



Anger and aggression problems in veterans are associated with an increased acoustic startle reflex



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ABSTRACT

Anger and aggression are frequent problems in deployed military personnel. A lowered threshold of perceiving and responding to threat can trigger impulsive aggression. This can be indicated by an exaggerated startle response. Fifty-two veterans with anger and aggression problems (Anger group) and 50 control veterans were tested using a startle experiment with 10 startle probes and 10 prepulse trials, presented in a random order and with a random interval between the trials. Predictors (demographics, Trait Anger, State Anger, Harm Avoidance and Anxious Arousal) for the startle response within the Anger group were tested. Increased EMG responses were found to the startle probes in the Anger Group compared to the Control group, but not to the prepulse trials. Furthermore, Harm Avoidance and State Anger predicted the increased startle reflex within the Anger group, whereas Trait Anger was negatively related to the startle reflex. These findings indicate that threat reactivity is increased in anger and aggression problems. These problems are not only caused by an anxious predisposition, the degree of anger also predicts the startle reflex.

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1. Introduction

Anger and aggression related problems have widespread consequences, ranging from partner/familial violence to a burden for society. These problems are frequently found in samples of deployed military veterans (Elbogen et al., 2010; Heesink, Rademaker, Vermetten, Geuze, & Kleber, 2015) and appear to be rather chronic (Heesink et al., 2015). In case of a psychiatric disorder with comorbid anger and aggression, treatment outcome is impaired (Forbes et al., 2008).

Definitions of anger and aggression are diverse. In short, aggression refers to behaviour with the intention to harm, whereas anger refers to the emotion (Anderson & Bushman 2002). Often, a distinction is made between the planned, premeditated form of

aggression, and unplanned, impulsive aggression. The focus of this study is the impulsive form of aggression, in which anger plays an important role.

Dysregulated anger and aggression are symptoms of many disorders, such as posttraumatic stress disorder (PTSD; McHugh, Forbes, Bates, Hopwood, & Creamer, 2012), depression (Painuly, Sharan, & Mattoo, 2005) and Intermittent Explosive Disorder (IED; Coccaro, 2012). The importance of diagnostic criteria for dysregulated anger has been stated before, in order to recognize and study these problems (Del Vecchio and O'Leary 2004; Morland, Love, Mackintosh, Greene, & Rosen, 2012). Since aggressive behaviour is prevalent in many disorders, it is relevant to study it under NIMH's Research Domain Criteria (RDoC).

RDoC is a dimensional approach in which behavioural measures and neuroscience are integrated (Cuthbert 2014). Within the RDoC framework, impulsive aggression fits into the negative valence domain. Part of the negative valence domain is the acute threat response. It is hypothesized that impulsive aggression is accompanied by a lowered threshold of perceiving situations as

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threatening, and threat activates a biologically predisposed survival mode, including fear and flight reactions as well as anger and fight reactions (Novaco & Chemtob 2002). This defensive motivational system is related to activity in limbic brain structures. Furthermore, the domain of arousal within RDoC is an important construct in aggressive behaviour, as it regulates the processes within the negative valence system. Arousal plays a role in the sensitivity to stimuli. For example, heightened arousal might lead to threat-related vigilance. Dysfunctional anger and aggression have been linked to heightened physiological arousal (Mackintosh et al., 2014).

The startle reflex is a response to a sudden, intense stimulus leading to a rapid muscle contraction. This can be measured by a facial electromyography (EMG) in response to a loud noise. An exaggerated startle reflex can indicate the lowered threshold of perceiving threat, due to the sudden and intense nature of the stimulus that leads to a defensive response. Baseline startle reactivity is influenced by the activity of limbic brain structures (Baas, Milstein, Donlevy, & Grillon, 2006) as the amygdala, the bed nucleus of the stria terminalis (BNST) and the brainstem (Grillon & Baas, 2003). This reflex is thought to initiate the selection of an appropriate response to a certain threat. When the startling stimulus is presented several times, the startle reflex diminishes; this is known as habituation. Furthermore, when a less intense stimulus precedes the startle-eliciting stimulus, the response is inhibited. This prepulse inhibition (PPI) is thought to reflect low-level gating of information processing, or early attentional regulation (Grillon & Baas 2003). Deficits of PPI are an indication of the inability to filter out unnecessary information.

Mice genetically predisposed to aggression show an enhanced acoustic startle response and diminished PPI compared to controls (Naumenko, Kozhemyakina, Plyusnina, & Popova, 2014; Sallinen, Haapalinna, Viitamaa, Kobilka, & Scheinin, 1998). In humans with dysfunctional anger and aggression, the acoustic startle reflex has not been studied before in startle trials alone, without other stimuli as affective pictures or faces. Within a healthy population higher levels of aggressiveness as a personality trait were associated with a slower habituation rate (Blanch, Balada, & Aluja, 2014). This habituation is thought to reflect the biological background of judgment and motor or cognitive responses (Blanch et al., 2014).

