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Automatic information processing and stress in the
natural environment: An emotion-modulated startle response study

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A Master's Thesis
in the Department of
Psychology

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ABSTRACT

Automatic information processing and stress in the natural environment: An emotion-modulated startle response study

Rami Nijjar

Positive interpersonal relationships are integral to individuals' mental health and well being. Biases in the automatic processing of threatening social stimuli has been suggested as one mechanism that puts people at risk for greater dysfunction in interpersonal realms. The present study sought to explore this relationship using the emotion-modulated startle paradigm, a well-validated measure of automatic processing and defensive motivational system activation. Three separate objectives were addressed: 1) whether angry and happy facial images would differentially modulate the eye-blink startle response, 2) whether the emotion-modulated startle response to angry faces predicts the experience of chronic stress and stressful life events (SLEs) in the natural environment, as determined by the UCLA Chronic and Episodic Life Stress Interview, and 3) whether the relationship between the emotion-modulated startle response and indices of stress is moderated by depression scores. Results indicate that those who exhibit greater startle magnitude to angry faces also experience greater chronic stress and SLEs in non-interpersonal realms. Furthermore, depression and startle magnitude were seen to interact in the prediction of non-interpersonal stress such that high startle was predictive of stress in those with low depression scores. This study is among the first to demonstrate a relationship between psychophysiological measures of attention and the experience of stress in the natural environment, opening up avenues for future investigation.

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The development and maintenance of positive interpersonal relationships is integral to an individual's mental and physical well-being. In fact, a major factor in human motivated behaviour is the pervasive need to belong and be close to others (Baumeister & Leary, 1995). Chronic difficulties in interpersonal functioning are related to higher morbidity and mortality (Cacioppo, Hawkley, & Bernston, 2003; Seeman, 2000), as well as increased occurrences of mental disorders, particularly anxiety and depression (Hammen, 2003). Indeed, evidence from prospective research show that problems in interpersonal functioning represent a proximal risk factor in the development of depression (Daley, et al., 1997; Hammen, 1991). Despite its profound impact, the psychological mechanisms surrounding poor interpersonal functioning are not well known. Consequently, there is a need in psychological research to elucidate factors that contribute to the development of adaptive and maladaptive social patterns.

In the past decade, empirical researchers have become increasingly interested in the automatic, pre-conscious processes (such as heightened vigilance for negative information) that govern an individual's interpretations of their environment (i.e., Chartrand, et al., 2006). Recent evidence suggests that individuals' automatic, unconscious reactions to socially relevant images, such as those depicting rejection cues, are predictive of social functioning (Downey, 2004). However, many important questions remain unaddressed. For instance, it remains unclear whether those who are sensitive to social threat cues, such as angry faces, are more apt to have enduring interpersonal problems. Furthermore, it is necessary to elucidate whether individual differences in attention and depressive symptoms interact with such automatic processes to influence one's social well-being. The present study, using both psychophysiological recordings

and measures of functioning in the natural environment, seeks to address these questions and build an integrative understanding of interpersonal functioning.

Emotional regulation, especially the regulation of negative affect in stressful situations, has been repeatedly implicated in adaptive and maladaptive functioning (Eisenberg, et al., 2005; Ellenbogen, et al., 2006; Lazarus & Folkman, 1984; Richards, Butler, & Gross, 2003). Importantly, emotional regulation facilitates appropriate interpersonal sensitivity, helping individuals to develop strong, reciprocal relationships (Lopes, Salovey, Cote, and Beers, 2005). Much research has been conducted on conscious, voluntary strategies that facilitate emotional regulation such as various behavioural coping strategies (Lazarus & Folkman, 1980; Thompson & Schlehofer, 2008) and attentional control (Ellenbogen & Schwartzman, 2009). However, the general mechanisms that contribute to the experience and regulation of negative affect remain somewhat elusive. Covert processes carried out early on in information processing likely play an important role in self-regulation (Derryberry & Rothbart, 1981), warranting investigation.

Automatic attentional processes have become increasingly implicated in individual's regulatory capabilities (Mogg, Bradley, & Williams, 1995). According to Williams & Gordon (2007), particularly significant environmental cues, such as those signalling threat, provide implicit signals that trigger automatic "action tendencies" in the absence of conscious awareness, while controlled responses to these cues rely on explicit information and awareness. Of these automatic processes, perhaps the most important is that of attention orienting. According to Sokolov (1963) the attention orienting response serves to decrease the perceiver's sensitivity threshold for environmental stimuli allowing

them to anticipate incoming information. The process of orienting involves the alignment of attention with the source of sensory signals, and achieving and maintaining a high state of sensitivity to incoming stimuli, a process that occurs at a pre-conscious level, with or without eye movement (Beck & Clark, 1997; Posner & Rothbart, 2007). Furthermore, attention orienting is thought to develop in the context of early interpersonal interactions, promoting emotional regulation throughout the lifespan (Harman, Rothbart, & Posner 1997). It is possible that the development of maladaptive orienting, such as heightened orienting towards threat, is both born of and contributes to interpersonal dysfunction.

Social cognition refers to the cognitive processes that represent our interactions with others and how they subsequently affect our behavior (Adolphs, 2001). Emotion processing is a key component of social cognition and often occurs without awareness (Lane & Schwartz, 1987). It has been suggested that those who exhibit an automatic sensitivity to negative social cues are more vulnerable to experience difficulties in interpersonal domains (Downey, 2004). Indeed, a study by Johnson (2009) showed that those who were taught to focus their attention away from angry faces were better able to regulate their frustration and anxiety during subsequent stress exposure. Moreover, greater ability to focus away from angry faces was related to lower negative affect during stress exposure. However, most work in this area has focused on effortful processes. The relationship between the automatic emotional information processing and the experience of stress has yet to be studied outside the laboratory. In order to do this, it would be necessary to relate measures of emotional responding found in the laboratory to the actual stress experienced in everyday life.

Facial stimuli provide us with a unique opportunity to assess the emotional and attentional processes relevant to social interactions. Dating back to Darwin (1965) it has been suggested that emotions serve an evolved communication function, allowing humans to take their cues from one another and behave accordingly. Facial emotions, in particular, are a potent form of non-verbal social communication and the cornerstone of human social interaction, facilitating either approach or avoidance behaviour (Ekman, 1973). In addition, there is an intriguing universality in the recognition and experience of several emotional expressions, including anger, sadness, and happiness (Ekman & Oster, 1979; Gur et al., 2002; Kohler et al., 2003) suggesting that emotions are more than just culturally bound modes of communication. This notion is further supported by neuropsychological findings. For example, evidence from brain imaging studies (Kanwisher, McDermott, and Chun, 1997) reveals specific areas of the fusiform gyrus, which are thought to be dedicated exclusively to facial recognition. Also, oxytocin, a nanopeptide which facilitates prosocial behaviour by encouraging approach behaviour and inhibiting avoidance, attenuates aversive reactions to negative facial images (Domes et al., 2007; Kirsh, et al., 2005) and to other fear conditioned social stimuli (Petrovic, Kalisch, Singer, & Dolan, 2008), reflecting a social-motivational component to face perception. Angry faces, in particular, have been shown to draw individual's attention faster than other facial images (Esteves, F, 1999) perhaps suggesting a particular significance in mobilizing behaviour. This is in line with information processing theories that suggest negative emotional images to have processing priority (Cappiocco & Bernstein, 1994; Rozin & Royzman, 2001; Williams & Gordon, 2007). However, it has yet to be determined how individual differences in the propensity to perceive angry faces

as threatening are related to difficulties in everyday social interactions. It is possible that heightened vigilance towards threat (i.e. angry faces), although adaptive from an evolutionary standpoint, becomes maladaptive when over-utilized or used inappropriately in social contexts.

Though findings from this line of research are intriguing, biases in the early stages of information processing are, at best, difficult to measure. The emotion-modulated startle reflex paradigm provides means of assessing early affective processing propensities. That is, it can be used to assess trait differences in affective processing, and sensitivity to emotional stimuli (for review see, Grillon & Baas, 2003; Lang, Bradley, & Cuthbert, 1998). The startle reflex, in and of itself, is a ubiquitous, cross-species response to abrupt and intense stimulation that presumably prepares the body for fight-or-flight reactions. The reflex is made up of an interruption of ongoing behaviour paired with multiple motor responses, including a thrusting forward of the head, tensing of neck and back muscles, and a prominent eye-blink reflex (Landis and Hunt, 1939). It follows unexpected, aversive stimuli and serves as a behavioural interrupt that helps to increase vigilance and orient attention towards potential threat (Graham, 1979; Grillon & Bass). According to Davis (1992) this occurs through direct priming of subcortical circuitry by the amygdala, an area of the brain often implicated in fear and avoidance responses.

The eyeblink reflex can be easily measured through electromyographic (EMG) recordings taken from the obicularis oculi muscle located near the bony orbit of the eye (Blumenthal et al. 2005). Such recordings provide easily recordable and quantifiable information about the relative magnitude of the response, making it a particularly attractive method of assessing emotional processes. Of particular interest to

psychological research has been the impact of emotional foregrounds on the magnitude of the startle response. Vrana, Spence, and Lang (1988) discovered that the startle response was potentiated while viewing negative foreground stimuli, and diminished while viewing positive foreground stimuli, suggesting potential emotional priming of the response. The logic behind the emotion modulated startle paradigm is that when the avoidance system is activated by a negative emotional state, defensive responses, such as the startle response, are primed and therefore heightened. Positive emotional states, on the other hand, facilitate approach motivation and inhibit avoidance, leading to a lesser startle response relative to neutral states. Numerous studies have supported this theory (i.e. Greenwald, Bradley, Cuthbert, & Lang, 1998; Larson, Ruffalo, Nietert, & Davidson, 2005; Yartz & Hawk, 2000). Furthermore, the modulation of the startle response does not seem to be limited to visual stimuli, as potentiation and attenuation occur in response to negatively and positively valenced sounds (Bradley, 1994) and smells (Ehrlichman, Brown, Zhu, and Warrenburg, 1995). The degree of the effect is positively related to the amount of affective arousal provoked by the foreground stimuli (Cuthbert, Bradley, & Lang, 1996). Moreover, it has been shown that the magnitude of startle modulation can be altered based on instructions to either enhance (by attending to), or suppress the elicited emotion (Jackson, Malmstadt, Larson, & Davidson, 2000).

Work with the startle response has helped to advance our knowledge of the structure of basic emotions. Lang (1990) described an influential model of emotion in which emotions are viewed as the output of neural systems setup to respond to two types of salient information: appetitive and aversive. In this view, as first described by Darwin (1965), human beings have evolved to automatically recognize and avoid threat, and

approach aspects of the environment that are more adaptive in nature. Of interest to the present study, the emotion-modulated startle response, as part of a defensive motivational system, appears to tap into individual differences with respect to approach/avoidance tendencies and threat vigilance (Lang, 1990).

