

The Effect of Emotional Comments on Cortisol in Healthy Adults

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ATTESTATION OF AUTHORSHIP

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Signed _____ Date 07/01/2022

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ABSTRACT

Expressed emotion (EE), is a measure of the emotional temperature of the family environment which encompasses different interaction patterns and the quality of the relationships within the family. Evidence suggests that perceived EE is one of the major psychological stressors that predicts clinical outcomes in various mental disorders. Few studies have investigated the effect of EE on hypothalamic-pituitary-adrenal (HPA)-axis activity suggesting the potential linear relationships. However, the level of perceived EE can be modulated by individual characteristics, such as negative mood and attachment with family. This study investigated the link between levels of the stress hormone cortisol and sensitivity to EE (through ratings of arousal and relevance), as well as attachment and psychological well-being (stress, anxiety and depression) using standardised psychometric measures among participants ($N=26$). This study found that there was no significant correlation between cortisol levels and EE (arousal and relevance ratings) across the positive, critical, or neutral comment condition. The findings from this study suggest that salivary cortisol changes might be somewhat independent from self-report perception of EE, at least in healthy participants. However, individual sensitivity to criticism is likely to be heightened by ones perceived life stress, current depressive mood, and anticipation of punishment (or punishment and reward sensitivity). Further research is recommended to further investigate this link in depth with a larger sample and the addition of a clinical population to assess the differences and further validate the current findings.

CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW

Expressed emotion

EE refers to the family environment which encompasses different interaction patterns and the quality of the relationships within the family (Amaresha & Venkatasubramanian, 2012). There has been an established link between the perceived EE of an individual and the resulting negative outcome in mental disorders such as schizophrenia (Butzlaf & Hooley, 1998; Premkumar et al., 2013). This established link involves psychopathology which refers to the study of mental disorders. There are multiple frameworks for understanding how mental disorders develop in individuals and one such framework underlying this link is the diathesis-stress model (Broerman, 2017). The diathesis-stress model, also known as the vulnerability-stress model, describes the interaction between a person's genetic disposition, their tendency and vulnerability to develop a mental disorder, and the environment. In particular, it is the stressors from the environment that can activate an individual's diathesis (Solar et al., 2019). One prevalent stressor in the environment could be related to EE. This model conceptualises that those who come from family environments with high EE have a greater vulnerability for developing a mental disorder, as well as experiencing a relapse of an already diagnosed disorder (Hooley & Gotlib, 2000; Millman et al., 2018).

Different levels of EE within families are measured through statements that family members make regarding a further family member that suffers from a mental illness through criticism, emotional over-involvement (EOI) and hostility (Wuerker, 1996). EE can be categorised as high or low with EE being characterised by patterns of criticism, hostility and EOI. Noted characterisations within households with reported high EE include verbal exchanges that are increasingly intense and negative as well as conflictual and oppositional (Amaresha & Venkatasubramanian, 2012). There are additional features and characteristics of high EE households/relatives and these are used to distinguish between high and low EE households. Within these, one such

characteristic of high EE households indicates that high EE relatives demonstrate lower tolerance towards atypical behaviour that differ from their own cultural norm than relatives with low EE (Hooley & Hiller, 2000). High EE relatives also tend to hold the belief that family members with mental illness poses greater control over their illness-related behaviours than that of low EE relatives (Hooley, 2007). Additionally, high EE relatives also show less empathy for others than relatives of low EE (Hooley & Hiller, 2000).

High EE households can result in a range of outcomes for an individual. For example, those from high EE households are more impaired in social functioning which impacts their independence and interpersonal functioning (Smith et al., 1993). Additionally, higher levels of EE in a household are known to influence treatment outcomes of individuals within the house suffering from a mental illness (Butzlaff & Hooley, 1998; Hooley, 2007).

Attachment

Current literature that has assessed the link between attachment and EE has found that the attachment style of relatives can mediate the link between perceived loss (physical loss or feelings of hopelessness), criticism and emotional over-involvement (Hinojosa-Marqués et al., 2019). High EE households often have insecure attachment styles which contributes to the acute stress within the household environment as caregiver behaviours are influenced by their attachment styles (Chen, 2006). In particular, individuals with an avoidant and insecure attachment style are positively correlated with higher ratings of hostility and critical comments (Cherry et al., 2018).

The theory of attachment proposes that the developmental outcome and attachment style of a child is influenced by the quality of relationships that a child has, as well as early infantile experiences (Bowlby, 2007). While the development of a secure base and the responsiveness of a caregiver impact the type of attachment that

an individual develops, it is also noted that the basis of this relationship is fundamental for further healthy development (Flaherty & Sadler, 2011). There are four types of attachment, three of which are considered disorganised (insecure) and one is organised (secure) (Benoit, 2004). Secure attachment is a result of an infant's caregiver possessing qualities such as loving and sensitivity such as promptly responding to an infant's cries. This secure attachment results in an organised strategy to deal with distress as the child knows that the caregiver will respond when the child is distressed and has a known source of comfort and safety (Benoit, 2004; Van Ijzendoorn et al., 1999).

The final three attachment styles include insecure-avoidant attachment, insecure-resistant attachment and insecure-disorganised attachment (Ainsworth et al., 2015; Main & Soloman, 1990). Insecure attachment styles comprise of avoidant, anxious and disorganised. A child with an insecure-avoidant attachment style is characterised by an insensitive and rejecting caregiver when responding to a distressed infant. The resulting strategy to deal with stress is organised as the child learns to avoid the caregiver in times of distress and this insecure attachment is insecure as the child is at risk for developing adjustment issues (Benoit, 2004; Van Ijzendoorn et al., 1999). Insecure-resistant attachment is a result of an insensitive and inconsistent caregiver who is inconsistent in responding to the infant's needs. The resulting strategy to dealing with distress is organised as an infant will know how to attract an inconsistent caregivers attention such as exaggerated displays of distress (Benoit, 2004). Finally, an insecure-disorganised attachment is the result of atypical parenting characteristics such as frightened and dissociated (Lyons-Ruth et al., 1999). Children with this style of attachment have a disorganised strategy to deal with distress as there is no standard response to separation from a caregiver and emit disorganised patterns of behaviour (Main & Soloman, 1990).

Children with a secure attachment style to their caregiver develop a protective factor against emotional and social disturbance (Egeland & Hiester, 1995). A secure

attachment provides a foundation for exploration and normal development (Greenberg et al., 1993), as well as the ability to interact with others appropriately throughout life and appropriate social development (Belsky & Fearon, 2002). Insecure attachment styles comprise of avoidant, anxious and disorganised strategies.

The emotional impacts of different attachments styles are evident in individuals and can be long-lasting. Individuals with a secure attachment typically have a greater ability to accept and integrate positive and negative emotions (Cassidy, 1994). However, the negative impact on emotional regulation can be seen in insecure attachments (insecure-avoidant, insecure-resistant and insecure-disorganised attachment) as individuals will display emotional detachment (Armsden & Greenberg, 1987). Additionally, insecurely attached individuals are more heavily impacted by negative emotions (Cassidy, 1994).

However, the link between attachment styles and EE is not always consistent. Cherry et al., (2018) found that attachment avoidance and critical comments/hostility were directionally and positively associated. Attachment styles alone had no associations to EE, in particular emotional overinvolvement. This study concluded that further research is needed to clarify the extent of the association between attachment and EE before any conclusions could be made.

Negative emotions: Depression, Anxiety and Stress

Stress, while a well-known and heavily researched concept, is difficult to define with no one definition that researchers can agree upon. However, it has been agreed upon that stress is used to describe a stimulus, response and an interaction between an individual and their immediate environment (Rice, 1992, as cited in Martinez, 2014). Stress as a stimulus refers to a situation and the demand on an individual and has the potential to result in harm. Stress as response refers to the state of arousal, tension or

fear in an individual as a result of the environment or an external perceived threat (Martinez, 2014).

Stress overall is associated with poor physical and mental health outcomes (Segerstrom & O'Connor, 2012). The notion of stress has been proven to be strongly related to disorders such as anxiety and depression (Heim, et al., 2008; Martin et al., 2009). Life stress in particular, is heavily associated with the development and maintenance in particular of many physical and mental health disorders, in particular, depression and anxiety among others (Slavich, 2016). Depression is a common mood disorder, affects an individual's thoughts, and feelings as well as day to day functioning (National Institute of Mental Health, 2018). Anxiety is a further mental illness that is comorbid with depression and can impact the quality of an outcome and intervention for mental health (Bilberg et al., 2012).

