin, Lorenz, Wilson, and others have

intuited that the human war-state is based on evolutionarily conserved mechanisms, and thus likely supported by shared biological processes. I further propose that a neurobiological “war-state” inducing enhanced salience of group identity, binarization of group categories and prioritization of group outcomes would be an effective way to organize this response. These changes would result in alignment of individual goals with group aims, contribution of resources to the group, and engagement in high-risk behaviors that characterize war-related ingroup hyper-altruism and outgroup hyper-hostility (Fig. 1).

A neurobiological war-state is a modulation of caregiving circuitry

From an evolutionary perspective, humans and other social species have evolved to collaborate with ingroup members and compete with outgroups for resources. This typically involves favoring ingroup members for prosocial behavior, cooperative foraging, mating, and coordinated defense of territory, offspring and food against intraspecific raids and predation. Proximally, a prosocial response to others' needs or distress is facilitated by vicarious affective arousal promoting approach and caregiving that ultimately enable genetic continuity. Expression of prosocial behavior towards ingroup members relies on biological mechanisms overlapping with parental care, which support group survival and thriving (Preston and de Waal, 2002).

The caregiving mechanism, which involves activity in a dispersed brain network of sensory, affective and motivational regions, is characterized by three notable aspects relevant for understanding the war-state: (1) it involves prioritizing the needs of others (i.e. the offspring) over individual goals. (2) the prosocial response is preferentially engaged for ingroup members; affect sharing and prosocial motivation are lower for outgroup members even in neutral situations. (3) a

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significant overlap exists between the hormonal and neural mechanisms involved in caregiving and in defensive aggression elicited by threat (think of dangerous “mama bear”). Both responses are adaptive and originate from attachment to a specific individual. Thus to understand the war-state, we need to ask how the caregiving mechanism is extended to the ingroup.

Neural changes to social categories and goal valuation associated with the neural war-state

When a conspecific is highly valued, their outcome becomes a salient motivator, inducing acts meant to improve their well-being and protect them from threat, even outweighing personal considerations. While these behaviors are not astonishing when expressed in a parental context, there is something mystifying in hyper-altruism towards strangers, such as observed towards ingroup members in war. During war, existential threat causes a shift from individual social identity towards a collective self-categorization (Jonas and Fritzsche, 2013). The enhanced salience of group identity occurs in the context of war because precisely this parameter renders the individual a target of aggression by the outgroup. Importantly, embracing group membership signals to the group that one is entitled to its collective protection and care. As individual survival ultimately depends on the group overcoming the threat, it makes sense from an evolutionary perspective to shift from “I” to “us”. Considering the extension of the caregiving drive to the ingroup from a neurobiological perspective can elucidate this phenomenon. Binary social categories facilitate rapid decisions based on minimal information and are adaptive in a situation of intraspecific conflict. If there are only two social groups (us or them), it is easier to determine whether a stranger should be attacked or protected. In this situation, the differences between community, family, and self are diminished. From a neural perspective, cognitive and social maps are represented in the

hippocampus. Thus, a retuning of hippocampal populations could induce a shift in the representation of group categories. Hippocampal connectivity with the striatum and frontal regions may mediate large-scale behavioral effects of group identity on affective and motivational responses to others.

An additional neural mechanism involved in the recruitment of individuals for group aims involves decreased valuation of personal goals and increased valuation of ingroup outcomes. Prioritizing others’ outcomes (such as during parenthood) is likely supported by frontocortical regions coding value attribution to such events, and ensuing recruitment of motivation and reward systems. Such a mechanism may underlie ingroup bias for empathy and prosocial behavior typically manifested by humans and other species (Van Bavel et al., 2008). Yet hyper-altruism expressed during war towards the extended ingroup, including intense empathy, solidarity and self-sacrifice, suggests that the neural war-state is a unique instantiation of this mechanism. I thus propose that the behavioral changes that occur during war and reflect these processes can be thought of as a state shift similar to that which has been reported during parenthood, where myriad changes to function and cytoarchitecture occur to streamline parental care (Numan, 2020). Like parenthood, the war-state may entail long-term structural changes to the brain that endure months or years.

