Attentional Bias and Psychophysiological Arousal in Seasonal and Nonseasonal Depression Symptoms

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Abstract

The present study investigated cognitive specificity in individuals with seasonal depression symptoms (SDS) by comparing their attentional bias and psychophysiological arousal to cognitive schema-relevant stimuli with those in individuals with nonseasonal depression symptoms (NSDS) and nonseasonal and nondepressed individuals (control). Attentional bias was measured with responses on a modified Stroop test and a recall task, while psychophysiological arousal was measured with facial EMG recordings and image valence ratings during an image-viewing task. The Stroop word categories reflected constructs that were related to seasons (summer/winter), light (light/dark), and mood (happy/sad). The recall task involved incidental recall of the Stroop words following the Stroop test. The image-viewing task consisted of viewing and rating winter and summer scenes for degree of appeal while facial EMG recordings of the *corrugator supercilii* and *zygomaticus major* muscle regions were taken. Findings revealed that individuals in all three group conditions were slower to colour-name summer words than winter words, slower to colour-name light words than dark words, recalled more dark words than light words, frowned more (*corrugator supercilii*) when viewing high luminance than low luminance images, smiled more (*zygomaticus major*) when viewing high luminance than low luminance images, smiled more when viewing high luminance winter images than either medium or low luminance winter images, and rated winter images as more appealing than summer images. The two groups with elevated depression symptoms (seasonal and nonseasonal) smiled less than the control group when viewing low luminance images. The results do not show a convergence across the different experimental tasks, and do not support the notion that seasonal individuals with depressed symptoms would respond more negatively than nonseasonal individuals with depressed symptoms to winter or low luminance stimuli. Limitations of the study are discussed.

Keywords: seasonal depression, nonseasonal depression, attentional bias, psychophysiological arousal, EMG, Stroop test

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Attentional Bias and Psychophysiological Arousal in Seasonal and Nonseasonal Depression Symptoms

The effects that the changing seasons have on mood and behaviour have long been recognized. The notion that seasons can be at the root of mood change or disease dates back to Hippocrates, an ancient Greek physician who is considered by many scholars to be one of the most outstanding figures in the history of medicine (Strong & Cook, 2007). Hippocrates (trans. 1822) wrote, "… The changes of the seasons are the principal causes of diseases: in the same seasons great changes of temperature; so likewise of others according to their degree". This statement represents Hippocrates' belief that the seasons have a general overall influence on human disease. He went on to add, "Of constitutions, some indeed are well adapted to summer, others to winter, and the reverse" which signifies his view that some individuals have a greater vulnerability to the influence that the seasons have on disease. These earlier ideas of season-related diseases are also evident throughout the writings of 19th century psychiatry such as Pinel and Esquirol (see Wehr, 1989). Throughout the course of the 20th century, research in this domain has expanded considerably. For example, Durkheim (1951) suggested that higher rates of suicide during spring and summer months can be attributed to seasonal changes in social behaviour. Seasonal Affective Disorder (SAD, also known as *winter depression*) has been given particular research attention from the latter part of the 20th century and into the 21st century. Rosenthal et al. (1984) describe those suffering from SAD as experiencing regularly occurring fall/winter onset of depressive symptoms followed by a remission period in the spring/summer.

SAD is defined as a depressive episode with a recurring seasonal pattern in which the symptom onset occurs in the fall/winter and remits in the summer. The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Text Revision (DSM-IV-TR; American Psychiatric Association, 2000) does not identify SAD as a distinct diagnostic disorder, but defines it as a seasonal specifier of a depressive disorder that includes Major Depressive Episodes in Bipolar I Disorder, Bipolar II Disorder, or Major Depressive Disorder, Recurrent (see Appendix A). Additionally, the criteria specify that the individual must not be experiencing any regularly occurring seasonal stressors, that the seasonal pattern must have been evident during the last two years, and that seasonal major depressive episodes have to substantially outnumber nonseasonal depressive episodes over the individual's lifespan.

There are certain atypical depressive symptoms that are found to a greater degree in SAD than in nonseasonal depression (Allen, Lam, Remick, & Sadovnick, 1993; Garvey, Wesner, & Godes, 1988; Lam, Tam, Yatham, Shiah, & Zis, 2001; Meesters, Jansen, Bouhuys, Beersma, & van den Hoofdakker, 1993; Partonen & Rosenthal, 2001; Rosenthal et al., 1984; Sakamoto, Nakadaira, Kamo, Kamo, & Takahashi, 1995; Young, Watel, Lahmeyer, & Eastman, 1991). The term "atypical" refers to the observation that these symptoms are opposite to those more typically experienced in nonseasonal depression. These atypical symptoms are somatic-vegetative in nature and include weight gain (rather than weight loss), hyperphagia (rather than hypophagia), carbohydrate craving, and hypersomnia (rather than hyposomnia).

Some individuals experience seasonal depression symptoms that are not sufficiently severe to meet the clinical criteria for SAD. These individuals are deemed to suffer from sub-syndromal SAD or S-SAD (Kasper, Wehr, Bartko, Gaist, & Rosenthal, 1989). Nevertheless, they do report similar problems associated with the changing of seasons, such as changes in sleeping or eating patterns, decreased productivity or creativity, a diminished sense of well-being (Partonen & Rosenthal, 2001; Westrin & Lam, 2007), and a high level of stress and impairment, as well as therapeutic benefit from treatments that are typically used for the full-fledged disorder, such as bright light therapy that is prescribed for clinical SAD (Kasper et al., 1989; Westrin & Lam, 2007).

Prevalence, Latitude, and Photoperiod

Epidemiological studies show that the prevalence rate for SAD in the general population varies between .4% and 12.4% (Blazer, Kessler, & Schwartz, 1998; Booker & Hellekson, 1992; Dam, Jakobsen, & Mellerup, 1998; Eagles, Naji, Gray, Christie, & Beattie, 1998; Eagles et al., 1999; Magnusson, 2000; Magnusson & Stefansson, 1993; Mersch, Middendorp, Bouhuys, Beersma, & van den Hoofdakker, 1999a, 1999b; Michalak, Wilkinson, Dowrick, & Wilkinson, 2001; Rosen et al., 1990; Saarijarvi, Lauerma, Helenius, & Saarilehto, 1999). One explanation for this wide variation may relate to differences in the geographical latitude of the sites where the various studies were carried out. Northern sites with higher latitudes have considerably fewer daylight hours than more southern areas during the winter months. It has been proposed that SAD symptoms are related to the shorter photoperiod that occurs during the winter months (Rosenthal et al., 1984). Various studies have provided support for this position; higher prevalence rates of SAD are found in more northerly regions (Booker & Hellekson, 1992; Lee et al., 1998; Mersch et al., 1999b; Potkin, Zetin, Stamenkovic, Kripke, & Bunney, 1986; Rosen et al., 1990; Sourander, Koskelainen, & Helenius, 1999; Suhail & Cochrane, 1997; Terman, 1988), and there is an inverse relationship between SAD prevalence and the average amount of daily sunlight (Magnusson & Axelson, 1993; Mersch et al, 1999b; Molin, Mellerup, Bolwig, Scheike, & Dam, 1996; Sakamoto, Nakadaira, Tamura, & Takahashi, 1993). The strongest support for the link between photoperiod and SAD comes from an abundance of literature that shows the effectiveness of bright light therapy for SAD (for a meta-analysis, see Golden et al., 2005).