All three - depression, anxiety, and stress - are intertwined and the presence of one can often affect the outcome of an individual's mental health and wellbeing. Emotional regulation is also known to be impaired by depression, anxiety, and stress. Emotional regulation is the process that evaluates and monitors emotional reactions which encompass both positive and negative emotions (Thompson, 1994). Additionally, depression and anxiety influence an individual's ability to deal with stressful situations and emotions. In particular, an anxious or depressive mood increases the likelihood that an individual will become uncomfortable or upset in the presence of criticism thus impacting EE (Steketee et al., 2007).

Depression, anxiety, and stress can impact one's perception of EE. Connor & Birchwood (2011), looked at individuals with depression who also heard voices and the resulting distress. This study found that the auditory comments and the tone of voice can be perceived differently in those with depression, as individuals who rated higher in both authoritative power and EE also scored higher in depression than those who rated the voices as lower authoritative power and EE. Furthermore, depression can be linked to perceived criticism as depression can result in an increase in maladaptive cognitive

beliefs about social threats. In turn, this would allow an individual to believe the threat of criticism is greater and uncontrollable (Nordahl et al., 2018). Additionally, stress is known to impact EE within a household as higher ratings of EE are associated with maternal stress (Baker et al., 2005) as well as decreasing overall functioning of the family (Wamboldt, et al., 2000). Stress can also be impacted by EE, as individuals with high EE relatives are more likely to report feeling stressed during interactions (Cutting et al., 2006). Anxiety can also impact an individual's perception of EE and criticism as higher levels of anxiety often result in a greater vulnerability to social stressors and a tendency to display a lower tolerance towards negative emotion and stress from others than those with lower levels of anxiety (Docherty et al., 2011).

Coping

Coping is a central process in adaptation and survival and refers to the basic process of how individuals detect, learn and deal with stressful events (Skinner & Zimmer-Gembeck, 2016). A variety of coping strategies are used by individuals depending on the stressful event and the perceived threat of the environment (Lazarus & Folkman, 1984).

There are a multitude of coping strategies and distinctions in the way individuals will cope with stressful events, stimuli, or emotions. The first distinction in coping is between problem-focused and emotion-focused coping. Problem-focused coping refers to the strategy in which coping is targeted towards a stressor and involves an individual taking measures to avoid the stressor or decrease the impact of the stressor (Carver, 2013). Emotion-focused coping is the process in which an individual focuses effort on reducing the emotional impact of stressful events such as fear, stress, and anxiety (Folkman, 2007). A further distinction in coping styles is between engagement and disengagement coping. Engagement coping refers to the process in which an individual will actively confront and deal with the emotions arising from a stressful event

(Carver, 2013). While disengagement coping refers to strategies that are used to divert attention away from the stressor and any resulting negative emotions (Dijkstra & Homan, 2016). Additionally, there is also accommodative and meaning-focused coping. Accommodative coping is the strategy in which an individual will change their goal to accept the negative circumstances and promote the acceptance of failure. This strategy of adjusting cognitive schema is used when there is an incongruence between the desired and perceived circumstances (Brandtstädter, 2009). Finally, meaning-focused coping aids in the regulation of positive emotions as this coping strategy focuses on deeply held values and beliefs to focus on the strength gained through challenges and stressful situations (Folkman, 2010).

The approach and strategy that an individual adopts when dealing with a stressor or stressful environment can impact both psychological and physical outcomes. Coping can amplify the effects of stress on the resilience and psychopathology of the individual (Skinner & Zimmer-Gembeck, 2016). Coping strategies also influence an individual's perceived level of stress with active engagement and coping being negatively correlated with an individual's perceived stress. However, disengagement is more positively correlated with perceived stress (Muller & Spitz, 2003, as cited in Doron et al., 2014).

Reinforcement sensitivity: Behavioural Inhibition System and Behavioural Activation System

The behavioural approach system (BAS) and behavioural inhibition system (BIS) both stem from reinforcement sensitivity theory. This theory proposes that emotion and motivation are central to an individual's trait differences (Gray, 1987). This theory also proposes that there are three main systems, the behavioural approach system (BAS), behavioural inhibition system (BIS) and the fight/flight system with behavioural approach and behavioural activation being central in the BIS/BAS (Colder

et al., 2011). This theory also proposes that there are two distinct systems central to emotions, thoughts, and behaviour. These systems are the BIS and BAS. The BIS is activated when there is recognition of cues associated with punishment and this system facilitates avoidance behaviours to decrease the likelihood of punishment occurring. The BAS system however, is activated in the presence of cues that have been associated with rewards and in turn allows for the increase of approach behaviours due to the possibility of a reward (Serrano-Ibáñez, et al., 2018).

Reinforcement sensitivity theory proposes that there will be a variation in trait tendencies and thus the activation of the two systems. Invariably, this means that there will be a difference in the emotional experience for different individuals. A higher activation rate of the BIS can be seen as an indicator of the experience of greater negative emotions. Even more so, those with higher sensitivity to punishment and activation of BIS experience smaller increases in positive emotion despite being in a reward scenario as opposed to those with sensitivity to reward and activation of the BAS (Hundt et al., 2013).

Because of the influence of the BIS and BAS on approach and avoidance behaviour, these systems and overactivation are associated with certain mental illnesses. In particular, individuals with low BAS scores and thus lower activation of the BAS, were high scorers on scales for major depressive disorder as such individuals had lower rates of responsiveness to reward and often receive little reward as a motivator for engagement. Additionally, individuals with higher scores and BAS activation scored higher on scales representing bipolar-I (Arfaie et al., 2018).

Current research suggests that the perception of social support from family and friends, as well as the perception of negative emotions through the BAS, can be a predictor of risk-taking behaviour (Damirchi et al., 2019). Additionally, previous literature suggests a link between the BAS and emotion as dysregulation in the motivational system suggests an individual will have difficulty with socio-emotional

processing (Monteleone et al., 2018). This could be due to the recognition of stimuli, both rewarding and aversive, as one of the main constructs of emotional processing (Ochsner, 2008). This suggested link between lower socio-emotional processing and the BAS has been heavily assessed in individuals with eating disorders as a heightened sensitivity towards aversive stimuli and outcomes may be responsible for an attention bias in which emotional stimuli is perceived as threatening (Oldershaw et al., 2011).

Hypothalamic-Pituitary-Adrenal (HPA)-Axis

Stress is the state of a perceived or real threat to the homeostasis of an individual. The stress response in the presence of aversive stimuli triggers a range of autonomic responses of the body through multiple systems such as the endocrine, immune and nervous systems (Smith & Vale, 2006). The HPA axis is a hormonal response system to stress and controls multiple stress hormones such as glucocorticoids (Stephens & Wand, 2012). The activation of the HPA axis is initially triggered by exposure to stress, which in turn increases circulating levels of glucocorticoids and this stress hormone controls the regulation of the strength and duration of the HPA axis response (Keller-wood & Dallman, 1984; Smith & Vale, 2006). However, when there is dysfunction within the HPA axis, glucocorticoid receptors begin breaking down which in turn can lead to hypercortisolaemia which increases levels of cortisol within the body (Young, 2004). An increase in stress hormones due to the lack of HPA axis integrity in the body is known to be a cause for a variety of depressive disorders and cognitive deficits (Sapolsky et al., 1986; Wolkowitz et al., 1990; Young, 2004).

Cortisol is a hormone produced by the body through the HPA axis and thus is important in the body's response to stress. However, cortisol also functions as a maintainer of blood glucose levels (Heim et al., 2000). In the occurrence of a stressor, which causes a state of stress or anxiety within an individual, cortisol levels will

increase due to a perceived threat (Hannibal & Bishop, 2014). Perceived threats are those that an individual believes to be an uncontrollable or a social-evaluate threat (Jones & Fernyhough, 2007). Social-evaluative threats refer to the self-esteem of the individual and when an aspect of the individual is negatively judged such as a trait or a characteristic (Dickerson & Kemeny, 2004).

Current research also suggests that excessive activation of the HPA axis can lead to changes in the baseline function of the HPA-axis as well as the response of the system to current and ongoing stress. These changes in turn lead to a host of physical illnesses such as immune dysfunction and metabolic dysfunction (Barbosa et al., 2012; Barbosa et al., 2014). Additionally, glucocorticoids - which are released by the HPA axis - have an excitatory effect on regions of the brain which are involved in emotion and emotional regulation, such as the amygdala (Cook, 2002). The extent of the effect of glucocorticoids on the brain is influenced by a range of factors as the effect on an individual's emotional state is dependent on the environment and situational factors. Such environmental factors then in turn impact the effect of cortisol as an emotional response (Wirth et al., 2011).

EE has been a heavily researched topic in relation to relapse and development of physiological disorders and there has been an established link between EE and a psychological responses and arousal. For example, a study with adolescents found that those from high EE families would experience greater arousal when they were actively anticipating an encounter with relatives (Valone et al., 1984). Additionally, Vitaliano et al., (1993) found that EE, along with other variables, was able to explain physiological reactivity in response to emotional tasks. Furthermore, Hooley et al., (2005) validated the link between EE and mental wellbeing of an individual with their findings suggesting that those with depression showed a greater increase in negative aspects of mood after listening to comments of criticism than those who had not been diagnosed with depression and considered healthy.