Interestingly, animal studies have shown that the startle response is potentiated in primates who have experienced early interpersonal stress, namely, unpredictable maternal separation (Sanchez, et al., 2005), suggesting a developmental, socially derived component of the reflex. Moreover, work with clinical populations provides support of the emotion-modulated startle as an indicator of maladaptive affective processing. For example, the emotion modulation of the startle response is attenuated in psychopaths relative to non-psychopaths and young adults with no mental disorder (i.e. Patrick, Bradley, and Cuthbert, 1993) whereas patients with borderline personality disorder, known to have heightened emotionality, exhibited a larger than usual startle responses to unpleasant stimuli than healthy controls, with greater symptom severity being associated with greater startle reactivity (Hazlett, et al.2007). Increased startle is also found in participants having a clinical phobia, while viewing slides relating to their feared object (Hamm, Cuthbert, Globisch, & Vaitl, 1997) and in PTSD victims who are confronted with stimuli that is reminiscent of their trauma (Buckley & Kaloupek, 2001). Furthermore, in a non-clinical population, Downey (2004) observed a potentiated startle response to rejection cues was particular to individuals high in rejection sensitivity, but not among those low on this trait. As such, the emotion-modulated startle paradigm is a convenient one with which to assess emotional reactivity to threatening contexts. It has been suggested that hyper-vigilance to threat results in avoidance behaviour in social

situations (i.e. Mogg et al., 2007). In this situation, we would expect to see increased social dysfunction in those with enhanced processing (i.e. heightened startle) of socially relevant threat cues.

The literature suggests a strong transactional relationship between stressful interpersonal situations and depressive symptoms (i.e. Potthoff, Holahan, & Joiner, 1995). The stress generation perspective, in particular, (Hammen, 1991, 1999, see Hammen 2006 for review) suggests that depressed individuals create stressful environments for themselves and this in turn propagates depressive symptoms by virtue of interpersonal stressors. According to this hypothesis individuals are actively involved in shaping their environments, rather than passive recipients of environmental stress. Indeed, research has shown that those who experience more stress are more prone to depression (i.e. Brown & Harris, 1978) but also that those who have more depressive symptoms are more likely to experience stressful events which are interpersonal in nature, and at least partly due to their own behaviour (Chun, Cronkite, & Moos, 2004; Hammen, Davila, Brown, Ellicott, & Gitlin, 1992), creating a bidirectional relationship between the two. Importantly, these findings have held in sub-syndromal populations (i.e. Hankin, Kassel, & Abela, 2005; Joiner, Wingate, Gencoz, & Gencoz, 2005) as well as in those with remitted depression (Gotlib & Lee, 1989). This relationship between mood disorder and interpersonal stress appears to be exclusive to depression (Van Os & Jones, 1999; Ostiguy, et al., 2009). This association may be explained by cognitive and emotional impairments often seen in depression such as heightened negative affect/absent positive affect (Clark & Watson, 1991), negative appraisals of interpersonal situations, such as perceptions of poor social skills and high social rejection (Joiner, 1999;

Lewinsohn, Mischel, Chaplin, & Barton, 1980) and poor coping strategies (Ravindran, Matheson, Griffiths, Merali, & Anisman, 2002; Segrin, 2000). Moreover, studies of the hypothalamic-pituitary-adrenal-axis suggest that the heightened physiological arousal that accompanies stressful life experiences produces lasting changes in the brain and the body's regulatory system, propagating depression and physical illness (for review see Lupien, McEwen, Gunnar, & Heim, 2009). In sum, it would appear that depressive symptoms often arise in the context of stressful environments, and themselves characterize a way of being that leads to further problematic encounters.

Importantly, attentional biases for negative information have been observed, albeit somewhat inconsistently, in depressed populations (for review see, Ingram, Miranda, & Segal, 1998; Williams, Watts, MacLeod & Mathews, 1988). Specifically, it has been shown that depressed individuals have difficulty disengaging their attention from images depicting sad and interpersonal themes (Ellenbogen & Schwartzman, 2009; Gotlib, Krasnoperova, Yue, & Joormann, 2004) and that these attentional biases generally occur during later elaborative information processing (Ellenbogen & Schwartzman, 2009; Mathews & McLeod, 1994). Given the associations between depression, stress, and attentional biases, it is of interest to explore whether those with both heightened depressive symptoms and higher startle responses to perceived threat are prone to suffer the most in interpersonal realms.

The present study utilizes the emotion modulated startle response paradigm to explore automatic information processing as it relates to indices of stress and functioning in the natural environment. The central idea is that the orienting response to startling stimuli may serve as a precursor to basic self-regulatory tendencies (inflexibility, biased

selective attention, etc) that predict naturalistic functioning. Functioning will be assessed through episodic stress (stressful life events) and chronic stress measures in order to explore three main hypotheses. The first hypothesis is that, in line with past research, startle magnitude will be enhanced while viewing angry facial images and diminished while viewing happy facial images, when compared to sad and neutral facial images. The second hypothesis is that relatively large amplitude startle responses following angry facial stimuli will be associated with more episodic stress and worse chronic functioning. The third hypothesis is that depressive symptoms will interact with the emotion-modulated startle response to exacerbate the experience of stress, particularly in interpersonal domains and with respect to dependent life events.

Method

Participants

Participants were 58 (24 male and 34 female) undergraduate students aged 18-35 years ($M = 24$; $SD = 4.16$), recruited from Concordia University to participate in this study. University students were recruited through classroom visits and advertisements posted around campus and on the University website. Those who expressed interest were contacted by telephone. Exclusion criteria were smoking, regular drug use (medicinal or recreational), past or present mental illness, chronic physical illnesses (i.e. asthma, diabetes, hypertension, epilepsy, cardiac, and neuroendocrine disorders), sleep disorders, and pregnancy. Those who met the criteria for the study were then scheduled for the initial testing session.

Measures

UCLA Life Stress Interview: Chronic Stress. The UCLA Life Stress Interview is a semi-structured interview that was developed to assess chronic and episodic stressors. The interview examines chronic functioning in nine different domains (close relationships, social life, intimate relationships, family relationships, school, work, finances, health of self, and health of the family members) over the six months preceding the interview. The interview consists of open-ended questions and specific probes that aim to assess functioning in each domain for the given individual (see Appendix A for sample questions). Each domain is then coded on a five-point scale by the interviewer, using behaviour-specific anchor points. Higher scores reflect worse circumstances and impairment; factors that are in turn assumed to reflect more stressful conditions.

Composites of chronic functioning were created by summing certain domain ratings: total (all nine domains), interpersonal (friends, social life, romantic relationships, and family) and non-interpersonal (school, work, finances, health of the self, and health of the family members) functioning. The interviews were conducted by a graduate student in clinical psychology, as well as the lab co-ordinator, both of whom underwent extensive training in this assessment. Interviewers were trained by senior graduate students with experience conducting the interview, one of whom was trained at UCLA by Dr. Constance Hammen. Interrater reliability was evaluated using the intraclass correlation coefficient for consistency. Using independent interviewers' ratings of 7 participants, intraclass correlation coefficients revealed high reliability for all domains, with a mean of 0.81, which is similar to what has been obtained in other studies using the same instrument (Eberhart & Hammen, 2006; Hammen & Brennan, 2002, Ostiguy, et al., 2009; Shih et al., 2006).

UCLA Life Stress Interview: Episodic Stress. Episodic stressors are defined as events with a clear beginning and ending. When probing about ongoing situations, the interviewer inquired about the presence of negative stressful life events (or SLEs) related to the domain being discussed. Episodic events were elicited by the following question: "Did you experience any changes or did anything happen that has caused you trouble or made you upset?" Circumstances surrounding each episodic event are documented (e.g., timing, duration, previous experience with this type of events, consequences, functional impairment, etc.), but information regarding the subjective emotional response to the event is excluded. One of the goals of the coding procedure of the UCLA Episodic Life Stress Interview is to acquire ratings of life events that are objective and independent of

mood and emotionality biases, a well known problem with life event data collected from self-report stress checklists (Rudolph et al., 2000). All events, documented by the interviewer, were then coded by a team of raters, composed of four to eight laboratory members. Events were coded on two dimensions: severity and independence. Severity ratings range from 1 (no or minimal stress/negative impact) to 5 (severe stress/negative impact). Independence refers to the degree to which someone has contributed to an event, ranging from 1 (the event is entirely independent on the individual's own behaviour) to 5 (the event is entirely dependent on the individual's own behaviour). Final ratings for each event were determined by group consensus. Ratings of 3 or above were categorized as dependent in analyses (Daley et al., 1997; Rudolph & Hammen, 1999). Finally, each event was categorized as interpersonal (any event where the source of stress is related to a relationship or interaction with another person) or non-interpersonal by the raters. To obtain interrater reliability, 15% of the interviews were rated by two independent rating teams. Intraclass correlation coefficients revealed high reliability (0.89). Indices of the severity of stress exposure were computed for independent, dependent, interpersonal, and non-interpersonal SLEs by summing the objective severity ratings across the relevant events and dividing this number by the total number of events in that category.

Beck Depression Inventory-II. The Beck Depression Inventory-II (BDI-II, see Appendix B), a 21-item questionnaire, was used to assess depressive symptomatology (Beck, Steer, & Brown, 1996). Participants rated their affective, cognitive, and behavioural symptoms of depression on a 4-point scale (0-3). Ratings were summed to create a composite score ($M = 7.62$, $SD = 6.26$). Subsyndromal depressive symptoms have been shown to be

predictive of future depression, anxiety, and suicide attempts and ideation (Fergusson, Horwood, Ridder, & Beautrais, 2005), making them a valuable measure of vulnerability.

Stimuli

The emotion-modulated startle probe protocol was administered using an integrated stimulus presentation and physiology recording system from the James Long Company (Caroga Lake, NY). Acoustic startle stimuli were presented binaurally through Telephonics high-impedance headphones. The acoustic startle probe were 50 ms pulses of 90 db sound pressure level white noise (limited to below 4 kHz) with 0 ms rise and fall times.