The wide range in prevalence rates also may be partially accounted for by the type of measurement instrument used to gather the prevalence data. Studies that use the Seasonal Pattern Assessment Questionnaire (SPAQ: Rosenthal et al., 1987), which is a measure of seasonality and a screening tool for SAD, would capture both clinical and subclinical cases (Eagles et al., 1998; Eagles et al., 1999; Levitt & Boyle, 2002; Levitt, Boyle, Joffe, & Baumal, 2000; Magnusson, 1996; Michalak et al., 2001; Michalak, Wilkinson, Hood, & Dowrick, 2002; Partonen, & Lonnqvist, 1998) rather than just clinical cases, as would be the case for studies that use diagnostic assessment tools only.

Etiological Models

Etiological models of SAD have been an important focus of research since the disorder was originally conceptualized by Rosenthal in 1984. Over the years, etiological research has looked at various biological and hormonal contributors, environmental factors, psychological factors, and the complex interactions between these models. The following sections highlight some of the more prominent etiological models of SAD in the literature.

Melatonin Hypothesis

Melatonin has been proposed as the physiological mechanism by which photoperiod is related to SAD. Melatonin is a pineal hormone that is produced during hours of darkness and is related to the regulatory process of the sleep-wake cycle (Arendt, 2006; Cable, Drust, & Gregson, 2006). Its release can be suppressed or delayed by exposure to environmental light (Lewy, Miller & Hoban, 1987). Its role in SAD was demonstrated in a study by Wehr (1991) where the duration of nocturnal melatonin secretion was found to be longer when the participants were exposed to an imitation "winter photoperiod" (shorter hours of environmental light) than when they were exposed to an imitation "summer photoperiod" (longer exposure to environmental light). Furthermore, SAD patients who were exposed to environmental light in order to mimic a longer photoperiod displayed a remission of depressive symptoms (Rosenthal, Sack, & Skwerer, 1988). However, many of their atypical symptoms returned with oral administration of melatonin during this light exposure.

Phase Shift Hypothesis

The phase shift hypothesis (Lewy et al., 1987) proposes that because of a later dawn during the winter months, there is an abnormal delay of circadian rhythm relative to clock time and the sleep/wake cycle. In other words, the internal circadian clock of SAD individuals that is entrained to the external light/dark cycle is asynchronous with the external civic clock that dictates sleep/wake schedule. Because the length of exposure to daylight decreases substantially during winter months at higher latitudes, individuals in these locations are more likely to experience this mismatch between their internal biological and external environmental rhythms. This can have a substantially negative impact on their sleep habits, mood, temperament, diet, and other aspects of day-to-day life functioning (Arendt, 2006; Lewy, 2002). Research has shown that depressive symptoms (atypical symptoms in particular) can increase with this disruption of regular diurnal patterns (Lewy, Sack, Singer, White, & Hoban, 1989). With well-timed bright light treatment the circadian pattern can be corrected (Lewy et al., 1989). It has been proposed that the reason that exposure to bright light helps to relieve symptoms of SAD is that it delays the secretion of melatonin, thereby correcting the circadian pattern. Overall, morning exposure to environmental bright light in patients with SAD has been found to be more effective than both afternoon and evening exposure to bright light (Lewy et al., 1998; Terman, Terman & Ross, 1998).

Dual Vulnerability Hypothesis

Young et al. (1991) investigated the temporal onset of the different symptoms in SAD. They found that the atypical symptoms (fatigue, hypersomnia, hyperphagia, and weight gain) developed at the onset of the seasonal depressive episode. The timing of the onset of the remaining symptoms (i.e., the typical depressive symptoms) was different for different individuals and varied throughout the course of the depressive episode. The researchers forwarded the dual vulnerability hypothesis (DVH), which states that the development of atypical and typical depressive symptoms is linked to two different underlying pathological mechanisms. The atypical depressive symptoms consisting of vegetative/physiological changes that are characteristic of SAD are proposed to reflect an underlying biological vulnerability to seasonality whereas the typical depressive symptoms that are more affective and cognitive in nature are said to reflect a psychological vulnerability to depression (Young, 1999). Lam et al. (2001) extended the original DVH by proposing that different combinations of loadings on the seasonality and depression dimension would result in the expression of variations of depression. More specifically, S-SAD would load mostly on the seasonality factor with little to no loading on the depression factor. Nonseasonal depression would be the opposite with most of the loading on the depression factor and little to no loading on the seasonality factor. SAD would have intermediate loadings on both seasonality and depression with higher loading on seasonality. A fourth group called ISR (incomplete summer remission) that experiences winter depression with incomplete symptom remission in the summer would likewise have intermediate loading on both factors but would have higher loading on the depression factor. It may therefore be the case that the typical and atypical symptoms associated with SAD exist on a continuum, rather than in a categorical model.

Subsequent research has produced some support for the DVH by showing that rumination (a cognitive vulnerability factor in depression) predicted winter typical symptoms in SAD patients (Young & Azam, 2003). As well, among those with seasonal changes in atypical symptoms, a cognitive vulnerability to depression (denoted by rumination, dysfunctional attitudes, internal attributional style for negative events) was associated with greater typical symptoms (Engasser & Young, 2007) in the winter.

Cognitive Factors

Recent research has focused on cognitive aspects in SAD to see how they might be involved in the development and maintenance of the disorder. Individuals with SAD and nonseasonal depression respond to depressed moods with greater rumination than nondepressed controls, and greater rumination is associated with more severe winter depression in SAD patients (Rohan, Sigmon, & Dorhofer, 2003; Young & Azam, 2003). Similarly, SAD and nonseasonal depressed individuals report more negative automatic thoughts in response to neutral stimuli compared to nondepressed controls (Hodges & Marks, 1998; Rohan et al., 2003).