Despite this being a heavily researched topic, there is currently very little literature on the effect of EE and HPA in a healthy adult population suggesting different patterns of physiological responses to EE in healthy individuals compared to those with psychological disorders. Furthermore, levels of perceived EE can be modulated by individual characteristics, such as negative mood, attachment and coping style. It has been shown that individuals with an already existing mental illness such as depression and anxiety can be more sensitive to criticism (Atlas, 1994; Hooley et al., 2005). Moreover, perceived EE has been found to be influenced by coping styles with the use of maladaptive coping being a predictor of higher perceived EE (Sharma et al., 2020).

To date, the link between EE and HPA and their associations with individual characteristics are not well understood (Christiansen et al., 2010; Snoek et al., 2004). While stressful events such as the experiencing of EE can evoke a biological response in the HPA, there is still limited research into the biological response of stress hormones in particular. Instead, there is a focus on the HPA as a system broadly (Dickerson & Kemeny, 2004; Gunnar & Adam, 2012). Additionally, there is inconsistency in cortisol research with literature that investigates cortisol not producing mean changes in cortisol scores (Gunner et al., 2009). Furthermore, individual factors such as gender, attachment, perceived stress have not been heavily investigated and further research is required to investigate the link between these factors and EE (Cherry et al., 2018).

The Relevance of the Present Research to an Aotearoa Context

The prevalence of individuals with mental health issues and disorders within New Zealand is known to be significant with approximately 50-80% of New Zealanders experiencing a form of mental distress (Mental Health Inquiry, 2018). Furthermore, the prevalence in which individuals seek treatment can be seen in the 2019/2020 mental health survey which found that a total of 184,711 individuals were actively engaging

with mental health and addiction services (Ministry of Health, 2021). Due to such high rates of mental health issues and the seeking of treatment within New Zealand, the treatment of mental illnesses has many integral parts and concepts through a variety of treatments ranging from cognitive behavioural therapy to acceptance and commitment therapy. However, one such concept that is of particular importance across different modalities of therapy is that of including whānau in the recovery and care of those with mental illnesses (Waikato District Health Board, 2021).

EE and the level of criticism within a household is important in the treatment of individuals as the involvement of family is an integral part of the recovery process (Kean, 2017). Specifically, the impact of EE on an individual has been heavily researched with high levels of EE within relatives and the household being a predictor for lesser changes and a worse off outcome as opposed to individuals with low scoring EE relatives and households (Hinojosa-Marqués et al., 2019; Tarrier et al., 1999). EE is important to consider when implementing treatment for individuals with mental illnesses due to EE encompassing hostility, criticalness and emotional over-involvement, all of which can hinder the effectiveness of the treatment in preventing relapse (Koujalgi et al., 2020).

Due to the known influence that EE can have on an individual seeking help and treatment, EE must be controlled for in a clinical setting to allow for the best outcome of the individual. Strategic interventions are used in a diverse range of psychosocial settings in which education is used to allow family members to understand the impact of EE and reducing direct contact with high EE relatives through the development of family-based psychosocial interventions (Amaresha & Venkatasubramanian, 2012). Furthermore, EE plays a considerable role in the treatment of those with mental illnesses as the relationship with relatives and familial connections aids in the effectiveness of treatment (Bogojevic et al., 2015). This is of particular importance in the context of New Zealand due to the importance of the involvement of whānau in

treatment as part of a multidimensional approach to health and wellbeing in both mental and physical aspects (Durie, 1997).

Research Rationales and Aims

The importance of EE in health research and mental health outcomes with EE being a proven factor influencing the outcome of an individual's mental health is well established. However, the mechanisms underlying this link remain unclear.

Given the link between the dysfunction of the HPA axis, - i.e., cortisol levels and stress, depression, anxiety - there might be a possibility that hostility and criticism expressed by caregivers/family members towards an individual can lead to adverse negative health consequences and are a result of neurobiological changes. However, it should be noted that perceived EE could be modulated by a range of individual factors such as one's attachment, negative emotions (depression, stress and anxiety), and reward sensitivity.

This dissertation will investigate 1) the relationships between perceived EE, cortisol, and a range of individual characteristics, including perceived stress, negative emotions, attachment, coping style and reward sensitivity, and 2) the cortisol level will be affected by criticisms and positive comments, in healthy adults. We hypothesised that 1) cortisol responses to critical comments are positively related to how individuals rate their perceived stress, negative emotions, and reward sensitivity (H1); 2) cortisol would be increased by critical comments due to increased perceived stress and hostility (H2). Cortisol would be correlated with ratings of arousal and relevance.

Outline of Dissertation

Chapter one included an introduction and literature review related to EE and cortisol as well as relevant contextual research information, the research aims and the structure of this dissertation. Chapter two outlined the research method, participants,

psychological measures, the audio task and the data analysis undertaken. Chapter three reported the results discovered in this study and reported all correlations discovered. Finally, chapter four gave an overview of the findings and what this means for research on cortisol and EE as well as the reasons for such findings. Chapter four also discussed the implication of study findings as well as limitations of the study and future research directions.

CHAPTER TWO: METHODS

Participants

There was a total of 26 participants included in the present study across a range of ages and ethnicities. The exclusion criteria for this study included: any individuals who had been on antibiotics or had major surgery in the last 3 months, individuals with a diagnosis of a mental or neurological disorder, regular intake of psychotropic or anti-inflammatory drugs, the presence of any major medical illnesses or a substance use disorder. The inclusive criteria of the participants of this study included: individuals over the age of 18 years and must have a close relative with whom they spend at least 10 hours a week face-to-face or phone contact and spoke English during these interactions. This criterion ensured that participants were able to give informed consent to participate in the study and that they were able to adequately perform the task of listening to and rating positive, neutral, and critical comments by referring to the close relative with whom they had frequent contact. This criterion also allowed for the avoidance of confounding effects of physical and mental illness on cortisol levels.

Measures

Perceived Stress Scale (PSS)

The PSS is a 14-item psychometric scale that is widely used to assess the perception of stress within an individual and the degree to which an individual perceives their life to be unpredictable, overwhelming and uncontrollable (Cohen et al., 1983). The PSS is assessing stress through the evaluation of affect and thoughts in relation to stressful events that have occurred in the previous month for an individual and is based on the theoretical foundation that the perceived stress response is determined by the perception of environmental stressors rather than the occurrence of the external stressors themselves (Mondo et al., 2019; Ribeiro Santiago et al., 2020). This scale utilises a 5-point Likert scale with 7 of the questions being positively stated

and reverse coded and 7 negatively stated items (Chan & La Greca, 2013; Lee, 2012). The PSS has demonstrated high reliability and validity. Reliability is high with a reported Cronbach's alpha of 0.89 (Mitchell et al., 2008). The validity of this scale is also supported with samples of college/university students and workers (Lee, 2012), which is appropriate for the sample in the present study. Additionally, it is important to note that this scale has shown a decrease in test-retest reliability across time. However, this study used this measure across all three-time points which were less than two weeks apart and thus the test-retest reliability is higher as after two weeks the Cronbach's alpha drops to below 0.73 (Cohen & Williamson, 1988; Mitchell et al., 2008). The internal reliability for the PSS was 0.836 which is high internal reliability.

Adult Attachment Scale (AAS)

Attachment has been shown to influence a wide range of biopsychosocial factors including an individual's stress response (Ravtiz et al., 2010). One way that attachment can be measured is through the AAS. The AAS is a self-report measure that reflects attitudes towards attachment and the revised edition was utilised for this study and has a total of 18 items and utilises a 5-point Likert scale (Schmidt et al., 2004). This scale utilises three dimensions to measure attachment style which falls under three subscales, each with 6 items. The first is the close subscale which encompasses closeness and intimacy. Dependency is the second subscale and evaluates comfort with dependency on others. Finally, the third subscale is the anxiety subscale which encompasses an individual's worries about being rejected (Collins & Read, 1990; Fernández & Dufey, 2015). Total scores that emerge from this scale can be used in two ways. Firstly, they can be used as continuous measures of the different components that contribute to the overall attachment score. Secondly, scores can be used to categorise individuals into different attachment styles through cluster analysis (Collins, 1996; Collins & Read, 1990). This revised AAS has been shown to have adequate reliability with reported Cronbach's alphas for the three subscales, closeness, dependency and anxiety being 0.77, 0.78 and 0.85 respectively (Collins,

1996; Eng et al., 2001). The internal reliabilities for the subscales in the present study however were not as reliable with subscales closeness and dependence having a Cronbach's alpha of .363 and .222 respectively. However, the anxiety subscale had an acceptable level of reliability with a Cronbach's alpha of .821.