The visual stimuli employed in the present study were chosen from the Karolinska Directed Emotional Faces (KDEF; Lundqvist, Flykt, & Öhman, 1998) picture set. This series is comprised of an extensively validated set of facial images that display various types of emotions, including happy, angry, sad, and neutral. Visual stimuli, 1024 x 768 pixels, were presented on a 19-in. color monitor, using the STIM visual presentation software (James Long Company, Caroga Lake, NY). Participants were positioned on a chin rest to ensure a 57 cm viewing distance. We followed published guidelines for human startle blink studies, including subject presentation, electrode placement, amplification and filtering, response quantification, and artifact analysis and removal (Blumenthal et al. , 2005). Prior to the placement of electrodes, the skin was prepared with an abrasive solution (NuPrep) to keep impedances under 20,000 Ω . Electromyographic (EMG) activity from the orbicularis oculi muscles were measured from the right eye, using two Electro-Cap International Inc. (Eaton, OH) E21-6S 6 mm

tin cup electrodes, one under the pupil and the other 2 cm lateral to the first, as close to the margin of the lower lid as possible (as described by Blumenthal et al., 2005). A ground electrode was placed behind the right ear, on the mastoid. Electrodes were filled with high-conductivity electrode gel and affixed with adhesive collars.

Participants with no defined EMG response to the first three startle probes were deemed “non-responders” and were excluded from the analysis. Raw EMG was digitally bandpass filtered at 80 Hz to 240 Hz. The data were analyzed in 75 percent overlapping 8 ms windows, yielding a time resolution of 2 ms. Baseline EMG activity was sampled 50 ms before stimulus onset to 20 ms after stimulus onset and aggregated across all trials. This aggregated baseline was used to detect confounding natural blinks exceeding baseline. Trials with baseline periods in which the threshold was exceeded (greater than 2 SD above aggregate baseline mean EMG) were rejected from the analysis. The EMG peak amplitude between 20 ms and 200 ms post startle probe was analyzed. The latency from probe onset to peak EMG, for each trial was recorded, but is not presented here.

An average EMG score was created for each of the four emotion groups (angry, sad, happy, neutral). These scores were calculated by averaging the amplitude of the subject’s EMG responses for each emotion category, and served as our dependent variables.

Procedure

Testing was carried out over two consecutive lab visits. On the first visit, upon obtaining informed consent (see Appendix C for consent form), participants were led into the testing room, where they were seated in a comfortable chair and electrodes were

attached as described above. Participants were informed that they would be viewing a selection of slides depicting pictures of faces that would vary in facial expression and that they should try their best to attend fully to the slides. In order to ensure attentiveness, they were told that they would be asked some questions about the pictures at the end of the task. They were also informed that they would periodically hear a loud tone through the headphones, but that they should ignore this tone and simply focus on the pictures displayed.

Participants viewed 64 pictures, 16 per emotion category, in random order. Each picture was displayed for a total of 6 s, with interstimulus intervals of 18 – 24 s. Trials commenced with the presentation of a fixation cross in the center of the screen. For each picture slide, an acoustic startle stimulus was presented randomly at either .5 s, 2.5 s, or 4.5s after slide onset. On 16 trials (4 per emotion category) pictures were presented without an acoustic startle probe. This was done in attempt to minimize the impact of habituation; responses to these slides are not included in the analyses.

Following the startle task, electrodes were removed and participants rated printed copies of each picture on a five-point-scale for arousal/interest (how much the picture caught their attention at first glance) and valence (see Table 3). There is consistent agreement in the startle literature that the emotion modulated startle response is contingent on stimuli that are both arousing and are subjectively viewed as negative or positive (for review see Lang, 1990). Participants then filled out a set of questionnaires including the BDI-II. Participants were then trained to collect salivary cortisol in the natural environment and were given all the necessary materials: these data are not presented here. At a second visit scheduled a few days later, the UCLA Chronic and

Episodic Life Stress Interview was administered. Participants were debriefed and compensated \$50 CAN, or received psychology participant pool credits, for the time spent in the laboratory and at home collecting saliva samples. All procedures were approved by the Human Research Ethics Committee of Concordia University.

Data Analyses

Prior to conducting statistical analyses, descriptive statistics were used to assess the normality of the distribution, skewness for each variable, and to identify outliers. In cases where there was non-normality, significant outliers (defined as those whose values fell above 3 standard deviations from the mean) were corrected by converting them into a value that was 2 standard deviations above the mean. One outlier value was detected in the startle magnitude data and another was detected among the non-interpersonal stress index scores. Analyses were conducted with and without the transformed data. As the outliers did not effect the outcome of the results, it was elected to use the untransformed values.

Hierarchical multiple regressions were performed on total, interpersonal, and non-interpersonal chronic stress, as well as interpersonal, non-interpersonal, dependent, and independent SLEs, in order to parcel out the variance associated with individual differences in startle magnitude, as well as the interactions between startle and depressive symptoms. To this end, seven separate regressions were performed (three for chronic measures, four for episodic measures). For each of these regressions, BDI-II scores were entered into the first step of the regression, followed by startle magnitude in the second step, and the interaction between startle and BDI-II scores in the final step. All data

analyses were conducted using SPSS 16.0.

Results

Descriptive Statistics

Means and standard deviations of EMG and UCLA measures are presented in Table 1. A within subjects ANOVA was conducted to assess for differences between mean amplitude for each picture type. The main effect for picture type did not achieve statistical significance. Planned comparisons were conducted to compare slide types. The amplitude of the EMG response for angry faces was larger than the response to happy faces, but this difference fell short of conventional statistical significance ($p = .062$). Surprisingly, no differences in EMG response were found between neutral and emotional faces. For this reason, we utilized the EMG response to happy faces, rather than neutral faces, as the “baseline” for computation of the relative increase in EMG response to angry faces. In other words, a measure of startle magnitude was created by subtracting the response to happy faces from the response to angry faces. This measure was then used as a predictor of chronic and episodic stress in the regressions described below. Non-significant results are presented in Appendix D.

Correlations

Intercorrelations of all stress variables examined in the regression analyses can be found in Table 2. Notably, the correlation between interpersonal and non-interpersonal episodic stress is non-significant. Similarly the association between independent and dependent episodic stress is small. These correlations confirm that dependent versus independent stress and interpersonal versus non-interpersonal stress represent independent dimensions (Rudolph & Hammen, 1999).

Does the emotional modulated startle response predict indices of stress exposure?

Hierarchical multiple regressions were conducted to parcel out the variance associated with startle magnitude from that of having depressive symptoms on measures of total, interpersonal, and non-interpersonal chronic stress, as well as on measures of interpersonal, non-interpersonal, dependent, and independent SLEs. Independent variables were entered in the following steps: (1) depression (BDI-II scores) (2) magnitude of the startle response to angry faces (3) BDI-II by startle magnitude interaction. Main effects will be discussed in this section, followed by a section dealing specifically with significant interactions.

Chronic stress

The regression predicting total chronic stress from the magnitude of the startle response to angry faces and depressive symptoms was significant ($R = 0.49$, $F(3, 44) = 4.50$, $p < .01$), accounting for 23 % (18% adjusted) of the variance. Depressive symptoms accounted for 19% (16% adjusted) of the variance in the prediction of chronic stress ($Beta = 0.44$, $t = 3.29$, $p < .01$), indicating that those who reported more depressive symptoms experienced more total stress in their daily lives (Table 3). Importantly, depressive symptoms remained a significant predictor even after startle magnitude and the interaction term were added into the equation. There were no significant main effects of startle magnitude. Next, we examined whether these results were specific to interpersonal or non-interpersonal chronic stress.

The regression equation examining startle magnitude and depressive symptoms as predictors of chronic *interpersonal* stress constituted a non-significant trend. It accounted

Table 1

Descriptive information of startle and stress measures

		M	SD	Range
<i>Magnitude (μV)</i>				
Angry		45.14	44.14	4.1: 231.5
Happy		42.62	40.8	4.8: 206.7
<i>Picture Ratings</i>				
Valence	Angry	1.2	0.44	1.0: 2.9
	Happy	4.2	0.63	6.0: 15.0
Arousal/Interest	Angry	2.9	0.91	1.1: 5.0
	Happy	2.9	0.7	1.5: 4.6
<i>UCLA</i>				
Chronic Interpersonal Stress		7.81	2.1	4.0: 12.5
Chronic Non-Interpersonal Stress		10.07	2.03	6.0: 15.0
Total Chronic Stress		17.88	3.2	10.0: 25.0
Interpersonal SLE Index		2.21	2.0	0.0: 6.7
Non-Interpersonal SLE index		3.15	2.43	0.0: 11.0
Total SLE index		5.32	3.01	0.0: 12.7
Dependent SLE index		3.01	2.46	0.0: 8.5
Independent SLE index		1.46	1.71	0.0: 6.0

Note: SLE = stressful life events

Table 2.

Intercorrelations among variables examined in the regression analyses

		1.	2.	3.	4.	5.	6.	7.	8.	9.
1.	Chronic interpersonal stress		.18	.19	-.24	-.04	.28*	-.20	.29*	-.19
2.	Chronic non-interpersonal stress			.14	.28	.10	.28*	.21	.36*	-.21
3.	Interpersonal SLE				-.09	.54**	.09	.08	.15	.08
4.	Non-interpersonal SLE					.03	.74**	.25	.14	-.28
5.	Independent SLE						-.23	-.05	.15	-.16
6.	Dependent SLE							.31*	.16	-.06
7.	EMG magnitude								.15	.31*
8.	BDI-II score									-.15
9.	EMG x BDI									

Note: † p < .10, * p < .05, ** p < .01

Table 3.

Summary of Hierarchical Regression Analysis for Startle Magnitude and Depression
Predicting Total Chronic Stress

Variables	Beta	t	R^2_{ch}	F_{ch}
<u>Step 1</u>				
			.19	10.95**
BDI scores	.44	3.31**		
<u>Step 2</u>				
			.00	.11
BDI scores	.45	3.29**		
Startle Magnitude	-.04	-.32		
<u>Step 3</u>				
			.04	2.34
BDI Scores	.40	2.93**		
Startle Magnitude	.03	.21		
BDI x Startle	-.22	-1.53		
	$R = .49$	$R^2_{adj} = .18$	$F = 4.50^{**}$	

Note: * $p < .05$, $t p < .10$, ** $p < .01$

for 14% (9% adjusted) of the total variance ($R = 0.38$, $F(3,45) = 2.51$, $p = .07$). As expected, depressive symptoms emerged as significant predictors of chronic interpersonal stress ($Beta = 0.33$, $p < .05$) accounting for 14 % of the change in variance (Table 4). In contrast, there were no significant main effects of startle magnitude.

The regression equation predicting chronic *non-interpersonal stress* ($R = 0.46$, $F(4, 43) = 3.94$, $p < .05$) was significant, accounting for 21% (14% adjusted) of the variance. Depressive symptoms emerged as a significant predictor of chronic non-interpersonal stress ($Beta = 0.28$, $p < .05$), accounting for 16% of the variance. Higher depression scores were associated with more stress. For startle magnitude, a trend for significance was observed ($Beta = 0.26$, $p = .08$), accounting for 5 % of the variance in chronic non-interpersonal stress (Table 5). Those with higher startle magnitudes tended to report more chronic non-interpersonal stress. In sum, participants with depressive symptoms reported high chronic stress in their daily lives, for both interpersonal and non-interpersonal stress. The relationship between startle magnitude and chronic stress, in contrast, was only observed for non-interpersonal stress, and this effect fell short of conventional statistical significance.