Another interesting finding related to cognition is that the perception and interpretation of symbolic light in SAD individuals is significantly different from that of controls (Bouhuys, Meesters, Jansen, & Bloem, 1994). Those with SAD rated ambiguous faces with dark backgrounds as less inviting than those with light backgrounds, while the control group did not show any difference between ratings in the two lighting conditions. In a separate study, Spinks and Dalgleish (2001) determined that winter performance on a modified Stroop test predicts summer depressive symptom levels in individuals suffering from winter SAD. A greater Stroop effect (amount of time taken to colour-name a word) for threat-related (season-related and negative) words in the winter predicted better mood in the summer months.

The Stroop effect, which reflects cognitive interference, is named after John Ridley Stroop who first published on the phenomenon in the English language in 1935. The effect was previously published in 1929 in German (Jaensch, 1929). In its original version, the Stroop test consists of a list of coloured words (i.e., words such as RED, BLUE) presented in different coloured ink on cards. The participant's task is to name the *colour* of the ink that the word is printed in rather than reading the word itself. In addition to tracking the accuracy rate, the amount of time that it takes for the participant to respond following the showing of the card (response latency) is also measured. Error rates and response latency typically increase when the task is incongruent (e.g., the word RED is printed in green ink) than when the task is congruent (e.g, the word RED is printed in red ink) (Jensen & Rohwer, 1966). Since the development of Stroop's initial test, there has been an assortment of modifications made to it, such as sorting stimuli into categories rather than naming the color of the word (see MacLeod, 1991). For example, a participant may be asked to look at a card with a word printed in a given colour, and then decide which coloured box to place the card in, based on the colour of the ink.

The Stroop test has also been modified to test other modalities (e.g., visual vs. auditory functioning) as well as the effects of biligualism on cognitive interference (Rosselli, Ardila, & Santisi, 2002). Most recently, the Stroop has been modified to investigate the effect of emotions on cognitive interference (Kampman, Keijsers, Verbraak, Näring, & Hoogduin, 2002). For example, on an emotional Stroop test assessing mood, the word DELIGHT might be printed in blue ink. Again, the participant's task is to name the colour of the word's letters rather than reading the word itself. Research shows that individuals are slower to colour-name word letters when the word (semantic) meanings are associated with symptoms and concerns relevant to their specific clinical condition (Bental & Thompson, 1990; Channon, Hemsley, & de Silvia, 1988; Cooper, Anatasiades, & Fairburn, 1992; Cooper & Fairburn, 1992; Dalgleish, 1995; Dawkins & Furnham, 1989; Foa & McNally, 1986; Fox, 1993; Hill & Knowles, 1991; Klein, 1964; Klieger & Cordner, 1990; Lavy, Oppen, & Hout, 1994; MacLeod, Mathews, & Tata, 1986; MacLeod & Rutherford, 1992; Mogg, Kentish, & Bradley, 1993; Williams, Mathews, & MacLeod, 1996). Beck's cognitive theory (Beck, Emery, & Greenberg, 1985) and Bower's (1981) network theory have both been used to explain the Stroop cognitive interference effect observed in research with participants with psychological symptoms.

Beck and colleagues (1985) posited that individuals' negative thoughts about the self, the world, and the future shape their experiences. An individual who has a negative style of thinking will be more likely to focus on negative stimuli. Thus, someone who is depressed would take longer to colour-name negative valence words on the Stroop test. According to Bower's (1981) network theory, semantic and affective *nodes* hold our memories in a memory network. Similar nodes are connected and associated with one another. When a single node is activated, similar ones will also be activated, while other dissimilar ones will be deactivated. For example, if an individual is reminded of a happy memory, they will also be reminded of other similar happy memories. Similarly, when a person suffering from a specific disorder is reminded of their symptoms on a Stroop test, it would be expected that he or she will focus more on the emotional meaning of the word than its colour and therefore take longer to name the colour of the word.

Results from previous works with the emotional Stroop test have implications for our understanding of the development and maintenance of SAD. It is possible that *attentional bias* might play a role (Sigmon et al., 2007). Attentional bias can be conceptualized within the framework of cognitive theory. As mentioned, cognitive theory puts forth that individuals who suffer from depression will focus their attention toward negative-content stimuli due to their internal negative schemas (Williams et al., 1996), thus rendering them susceptible to a negative attentional bias. In direct support of the cognitive theory, attentional bias has been demonstrated using modified Stroop tests in those suffering from nonseasonal depression in which individuals with nonseasonal depression take longer than controls to colour-name words with negative content versus words with either a positive or neutral meaning (Williams et al., 1996; Williams & Nulty, 1986).

More recently, research has shown evidence of a negative content attentional bias in SAD individuals for depression-related stimuli (Sigmon et al., 2007). The findings in the Sigmon et al. study were similar to those found in other studies with nonseasonal depressed groups, i.e., the SAD individuals took longer than controls to colour-name negative content words. Dark words were also used in their Stroop design. Similar to the results with depressed-content words, the SAD and nonseasonal depressed groups took longer to colour name dark-related words. Conversely, there was no difference between SAD and control groups for neutral words. However the nonseasonal depressed group took longer to colour name words in all categories, which may have been due to cognitive factors that are typically associated with nonseasonal depression such as slowed processing and concentration difficulties (Sigmon et al., 2007).

Nonetheless, it should be noted that prior research had demonstrated greater attentional bias for depressed-content words only (see Williams et al., 1996). The Stroop effect was also observed with season-related stimuli in SAD groups (Spinks & Dalgleish, 2001). There was an increased interference in the responses to season-related words when compared with responses to neutral words. The SAD individuals also took longer in general to colour-name all words during the winter months than they did in the summer months. A limitation of the Spinks and Dalgleish study is that only a SAD group was included in the design. It would be informative to include a nonseasonal depressed and a control group to investigate the differences in responses to such stimuli between these groups.

Psychophysiological Factors

Attention to cognitive factors in SAD has given rise to increased interest in comparing psychophysiological reactions in SAD individuals versus controls. Research findings support the position that sensitivity to aversive events may be a predisposing factor in major depression (Lewinson et al., 1985; Sigmon & Nelson-Gray, 1992; Sigmon, Hotovy, & Trask, 1996). Aversive stimuli used in these studies ranges from self-referent depressive statements (e.g., *I am worthless*) to unsolvable stressful tasks to the observation of aversive visual imagery (such as human faces with unhappy or angry expressions).