Depression, Anxiety, and Stress Scale (DASS-21)

The DASS-21, a shortened version of the original 42 item DASS, is a self-report measure that is used to identify the signs and severity of depression, stress, or anxiety in an individual with each of these subscales having 7 items (Lovibond & Lovibond, 1995). The DASS-21 utilises a four-point Likert scale ranging from zero to three which refers to the degree to which the items applied to the individual (Lovibond & Lovibond, 1995; Norton, 2007). The scores are divided into three different subscales to assess the presence and severity of signs for depression, anxiety, and stress. However, the score for each subscale can also be combined to represent general distress (Chin et al., 2018). The reliability of the DASS-21 is high with reported Cronbach alpha values for the depressive, anxiety and stress subscales being 0.81, 0.89 and 0.78 respectively (Coker et al., 2018). The internal reliabilities for the subscales in the present study were 0.842 for the depression subscale, 0.570 for the anxiety subscale, and finally, 0.834 for the stress subscale.

Behavioural Inhibition System and Behavioural Activation System Scale (BIS/BAS)

The BIS/BAS is a self-report measure based on reinforcement sensitivity theory. This scale contains 24 items with four filler questions that are not scored with all questions utilising a Likert scale and a 4-point response system that ranges from strong agreement to strong disagreement and a total of four subscales under the BIS/BAS (Carver & White, 1994). There is one subscale under the BIS scale which is the punishment sensitivity scale which includes any items that reference reactions in response to the anticipation of punishment. Additionally, there are three subscales

under BIS which include reward responsiveness, drive and fun-seeking. Reward responsiveness refers to an individual's focus on the positive response to a reward. The drive subscale consists of items relating to the pursuit of goals and finally, the fun-seeking subscale refers to items reflecting an individual's desire for new rewards and willingness to pursue rewarding events (Beck et al., 2009; Carver & White, 1994). The reliability of this scale has been demonstrated with reported Cronbach's alpha of the BIS and BAS scales being 0.75 and 0.72 respectively (Vandeweghe et al., 2016). The internal reliabilities for the subscales in the present study were deemed reliable as Cronbach alphas for both subscales were ≥ 0.6 which is indicative of an acceptable level of reliability (Ursachi et al., 2015), with the BIS subscale having a Cronbach's alpha of 0.819 and BAS having a Cronbach's alpha of 0.615.

Audio Task

Participants were required to listen to a total of 120 auditory comments across three different days. The auditory comments that participants were exposed to include positive, neutral, and critical comments with a total of 40 comments in each of the comment categories and the order in which participants listened to the comments was random. The comments were delivered by either a male or female voice over. The emotional comments (positive and critical comments) were based on comments that individuals would hear in interactions with their close relatives with whom they have a minimum of 10 hours of communication a week with. For example, positive comments were centred around positive and specific aspects of the individual such as, "you are very conscientious. You are good at organising things and paying attention to detail. It makes you helpful". Neutral comments were unrelated statements to the individual and typically centred around factual statements such as "The Emu is the largest native bird in Australia, with long neck and legs. It can reach up to 2 metres in height". Finally, negative comments were broad negatively toned statements around personal characteristics such as "You are too emotional. You shouldn't let things that people say, even things said in a jokey manner, upset you".

Cortisol

Cortisol was measured in this study as it is one of the major hormone outputs of the body's stress response system, the HPA-axis, and is used to investigate stress within an individual. Released by the HPA-axis in response to stress, as discussed prior, this hormone can be measured in a multitude of ways (King & Hegadoren, 2002). Cortisol can be measured multiple ways through saliva, urine and blood. However, for the purpose of this study, cortisol was measured through saliva samples as this offers a reliable yet non-invasive alternative to blood draws and saliva samples can show changes in unbound cortisol that may not have yet bound to blood and thus offers a reliable alternative (El-Farhan et al., 2017).

Procedure

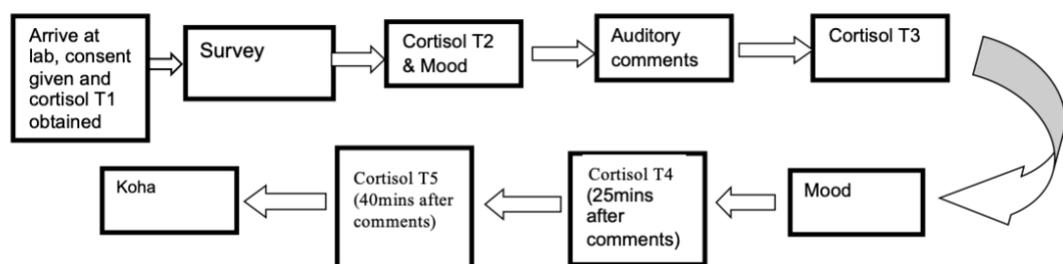
Ethics approval was obtained by the Auckland University of Technology Ethics Committee (AUTEK) on the 2nd of October 2019 under the reference number 19/231 (see Appendix B). Prior to data collection, potential participants were given a copy of the information sheet (see Appendix A) and given time to read through and ask any questions before voluntary signing consent forms. Participants then attended lab testing sessions on three separate days in the morning (with a 3–7-day gap in-between) and all sessions were approximately 50 minutes in duration. Before listening to the auditory comments, the participants completed a mood rating survey.

Participants then listened to the randomised auditory comments through headphones after which, those participants were asked to rate the arousal (emotionally demanding) and relevance of the comments based on their relationships with close relatives on an 11-point Likert scale. Participants then completed the psychometric measures and completed the mood survey again, however this has not been included in this dissertation. Saliva samples were used to collect and measure cortisol levels. For each experimental trial 5 saliva samples will be collected (resting, pre-testing (listening to

audio comments), post-testing, 20 mins follow-up, 40 mins follow-up). In total 15 saliva samples will be taken (5 samples across 3 trials). The five samples were T1: arrive with a few mins rest; T2: prior to the comments; T3: immediately after the comments; T4: 25 mins after the comments; T5: 40 mins after the comments, as seen in Figure 1. Saliva samples were obtained using 7ml capacity bijou tubes with a screw top. Saliva collections were made over a two-minute period unless insufficient volume was obtained, in which the collection period was increased to 3 minutes. All saliva sample collections were completed with participants seated, leaning forwards with their heads tilted downwards. Participants were asked to allow the saliva to fall into the tube with minimal orofacial movement. Samples will be stored in a plastic tube in a freezer at the alarmed locked psychophysiology lab first and then transported to the Auckland University of Technology Roche Diagnostics Laboratory in a chilly bin with ice packs. Samples were stored at -20°C until batch analysis using a Roche Diagnostics Modular E170 automated instrument (Roche Diagnostics, Auckland, New Zealand) at the Auckland University of Technology Roche Diagnostics Laboratory. Quantitative results were determined via an instrument-specific full point calibration curve.

Figure 1

Steps Involved in the Testing Session



Data Analysis

All statistical analyses were conducted using IBM SPSS Statistics (version 27). Participant demographic descriptive statistics were run and this included age, gender, education, marital status, and ethnicity. Comment condition descriptive statistics were also run and used the median scores for arousing and relevance ratings to look at the gender differences in participant scorings of arousal and relevance. Median scores were used in this study and analyses as arousal and relevance ratings were scored using Likert scales and thus a median score is more appropriate to use to represent an individual and the overall participants than a mean score.

Shapiro–Wilk was used to check the normality of the data. Additional inspection of QQ plots confirmed that the data was not normally distributed and thus log transformation was used to normalise the data with skewness. Pearson correlation analysis was performed between perceived EE, cortisol (at time 3, 4 and 5 after listening to the audio comments), and psychometric measures (depression, stress, anxiety, sensitivity to reward and punishment and perceived criticism). This study utilized a linear mixed-effects model rather than traditional repeated measures methods such as analysis of variance (ANOVA) to investigate the cortisol change over time, because the latter allows for better handling of dependencies and missing data in repeated measures data in experimental research (Magezi, 2015). Paired samples T-test was used to examine the difference in cortisol levels between the conditions while critical, positive and neutral comments were administered.