Stressful life events

Hierarchical regressions examined the magnitude of the startle response to angry faces and depressive symptoms as predictors of non-interpersonal, interpersonal, independent, and dependent SLE severity scores. The regression equation predicting *non-interpersonal* SLEs ($R = 0.46$, $F(3, 42) = 3.71$, $p < .05$) was significant, accounting for 21% (15% adjusted) of the variance. Startle magnitude ($Beta = .37$, $t = 2.52$, $p < .05$) emerged as

Table 4.

Summary of Hierarchical Regression Analysis for Startle Magnitude and Depressive Symptoms Predicting Chronic Interpersonal Stress

Variables	Beta	t	R^2_{ch}	F_{ch}
<u>Step 1</u>				
			.09	4.36*
BDI scores	.29	2.09*		
<u>Step 2</u>				
			.05	2.77
BDI scores	.33	2.36*		
Startle Magnitude	-.23	-1.66		
<u>Step 3</u>				
			.01	0.35
BDI Scores	.31	2.17*		
Startle Magnitude	-.20	-1.35		
BDI x Startle	-.09	-.59		
	$R = .38$	$R^2_{adj} = .14$	$F = 2.51t$	

Note: * $p < .05$, $t p < .10$, ** $p < .01$

Table 5.

Summary of Hierarchical Regression Analysis for Startle Magnitude and Depressive Symptoms Predicting Chronic Non-Interpersonal Stress

Variables	Beta	t	R^2_{ch}	F_{ch}
<u>Step 1</u>				
			.13	6.80*
BDI scores	.36	2.61		
<u>Step 2</u>				
			.03	1.59
BDI scores	.33	2.40*		
Startle Magnitude	.18	1.26		
<u>Step 3</u>				
			.05	2.96t
BDI Scores	.28	2.03*		
Startle Magnitude	.26	1.80t		
BDI x Startle	-.25	1.72t		
	$R = .46$	$R^2_{adj} = .18$	$F = 3.94^*$	

Note: * $p < .05$, t $p < .10$, ** $p < .01$

a significant predictor in the final step of the regression, accounting for 14% of the change in variance (Table 6). Results indicate that higher startle magnitude is predictive of more severe non-interpersonal episodic stress. The regression equation predicting independent SLEs did not yield significant results. However, the regression predicting dependent SLEs ($R = 0.39$, $F(4, 43) = 2.55$, $p = .07$) constituted a non-significant trend, accounting for 14% (9% adjusted) of the variance. Startle magnitude emerged as a significant predictor ($Beta = .37$, $p < .05$) of dependent SLEs, indicating that those who displayed greater startle magnitudes tended to have more severe dependent SLEs (see Table 7).

In sum, depression was clearly associated with higher levels of chronic, but not episodic stress. After controlling for depressive symptoms, high startle magnitude predicted poor non-interpersonal functioning, both in the context of chronic and episodic stress and greater exposure to SLEs that are dependent, in part, on the person's own behaviour.

Does depression moderate the relationship between emotion-modulated startle and indices of stress exposure?

Chronic Stress

In the above regressions, we examined whether the depression x startle magnitude interaction was predictive of chronic and episodic stress. For chronic *non-interpersonal* stress, the interaction term approached statistical significance ($Beta = -0.25$, $p = .09$), accounting for 5% of the variance (Table 5). To follow up the interaction, simple slope

Table 6.

Summary of Hierarchical Regression Analysis for Startle Magnitude and Depressive Symptoms Predicting Non-Interpersonal SLEs

Variables	Beta	t	R^2_{ch}	F_{ch}
<u>Step 1</u>				
			.02	.94
BDI scores	.15	.97		
<u>Step 2</u>				
			.05	2.43
BDI scores	.12	.72		
Startle Magnitude	.23	1.56		
<u>Step 3</u>				
			.14	7.24*
BDI Scores	.02	.13		
Startle Magnitude	.37	2.52*		
BDI x Startle	-.40	-2.69*		
	$R = .46$	$R^2_{adj} = .15$	$F = 3.71^*$	

Note: * $p < .05$, $t p < .10$, ** $p < .01$

Table 7.

Summary of Hierarchical Regression Analysis for Startle Magnitude and Depressive Symptoms Predicting Dependent SLEs

Variables	Beta	t	R^2_{ch}	F_{ch}
<u>Step 1</u>				
			.03	1.24
BDI scores	.16	1.11		
<u>Step 2</u>				
			.10	5.03*
BDI scores	.11	.79		
Startle Magnitude	.32	2.24*		
<u>Step 3</u>				
			.02	1.24
BDI Scores	.08	.55		
Startle Magnitude	.37	2.49*		
BDI x Startle	-.17	-1.11		
	$R = .39$	$R^2_{adj} = .09$	$F = 2.55$	t

Note: * $p < .05$, t $p < .10$, ** $p < .01$

analyses were performed. They revealed that low startle magnitude (one standard deviation below the mean) was associated with less chronic non-interpersonal stress among participants with low depression scores and high chronic non-interpersonal stress among those with high depression scores ($t = 3.00, p < .00$; see Figure 1). In contrast, the slope for participants with high startle magnitude (one standard deviation above the mean) across depression did not differ from zero. The interaction predicting *interpersonal* stress was not significant.

Stressful life events

An interaction was also found between depression scores and startle magnitude in the prediction of non-interpersonal SLEs (Beta = $-.40, p < .05$), accounting for 14 % of the change in variance (Table 6). Simple slope analyses revealed that low startle magnitude was associated with fewer non-interpersonal SLEs among participants with low depression scores and more non-interpersonal SLEs among those with high depression scores ($t = 2.21, p < .05$; see Figure 2). The slope for participants with high startle magnitude across high and low depression did not differ from zero.

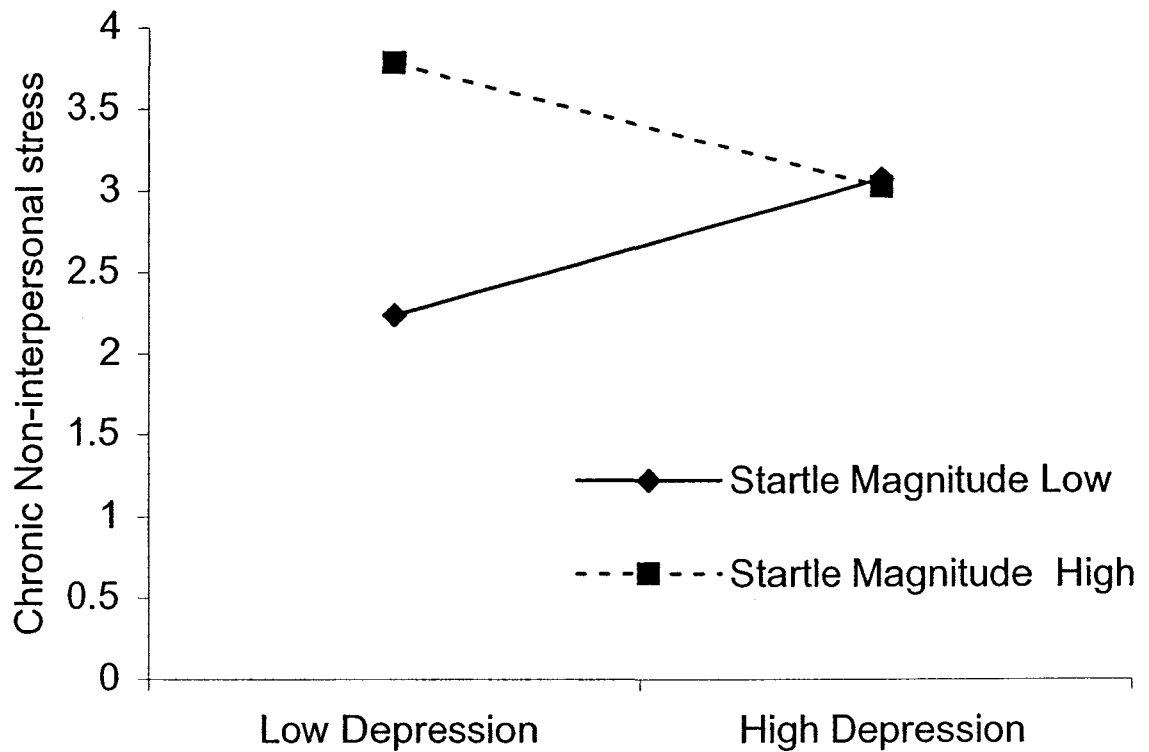


Figure 1. Interaction between startle magnitude and BDI scores in the prediction of chronic non-interpersonal stress. Low depression is defined as one standard deviation below the mean of BDI scores in the sample, and high depression is defined as one standard deviation above the mean of BDI scores in our sample. Likewise, low startle magnitude is defined as one standard deviation below the mean of EMG difference scores in the sample, and high startle magnitude is defined as one standard deviation above the mean of EMG difference scores in this sample.

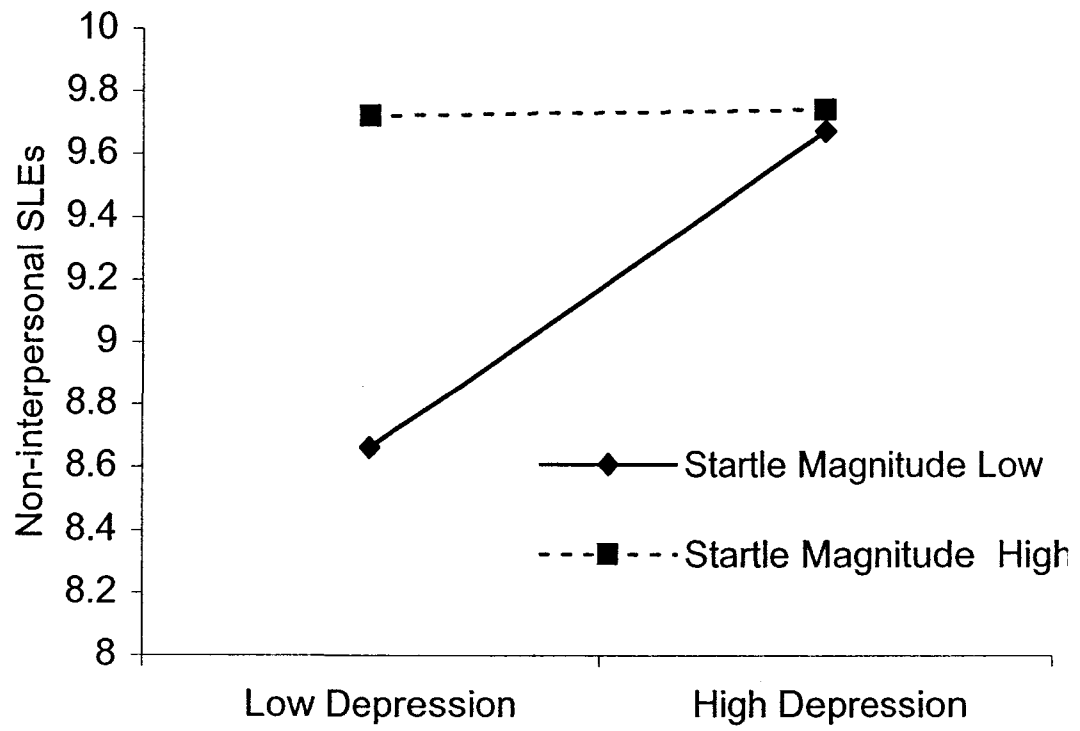


Figure 2. Interaction between startle magnitude and depression in the prediction of non-interpersonal SLEs.