SAD researchers have reported differences in levels of psychophysiological arousal (skin conductance levels) in response to such types of aversive stimuli in SAD versus nonseasonal depressed individuals (Austen & Wilson, 2001; Genricke & Shapiro, 2000; Rohan et al., 2003; Sigmon et al., 2007). Studies that assess psychophysiological arousal use a variety of different types of assessment measures. One common method of assessing psychophysiological responses is skin conductance recordings. In a study by Austen and Wilson (2003), no differences in skin conductance levels as a function of seasonality were found in non-seasonal stressful task (i.e., a digit-span task). A similar study by Rohan et al. (2003) examined skin conductance levels in response to outdoor scenes with varying degrees of luminance. The authors found that women with a history of SAD presented with greater skin conductance amplitude and greater depressive affect than women who did not have a history of SAD when exposed to low-light stimuli. The researchers did not use a nonseasonal depressed group, rendering it impossible to discern whether the results are unique to SAD or would be equally applicable to women with nonseasonal depression.

Similar findings were discovered in a related study that assessed cognitive bias and psychophysiological arousal in SAD and nonseasonal depression (Sigmon et al., 2007). Participants in that study engaged in a modified Stroop test and viewed winter and summer content scenes while skin conductance readings were taken. The researchers found that participants in both depressed groups took longer than controls to colour-name dark and depressive content words, but that the individuals with nonseasonal depression took longer to colour-name words in all categories when compared to SAD and control groups. When viewing winter scenes, individuals with SAD exhibited significantly greater frequency and amplitude of skin conductance levels when compared to nonseasonal depressed and control participants.

There are several limitations in Sigmon et al.'s study. The Stroop test that they used included words from four main categories: dark-related, light-related, depressive-related, and neutral words. The words on those lists might have confounds. For example, the word "bright" in their light-related list has a dual meaning because it could also mean positive mood. Similarly, the word "sunshine" on the light-related list might tap into the dual concept of bright luminance and the summer season, which is often associated with enjoyable outdoor activities such as barbequing, playing Frisbee, or fishing. Also, the authors included depression-related words on their Stroop test, but did not include any positive-mood related words. It is therefore not clear whether the participants' responses were characteristic of affective words in general regardless of their valence, or whether the responses were specific to depression-related words. Another limitation in the study is the failure to control for the averaged luminance of the summer and winter images used in the skin-conductance task, which could have been a methodological confound. The reactions of the participants could in part be due to the different luminance levels in the images, as well as to the type of seasons depicted. Both seasons and luminance levels are implicated in the expression of SAD as previously discussed and their effects on the psychophysiological responses need to be addressed separately.

Evidence for psychophysiological differences between depressed and nondepressed individuals can also be found in studies that utilize facial electromyography (EMG). EMG involves the strategic attachment of electrodes to certain facial areas near a given muscle region (typically the *musculus corrugator supercilii* near the brow and *musculus zygomaticus major* near the corner of the mouth) and the presentation of various stimuli. EMG recordings show measurements of the electrical activity of motor units in the striated muscles of the face (Fridlund & Cacioppo, 1986). Facial muscle movement is indicative of facial expression of a given emotion, and is a more definitive physiological measure of expression of emotion than skin conductance. For example, smiling is increased in pleasant situations, while frowning and furrowing of the brow is increased in unpleasant situations. The *force* and *velocity* of movement in the muscles are controlled both by the number of motor units in the muscle region and by their rate of firing (Fridlund & Cacioppo, 1986). The size and shape of the waveform on the EMG output represents the degree of muscle movement in each region. Gehricke and Shapiro (2000) examined facial muscle responses to emotional stimuli in participants with major depression and controls. Participants were asked to imagine happy and sad situations. They found that the depressed group displayed reduced muscle activity when imagining both happy and sad situations in comparison to controls. However, self-reported emotion showed no group differences. These findings suggest that there might be psychomotor retardation in depressed individuals with regards to facial expression of emotions. However, given that the researchers used an imaginal task rather than a more concrete form of stimulus presentation (e.g., a picture), the validity of the findings is questionable because there was no direct experimental manipulation of the conditions (happy versus sad situations); nor was there an experimental check undertaken to determine how well the participants were engaging in the imaginal task as instructed. It is also possible that the "happy" situations imagined by the depressed group were, on average, less positive than those imagined by the control group, and that the "sad" situations imagined by the depressed group were more negative. No study has yet examined facial muscle response to emotional stimuli in SAD individuals.

EMG is often used in laboratory studies of psychophysiology (Harrigan, Rosenthal, & Scherer, 2005). Because there is more than a single muscle in most areas of the face, and muscle fibers tend to interweave and overlap, surface EMG readings have low specificity (Harrigan, Rosenthal, & Scherer). Researchers, therefore, need to be careful about referring to specific muscles. Fridlund and Cacioppo (1986) suggest that EMG should be discussed in reference to facial region (e.g., rather than referring to activity in the *corrugator supercilii* muscle, it is preferable to refer to the broader *medial frontalis region*). The majority of researchers, however, consistently refer to specific muscles in the face when discussing EMG findings, while cautioning the reader about the potential lack of specificity. In order to increase specificity, some researchers have used needle electrodes, which involve the insertion of very fine wires directly into the facial muscle (Harrigan, Rosenthal, & Scherer, 2005). However this method requires special medical training to perform and can be somewhat invasive for the participant as opposed to surface electrodes which are simple to attach and non-invasive. Furthermore, research has indicated that even when using needle electrodes one should be careful to refer to the facial region rather than the specific muscle when interpreting the waveforms (Fridlund & Cacioppo, 1986).

With regards to test-retest reliability, facial EMG shows moderate levels of stability over long intervals of time. Harrigan, Rosenthal, & Scherer (2005) indicate that this level of test-retest reliability is comparable to that for self-reported emotion.

An advantage of EMG is that the recordings have high spatial and temporal resolution (Harrigan, Rosenthal, & Scherer, 2005). High temporal resolution makes EMG well suited to measure facial expression of emotions that can have a rapid onset and is often short in duration. Dimberg, Thunberg, and Grunedal (2002) asked participants to either not react with their facial muscles, or react as quickly as possible by contracting their *corrugator supercilii* muscle (i.e., furrowing the eyebrows, which is associated with frowning) or contracting their *zygomaticus major* muscle (i.e., elevating cheeks, which is associated with smiling) while being exposed to pictures of positive and negative stimuli. Their findings were consistent with the notion that facial reactions are automatic in nature. That is, contraction of the *zygomaticus major* was associated with a happy face and contraction of the *corrugator supercilii* was associated with a sad or angry face. The temporal resolution of their EMG recordings was high enough to discriminate differences in response time within 500 milliseconds. EMG recordings can detect muscle movements whether or not they are visible to the human eye. The temporal resolution is high enough that they can detect even the slightest muscle movement (Harrigan, Rosenthal, & Scherer, 2005).