CHAPTER THREE: RESULTS

Descriptive Statistics

As seen in Table 1, 12 males and 14 females with an age range between 18 and 40 years (Mean=26.46, with standard deviation (SD) of 6.11) took part in the study. Due to dropouts, the resulting participation was 25 participants for the positive comment condition, 21 for the neutral comment condition and 23 for the negative comment condition. There was a total of four ethnicity categories, these being NZ European, Māori, Asian and other with there being a total of 3, 3, 15 and 5 individuals in each group respectively. With regards to education, 50% (13) of the participant had a postgraduate degree, with the next highest representation being 26.92% (7) of participants having a high school diploma as their highest level of qualification. Degree qualification and diploma or equivalent had the smallest representation in the sample with 3 participants in each category, which is 11.54% of the sample for each group. Finally, with regards to the marital status of participants, 20 (76.92%) were not married or never registered a same-sex civil partnership, while for both engaged and 'prefer not to say', there was just 1 participant (3.85%) and for both married and in a relationship, there were 2 participants (7.69%).

Table 1*Sample Demographic Characteristics*

Characteristic	Frequency (n)	Mean (SD)	Range
Age (Years)	26	26.46 (6.11)	18-40
Sex			
Female	14 (53.85%)		
Male	12 (46.15%)		
Ethnicity			
Asian	15 (57.69%)		
Other	5 (19.23%)		
NZ European	3 (11.54%)		
Maori	3 (11.54%)		
Marital Status			
Never married or never registered a same-sex civil partnership	20 (76.92%)		
Married/ in a same-sex civil partnership	2 (7.69%)		
In a relationship	2 (7.69%)		
Engaged but getting married soon	1 (3.85%)		
Prefer not to say	1 (3.85%)		
Education			
Postgraduate degree (for example MA, PhD)	13 (50.00%)		
High School	7 (26.92%)		
Diploma or equivalent	3 (11.54%)		
Degree (for example, BA, BSc)	3 (11.54%)		

Descriptive statistics were also investigated for the three comment conditions as seen in Table 2 which assessed the median scores of arousal and relevance ratings for audio comments. Ratings of relevance and arousal for positive comments were the highest with a mean of 7.28(2.48) and 6.70(1.83) respectively, which was greater than ratings of relevance and arousing for critical comments or neutral comments.

Table 2*Descriptive Statistics for Comment Conditions, Arousal and Relevance Ratings*

Comment condition	Minimum	Maximum	Mean	Std. Deviation
Positive Comment Median Arousing	0.00	10.00	7.28	2.48
Neutral Comment Median Arousing	0.00	8.00	2.81	2.50
Critical Comment Median Arousing	0.00	10.00	5.39	2.73
Positive Comment Median Relevance	3.00	10.00	6.70	1.83
Neutral Comment Median Relevance	0.00	8.00	1.93	2.45
Critical Comment Median Relevance	0.00	10.00	4.04	2.85

Correlation between cortisol levels, EE and individual characteristics

Table 4 shows the correlation between cortisol levels of PC and CC conditions and psychometrics. However, the results showed that there was no significant correlation between cortisol levels and ratings of arousal and relevance for critical and positive comments ($p > 0.05$).

Critical comments condition (CC)

As seen in Table 3, there was a significant correlation between the median rating of relevance for CC and the DASS stress subscale at T4 $r(21) = .444$, $p = .010$, and anxiety at T3 $r(20) = .447$, $p = .037$, T4 $r(20) = .534$, $p = .010$, and T5 $r(18) = .533$, $p = .016$. However, no significant correlation was found between cortisol levels and ratings of expressed emotion ($p > 0.05$). Furthermore, there was no significant correlation between CC and subscales in the LEE ($p > 0.05$).

Ratings of relevance and arousal levels for CC were found to be correlated with psychometric measures (see Table 3). In particular, median arousal ratings for CC were correlated with BIS scores $r(19) = .451$, $p = .040$. Additionally, scores for the BAS subscale reward, were significantly correlated with median arousal ($r(21) = .439$, $p = .036$) and relevance ($r(21) = .435$, $p = .038$) ratings of positive comments. Finally, PSS scores were significantly correlated with median arousing ratings of CC $r(21) = .432$, $p = .040$. Furthermore, scores for emotional coping were significantly correlated with CC relevance scores $r(13) = .656$, $p = .008$. Relevance ratings were also seen to be significantly correlated with anxiety attachment scores $r(18) = .487$, $p = .025$. Finally, anxiety attachment was also significantly correlated with arousing ratings $r(18) = .495$, $p = .022$.

Positive comment condition (PC)

In the PC condition, there was a significance found between positive comment cortisol levels at T5 and perceived stress $r(19) = .443$, $p = .045$. However, there was no

significant correlation between any cortisol levels in PC conditions and subscales with LEE ($p > 0.05$).

Ratings of relevance and arousal levels for PC were found to be correlated with psychometric measures (see Table 3). In particular, ratings of arousal were correlated with sensitivity to reward $r(19) = .439, p = .036$. Additionally, ratings of relevance were seen to be significantly correlated with sensitivity to reward $r(19) = .435, p = .038$. Furthermore, avoidance coping scores were significantly correlated with arousing rating of PC $r(14) = .482, p = .050$, as well as relevance ratings $r(14) = .555, p = .021$.

Table 3

Pearson's Correlation Coefficients for Relevance and Arousal Ratings of Critical and Positive Comment Conditions and Psychometrics

	Positive Comment-Median Arousing		Critical Comment-Median Arousing		Positive Comment-Median Relevance		Critical Comment-Median Relevance	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
DASS- Depression	0.204	0.328	0.363	0.089	-0.046	0.826	0.548**	0.007
DASS- Anxiety	0.143	0.494	0.111	0.615	0.077	0.713	0.113	0.608
DASS- Stress	0.226	0.277	0.187	0.393	0.008	0.968	0.357	0.094
BIS	0.401	0.058	0.451*	0.040	0.286	0.186	0.315	0.164
BAS- Drive	0.017	0.940	0.059	0.800	0.049	0.824	0.192	0.405
BAS- Fun	0.173	0.430	0.218	0.343	0.065	0.767	0.315	0.164
BAS- Reward	0.439*	0.036	0.112	0.628	0.435*	0.038	0.117	0.615
PSS- Positive Comments	0.302	0.151	0.344	0.126	0.106	0.622	0.430	0.052
PSS- Critical Comments	0.363	0.082	0.432*	0.040	0.171	0.423	0.432*	0.039
Coping- Rational Coping	-0.156	0.551	-0.113	0.688	0.017	0.948	-0.105	0.709
Coping- Emotional Coping	0.379	0.134	0.426	0.114	-0.014	0.956	0.656**	0.008
Coping- Detached Coping	-0.056	0.830	0.005	0.985	-0.040	0.880	0.034	0.905
Coping- Avoidance	0.482	0.050	0.437	0.103	0.555*	0.021	0.414	0.125
Attachment- Closeness	-0.044	0.844	-0.074	0.749	0.132	0.548	-0.243	0.289
Attachment- Dependence	-0.196	0.844	-0.171	0.459	-0.287	0.184	-0.181	0.433
Attachment- Anxiety	0.345	0.107	0.495*	0.022	0.042	0.849	0.487*	0.025

Note: Correlation is significant at * $p \leq 0.05$, and ** $p \leq 0.01$ (2-tailed). DASS: depression, anxiety and stress scale, BIS: behavioural inhibition system scale, BAS: behavioural activation system scale, PSS: perceived stress scale.

Table 4

Pearson's Correlation Coefficients for Cortisol Levels (T3, T4, T5) in Positive and Critical Comment Conditions and Psychometrics