Discussion

The present study examined whether the emotion-modulated startle response, a well-known psychophysiological marker of automatic processing, predicts chronic stress and stressful life events (SLEs) in a healthy, young adult population. Three main objectives were addressed: 1) to examine whether the negative and positive facial stimuli would differentially modulate the eye-blink startle response, 2) to assess whether the emotion-modulated startle response to angry faces predicts the experience of chronic stress and SLEs in the natural environment, and 3) to assess whether the relationship between the emotion-modulated startle response and indices of stress is moderated by depression scores. The results of this study partially supported our hypotheses and together highlight automatic emotional information processing and depressive symptoms as potential correlates of the experience of stress in everyday life.

Based on past findings of the emotion-modulated startle response (i.e. Gyurak & Ayduk, 2007; Vrana, Spence, & Lang, 1988), we hypothesized that, in general, people would exhibit an attenuated response to the acoustic startle probe while viewing happy faces, and an amplified response while viewing angry faces. This hypothesis received modest support. Happy faces failed to show evidence of attenuation and angry faces did not differ significantly from neutral faces. However, angry faces did elicit a larger startle response than happy faces, though this finding fell just short of statistical significance. The fact that angry faces appeared to potentiate startle circuitry relative to happy faces is consistent with the literature. Potentiated startle responses to negative foreground stimuli have been found in infants as young as 5-months-old (Balaban, 1995), as well as specific populations, such as phobics (Hamm, 1997; Sabatinelli, 2001) and symptomatic anxious

and depressed individuals (Larsen, Nitschke, & Davidson, 2007). Furthermore, the lack of findings for positive stimuli is not entirely surprising, as research with positively valenced stimuli has yielded inconsistent results. A number of studies have shown a lack of response modulation to positive faces (Springer, Rosa, McGetrick, & Bower, 2007) and to general positive stimuli with the exception of erotic material (Bradley, Cuthbert, & Lang, 1999; Gooding et al., 2002; Manber et al., 2000). It has been suggested that positive stimuli do not consistently attenuate the startle response because positive faces of strangers are simply not sufficient enough and do not produce sufficient autonomic arousal to facilitate approach behaviour (Jackson, Malmstadt, Larsen, & Davidson, 2000).

The second set of hypotheses, that heightened startle magnitude to angry faces would be predictive of both chronic interpersonal stress and more interpersonal SLEs, were not supported. Counter to our expectations, startle magnitude was found to be unrelated to interpersonal stress in either the chronic or episodic (SLE) domain. Interestingly however, heightened sensitivity to angry faces was found to be predictive of both chronic non-interpersonal stress (albeit this finding fell just below the conventional level of statistical significance) and more non-interpersonal SLEs.

To understand these findings, it is helpful to revisit the composition of the chronic interpersonal and non-interpersonal domains on the UCLA Life Stress Interview. The chronic interpersonal domain consisted of stress pertaining to close friendships, social life, family, and romantic partnerships. In other words, chronic interpersonal stress measures sustained stressful interactions with individuals who are very familiar to the person and integral to their social network. Beck and Clark (1997) have suggested

negative, personally relevant information, such as familiar faces, are more potent in automatic information processing. Orienting to such faces represent an initial step in schema-driven appraisal of social information (Beck & Clark, 1997). Indeed, it has been shown that familiar faces are not only recognized (as evidenced by brain activation in the amygdala and areas of the anterior frontal cortices) more rapidly (Sugiura et al., 2001), but they also cause quicker access to semantic information (Bruce and Valentine, 1985). Furthermore, perceptual tasks have shown that highly familiar faces are associated with greater processing efficiency in change-detection (Buttle & Raymond, 2003) and inattention blindness tasks (Ryu & Chaudhuri, 2007). Given the negative result for the interpersonal chronic stress domain, it could be the case that the unfamiliar faces used in this study did not tap into socially relevant information processing biases, leaving us unable to make the association between automatic processing and interpersonal dysfunction. Alternatively, it may be that the relationship between interpersonal stress and startle magnitude is specific to certain personality factors pertaining to social functioning, such as rejection sensitivity (Downey, 2004; Gyurak & Ayduk, 2007). Such people show a heightened tendency to anxiously expect, readily perceive, and intensely react to rejection (Downey & Feldman, 1996), making them more likely to exhibit attentional biases to social cues. It is likely that social cues, such as angry faces, have the same effect in the general, non-rejection sensitive population.

Chronic non-interpersonal stress, on the other hand, is defined by poor functioning at work and school, heightened financial concerns, as well as health issues experienced by the individual and their family. School and work are both venues in which, at least initially, people are interacting with those who are unfamiliar with them.

In many cases, success in these realms depends on one's ability to integrate into the social environment and build good working relationships with colleagues, professors and/or employers. As such, those who are more vigilant to ambiguous facial cues may be less at ease in these new environments, leading to a compromised ability to function in these occupational realms. Indeed, past research has found that employees who were more likely to perceive threat from others had lower occupational status, experienced more negative emotion and stress at work, and were, in turn, at greater risk of developing cardiovascular disease (Flory, Matthews, & Owens, 1998). Alternatively, it could be the case that exposure to non-interpersonal stressors alters information processing, and not the other way around. For example, low socioeconomic status has been linked to greater threat vigilance, as well as increased heart rate reactivity in ambiguous social situations (Chen, Langer, Raphaelson, & Matthews, 2004), suggesting that the social environment at least partially dictates how people respond to threat.

The chronic non-interpersonal portion of the stress interview further inquired about health factors such as diet, substance abuse, exercise, acute illness, and chronic health conditions. Our findings suggest that those who were found to be more responsive to angry faces likely reported poor physical health as part of the chronic non-interpersonal domain. Poor physical health may alter the functioning of basic motivational systems that underlie the early processing of negatively valenced stimuli. That is, consistent with some studies, poor health may heighten one's vigilance for threat (Constans, Mathews, Brantley, & James, 1999). Alternatively, a relationship between hyper-vigilance to threat in the environment and poor physical health may be explained by poor coping strategies. It is possible that those who show enhanced processing of

negative stimuli also acquire stress-coping behaviours that are detrimental to their physical health. Substantial evidence has shown that stress and increased negative emotion leads to an increase in alcohol consumption and drug seeking behaviour (Goeders, 2004; Piazza & Le Moal, 1998; Sinha, 2008), especially in cases of sustained early life stress (i.e. Hyman & Sinha, 2009). Similarly, sensitivity to threat, especially to cues previously related to punishment, has been found in women who exhibit dysfunctional eating and alcohol misuse (Loxton & Dawe, 2007). In addition, the relationship between chronic stress and over-eating, leading to obesity, has been seen in both animal (i.e. Dallman et al., 2003; Pettenuzzo et al., 2008; Surwit & Williams, 1996) and human samples (Cozier, Wise, Palmer, & Rosenberg, 2009; Lo Sauro et al., 2008; Teegarden & Bale, 2007), again indicating self-detrimental behaviour in the face of continuous stress. Moreover, people with higher exposure to stress are often more susceptible to colds (Cohen, Tyrell, & Smith, 1993) and are less able to maintain antibody levels related to vaccinations (Burns et al., 2003), hinting at a down regulation of the body's defence systems. Unfortunately, the small sample size and low base rate of problems in chronic functioning precludes an investigation of the individual non-interpersonal stress domains of the UCLA interview, making it difficult to ascertain such links. As such, our conclusions remain speculative and open to further investigation.

As aforementioned, heightened startle magnitude for angry faces was also predictive of high severity non-interpersonal SLEs. Severity of SLEs was specified on the basis of disruptive impact on the individuals' functioning, and non-interpersonal events were defined as those that did not involve any changes to a personal relationship. Examples of severe non-interpersonal SLE would be sustaining a physical injury, severe

financial difficulty, or experiencing the death of someone close. Although the causal relationship of these associations are not known, exposure to episodic stress may have preceded and altered threat processing. Bower (1981) describes a model of information processing in which emotional states lead to mood-congruent information processing. In other words, it is the mood set by events that precede the situation which have the greatest impact on selective processing and not the processing biases that predict stress.

The SLEs that participants reported in this study were both recent (occurring in the last year) and of moderate to high severity, making it not unlikely that their affective state, and subsequent affective processing, was a product of recent events. Evidence of increased stress leading to enhanced processing for negative information is inherent in studies of PTSD victims. Combat veterans show greater response latencies to threat-depicting words in emotional Stroop tasks (Constans et al., 2004; Kaspi, McNally, & Amir, 1995; McNally, Kaspi, Reimann, & Zeitlin, 1990). Furthermore, people with subsyndromal PTSD symptoms show greater activation in the anterior cingulate gyrus, an area implicated in both emotion and attention, while viewing negative images (Hayes, Labar, Petty, McCarthy, & Morey, 2008), suggesting an important link between recent stress and altered emotional information processing. Similarly, past research on SLEs has made some noteworthy associations between recent SLEs and maladaptive emotional outcomes. For example, it has been previously shown that exposure to at least one moderate to severe life event increases the risk of developing conduct disorder and emotional symptoms by a factor of three to six (Goodyer et al., 1987). Furthermore, the risk for depression, a mood disorder characterized by negative affect, is 5.6 times higher following a major stressful life event (Paykel, 1979). As such, heightened threat

sensitivity may represent a putative mechanisms by which SLEs lead to future emotional distress.