General Summary

The dual vulnerability hypothesis postulates two underlying dimensions in SAD: seasonality and depression. The vulnerability to seasonality is expressed in the presentation of vegetative-somatic symptoms with the advent of winter when photoperiod decreases. The vulnerability to depression is demonstrated by studies that show cognitive vulnerability reflected in rumination and negative automatic thoughts. More recent research in the area of SAD has focused on attentional biases on the premise that they have implications for the development and maintenance of SAD. Findings suggest that SAD individuals are sensitive to low light stimuli, season-related words, negative-content words, depression-related words, dark-related words and season-related images. The experimental methods used to investigate attentional biases in SAD have used ratings of images and the Stroop test.

Given that research into cognitive vulnerability and attentional biases in SAD is quite recent, only a handful of studies have been published. The research available has methodological limitations that include lack of comparison to nonseasonal depressed group which preclude any conclusions relating the uniqueness of the findings in relation to SAD. As well, there has been inadequate experimental control leading to possible confounds in the experimental tasks. Some of the words in the Stroop test have had more than one meaning and might tap into multiple constructs. Failure to use positive valence words and testing only negative valence words limits the interpretability of the results. Using images that represent seasons without ensuring that the images are equal on their averaged luminance makes it difficult to conclude that the subjects are responding to the seasonal content of the images and not to the degree of image luminance instead. Finally, the few psychophysiological studies on SAD have used skin conductance readings that measures degree of physiological arousal. None have used facial EMG recordings where different patterns of facial activity can reflect different emotional states, and in response to different negative and positive affective imagery. Facial EMG recordings can detect subtle facial emotive expression even when the participant is instructed to suppress their emotional response, and are thus appropriate for testing subtle emotional reactions and for identifying the valence of those reactions.

The Present Study

The objective of the present study, which was carried out during the winter months (late November to March), was to investigate cognitive specificity in individuals with seasonal depression symptoms (SDS) by comparing SDS with individuals with nonseasonal depression symptoms (NSDS) and healthy (nonseasonal and nondepressed) individuals (control). To this end, attentional bias and psychophysiogical arousal in response to cognitive schema-relevant stimuli were assessed.

Attentional bias for the three groups was measured with a modified Stroop test that involved three types of bipolar word conditions: Season word type (summer/winter), Light word type (light/dark), and Mood word type (happy/depressed). Each word was yoked to a neutral word that was matched on the basis of word length, number of syllables, and part of speech to exclude the influence of these said word characteristics on the findings. The dependent variables derived from the modified Stroop test were response latency and proportion error. Response latency was calculated as the difference in response time (*ms*) between a stimulus word presentation and its yoked neutral word presentation. Proportion error was calculated as the number of incorrect responses in colour naming divided by the total number of words within a given category.

A five-minute spontaneous recall task was also administered after the modified Stroop test to ascertain how many words from each word category (summer, winter, light, dark, happy, depressed) the participants were able to accurately recall from their modified Stroop test. Accuracy recall rate was defined as the number of words accurately recalled from each word category expressed as a proportion.

Psychophysiological arousal was measured with a facial EMG recording of the *corrugator supercilii* and *zygomaticus major* muscles while participants viewed seasonal images (winter and summer), each with three levels of luminance (low, medium, high). This enabled the differential assessment of the impact of seasons and luminance level on the EMG reactions. The degree of facial muscle movement was indicated by the area amplitude of the EMG waveform generated by the recordings. More specifically, it was indicated by the difference in area amplitude of the baseline measurement and the trial period measurement. The participants also rated each scene for its degree of appeal to them.

Hypotheses

The following hypotheses were developed for the present study:

1. On the Stroop test, the SDS and NSDS groups were expected to display a greater attentional bias for depressed words compared to the control group in that they would make more errors in colour-naming and take longer to colour-name depressed words.
2. SDS would take longer and make more errors on the Stroop test than the other two groups to colour-name dark words and winter words.
3. On the recall task, NSDS and SDS were expected recall more depressed words than the control group.
4. SDS would recall more season-related words and light-related words than either NSDS or controls.
5. On the facial EMG task, SDS was expected to respond with greater facial muscle activity compared to NSDS and controls over the *corrugator supercilii* area when examining winter images.
6. Similarly, SDS would show increased facial muscle activity compared to NSDS and control over the *corrugator supercilii* area when presented with low luminance images on the facial EMG task.

Method

Prior to conducting the main study, stimulus materials for the experimental tasks were developed. The following sections describe the development of stimulus word lists for the modified Stroop test, and the development of stimulus images for the EMG task.

Development of Stimulus Words for the Modified Stroop Test

Development of the Stroop stimulus words were carried out in three stages.

Stage one: Generation of potential Stroop stimulus words. Potential stimulus words (see Appendix B, sections B to G) for the Stroop test were developed by the present researcher, a peer MA student, and the project supervisor along with six other individuals who were asked to generate as many words as possible that would reflect one of these six constructs: summer, winter, light, dark, happy, and depressed. In addition, the dictionary and thesaurus along with published studies were consulted for the task of word generation. The words were then classified into their respective word lists.

Stage two: Rating of potential Stroop stimulus words. The words in the six word lists that were generated in Stage 1 were reviewed by 43 raters for the degree to which each word was representative of the constructs they were selected to reflect. The 43 raters (age M = 23.43 years, SD = 5.02) who were recruited from the Lakehead University student population and the general community consisted of 10 males, 32 females, and one individual who did not specify their gender. Thirty-four raters were single, four were living with a common-law partner, and four were in married relationships. Most were students (n = 28) and all raters indicated their ethnicity as White. Of the 43 participants, 18 had obtained a high-school diploma as their highest level of education, 15 were university graduates, four were college graduates, four had obtained a graduate school degree, and one rater had indicated an education level of eighth grade or less. One individual did not specify their highest level of education.

It was explained to the raters that the task involved their reviewing different words that people use to describe a variety of concepts, and rating them on the degree of their representativeness of the concept (see Appendix C). The raters were also told that the information collected would be used to develop materials to be utilized in future research involving people's reactions to different stimuli. Furthermore, they were notified that their participation in the stimulus development task was completely voluntary and that they were free to withdraw at any time without penalty, that their responses would be kept confidential and anonymous, and that the data would be kept in secure storage in Dr. Tan's lab for a period of seven years. The raters were also informed that there were no psychological or physical risks or benefits to participating in the stimulus development, and that the word ratings would take approximately one hour to complete.