	Cortisol in response to Critical comments						Cortisol in response to Positive comments					
	T3		T4		T5		T3		T4		T5	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
Positive Comment- Median Arousing	-0.068	0.769	0.029	0.901	-0.069	0.778	-0.096	0.663	-0.134	0.562	-0.293	0.185
Critical Comment- Median Arousing	-0.225	0.340	-0.091	0.704	-0.277	0.266	-0.245	0.285	-0.201	0.424	-0.356	0.134
Positive Comment- Median Relevance	-0.357	0.113	-0.221	0.337	-0.337	0.158	-0.073	0.742	-0.145	0.530	-0.215	0.336
Critical Comment- Median Relevance	-0.249	0.289	-0.061	0.799	-0.313	0.206	-0.291	0.200	-0.192	0.444	-0.288	0.231
DASS- Depression	0.329	0.135	0.374	0.086	0.048	0.840	0.023	0.919	0.087	0.709	0.020	0.929
DASS- Anxiety	0.447*	0.037	0.534*	0.010	0.533*	0.016	-0.026	0.906	-0.177	0.443	-0.117	0.603
DASS- Stress	0.357	0.103	0.444*	0.039	0.231	0.327	-0.198	0.366	-0.095	0.683	-0.191	0.395
BIS	0.271	0.248	0.262	0.265	0.128	0.613	-0.259	0.256	-0.291	0.226	-0.375	0.103
BAS- Drive	-0.244	0.299	0.044	0.853	0.011	0.964	0.050	0.829	-0.023	0.925	-0.017	0.943
BAS- Fun	-0.265	0.258	-0.017	0.942	-0.073	0.772	0.111	0.632	-0.016	0.948	-0.063	0.790
BAS- Reward	-0.274	0.242	-0.226	0.338	-0.227	0.364	0.037	0.873	-0.120	0.624	-0.241	0.306
PSS- Positive Comments	-0.201	0.396	0.006	0.980	0.019	0.942	-0.337	0.126	-0.323	0.165	-0.443*	0.045
PSS- Critical Comments	0.196	0.382	0.392	0.071	0.270	0.250	-0.034	0.881	-0.051	0.830	-0.244	0.287
Coping- Rational Coping	-0.342	0.231	-0.339	0.235	-0.372	0.190	0.273	0.306	0.229	0.412	0.328	0.215
Coping- Emotional Coping	0.375	0.186	0.358	0.209	0.284	0.326	-0.281	0.292	-0.153	0.585	-0.201	0.455
Coping- Detached Coping	-0.353	0.216	-0.392	0.166	-0.328	0.253	0.169	0.532	0.122	0.664	0.167	0.537
Coping- Avoidance	-0.371	0.192	-0.438	0.118	-0.366	0.198	-0.281	0.293	-0.268	0.335	-0.283	0.289
Attachment- Closeness	0.091	0.701	0.123	0.606	-0.237	0.344	0.297	0.191	0.180	0.462	0.250	0.288
Attachment- Dependence	-0.072	0.763	-0.079	0.741	0.314	0.205	0.037	0.873	0.012	0.962	0.149	0.530
Attachment- Anxiety	0.415	0.069	0.374	0.104	0.123	0.628	0.168	0.468	0.182	0.455	0.031	0.896

Note: T3-immediately after listening to audio comments; T4- 25 minutes after listening to audio comments; T5- 40 minutes after listening to audio comments

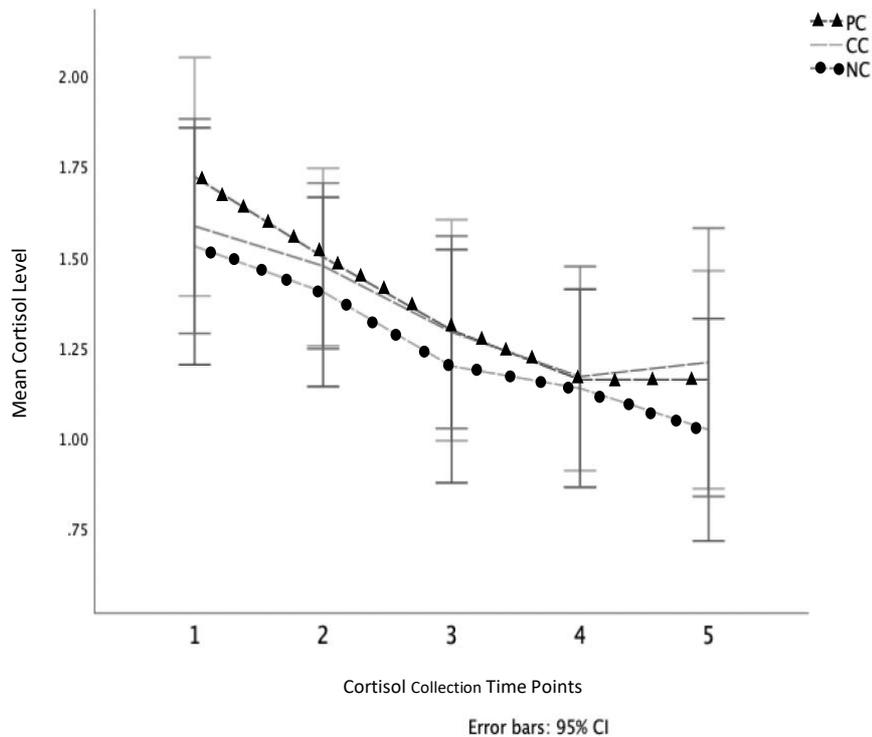
Note: Correlation is significant at * $p \leq 0.05$, and ** $p \leq 0.01$ (2-tailed). DASS: depression, anxiety and stress scale, BIS: behavioural inhibition system scale, BAS: behavioural activation system scale, PSS: perceived stress scale.

Cortisol changes over time and conditions

In the linear mixed model analysis, there was a significant effect of time in cortisol levels for positive comments ($F = 14.0$, $p < 0.001$), as seen in Figure 2. Compared to the baseline measurement (T1), cortisol was significantly reduced at T2 as seen in Table 4 (mean difference [MD]= -0.29 , $p=0.002$), T3 (MD= -0.425 , $p < 0.01$), T4 (MD= -0.597 , $p < 0.01$), T5 (MD= -0.690 , $p < 0.01$). Similarly, cortisol was significantly reduced over-time in the critical comment condition ($F = 5.31$, $p = 0.01$), as seen in Figure 2. However, as seen in Table 5, this significant difference was observed at T4 (MD= -0.535 , $p = 0.017$) and T5 (MD= -0.677 , $p = 0.002$). Furthermore, as seen in Figure 2, cortisol was significantly reduced across time for neutral comments ($F = 5.305$, $p = 0.005$). As seen in Table 6, this significance was observed at T1 and T5 (MD= -0.472 , $p = 0.016$). There was no significant difference seen in T2 (MD= -0.472 , $p = 0.016$), T3 (MD= -0.472 , $p = 0.016$) and T4 (MD= -0.472 , $p = 0.016$).

Figure 2

Profile Plot of Changes of Cortisol Levels over Time



Paired samples T-test revealed no differences in the levels of cortisol between the experimental conditions. In particular, cortisol baseline (T1) at the start of the day listening to positive comments vs. cortisol baseline (T1) at the start of the day listening to negative comments; cortisol measured (T4) 25 mins after listening to positive comments vs. cortisol measured (T4) 25 mins after listening to negative comments.

Chapter 4: Discussion

Overview

EE reflecting an adverse family environment is considered one of the robust predictors of relapse in mental health patients such as schizophrenia, mood disorders, anxiety disorders and eating disorders (Hooley, 2007; Hooley & Parker, 2006; King & Dixon, 1999). It is argued that one of the prevalent stressors in an environment could be related to EE and contribute to a patients' symptoms of a mental disorder, as well as relapse of an already diagnosed disorder (Hooley & Gotlib, 2000; Millman et al., 2018). EE can also be understood through the diathesis-stress model which conceptualises that those who come from family environments with high EE have a greater vulnerability for developing a mental disorder, as well as experiencing a relapse of an already diagnosed disorder (Hooley & Gotlib, 2000; Millman et al., 2018). This view of EE proposes that both the individual with a mental illness and their family members are a system of influences that contribute to the stress an individual experiences which in turn acts on their underlying vulnerabilities as this framework emphasises the importance of the interaction between vulnerability and stress (Amaresha & Venkatasubramanian, 2012).

EE has been heavily researched within the context of individuals who already have been diagnosed with mental illnesses. However, current gaps in literature include the lack of research and findings looking at the link between EE and cortisol levels in healthy adults and any influencing factors. Due to this lack of literature and research, the present study was to investigate 1) the relationships between cortisol, perceived EE and perceived stress, negative emotions, and reward sensitivity, and 2) the change in levels of cortisol associated with emotional comments, in healthy adults, by assessing participants' cortisol change in response to positive, critical and neutral comments using arousal and relevance ratings given by the participants.

We hypothesised that 1) there would be positive correlations between cortisol, perceived EE (ratings of arousal and relevance for criticism), stress, negative

emotions, attachment, coping style and reward sensitivity (H1); 2) cortisol would be increased by critical comments (H2) Cortisol would be correlated with ratings of arousal and relevance.

Summary

The present findings partially support our hypothesis (H1) showing that cortisol measured during the critical comment condition was positively correlated with anxiety and stress as well as avoidance coping style. While cortisol during the positive comment condition were positively correlated with emotional and avoidance coping styles and attachment anxiety, but negatively correlated with perceived stress. However, neither ratings of arousal nor relevance for critical comments was correlated with cortisol levels. Furthermore, ratings of arousal for critical comments were positively correlated with punishment sensitivity, perceived stress, and ratings of relevance for critical comments were positively correlated with depression and perceived stress.

The present findings failed to support our hypothesis (H2) on the increased cortisol level induced by criticisms. In contrast, cortisol was significantly reduced in all conditions, regardless of the type of comments being administered. No significant differences in cortisol were found between the experiment conditions when different types of comments were administered.