Finally, a non-significant trend indicated that high startle magnitude tended to be associated with dependent SLEs, or, in other words, SLEs that were caused in large part by the individual's own behaviour. Events characterized as dependent generally involve a maladaptive choice of action on the part of the individual. The defensive motivational system, of which the startle response is an integral part, is set up so as to trigger quick responses under threat without needing time to think (Lang, et al., 2000; LeDoux, 1996; Metcalfe, & Mischel, 1999). However, if this system is activated when threat is only minimally present it may represent a maladaptive pattern of responding to one's environment leading to greater dysfunction. Similarly, trait impulsivity may be a potential factor in the link between startle magnitude and dependent SLEs. Personality research defines impulsivity as a tendency to act without thinking or to respond quickly to a given stimulus without weighing the consequences (White et al., 1994). In a study exploring decision-making in adolescents it was shown that those who were rated by their teachers as being highly impulsive were more likely to respond with aggression (Fite, Goodnight, Bates, Dodge, & Pettit, 2008). A similar moderation could be occurring in the present study and is worthy of further analysis. Importantly, this finding suggests a transactional relationship between the role of the individual and environment in stress generation, each having an integral role in propagating SLEs. The consistency of findings across non-interpersonal chronic and episodic domains is also important as it suggests that the relationship between stress and threat sensitivity is more than just an artefact of the data.

Our third set of hypotheses focused on the interaction between startle magnitude and individual differences in depressive symptoms. We hypothesized that startle and depression would interact such that high startle magnitude, an index of automatic processing, coupled with high depressive symptoms would evidence the greatest amount of interpersonal dysfunction. To this end, our hypotheses were not supported. We did, however, find a significant depression by startle interaction in the prediction of chronic non-interpersonal stress and in the prediction of non-interpersonal SLEs. In general, for those with high depression scores, startle magnitude did not add much to the equation; these people reported high stress regardless of startle magnitude. In those with low levels of depression, however, high startle magnitude to angry faces was associated with chronic non-interpersonal stress and non-interpersonal SLEs. In other words, although high startle and depressive symptoms, a conceived marker of vulnerability, did not have the predicted additive effect in the prediction of life stress, high startle constituted risk factor for chronic non-interpersonal stress and non-interpersonal SLEs for those low in depressive symptoms. Depressive symptoms were not found to be risk factors for non-interpersonal stress independent of startle magnitude.

Consistent with the stress generation literature (i.e. Chun, Cronkite, & Moos, 2004; Hammen, 1991; Hammen, Davila, Brown, Ellicott, & Gitlin, 1992; Harkness, Monroe, Simons, & Thase, 1999), depressive symptoms were predictive of interpersonal chronic and episodic stress. However, the nature of the interaction between depression and startle in the prediction of non-interpersonal stress was unexpected. Though at first puzzling, this finding may be better understood by revisiting what is known about information processing biases in depression. Information processing biases

have been repeatedly implicated in depression (Beck, Eizenman et al., 2003; Gotlib, Krasnoperova, Yue, & Joorman, 2004; Joorman & Gotlib, 2007). However, some evidence suggests that these biases occur at a later, more evaluative stage of processing, involving memory retrieval and association with themes that are more self-relevant and interpersonal in nature (Gotlib, Krasnoperova, Yue, & Joormann, 2004; Mathews & MacLeod, 1994; Mogg & Bradley, 2005; Mogg & Bradley, 1998; Rinck & Becker, 2005; Williams, Watts, MacLeod & Mathews, 1997). The startle response, on the other hand, is thought to be an indicator of automatic threat processing that occurs largely at a preconscious phase (Lang, 1990). As such, the association of high startle and low depression to non-interpersonal stress, may be indicative of an automatic vigilance-avoidance response pattern, in which threat is observed in early processing, followed by cognitive avoidance which deters further processing of the threatening material. Such a pattern has been implied as a central feature of maladaptive responding to feared situations (Foa & Kozak, 1986). Perhaps high threat sensitivity coupled with fewer depressive tendencies represents an increased likelihood of such a pattern.

In terms of the prediction of non-interpersonal rather than interpersonal stress, it may be that those who tend to avoid stressful situations come off as passive, or subdued. This passivity may be more problematic in non-interpersonal settings such as work and school, but could prove adaptive in interpersonal situations in which one's tendency to avoid may in fact decrease conflict. Alternatively, tendency towards avoidance could make it more difficult for people to rectify non-interpersonal situations. A study by Simpson and Arroyo (1998) found women who used avoidance coping to have more life stress, and have more difficulty accepting responsibility in work/school

related, relative to interpersonal, domains. Furthermore, avoidance coping has been found to be related to less job satisfaction (Welbourne, Eggerth, Hartley, Andrew, & Sanchez, 2007) and a harder time adjusting to workplace stress (Love & Irani, 2007). As such, it is possible that avoidance plays an integral role in the pathway between enhanced threat processing and dysfunction in stressful situations.

Interestingly, Rudolph and Hammen (1999) found that, while symptoms of depression were related to interpersonal stress, symptoms of anxiety bore a greater association with non-interpersonal stress. As such, it may be the case that the startle-depression interaction was representative of an anxiety driven response. Incorporating anxiety measures in future investigations would help to clarify this relationship.

Given the deleterious effects that stress can have on human beings, understanding the mechanisms that underlie dysfunction is important. Though our results do not indicate a specific relationship with interpersonal stress, as we had imagined they would, they do confirm threat sensitivity as an integral processing bias in stress prone individuals.

There are several limitations to this study. First, our sample size was modest, decreasing the power necessary to detect small effects; as such negative findings should be interpreted with caution. A larger sample size would also make it possible to ascertain the meaning of non-significant trends found in our data. In addition, the small sample made it difficult to look at specific domains of chronic non-interpersonal functioning so as to better understand the link between reactivity to angry faces and difficulties in these areas. Given our findings, a closer exploration of health, financial, and occupational domains is warranted. Our population also presents somewhat of a limitation; the non-clinical university student population used was relatively homogenous in terms of SLEs,

chronic functioning, and depression scores. This narrow range makes it difficult to fully study the relationship between individual vulnerabilities and stress in the natural environment. Using clinical or stress reactive populations in the future may aid in creating a more accurate picture of enhanced processing and naturalistic functioning. In additions, the impersonal nature of our stimuli may have precluded our ability to tap into domains of interpersonal dysfunction. Future work may attempt to incorporate personally relevant stimuli into this type of experimental paradigm. Finally, an important limitation of this work is that it is correlational and cross-sectional, and therefore provides no information with respect to the direction of the effect of these findings. Future studies should implement a longitudinal design to examine the association between threat processing and the experience of stress. This type of design would be helpful in examining stress and threat sensitivity in a temporal manner, making it possible to understand the causal relationship between stress and changes in the threat processing.

The current study highlighted important links between emotional information processing biases and maladaptive functioning. However, what remains to be explored in this context are the particular mechanisms that mediate such an association. Given the implications for the role of personality factors, such as impulsivity, and emotion-focused coping strategies in the experience of stress, it would be beneficial for future studies to include measures to assess such items. For example, it would be interesting to see if avoidance coping moderates the relationship between threat sensitivity and non-interpersonal outcomes. Also, given that information-processing biases appear to operate at different stages of processing for anxiety and depression, it would also be advantageous for future studies to compare depressed vs. anxious individuals on

measures of emotion-modulated startle and stress. Finally, the use of a mood-induction paradigm in future work could assist in exploring stress reactions in the controlled laboratory environment as they relate to stress experienced in naturalistic settings.

Conclusions

This study was the first to examine the relationship between a psychophysiological measure of early emotional information, as indexed by the emotion-modulated startle response, and chronic and episodic functioning in the natural environment. The key finding demonstrated an elevated startle response to angry faces was related to increased chronic and episodic non-interpersonal stress in the natural environment. Moreover, an interaction between depression and the magnitude of the startle response to angry faces predicted chronic and episodic non-interpersonal stress. Among persons with high depression scores, the magnitude of the startle response is unrelated to non-interpersonal stress, probably due to the robust association between stress and depression. However, among those with low depression scores, there is a strong positive relationship between the emotion-modulated startle response and non-interpersonal stress. Overall, these findings demonstrate that the psychophysiological response to angry faces, measured in a controlled environment, can predict indices of functioning in the natural environment. These data are consistent with the view that automatic information processing of threat is meaningfully related to the development of adaptive and maladaptive functioning in the natural environment.

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Appendix A

UCLA Chronic Stress Interview Sample Questions

Chronic & Episodic Stress Interview-Guidelines

Interview covers the following major domains:

- Intimate relationships
- Friendships
- Family relationships
- Relationship with children (or target child, if applicable)
- Work
- Finances
- Health-Self
- Health-Family

The interviewer follows the general format of the chronic stress interview as indicated below. However, within each domain, the interviewer also probes about occurrence of specific, episodic stressors. Chronic stress notes and ratings to be made on the rating sheet during the interview. Episodic events are queried, usually at the end of the chronic section, and filled in on the episodic stress rating sheet to be scored later by the team.

Chronic stress refers to ongoing conditions. Each area is queried and then rated by the interviewer based on objective information, not simply the participants' feelings about their situations. The time frame is the last ____ months (usual or 12 months).

Episodic stressors refer to events that occurred during the last ____ months (Usually 3 or 6 months) that had a distinct onset and do not refer simply to examples of the chronic stress conditions. Their occurrence may be elicited during the chronic stress interview, but they are examined and rated separately.

The interviewer introduces the stress interview by stating something like: *Now I'm going to ask you about various aspects of your life to get a sense of ongoing conditions that affect you. At the same time I will be asking you about specific events that might have happened in the last ____ months within each of several topic areas. [Do NOT ask interviewees to report "stresses that have happened to them" because what they define as a "stress" may be different from the current use of the terms.]*

DURING ASSESSMENT OF CHRONIC STRESS, REMEMBER TO AVOID ASKING LEADING QUESTIONS. For example, instead of asking if their relationship with their best friend is close and confiding, you might ask, "how close is your relationship with your best friend."

IT IS NOT NECESSARY TO USE EACH PROBE. All interviews should use the most general probes, followed by specific probes as needed in individual cases. Collect as much information as needed to make a valid rating.

CHRONIC STRESS RATINGS are made on a 5-point scale (and half-points are acceptable if the best rating appears to one that falls between two, e.g., 2.5). If circumstances in an area have changed during the period, get information about different conditions, and if necessary and appropriate, average the ratings to reflect changed conditions. A rating of 1 indicates severely adverse conditions, 4 refers to poor conditions, 3 to average or mixed, 2 refers to good, stress-free conditions, and the rating of 5 should be reserved for exceptionally good conditions. *Familiarize yourself with the rat before commencing the interview procedure.*

"We are interested in finding out how you have been doing in the past 6 months - that would be from _____ to today. I'd like to ask you some questions about different areas of your life. There are no right or wrong answers to these questions. If any question doesn't make sense to you, just let me know. Do you have any questions before we begin?" The first area is friendships....