For the rating task, each word was judged on a 1 (not representative at all) to 9 (extremely representative) scale for the degree to which it was representative of the construct it was selected to reflect (see Appendix B, sections B to G). Any word that could be related to more than one of the constructs was reflected in all of the associated rating lists. Ratings were carried out either through the use of a hard copy of the rating questionnaire or an online copy) available at <http://cbtc.utoronto.ca/opinio /s?s=302>. The online copy was developed using Opinio, a secure web-based survey development and data collection tool (see section on Main Study Materials for more information on Opinio).

Stage three: Selection of stimulus words for Stroop test. Ratings from Stage Two for each word were averaged across the 43 raters. It was decided on *a priori* basis that only words that received an averaged rating of 7 or higher would be considered for inclusion in the final list. Any word that was considered unknown (rated as DK) by three or more raters was excluded from consideration because it would mean that at least 7% of people might not recognize the word. Finally, to ensure that there was no construct overlap among the word lists, any word that received an average rating of 7 or higher for more than one construct was excluded. Consequently, the four highest-rated words were chosen for the dark word category, and the six highest-rated words were chosen for the remaining categories (summer, winter, light, happy, depressed). For a listing of the selected Stroop words and their mean ratings, the reader is referred to Tables 1 through 3. Each stimulus word was then yoked to its own neutral control word that was matched for word length, number of syllables, and part of speech (see Tables 4 to 6). The neutral words were developed by the researcher and a peer MA student, who determined that none of the words were reflective of any of the constructs under investigation in the study, were not affective-laden, and did not possess positive or negative valence in their semantic meaning.

Development of Stimulus Images for the EMG Task

The development of stimulus images for the EMG task in the main study was carried out in four stages.

Stage one: Generation of season images. A total of 64 winter and summer scenery images were collected from the Internet (www.google.ca) and from a collection of photos taken by the researcher. Each of them was edited using online photo editing software from <www.picnik.com> to ensure consistency in image size and perceived level of contrast and luminance.

Stage two: Rating of season images. The season images generated in Stage One were submitted to 35 raters (13 men, 22 women, age *M* = 23.46 years, *SD* = 6.30) recruited from the Lakehead University student population and from the general community for their opinion on how representative they thought each summer (winter) image was of the summer (winter) season on a scale of 1 (not representative at all) to 9 (extremely representative). Twenty-seven raters indicated that they were single, seven were living with a common-law partner, and one individual was a widow. Most were students (*n* = 21) and most specified their ethnicity as White (*n* = 33). One rater was Aboriginal and one participant was Black, not of Hispanic origin. Among the student population, 16 were undergraduate students and five were graduate students. Two raters from the non-student population had an education level of eighth grade or lower. One rater did not indicate the highest level of education completed.

It was explained to the raters that the study looked at different images that were intended to represent the concepts of summer and winter, and that the purpose of the study was to gain an understanding of people's conceptualizations of the seasons (see Appendix D). The raters were also informed that the data collected from the image ratings would be used to develop materials for future research involving people's reactions to different stimuli. They were notified that their participation in the development of stimulus materials was completely voluntary and that they were free to withdraw at any time without penalty, that their responses would be kept confidential and anonymous, and that the data would be kept in secure storage in Dr. Tan's lab for a period of seven years. Furthermore, they were told that there would be no foreseeable psychological or physical risks or benefits to participating in the stimulus development, and that the image ratings would take approximately 30 minutes to complete. Participants completed a demographic questionnaire (see Appendix E) before rating the images.

Stage three: Selection of season images for EMG task. Ratings from Stage Two for each image were averaged across the 35 raters. It was decided *a priori* that only images with averaged ratings of 7 or higher would be considered acceptable for use. A final list of six summer and six winter images (see Appendices F and G, respectively) with averaged ratings greater than 8 (see Tables 7 and 8) were chosen for inclusion as the stimulus images in the EMG task.

Stage four: Calibrating luminance levels of season images for EMG task. To calibrate the luminance level of each image for the light intensity condition in the main study, each image from the final list was measured for its spatial-averaged luminance. This was achieved with a Prichard spectroradiometer with 5^0 aperture setting centered on each of the spatially complex images. The image contrasts were adjusted prior to overall average luminance using JPEG image software. High, medium, and low luminance settings were adjusted to 65, 30, and 5 cd/m^2, respectively.

Main Study Participants

A total of 79 individuals who were recruited from students and staff of Lakehead University, as well as members from the general community, participated in the study. None of them had medical conditions that could cause depression or used medications or psychoactive substances that could produce depressed moods. Out of this initial group, 45 individuals (11 males, 34 females, age M = 25.78 years, SD = 9.80) were classified into the SDS (n = 16), NSDS (n = 15) and Control (n = 14) groups. Most of the individuals in the three groups were single, White, and students. An equal number of individuals in the SDS and NSDS group (four each) had a current diagnosis of major depression, three in the SDS group were currently diagnosed as having seasonal depression, while four in the SDS and three in the NSDS group had a current diagnosis of an anxiety disorder. Four SDS and three NSDS individuals were using antidepressants at the time of the study, and one SDS and one NSDS individual was on anxiolytic medication. None of the Control individuals had a clinical status or were using psychotropic medication. Table 9 displays detailed demographic information for each group, the pooled sample across groups, as well as the entire original sample.

Group classification. The measures used to classify participants were the Structured Interview Guide for the Hamilton Rating Scale for Depression – Seasonal Affective Disorder Version – Self-Rating (SIGH-SAD; Williams, Link, Rosenthal, & Terman, 1994) and the Seasonal Pattern Assessment Questionnaire (SPAQ; Rosenthal et al., 1987), The SIGH-SAD which assess both typical and atypical depression symptoms and can also yield a total depression score, is typically used in the literature to detect seasonal depression in research participants while the SPAQ is often used as a measure of seasonality. More information on these measures is provided in the section below entitled *Screening Research Questionnaire.*

The classification criteria for the SDS group were a SIGH-SAD Total score of 16 or higher and a Global Seasonality Score (GSS) on the SPAQ that is at least 12 with at least moderate seasonal impairment. The criteria for the NSDS group were a SIGH-SAD Total score of 16 or higher, and a GSS ≤ 8 or a GSS score of 9-11 with no seasonal impairment. Finally, the criteria for the Control group were a total SIGH-SAD ≤ 8 and GSS of ≤ 8. The cutoff scores for the SIGH-SAD were consistent with those used in previous research, which has proposed that a score of 16 or higher indicates at least a moderate level of depression severity (Bech, Kastrup, & Rafaelsen, 1986; Müller, Szegedi, Wetzel, & Benkert, 2000) while a score ≥ 28 indicates a severe level of depression severity (Angst, Amrein, & Stabl, 1995; Müller et al.). GSS cutoff scores and impairment level were also in accordance with seasonality cutoff scores used in previous research (Rosenthal et al., 1987).