Implication of Findings

Cortisol is considered by many studies as a biomarker for various chronic illnesses, showing increased levels induced by psychological and physical stresses (Noushad et al., 2021). It has been argued that the circulating cortisol levels changes enhance catabolic processes to supply more energy to the body for adaptation to the environment (Lee et al., 2015). These changes that are referred to as 'allostasis', however, can be adaptive or maladaptive depending on its degree or contextual

relevance (Ganzel et al., 2010). Previous research found a hypoactive HPA axis is associated with higher ratings of anxiety among female adolescents (Lu et al., 2018). Cortisol is also found to be significantly higher in individuals who experience stress and anxiety through generalised anxiety disorder (Lenze et al., 2011), and healthy university students (Xu et al., 2019). Consistently, our results highlight the relationship between higher cortisol levels and the increased likelihood of experiencing depressive and anxiety related symptoms. This is consistent with findings from previous research which too has demonstrated that higher cortisol levels in response to stress are heavily associated with acute and severe forms of depression (Dienes et al., 2013; Nandam et al., 2020) and anxiety due to hyperactivity within the HPA-axis (Lenze et al., 2011).

In contrast to the previous research showing the link between arousal in affect and cortisol (Hoyt et al, 2016), our findings suggest that salivary cortisol changes might be somewhat independent from self-report perception of EE, at least in healthy participants. Such findings were not expected due to the notion that the increased stress results in a prioritisation of automatic emotional processing which results in a range of biases within an individual and an increased focus on negativity (Brown et al., 2017). This relationship, which was not found in this study, is also supported by further literature by Abercrombie et al., (2005), which demonstrated that higher levels of cortisol were associated with greater ratings of arousal of stimuli, regardless of the nature of the stimuli as in this research even neutral stimulus was given greater arousal ratings as cortisol levels increased. Furthermore, previous research has suggested that under stress, the arousal experienced is heightened (Hoscheidt et al., 2014). Despite this, in previous research it has been found that healthy children showed the expected decrease over time without marked differences between the conditions when positive and negative comments were given respectively while completing a cognitive task (Christiansen et al., 2010). In line with this, reductions in cortisol levels have been found across all experiment conditions in the present study. Apparently, healthy participants can perceive the criticism expressed by those audio comments but may

not explicitly perceive this as an acute emotional stressor, but rather respond to it on a physiological level.

Additionally, previous research shows that EE is positively correlated with insecure attachment styles (Chen, 2006), sensitivity to rewards (Berghorst et al., 2013; Pizzagalli et al., 2007), and negative emotions such as depression, stress, and anxiety (Cutting et al., 2006). Consistent with these findings, the findings from this present study suggest that an individual's sensitivity to criticism is likely to be heightened by the perceived stress in one's life, current depressive mood, and anticipation of punishment (or punishment sensitivity). In other words, the higher an individual scores in symptoms related to depression, the possession of a greater sensitivity towards criticism is seen. Additionally, such individuals also appear to have a decreased sensitivity towards positive affect from positive comments and do not appreciate positive reinforcement as much as those who score lower in symptoms related to depression through the DASS.

The findings from this present study demonstrate the importance of additional factors such as attachment, sensitivity to reward and punishment and negative emotions on sensitivity in response to emotional comments and the resulting impacts on the HPA axis and thus cortisol. Such factors may influence the extent to which an individual perceives emotional comments in relation to criticism and hostility. Findings from this can also be used in additional research to further explore and understand the multitude of factors and the extent of such factors and their ability to influence an individual's sensitivity to criticism and the resulting fluctuations in cortisol levels which can be an indicator of mental illness. Understanding cortisol and the influencing factors is important within the mental health context due to the already established link between such physiological measures and the resulting stress which is also a marker for various mental illnesses (Lee et al., 2015). While previous research has highlighted the family environment and the resulting EE within the household being a robust predictor for relapse in individuals with an already diagnosed mental illness (Amaresha & Venkatasubramanian, 2012), however, this may not be entirely true for healthy

individuals with the current study indicating the importance of further factors that should be assessed in the treatment of individuals such as attachment and other psychometric features.

Possible contributing factors to the present findings

Cortisol levels can also be influenced by a variety of factors (Namdam et al., 2020). Risk factors for elevated cortisol can start from childhood with early life stress leading to an abnormal cortisol response to stress in adults (Hunter et al., 2011). In the current study, the effect of depression, anxiety, stress, and coping style on cortisol responses to criticisms appears to be more important than others. It is possible that these psychometric factors influence and possibly enhance one's perception of EE, which in turn impact the HPA-axis and thus the resulting variations in cortisol response. In particular, depression affects not only the cognitive aspects of an individual but also neurobiological mechanisms such as the HPA-axis which in turn results in higher secretion rates of cortisol (Compare et al., 2014). Additionally, gender is an associated factor with cortisol levels as female levels of cortisol can change depending on menopausal status with differences in HPA-axis regulation and thus resulting cortisol levels in menopausal and pre-menopausal women (Young et al., 1993). Furthermore, higher levels of cortisol can interfere with cognitive and emotional processing as lower levels allow and promote interaction with limbic and cortical structures (Qin et al., 2015), this interaction could explain the lack of significant findings between cortisol and EE through arousal and relevance ratings as an individual's emotional processing is hindered.

Additionally, cortisol can also be modulated with attachment. Previous research has found that individuals with an insecure attachment style have an increased likelihood of reporting greater perceived stress and a greater cortisol response (Dewitte et al., 2010). Attachment style may modulate and contribute to the dysregulation within the HPA-axis, in particular, with previous research highlighting the significant

association between attachment and cortisol and the rate of decline in cortisol levels (Kidd et al., 2013). Cortisol can also be modulated by coping styles with cortisol levels being significantly associated with emotional coping while those who used problem engagement as a coping style had lower cortisol levels (O'Donnell et al., 2008). Furthermore, an individual's coping style is significantly associated with cortisol levels, in particular, those who use social support as a coping mechanism have a lower cortisol stress response (Sladek et al., 2016).

Depression and related symptomology also increase an individual's perception of EE and associated criticism is a further proven factor to impact the HPA-axis and thus the resulting cortisol response (Compare et al., 2014). Furthermore, the attachment styles of the participants as well as wider family members may have contributed to the findings in this study. In particular, avoidantly attached caregivers are more likely to engage in hostile and critical behaviours which in turn can impact the participants and their own ability to deal with emotions and stressors (Cherry et al., 2018). Furthermore, higher levels of anxiety can affect the degree of sensitivity to criticism as a social stressor (Docherty et al., 2009). Overall, such psychometric measures are factors that could have contributed to the present findings

A further possible contributing factor towards the present findings is the design of the study. While the three different data collection sessions were scheduled for the same time of morning and the possible confounding effect of smoking, historical and current health status, medication etc were carefully controlled, there are unmeasured factors which could have impacted the cortisol levels within the study. For example, undisclosed recent life events and food consumption. There are multiple biological and lifestyle factors that an individual may possess which can influence salivary cortisol levels (Pritchard et al., 2017). One such factor is that saliva samples of cortisol can be affected by food and smoking habits (King & Hegadoren, 2002).

Study Limitations and Future Research Directions

There are several limitations identified within this research. First, this study had a small sample size and there were participants dropping out in some comment conditions. Recruitment and the maintenance of participants was particularly difficult in this present study due to disruptions caused by the COVID-19 pandemic within New Zealand. As seen in the results, there was a loss of participants across all three comment conditions with all three comment conditions having different participation rates. This could have impacted the findings of this study in what was found of significance and impact the ability to generalise the results found to the wider population of healthy adults. However, it should be noted that efforts were made in this present study to recruit a gender balanced sample with a wide range of age and ethnicity differences. Additionally, physiological data (EEG) was also collected, however this was not included in this dissertation.

Furthermore, the self-report nature of the data brings limitations due to the potential for bias from the participants. In particular, participants may have altered their answers to conform to social expectations rather than their true answers as to the relevance of negative and positive comments in their lives. Furthermore, despite participants being considered 'healthy' through excluding those with any pre-existing diagnosed mental health conditions, there is still a possibility for undiagnosed conditions to have impacted the study which were not accounted for, and an individual has not been seeking help for. Finally, the subjective nature of this study is a limitation. In particular, the self-reporting of arousal and relevance ratings of comments can be subject to reporting bias and recall bias (Gow et al., 2010). This recall bias could also have been present in the psychometric measures with participants altering answers to conform with social norms and to appear less affected by the emotional comments.

Limitations identified in this study provide the opportunity for further recommendations and directions for research such as larger sample sizes which would

aid in increasing the statistical power of the results and generalisability to wider populations. Additionally, future research could build on the present findings by ensuring that participation rates across all three comment conditions are equal to ensure greater reliability of the results. Further research can also include the addition of a clinical population as well as a healthy population to assess the differences and further validate the current findings. This would allow for a better understanding of how one's condition is gradually impacted by levels of EE and relationships with family members.