Close Friendships

"In the past 6 months, have you had a close friend(s)? Let's look at your relationship with your very best friend? Do you have a best friend? Who would that be? How has this relationship been going?"
[Must be nonfamily]

- existence of a close, confiding friendship

- quality: closeness, trust, availability, dependability, reciprocity, location (near by), arguments, confidential.

1 Presence of an exceptionally high quality, close, confiding, friendship. Mutually satisfying, reciprocal, good conflict resolution, mutual disclosure in many areas and comforting, mutual loyalty, trusting, and stable

2 Presence of a good quality, close, confiding friendship. Mutual disclosure in some areas and comforting, can trust with most things, reciprocal, satisfying, and stable.

3 Presence of a close, confiding, friendship although may be unstable at times, some trouble with conflict resolution or presence of only a moderately close friendship that is fairly stable and nonconflictual.

4 Presence of a poor quality friendship that is unstable, uncertain about trustworthiness, not reciprocal or presence of only a moderately close friendship that is sometimes unstable or conflictual

5 Absence of a close, confiding friendship where there is no-one they feel close to or confide in.

Social Life

"Do you have a social group that you hang out with? How many people are in that group? How has your social life been going lately? How have you been getting along with those people in your social group?"

- number of friends, conflict, number of activities, type of activities, conflict of interest or morals, popularity

1 Exceptional social life - many good friends, very popular and engages in frequent social activities outside school, gets along well with others, no conflict

- 2 Good social life with some close friends, engages in average number of social activities, good quality of social contacts with no significant problems with peers
- 3 Average popularity but has some conflicts with peers or difficulty making and keeping friends
- 4 Serious social problems - somewhat isolated from peers and spends much time alone. Some acquaintances but lacks stable friendships or has one or two friends but frequent conflicts
- 5 Severe social problems with no friends, totally isolated from peers or frequent conflicts and fights, rejected by peers

HAVE THERE BEEN ANY PARTICULAR EVENTS OR INCIDENTS INVOLVING YOUR BEST FRIEND OR ANY OTHER FRIENDSHIPS IN THE PAST XXX (e.g. an argument, supporting a friend through a stressful problem, problems with their child, or their health)? [these are noted and probed separately]

Romantic Relationship

"Do you have a steady romantic partner?"

R1 - In a relationship * How long have you been going together? * (If this is an exclusive relationship - not currently also dating others - rate here. If only casual dating, rate in next section)

"What is the relationship like?" "How often do you and _____ fight? what are they like, what are they about, and how do you deal with them?"

Qualities: Duration, stability, emotional supportiveness, conflict and resolution

- 1 Exceptional relationship on all quality factors with good conflict resolution
- 2 Stable, positive relationship where they can adequately solve conflicts - close, confiding, and trusting
- 3 Relationship has some significant problems (e.g., lacking on 1 or 2 quality factors), but basic strong foundation is present.
- 4 Deteriorating relationship or severe problems (e.g., lacking on 3 or more quality factors), more negative than positive, unstable, poor conflict resolution
- 5 Abusive relationship (physically or emotionally), negative conditions, lack of communication and/or a one-sided relationship

R2- No partner or brief or uncommitted relationship:

Possibilities available?, lonely?, content without?, looking for a partner? If dating? How often, how many different people? If not dating in past 6 months, assess how long since last relationship, what is the person doing to meet potential partners? Is subject pressured by friends or family?

- 1 Not dating: completely satisfied without partner, happy and not lonely, not looking for a partner, has other life plans for now and adequate social life
Dating: frequent dating, perceive partner(s) to be excellent potential for future relationship, excellent qualities
- 2 Not dating: Happy at present, not lonely, but would like to have a partner in the future, not having a partner does not cause concern, possibilities exist if desired
Dating: Some dating, some good prospects, but not certain
- 3 Not dating: Somewhat happy about not having a partner. Looking for someone and spends time thinking about how to find someone, limited possibilities and occasional distress about not having a partner, not preoccupied, has friends who are singles
Dating: Some dating, partner(s) not appropriate or ideal
- 4 Not dating: Unhappy about not having someone, causes distress more often than not, but not constantly concerned about not having a partner, limited prospects, most friends are in relationships
Dating: Potential partners disappointing, or infrequent, concern about limited opportunities
- 5 Not dating: Extremely unhappy and lonely without a partner. Ongoing concern about never having a partner, no attempts or unsuccessful attempts to find other, friends all have relationships or experiences pressure from others
Dating: Extremely adverse experiences, mistreated or highly inappropriate dates

HAVE THERE BEEN ANY PARTICULAR EVENTS REGARDING YOUR RELATIONSHIP OR DATING IN THE PAST XXX?

HAS ANYONE TRIED TO PHYSICALLY FORCE YOU TO HAVE SEX? HAS ANYONE PRESSURED YOU TO HAVE SEX WHEN YOU DID NOT WANT IT?

Family Relationships (with Parents)

Determine if parents live together; if separated, how much contact; include relationships with step-parents.

"How's your relationship with your parents been going?"

- Quality, closeness, confiding, communication, trust, availability, acceptance, dependability, frequency and nature of arguments, how are conflicts resolved

- how much contact with separated parent; relationship with step-parents

- 1 Exceptional quality relationship with all members of family - exceptional on all quality factors, good conflict resolution
- 2 Good quality relationship with primary parent(s) - majority of quality factors are good, good conflict resolution; no major difficulties with divorced or step-parents; frequent contact with both parents.
- 3 Good quality relationship with one parent, but some problems with other parent (e.g., lack of communication, trust, availability, etc). (if only one parent: child has inconsistent relationship with parent)
- 4 Poor quality relationship with both parents, significant problems (e.g., lacking in many quality factors), but some support or periods of good relationships.
- 5 Very poor quality relationship with parents, significant and enduring problems (abuse, neglect, disowned)

HAVE THERE BEEN ANY PARTICULAR EVENTS CONCERNING ANY FAMILY MEMBERS IN THE PAST XXX (e.g. anyone had an operation, have a car accident, have an argument, separate)?

Academic Experiences (if relevant)

"How have things been going in your school work?" (note what courses, whether special program). Grades, academic standing, failed in any tests or subjects, special awards, need special help

- 1 Superior performance in all areas – A's in all areas; may have received awards or recognition of performance
- 2 Good academic performance – Good grades in most subjects; no significant problems, no failures
- 3 Average academic performance. Average grades, or single failing grade but later resolved or near failure in 1 or 2 subjects or significant variability across academic courses and time. Tries hard.
- 4 Serious academic problems, failure of 1 or 2 subjects in the xxx or near failure in more than 2 subjects, part-time placement in special classes, poor study skills or habits, pattern of unstable effort or dropping out
- 5 Doing very poorly academically, failure in 3 or more subjects, full-time placement in special classes

HAVE THERE BEEN ANY PARTICULAR EVENTS RELATING TO SCHOOL IN THE PAST XXX?

Finances

"What is your financial situation?"

Determine subject's sources of support. Whether live at home, what expenses they are responsible for, such as car, telephone, clothing, entertainment.

"Can you (your family) afford housing, clothing, food, transportation, leisure activities?" "Do you or your family have enough money to pay monthly bills?" "Do you (your family) have outstanding debts or loans?"

- 1 More than enough money lives comfortably with security, enough for good leisure expenses, savings, no need to budget
- 2 Comfortable can afford necessities, some funds for leisure and small savings if budget carefully
- 3 Adequate for basics Requires very careful planning to meet essential expenses
- 4 Messy conditions Gets by but may have to work extra or borrow from friends, family. May experience periods of hardship with gaps in housing or food
- 5 Hardship/Poverty Mostly lacks housing, food, transportation. Struggles to get by, dependent on help from others, social assistance

HAVE THERE BEEN ANY PARTICULAR EVENTS IN THE PAST XXX RELATING TO MONEY OR FINANCES (e.g. being robbed, having unexpected expensive car repairs)?

Work

"Are you working?" (Assess how many hours, duration what kind of job). WHY are you working? (necessity to support self or family? Earn spending money for self?)

W1 - If Working

Conditions (safety, environment), work load, adequacy of rewards (pay, appreciation, possible advancement), relationship with boss and coworkers. Is work related to career goals? Does the person have options if conditions are poor? How does subject manage work and school demands?

- 1 Exceptionally good conditions, satisfying job in all areas above
- 2 Good conditions in all areas, feels appreciated. Manages work/school demands without difficulty.

- 3 Adequate but significant problems in 1 or 2 areas above, but positive aspects in other areas and/or other options available. Experiences some pressure to work or necessity. Some problems with time, impact on school.
- 4 Poor conditions with significant problems in 3 or 4 areas above, threat of job loss and limited options. Necessity to work, pressure from family is marked. Difficulty managing work and school; school work is significantly affected.
- 5 Chronic job instability changing jobs often because of inability to perform or keep job. Or, considerable urgency to work, pressure from family, school is severely affected. May quit school to work.

W2 - Not working

Assess reasons for not working, does person need or want to work? actively seeking, does person have adequate job skills and presentation?

- 1 No need for job. Keeping busy with study or other activities. Has job options if needed, has skills and could find a good job
- 2 Job desired but not needed. Good prospects if person seeks work, has skills and good presentation
- 3 Job desired and needed. Some but limited prospects, some skills and good qualities, actively pursuing
- 4 Job desired and needed. Limited work and interviewing skills. Actively seeking but prospects rather poor, or not as actively seeking as needed.
- 5 Job desired and needed but poor skills and prospects or needs job but not pursuing it or making needed efforts.

HAVE THERE BEEN ANY PARTICULAR EVENTS RELATING TO THE AREA OF WORK IN THE PAST YEAR (e.g. disagreements with a boss, being overlooked for a promotion, having hours cut)?

Health

Separately probe self and key family members. Critical issues are whether there are significant health concerns that affect life, need to take care of others due to poor health, living healthy lifestyle.

H1 - Self

'What is your health like?' Are there physical illnesses or medical conditions? What type, duration, treatment, care required, disability resulting?

Reduce score by .5 or more if person smokes, drinks excessively, does not pursue physical exercise or activity, is significantly overweight. Do not include psychiatric problems for self, but these may be included for family involving parents or siblings.

- 1 Exceptionally good health Excellent physical condition and healthy lifestyle
- 2 Typical problems but overall health Occasional colds or mild problems, generally healthy lifestyle
- 3 Significant chronic problem but not life threatening May cause mild impairment in job or activities, may require some treatment but not hospitalisation
- 4 Significant or potentially life threatening condition Requires ongoing treatment, results in significant impairment of functioning
- 5 Severe or life threatening disease or condition Needs continuous care and treatment, severe disability or complete or nearly complete impairment

H2 - Close family members

- 1 Exceptionally good health Excellent physical condition and healthy lifestyle among parents and siblings
- 2 Typical problems but overall health Occasional colds or mild problems, generally healthy lifestyle for all. Possible illness in more distant relative (eg grandparent) but does not require care by subject
- 3 Significant chronic problems in close family member, not life threatening May cause mild impairment in job or activities, may require some treatment but not hospitalisation
- 4 Significant or potentially life threatening condition Requires ongoing treatment, results in significant impairment of functioning. Subject may have some care-taking responsibility
- 5 Severe or life threatening disease or condition Needs continuous care and treatment, severe disability or complete or nearly complete impairment. Subject may have care-taking responsibility.