Validity of group classification. Group classification validity was tested by investigating group differences on the variables (see Table 10 for descriptive statistics) that were used to categorize participants into groups. A univariate ANOVA was performed on SIGH-SAD Total to test for group differences. A significant Group effect was revealed, $F(2, 42) = 56.57$, $p < .001$, $\eta^2 = .73$, power > .99. Post-hoc Tukey tests revealed that both SDS ($M = 30.44$, $SD = 9.12$) and NSDS ($M = 24.73$, $SD = 6.60$) scored higher than Control ($M = 5.02$, $SD = 2.41$).

Two separate ANOVAs were also carried out on the SIGH-SAD subscales (SIGH-SAD Typical, SIGH-SAD Atypical). A univariate ANOVA on SIGH-SAD Typical with Group as the independent factor revealed a significant Group effect, $F(2, 42) = 64.56$, $p < .001$, $\eta^2 = .76$, power > .99. A post-hoc Tukey analysis revealed that both SDS ($M = 19.50$, $SD = 5.18$) and NSDS ($M = 18.20$, $SD = 4.18$) scored higher than Control ($M = 3.87$, $SD = 2.25$). An ANOVA on SIGH-SAD Atypical with Group as the independent factor revealed a significant Group effect, $F(2, 42) = 25.15$, $p < .001$, $\eta^2 = .55$, power > .99. Post-hoc Tukey tests revealed that SDS ($M = 10.94$, $SD = 5.47$) scored higher than NSDS ($M = 6.53$, $SD = 3.14$) who scored higher than Control ($M = 1.14$, $SD = .95$). .

Another ANOVA was performed on GSS with Group as the independent variable. The results revealed a significant Group effect, $F(2, 42) = 64.81$, $p < .001$, $\eta^2 = .76$, power > .99. A post-hoc Tukey test revealed that SDS ($M = 15.25$, $SD = 2.38$) scored higher than NSDS ($M = 7.60$, $SD = 3.00$) who scored higher than Control ($M = 4.07$, $SD = 2.92$) on GSS.

Finally, a univariate ANOVA was carried out on degree of impairment as measured by the SPAQ with Group as the independent factor. There was a significant Group effect, $F(2, 42) = 49.83$, $p < .001$, $\eta^2 = .70$, power > .99. Post-hoc Tukey analyses revealed that SDS ($M = 2.81$, $SD = .66$) scored significantly higher than NSDS ($M = .73$, $SD = 1.22$) who scored higher than Control ($M = 0.00$, $SD = 0.00$) on degree of impairment.

In summary, the statistics showed the expected and desired group differences. Both SDS and NSDS were generally more depressed than Control. The typical depression scores for SDS and NSDS were not significantly different from each other, but were significantly elevated relative to that of the Control. The atypical depression scores (characteristics of seasonal depression) were higher in SDS than in NSDS, which in turn was higher than in Control. Finally, SDS was significantly higher than NSDS who in turn was higher than Control on degree of change with the seasons (i.e., seasonality) and on seasonal impairment.

Measures

Screening research questionnaire. The Screening Research Questionnaire (see Appendix H) was designed to screen individuals for participation in the main study based on whether they met the criteria for one of the three groups (see above). It had a total of four sections, which are detailed below.

Section A. This section was designed to collect demographic and background information in order to provide a description of the study sample and to ensure that participants did not meet the exclusionary criteria.

Section B. This section included the Seasonal Pattern Assessment Questionnaire (SPAQ; Rosenthal et al., 1987). As previously mentioned, the SPAQ is used as a retrospective self-report tool for identifying seasonal patterns in atypical depressive symptoms. The SPAQ was not developed as a diagnostic instrument; rather, it was designed to assess for seasonal changes in mood and behaviour.

There are two scales on the SPAQ that are relevant to the group classification on the basis of seasonality. The first is known as the Global Seasonality Score (GSS) and includes six items that measure the degree to which mood, weight, appetite, energy, sleep, and social activity change with the seasons. These six items are rated on a scale of 0 (no change) to 4 (extremely marked change). The GSS is calculated by adding up the scores of these six items, and can range from 0 to 24. A GSS equal to or less than 7 indicates a lack of seasonality, while a score between 12 and 24 suggests a high level of seasonality. A second scale evaluates the degree to which the respondent finds the seasonal changes problematic that range from "no problem" to "disabling".

The SPAQ has been shown to have good test-retest reliability with a Cronbach's alpha of 0.76 (Young, Blodgett, & Reardon, 2003) as well as good internal consistency, with a Cronbach's alpha of 0.85 (Merch et al., 2004). One study (Raheja, King, and Thompson, 1996) reported low test-retest reliability (r = 0.62) over a period of five to eight years, but the authors suggested that this might reflect true changes in the individuals being tested. Magnusson (1996) reported that the SPAQ was able to detect approximately the same number of SAD cases as clinical evaluations, and had a sensitivity of 94% and specificity of 73%. Mersch et al. (2004) determined that the SAD criterion (GSS and impairment level) shows good specificity (94%), though sensitivity was low (44%). The SPAQ is presently used in the literature as a screening tool for SAD and not for diagnostic purposes. Its GSS scale is used as a measure of seasonality.