Central research questions

In sum, I propose here that socially transmitted existential threat arousal experienced during wartime initiates a neurobiological war-state that supports social reorganization. Studying the hormonal and neural mechanisms that catalyze and characterize the war-state in humans and animal models should be prioritized by the scientific community and funding institutions. Moreover, identifying and neutralizing the drivers of these dynamics (e.g. echo chambers that

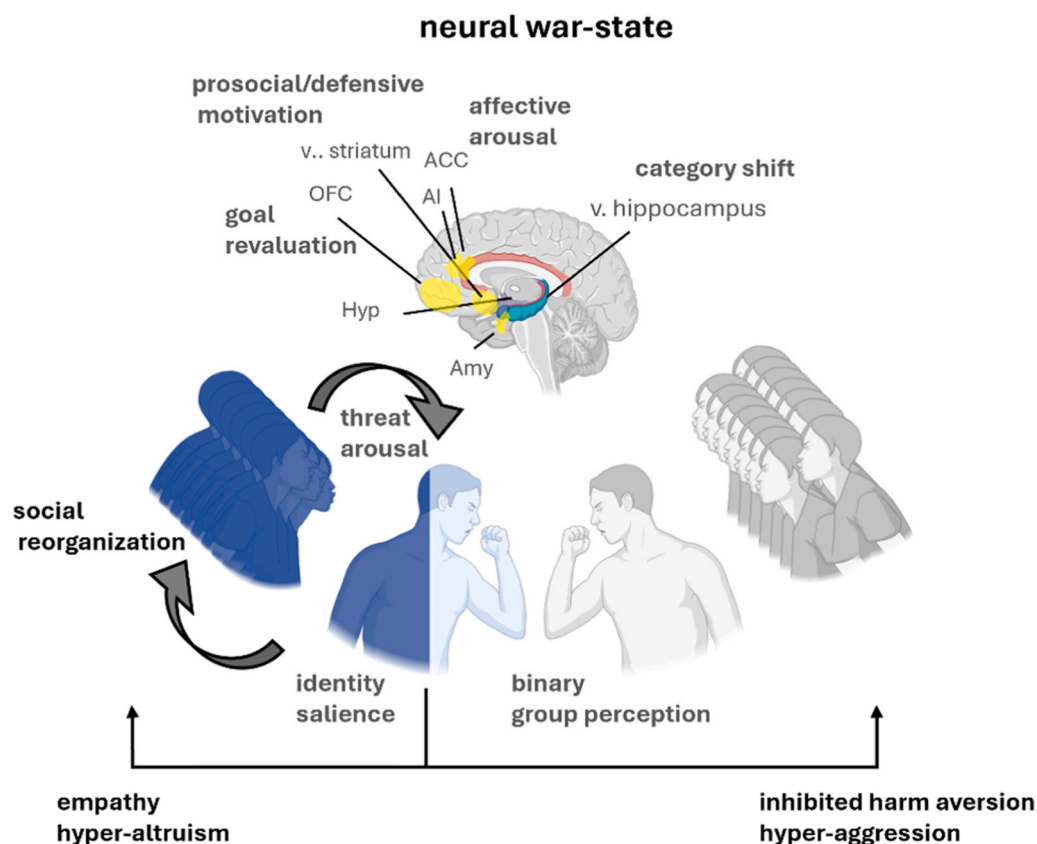


Fig. 1. The neural “war-state”. A physiological state-shift is generated by socially transmitted existential threat arousal. Neural changes support enhanced salience of group identity and binary group categorization and prioritization of group goals over personal goals. The war-state leads to ingroup hyper-altruism and outgroup hyper-aggression. The war-state enables group reorganization and coordination of defense and attack. OFC=orbitofrontal cortex, ACC=anterior cingulate cortex, hyp=hypothalamus, amy=amygdala. Figure assisted by BioRender.com.

inaccurately perpetuate outgroup threat perception) would be effective at influencing large populations.

Significant progress has been made towards understanding the neurobiological changes resulting from the trauma of war, and valuable work focuses on reducing the detrimental impact of war exposure. Yet, with the proposed framework I hope to inspire research on how war is initiated and perpetuated. Neural networks involved in social threat transmission as well as circuits involved in social group formation and threat perception are of interest to this question. Additionally, networks related to observation-execution contagion and mimicry underlying herd-like behavior, as well as reward, and salience systems in the war-state should be considered.

Proactive aggression, where an animal or group attacks in order to obtain resources with no previous direct provocation, is another instance of war that requires investigation. While likely involving a distinct neural mechanism than defensive aggression, there may be parallels in its initiation by group dynamics in a situation of resource scarcity.

An integrative social neuroscience approach is best suited for examining the behavioral shift induced by socially transmitted threat arousal in humans as well as other species. War-related violence cannot be understood without considering the social environment (Decety et al., 2018). Accordingly, research of the neurobiology of war, should be conducted during long-term exposure to threat cues transmitted between ingroup members.

Clearly, war cannot be understood merely as a neurobiological

process, yet focusing on this understudied aspect of war will be useful when combined with research into higher-level factors, all while carefully considering ethical issues and the potential impact of such research on public policy.

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