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Stress alters personal moral decision making

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Summary While early studies of moral decision making highlighted the role of rational, conscious executive processes involving frontal lobe activation more recent work has suggested that emotions and gut reactions have a key part to play in moral reasoning. Given that stress can activate many of the same brain regions that are important for and connected to brain centres involved in emotional processing we sought to evaluate if stress could influence moral decision making. Sixty-five undergraduate volunteers were randomly assigned to control ($n = 33$) and experimental groups ($n = 32$). The latter underwent the Trier Social Stress Test (TSST) and induction of stress was assessed by measurement of salivary cortisol levels. Subjects were then required to provide a response to thirty moral dilemmas via a computer interface that recorded both their decision and reaction time. Three types of dilemmas were used: non-moral, impersonal moral and personal moral. Using a binary logistic model there were no significant predicators of utilitarian response in non-moral and impersonal moral dilemmas. However the stressed group and females were found to predict utilitarian responses to personal moral dilemmas. When comparing percentage utilitarian responses there were no significant differences noted for the non-moral and impersonal moral dilemmas but the stressed group showed significantly less utilitarian responses compared to control subjects. The stress response was significantly negatively correlated with utilitarian responses. Females also showed significantly less utilitarian responses than males. We conclude that activation of the stress response predisposed participants to less utilitarian responses when faced with high conflict personal moral dilemmas and suggest that this offers further support for dual process theory of moral judgment. We also conclude that females tend to make less utilitarian personal moral decisions compared to males, providing further evidence that there are gender differences in moral reasoning.

1. Introduction

Moral reasoning and judgment is a core feature of all human endeavour and is increasingly coming under scientific scrutiny. Early psychological theory emphasized the role of higher cognitive processing in moral judgment (Kohlberg, 1981;

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Piaget, 1932) but a number of studies over the past decade have now demonstrated that emotional processing and the emotional state of the individual can influence moral judgments (Greene et al., 2001; Haidt, 2001; Schnall et al., 2008).

In attempting to explain the role of emotional processing Greene has suggested a dual process theory (Greene et al., 2004). He describes two 'competing' neurological systems responsible for moral judgments. The first involves a conscious, rational evaluation of the facts that produces a utilitarian response (one in which the outcome produces the greatest good to the most possible persons). This system is believed to be activated when there is reduced personal/emotional involvement with the decision making process. The second system involves affective responses and is the result of being emotionally invested in the situation; in this case responses tend to be non-utilitarian and less rational.

This dual concept has been supported by functional magnetic resonance imaging (fMRI) data that has identified brain regions associated with both rational processing and emotional processing during moral decision making tasks. In particular there is activation of the prefrontal cortex (PFC) (Young and Koenigs, 2007; Forbes and Grafman, 2010) which is considered the 'executive centre' of the brain, responsible for cognitive processing and decision making. However there is also activation of the inferior parietal lobes, the anterior temporal lobes and the anterior cingulate gyrus (Moll et al., 2005; Robertson et al., 2007), all considered important in processing emotions.

Stress is an adaptive physiological response that involves numerous biological processes in reaction to a physical or cognitive demand. Once this demand is perceived, central circuits initiate the stress response via activation of the hypothalamus (Herman and Cullinan, 1997). The exact pathways responsible are still to be elucidated but once activated the hypothalamus triggers two processes: (i) activation of the sympathetic nervous system and the release of adrenaline and (ii) activation of the hypothalamo—pituitary—adrenal (HPA) axis which releases large amounts of the hormone cortisol into the blood stream (Foley and Kirschbaum, 2010). Cortisol levels have been shown to increase in plasma within 3 min of exposure to a stressor and reach peak levels approximately 20 min later (Dallman, 2005).

Being liopophilic, cortisol crosses the blood brain barrier and acts on the central nervous system specifically targeting the prefrontal cortex and the limbic system (Dallman, 2005; McEwen, 2007; Rodrigues et al., 2009). The limbic system is considered integral to emotional processing and consists of several structures including the hippocampus, the amygdala, the hypothalamus and the anterior cingulate cortex. All of these regions have been shown to be profoundly influenced by stress (Kern et al., 2008; Kukolja et al., 2008; Pruessner et al., 2008; Dedovic et al., 2009b). Activation of these circuits is key to initiating the emotional response often associated with stressful conditions (Roozendaal et al., 2009). Beyond the neurobiology, acute stress has been shown to affect cognitive and behavioural responses including working memory (Duncko et al., 2009; Porcelli et al., 2008; Schoofs et al., 2009) and episodic memory (Jelici et al., 2004; Stawski et al., 2009). Of note, the effect of stress on episodic memory appears to be exaggerated when emotional stimuli are involved (Wolf, 2009).

Greene's dual process theory has also been supported by studies in which emotional inducement was found to alter moral judgments (Valdesolo and DeSteno, 2006) but perhaps more importantly clinical studies in which patients with fronto-temporal lobe dementia or damage to the prefrontal cortex also demonstrate differences in moral reasoning (Koenigs et al., 2007; Mendez et al., 2005). In both conditions noted above patients demonstrate impaired emotional responses. This body of work therefore suggests that regions of the brain important in emotional processing including the anterior cingulate cortex, the ventromedial prefrontal cortex, the amygdala and the hippocampus when activated can influence moral reasoning. These are some of the very same areas that are altered during the acute stress response. We therefore hypothesized that acute stress can modulate moral reasoning by its influences on the emotional processing centres of the central nervous system. A recent study considered this by focusing upon scenarios that distinguished between pro-social/altruistic and egotistical responses. While stress did not seem to influence decision making in these situations the study did note a positive correlation between egotistical decision making and the stress response in high-emotional situations (Starcke et al., 2010).

This study was carried out in Trinidad and Tobago (http://www.cia.gov/library/publications/the-world-factbook/geos/td.html) which has a unique socio-cultural environment. This is created by a heterogeneous population, with two major ethnicities dominating (40% African and 40% Indian), and another 20% drawn from Europe, China and the Middle East. These influences have created a melting pot of ethnicities, religions and cultural traditions as evidenced by the fourteen annual public holidays, the majority of which recognise various religious events associated with the three major religions: Christianity, Hinduism and Islam. Given the diverse religious backgrounds present within Trinidad and Tobago, the strong role religion plays within the society and its potential for influencing moral judgments, religious affiliation was used as a covariate for this study.

2. Materials and methods

2.1. Participants

This study was approved by the local Faculty Ethics Committee. Participants were recruited from students of the Faculty of Medical Sciences, Years 1—3 at the University of the West Indies, St. Augustine, Trinidad and Tobago. Only right-handed persons were recruited and participants with psychiatric or neurological illnesses were not included. Overall sixty-five healthy volunteers participated in the study (30 male and 35 female). The age range of the participants was 18-27 years with a mean age of 21.0 ± 0.2 years.

The study was carried out between 9:00 am and 1:00 pm to minimize circadian variations in cortisol levels and persons were required not to eat or drink anything for at least one hour prior to participation to ensure accurate salivary cortisol measures. Immediately after completion of the study subjects were debriefed and given insight into the nature of the study. No reward was given for participation in the study.