HAVE THERE BEEN ANY PARTICULAR EVENTS RELATING TO EITHER YOUR HEALTH OR THE HEALTH OF A FAMILY MEMBER IN THE PAST XXX?

HAVE THERE BEEN ANY EVENTS RELATING TO ANY other AREA OF YOUR LIFE THAT HAVE COME UP OVER THE PAST XXX? Accidents, legal issues, moves, other events? (review Paykel list)

Appendix B

Beck Depression Inventory Sample Questionnaire

BDI-IIDate:

Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the one statement in each group that best describes the way you have been feeling during the past two weeks, including today. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleeping Pattern) or Item 18 (Changes in Appetite).

<p>1. Sadness</p> <p>0 I do not feel sad.</p> <p>1 I feel sad much of the time.</p> <p>2 I am sad all the time.</p> <p>3 I am so sad or unhappy that I can't stand it.</p> <p>2. Pessimism</p> <p>0 I am not discouraged about my future.</p> <p>1 I feel more discouraged about my future than I used to be.</p> <p>2 I do not expect things to work out for me.</p> <p>3 I feel my future is hopeless and will only get worse.</p> <p>3. Past Failure</p> <p>0 I do not feel like a failure.</p> <p>1 I have failed more than I should have.</p> <p>2 As I look back, I see a lot of failures.</p> <p>3 I feel I am a total failure as a person.</p> <p>4. Loss of Pleasure</p> <p>0 I get as much pleasure as I ever did from the things I enjoy.</p> <p>1 I don't enjoy things as much as I used to.</p> <p>2 I get very little pleasure from the things I used to enjoy.</p> <p>3 I can't get any pleasure from the things I used to enjoy.</p> <p>5. Guilty Feelings</p> <p>0 I don't feel particularly guilty.</p> <p>1 I feel guilty over many things I have done or should have done.</p> <p>2 I feel quite guilty most of the time.</p> <p>3 I feel guilty all of the time.</p>	<p>6. Punishment Feelings</p> <p>0 I don't feel I am being punished.</p> <p>1 I feel I may be punished.</p> <p>2 I expect to be punished.</p> <p>3 I feel I am being punished.</p> <p>7. Self-Dislike</p> <p>0 I feel the same about myself as ever.</p> <p>1 I have lost confidence in myself.</p> <p>2 I am disappointed in myself.</p> <p>3 I dislike myself.</p> <p>8. Self-Criticalness</p> <p>0 I don't criticize or blame myself more than usual.</p> <p>1 I am more critical of myself than I used to be.</p> <p>2 I criticize myself for all of my faults.</p> <p>3 I blame myself for everything bad that happens.</p> <p>9. Suicidal Thoughts or Wishes</p> <p>0 I don't have any thoughts of killing myself.</p> <p>1 I have thoughts of killing myself, but I would not carry them out.</p> <p>2 I would like to kill myself.</p> <p>3 I would kill myself if I had the chance.</p> <p>10. Crying</p> <p>0 I don't cry anymore than I used to.</p> <p>1 I cry more than I used to.</p> <p>2 I cry over every little thing.</p> <p>3 I feel like crying, but I can't.</p>
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Subtotal Page 1

Continued on Back

11. Agitation

- 0 I am no more restless or wound up than usual.
- 1 I feel more restless or wound up than usual.
- 2 I am so restless or agitated that it's hard to stay still.
- 3 I am so restless or agitated that I have to keep moving or doing something.

12. Loss of Interest

- 0 I have not lost interest in other people or activities.
- 1 I am less interested in other people or things than before.
- 2 I have lost most of my interest in other people or things.
- 3 It's hard to get interested in anything.

13. Indecisiveness

- 0 I make decisions about as well as ever.
- 1 I find it more difficult to make decisions than usual.
- 2 I have much greater difficulty in making decisions than I used to.
- 3 I have trouble making any decisions.

14. Worthlessness

- 0 I do not feel I am worthless.
- 1 I don't consider myself as worthwhile and useful as I used to.
- 2 I feel more worthless as compared to other people.
- 3 I feel utterly worthless.

15. Loss of Energy

- 0 I have as much energy as ever.
- 1 I have less energy than I used to have.
- 2 I don't have enough energy to do very much.
- 3 I don't have enough energy to do anything.

16. Changes in Sleeping Pattern

- 0 I have not experienced any change in my sleeping pattern.
- 1a I sleep somewhat more than usual.
- 1b I sleep somewhat less than usual.
- 2a I sleep a lot more than usual.
- 2b I sleep a lot less than usual.
- 3a I sleep most of the day.
- 3b I wake up 1-2 hours early and can't get back to sleep.

17. Irritability

- 0 I am no more irritable than usual.
- 1 I am more irritable than usual.
- 2 I am much more irritable than usual.
- 3 I am irritable all the time.

18. Changes in Appetite

- 0 I have not experienced any change in my appetite.
- 1a My appetite is somewhat less than usual.
- 1b My appetite is somewhat greater than usual.
- 2a My appetite is much less than before.
- 2b My appetite is much greater than usual.
- 3a I have no appetite at all.
- 3b I crave food all the time.

19. Concentration Difficulty

- 0 I can concentrate as well as ever.
- 1 I can't concentrate as well as usual.
- 2 It's hard to keep my mind on anything for very long.
- 3 I find I can't concentrate on anything.

20. Tiredness or Fatigue

- 0 I am no more tired or fatigued than usual.
- 1 I get more tired or fatigued more easily than usual.
- 2 I am too tired or fatigued to do a lot of the things I used to do.
- 3 I am too tired or fatigued to do most of the things I used to do.

21. Loss of Interest in Sex

- 0 I have not noticed any recent change in my interest in sex.
- 1 I am less interested in sex than I used to be.
- 2 I am much less interested in sex now.
- 3 I have lost interest in sex completely.

Appendix C

Sample Consent Form

**CONSENT FORM TO PARTICIPATE IN THE EMOTIONAL INFORMATION PROCESSING
AND INTERPERSONAL STRESS STUDY**

This is to state that I agree to participate in a program of research being conducted by Dr. Mark Ellenbogen of the Stress and Developmental Psychology Laboratory at Concordia University.

Contact: (514) 848-2424, Ext. 5213; Mark.Ellenbogen@Concordia.ca

A. PURPOSE

I have been informed that the purpose of this research is to examine the relationship physiological recordings and the way we function in our everyday lives.

B. PROCEDURES

I understand that this study will take approximately 2.5- 3 hours in total at the laboratory, and there will be three parts to the study. During the first part of the study, I will be asked to complete a computer task. In the computer task, I will be looking at pictures of faces that display different emotions. I understand that during the computer task I will hear a loud tone once in awhile. Small electrodes to record physiological activity will be attached to my face, under my left eye, during the computer task. I am aware that all aspects of the study will take place under the supervision of trained staff. This part of the study will take approximately 45 minutes

In the second part of the study, I agree to provide eighteen (18) saliva samples over the course of three days at home. I will collect saliva when I wake up, 30 min and 60 min later, at 1300h, 1500h, and at 2000h. I will not eat, drink (with the exception of water), smoke, or brush my teeth for at least 60 min before sampling. After each sampling time, I will record what time I gave the sample and what activities I did before giving the sample

In the third part of the study, I will be asked to return my saliva samples to the laboratory, to fill out questionnaires, and take part in an interview in which I will be asked questions about stressful events that have occurred in the last year, feelings, moods, and behaviours. These questionnaires include the Beck Depression Inventory, Attentional Control Scale, NEO-five factor personality assessment, Parental Bonding Inventory, and the State-Trait Anxiety Inventory.

C. RISKS AND BENEFITS

I am aware that, although unlikely, it is possible that viewing the emotional face pictures may disturb me. I am also aware that the tone I will hear is not harmful

to my hearing in any way and that there is no health risk associated with the use of electrodes. The electrodes will be gently removed using facial wipes to lubricate the skin surface, this procedure is neither painful nor harmful. Furthermore, I understand that the saliva sampling procedure is totally without pain and is of no risk whatsoever to my health. Finally, I have been informed that I will be compensated \$ 50, or 3 participant pool credits, for my participation in this study.

D. CONDITIONS OF PARTICIPATION

- I understand that I am free to withdraw my consent and discontinue my participation at anytime without negative consequences.
- I understand that my participation in this study is CONFIDENTIAL (i.e., the researcher will know, but will not disclose my identity).
- I understand that the data from this study may be published.

I HAVE CAREFULLY STUDIED THE ABOVE AND UNDERSTAND THIS AGREEMENT. I FREELY CONSENT AND VOLUNTARILY AGREE TO PARTICIPATE IN THIS STUDY.

NAME (please print) _____

SIGNATURE _____

WITNESS SIGNATURE _____

DATE _____

If at any time you have questions about your rights as a research participant, please contact Adela Reid, Research Ethics and Compliance Officer, Concordia University, at 514.848.2424, x.7481 or by email at Adela.Reid@Concordia.ca.

Appendix D

Non-significant results tables

Table D1.

Summary of Hierarchical Regression Analysis for Startle Magnitude and Depressive Symptoms Predicting Interpersonal SLEs

Variables	Beta	t	R ² _{ch}	F _{ch}
<u>Step 1</u>				
BDI scores	.15	.99	.02	.97
<u>Step 2</u>				
BDI scores	.14	.87	.00	.24
Startle Magnitude	.08	.49		
<u>Step 3</u>				
BDI Scores	.16	.98	.00	.31
Startle Magnitude	.04	.23		
BDI x Startle	.10	.56		
		R= .19	R ² _{adj} =.04	F= .50

Note: * $p < .05$, $t p < .10$, ** $p < .01$

Table D2.

Summary of Hierarchical Regression Analysis for Startle Magnitude and Depressive Symptoms Predicting Independent SLEs

Variables	Beta	t	R^2_{ch}	F_{ch}
<u>Step 1</u>				
BDI scores	.15	.10	.02	.10
<u>Step 2</u>				
BDI scores	.16	1.06	.00	.26
Startle Magnitude	-.08	-.51		
<u>Step 3</u>				
BDI Scores	.13	.86	.01	.66
Startle Magnitude	-.03	-.20		
BDI x Startle	-.13	-.81		
	$R = .20$	$R^2_{adj} = -.02$	$F = .63$	

Note: * $p < .05$, $t p < .10$, ** $p < .01$