An enhanced startle response was found in healthy participants during the viewing of angry faces (Dunning, Auriemmo, Castille, & Hajcak, 2010; Springer, Rosas, McGetrick, & Bowers, 2007). These angry face stimuli are classified as threatening stimuli and might therefore elicit a defensive response, measured by an enhanced startle response. Furthermore, angry faces might elicit angry feelings, which in turn can increase startle reactivity. Additionally, hyperactivity of the amygdala was found in a population of Intermittent Explosive Disorder (IED) patients, a disorder characterized by impulsive aggressive behaviour, during aggressive faces viewing (Coccaro, McCloskey, Fitzgerald, & Phan, 2007). These aggressive faces are stated to be a paradigm for social threat. This hyperactivity of the amygdala might be linked to heightened arousal and a lower threshold for perceiving stimuli as threatening.

As stated before, dysfunctional anger and aggression have been linked to heightened arousal. Studying the startle response, including the habituation effect and prepulse inhibition, gives an objective, neurophysiological evaluation of regulation of arousal. It is hypothesized that military men with dysfunctional anger and aggression have an exaggerated startle response and show less PPI. Furthermore, we tested the influence of trait and state anger on the startle response within veterans with anger and aggression problems. In addition, given the link between anger, aggression and anxiety (i.e. Castillo et al., 2014) we also examined whether an exaggerated startle response is linked to underlying anxiety traits.

2. Methods

2.1. Participants

In this study, 52 veterans with dysregulated anger and aggression were included (Anger group). They were recruited via their psychologists/psychiatrists affiliated with Military Mental Health Care Institute and via advertisements in the waiting room and newsletters for veterans. Additionally, fifty control veterans without anger and aggression problems were also included. These were recruited by advertisements or had participated in previous studies. Inclusion criteria for the Anger group were based on the four research criteria for impulsive aggression described by Coccaro (2012): 1) Verbal or physical aggression towards other people occurring at least twice weekly on average for one month; or three episodes of physical assault over a one year period; 2) the degree of aggressiveness is grossly out of proportion; 3) the aggressive behaviour is impulsive (not premeditated); 4) the aggressive behaviour causes either distress in the individual or impairment in occupational or interpersonal functioning (Coccaro, 2012). Inclusion criteria for the Control group were 1) no current DSM-IV diagnosis; 2) no history of pathologic aggressive behaviour.

The Ethics Committee of the University Medical Center Utrecht, The Netherlands, approved this study and all participants signed an informed consent before participation after having received a complete written and verbal explanation of the study. This study was carried out in accordance with the Declaration of Helsinki.

2.2. Interview and questionnaires

The Dutch version of the International Neuropsychiatric Interview (MINI) was used in order to screen for the presence of comorbid psychiatric disorders (Van Vliet, Leroy, & Van Meegen, 2000). The complete MINI was administered. In this interview the following current or life-time disorders were screened: depressive disorder, dysthymia, suicidal risk, (hypo)manic disorder, panic disorder, anxiety disorder, agoraphobia, social phobia, obsessive compulsive disorder, PTSD, alcohol or drug dependence and/or abuse, psychotic disorders, anorexia nervosa, bulimia nervosa, generalized anxiety disorder, antisocial personality disorder, somatization disorder, hypochondria, body dysmorphic disorder, pain disorder, attention deficit hyperactivity disorder (ADHD) and adjustment disorder.

To measure anger and aggression, Dutch versions of the State-Trait Anger Expression Inventory-revised (STAXI-2; Hovens, Rodenburg, & Lievaart, 2015) and the Aggression Questionnaire (AQ; Meesters, Muris, Bosma, Schouten, & Beuving, 1996) were used. The STAXI-2 consists of 57 items on a 4-point Likert scale and is divided into two subscales; State Anger and Trait Anger. The AQ consists of 29 items on a 5-point Likert scale and is divided into 4 subscales; Physical Aggression, Verbal Aggression, Anger and Hostility.

The Mood and Anxiety Symptom Questionnaire (MASQ) Anxious Arousal subscale was used to measure current anxiety-specific symptoms (Watson et al., 1995). This scale consists of 17 items on a 5-point Likert scale. The Harm Avoidance subscale of the short version of the Temperament and Character Inventory (TCI; Cloninger, Svrakic, & Przybeck, 1993) was included to measure fearful, anxious personality characteristics and consists of 15 items on a dichotomous scale.

Exposure to childhood trauma was assessed using the Dutch short-form self-report version of the Early Trauma Inventory (Bremner, Bolus, & Mayer, 2007; Rademaker, Vermetten, Geuze, Mulwijk, & Kleber, 2008). This checklist assesses exposure to traumatic experiences (general trauma, physical abuse, emotional abuse and sexual abuse) before the age of 18 years using 27 dichoto-

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