Conclusion

In conclusion, this study aimed to investigate the relationship between cortisol levels and expressed emotion through psychometric measures and arousal and relevance ratings of audio comments. This study concluded that perceived EE (through arousal and relevance ratings) is positively correlated with psychometric measures (stress, current depressive mood, and anticipation or sensitivity of punishment). While cortisol is linked with stress, anxiety and depression among others, cortisol is minimally affected by perceived EE in a healthy adult population. Several limitations were identified within this study in relation to sample size and the self-report nature of the study and the measures used. Further research directions were discussed with a focus on future research required to further explore the role of factors such as negative emotions on cortisol levels and any further modulating factors in their correlations in healthy adults, which would lead to advancements in the understanding of the development of non-clinical mental health symptoms.

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APPENDICES

Appendix A: AUTECH approval letter



Auckland University of Technology Ethics Committee (AUTECH)

Auckland University of Technology
D-88, Private Bag 92006, Auckland 1142, NZ
T: +64 9 921 9999 ext. 8316
E: ethics@aut.ac.nz
www.aut.ac.nz/researchethics

2 October 2019

Grace Wang
Faculty of Health and Environmental Sciences

Dear Grace

Re: Ethics Application: **19/231 The effect of emotional comments on cortisol and frontal EEG asymmetry in healthy adults**

Thank you for your request for approval of amendments to your ethics application.

The amendment to the recruitment protocol/inclusion criteria (to include female) is approved.

I remind you of the **Standard Conditions of Approval**.

1. The research is to be undertaken in accordance with the [Auckland University of Technology Code of Conduct for Research](#) and as approved by AUTECH in this application.
2. A progress report is due annually on the anniversary of the approval date, using the EA2 form.
3. A final report is due at the expiration of the approval period, or, upon completion of project, using the EA3 form.
4. Any amendments to the project must be approved by AUTECH prior to being implemented. Amendments can be requested using the EA2 form.
5. Any serious or unexpected adverse events must be reported to AUTECH Secretariat as a matter of priority.
6. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the AUTECH Secretariat as a matter of priority.
7. It is your responsibility to ensure that the spelling and grammar of documents being provided to participants or external organisations is of a high standard.

AUTECH grants ethical approval only. You are responsible for obtaining management approval for access for your research from any institution or organisation at which your research is being conducted. When the research is undertaken outside New Zealand, you need to meet all ethical, legal, and locality obligations or requirements for those jurisdictions.

Please quote the application number and title on all future correspondence related to this project.

For any enquiries please contact ethics@aut.ac.nz. The forms mentioned above are available online through <http://www.aut.ac.nz/research/researchethics>

Yours sincerely,

A handwritten signature in black ink, appearing to read 'K O'Connor', is written over a light grey rectangular area.

Kate O'Connor
Executive Manager
Auckland University of Technology Ethics Committee

Cc: , Deborah Dulson

Appendix B: Participant information sheet



Participant Information Sheet

Date Information Sheet Produced: 11/05/2019

Project Title: The effect of emotional comments on cortisol and frontal EEG asymmetry in healthy adults

Researchers: Dr Grace Wang, gwang@aut.ac.nz; 921 9999 ext 7432

Dr Deborah Dulson, ddulson@aut.ac.nz

Thank you for considering participation in this research project. Before you decide whether to take part, it is important that you understand the reasons why this research is being carried out, and what your participation will involve. We would be grateful if you would take time to read the following information carefully and discuss it with colleagues or other people if you wish. Please feel welcome to get back to us if anything is unclear, and to take as much time as you need to decide whether or not to take part.

What is the purpose of the study?

People in day-to-day interaction with close relatives may encounter negative expressed emotion in the form of criticism. Evidence suggest that perceived expressed emotion predict clinical outcomes in various mental disorders. This project is to investigate the levels of a stress hormone cortisol released during those comments, and neural activity modulated by individual sensitivity to emotional comments.

Why have I been chosen?

We need 40 volunteers to complete the study and you have requested further information.

You are taking part because you meet our study eligibility below.

Inclusive criteria: At least 18 years old, are able to provide written consent, and have a close relative (parent, sibling or partner) with who you spend at least 10 hours a week face-to-face or phone contact and speak English during these contact.

Exclusion criteria included intake of antibiotics (within the previous 3 months), regular intake of psychotropic or anti-inflammatory drugs, major surgery (within the previous 3 months), major physical illnesses including gastrointestinal, inflammatory or autoimmune diseases, and personal history of diagnosed psychiatric and neurological disorder or substance use disorder, and the researchers' own students.

What happens if you agree to take part?

You will be asked to come to our lab three times. Each time, you will be asked perform a task that involves listening to auditory stimuli comprising either criticisms (e.g. 'I can't stand it when you are late; you leave things till the last minute and panic when it's too late'), positive comments (e.g. 'You have a great sense of humour. You are spontaneous and witty and say amusing things off-the-cuff') or neutral comments (e.g. 'Gastornis is an extinct genus of large flightless bird that lived during the Eocene epochs. It was 2 metres tall) respectively. The emotional comments are likely to be the kind of comments you hear in day-to-day conversation with close relatives (partner, parent or sibling). The comments from each category will be presented in a random order in either a male or female voice. On listening to each comment, you will answer on a scale of 0-10 how arousing (i.e. emotionally demanding) the comment was and how relevant the comment was to you in terms of your own close relationships. Cortisol will be measured prior to, and after exposure to audio comments, while neural activity will also be recorded using Electroencephalography (EEG).

EEG (Fig 1) is a non-invasive measure of the brain's electrical activity and has been used extensively to study emotion regulations and social cognition. Salivary cortisol test will be used to measure cortisol change induced by comments. This test has been used extensively in stress-related research.

Fig. 1 EEG equipment



You will then be asked to complete an online survey. Here, you will be asked to answer questions on awareness of emotional expressions from a most influential person (a parent, sibling or partner with whom you have contact for 10 hours or more a week, either face-to-face or by phone). This is because this person is likely to influence your own mood. You will also be asked to answer questions on your level of schizotypy, depression, aggression and current mood. Schizotypy is a specific type of personality trait characterised by a tendency for odd beliefs (e.g. belief in special, almost magical powers, or having the ability to read others' minds), unusual perceptions, lack of enjoyment from social sources and reckless behaviour.

The study will take place in the Psychology Department, Auckland University of Technology. Your participation will take approximately 90 minutes.

What are the risks of taking part?

1. Listening to the criticisms may be upsetting and lower your mood. These comments will be the kind of comments made by a close relative day to day in relationships, but they may cause you some discomfort. During the debrief at the end of the testing session, I will discuss with you about how you feel and ensure that any discomfort is minimized before you leave the room and suggest support services to contact. If you find the task too distressing, you can discontinue at any time.

2. You will also complete a range of questionnaires assessing your awareness of negative emotional expressions from the most influential person, your level of aggression, depression and anxiety and current mood. It is possible that answering these questions may cause you to think differently about yourself and to lower your mood in the context of listening to criticism. If you find the questions distressing, you may discontinue at any time.

Counselling services

If you need psychological support, you are advised to contact your general practitioner and the following support services: AUT student support (if you are an AUT student):

Website: <https://www.aut.ac.nz/student-life/student-support/counselling-and-mentalhealth?nav=inthissection>

Tel: 09 921 9292 Email: counselling@aut.ac.nz

Voluntary participation

It is entirely optional whether you wish to accept the invitation to take part in the study, but your participation will be greatly valued. You are under no obligation; there will be no impact on you, such as your work or studies, beyond the role you play in this study.

Confidentiality and how your data will be handled

On consenting to participate in the study, you need to provide an anonymous unique codename. This codename will be the only source of information used to link you to the data that you provide. You need to keep this codename in a safe place if you would like to retrieve your data at a later stage and if you decide to withdraw from the study. Your data will be stored on a password-protected computer used only by the researcher. You will not be named or otherwise identified in any publication arising from this project. On completion of the study, the data will be stored for a further six years. The data you provide will not be used in other studies.

How do I agree to participate in this research?

If you agree to be in the study, you need to complete a Consent Form.

Will I receive feedback on the results of this research?

The results of this project will be available to you. We will arrange to send you a summary of this upon completion of the project.

What if you decide you want to withdraw from the study?

If you decide to withdraw from the study, you can do so before 1 Oct 2020, as that is when analysis of the data is likely to begin. You can withdraw without giving any reason and your withdrawal will have no bearing on you beyond the role that you played in the study.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project leader, Dr. Grace Wang, Tel: 09 921 9999 Ext 7432; grace.wang@aut.ac.nz.

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEK, Kate O'Connor, ethics@aut.ac.nz , 921 9999 ext 6038.

Who should you contact to find out more about the study?

Grace Wang

Tel: 09 921 9999 Ext 7432

Email: grace.wang@aut.ac.nz