Section C. The Structured Interview Guide for the Hamilton Rating Scale for Depression – Seasonal Affective Disorder Version: Self-Rating (SIGH-SAD; Williams, Link, & Terman, 1994) was used in this screening questionnaire to assess the severity of seasonal depression. It has 29 items of which 21 (labeled as "H" items) reflect typical depressive symptoms and are rated on a severity scale that ranges from 0 to 4 with higher scores indicating greater severity. The remaining eight items (labeled as "A") assess atypical depressive symptoms that are rated on a scale from 0 to 3 with higher scores indicating greater severity. A total SIGH-SAD score is calculated by adding the scores from all 29 items together. Separate Typical and Atypical scores are computed by adding up, respectively, items 1-21, and items 22-29. With respect to internal reliability, studies report results that are adequate to excellent. Reynolds and Kobak (1995) found excellent internal reliability levels, with Cronbach's α of .92, while Akdemir et al. (2001) reported levels reaching .75. Studies of inter-rater reliability have produced equivocal findings. Pearson *r* studies of the SIGH-SAD tend to report excellent inter-rater reliability, with levels ranging from .90 (Pancheri, Picardi, Pasquini, Gaetano, & Biondi, 2002) to .97 (Baca-Garcia et al., 2001; Koenig, Pappas, Holsinger, & Bachar, 1995). However, intraclass *r* studies show that inter-rater reliability is not as high for some of the specific items on the inventory. McAdams, Harris, Bailey, Fell, and Jeste (1996) found adequate intraclass *r* levels .77, while Leung, Wing, Knowng, Lo, and Shurn (1999) report levels as high as .94. It is clear that, due to the discrepancy of results for intraclass r studies, more research needs to be done. Bagby, Ryder, Schuller, and Marshall (2004) report excellent test-retest reliability, ranging from .81 to .98.

Reports of good content validity have been found by Bagby et al. (2004), even though the SIGH-SAD is sometimes criticized for not being reflective of the DSM-IV-TR criteria. The researchers stress that the SIGH-SAD and DSM-IV-TR should not be compared, since they are intended to assess different aspects of depression. The SIGH-SAD was originally developed with the intention of assessing severity of depression symptoms, not the presence or absence of major depressive disorder as the DSM-IV-TR is designed to do. With regards to convergent validity, the SIGH-SAD correlates well with other measures that aim to assess the severity of depressive symptoms. Kobak, Greist, Jefferson, Mundt, and Katzelnick (1999) found that the Hamilton correlated well with the Beck Depression Inventory (BDI; Beck, 1967) with a Pearson's *r* of 0.89.

Experimental Tasks

The experimental tasks in the current study included the modified Stroop test to investigate attentional bias with respect to stimulus words, and the affective imagery viewing task with EMG recordings (i.e., the EMG task) to measure facial EMG reactions to stimulus images. These tasks are discussed in detail below.

Stroop test. For the attentional bias task, a modified Stroop test was used to determine whether each group showed a cognitive bias for a given type of stimulus word. The Stroop test required each participant to colour-name words from various categories (summer, winter, light, dark, happy, and depressed, with yoked-neutral words for each word in the six categories). A USB RB-830 Cedrus Corporation eight-button response pad was used by the participant to input his/her responses. Of the eight buttons, only four buttons were programmed for use in the task and the remaining four were covered. The word lists were combined together and the order of presentation of words was quasi-randomized across participants (see below).

Each participant viewed the Stroop words from a 66 cm distance on a 61 cm (52^0 visual angle) diagonal iMac screen. Each word was presented individually in one of four colours (red, blue, yellow, or green). Each of the colours was represented equally across the word categories. However, no colour was presented more than twice consecutively, and no word from the same category was presented more than twice consecutively in order to prevent an expectancy effect. The words appeared in the centre of the screen 14.2 cm distance (12^0 visual angle) from the top of the screen in lower-case 3^0 subtending letters (size 3.7 cm high) with the first letter capitalized, superimposed on a black screen background.

Prior to beginning the Stroop test, participants completed a practice trial that was composed of ten solid shapes (square, circle, diamond, or triangle) that appeared in one of four colours (red, blue, yellow, or green). Each shape was presented individually and no colour was presented more than twice consecutively. The shapes appeared in the centre of the screen and stood 5.8 cm high (5^0 visual angle) against a black screen background.

The Stroop test began with a set of instructions for the practice trial that appeared in white in the centre of a black screen background. The instructions were as follows:

> *The following is a practice trial to help familiarize yourself with the upcoming computer task. You will be presented with a series of shapes in different colours (red, green, yellow, and blue). Using the colour-coded keypad, please indicate the COLOUR of the shape as quickly as you can. Press any button on the response keypad to begin the practice trial.*

The instructions for the practice trial were followed by a 1-s blank black screen, which was followed by a 1-s symmetrical 1.1 cm ($.8^0$ visual angle) grey crosshair on a black background. A coloured shape then appeared that remained on the screen until the participant made a response on the keypad. After the participant made a response, the screen changed back to the 1-s blank black screen. The cycle then repeated itself until all 10 practice trial shapes were presented.

Once the practice trial was completed, a second set of instructions were presented on the screen for the main Stroop test:

> *You have just completed the practice trial and will now move on to the main task. At this time, please let the researcher know that you have completed the practice trial. The lights in the room will be turned off for the duration of the experiment. You will be viewing a series of words on the screen that will be presented in one of four colours (red, green, yellow, and blue). Using the colour-coded keypad, please indicate the COLOUR of the word as quickly as you can. Once the researcher has turned off the lights, begin by pressing any button on the response keypad.*

Once the participant indicated to the researcher that the practice trial was completed, the researcher asked whether the participant had any questions before moving on to the main Stroop test trials. The researcher then turned off the lights in order to avoid potential distractions in the room that could have taken focus away from the participant's task. When the lights were turned off, the researcher remained in the room, but out of the participant's line of sight. The set of instructions for the main Stroop test were succeeded by a 1-s blank black screen, followed by a 1-s symmetrical 1.1 cm ($.8^0$ visual angle) grey crosshair on a black background, and then followed by a coloured Stroop word that remained on the screen until the participant made a response, whereupon the screen changed back to the 1-s blank black screen. The cycle repeated itself until all of the words for the task were presented. After the final word in the Stroop test, the words "*You have* *completed this task. Please inform the experimenter that you are done*." appeared in the centre of a black screen in white letters to indicate to the participant that the experiment was completed.

Response latency and number of errors in colour-naming the words were recorded automatically using the program Superlab™ (which is also the software used to develop and present the stimuli). The difference between response latency for the stimulus and response latency for the yoked neutral word were then calculated. A larger difference in response latency and greater proportion error rate was indicative of a greater attentional bias to the word.

Incidental recall task. An *incidental recall task* of the words from the modified Stroop test was administered. Following the Stroop test, the lights in the lab were turned on and the participant was instructed to type out in a computer document as many words as s(he) could recall from the Stroop test within a span of five minutes. A proportion recall accuracy score for each word category was computed based on the number of words recalled from a particular category divided by the total number of words in that particular category. Errors were defined as recalled words that do not match those used in the Stroop test.

EMG task. Each participant engaged in an affective imagery viewing task during which s(he) was seated 66 cm away from a 40.5 cm diagonal (34^0 visual angle) CRT monitor that presented in succession 36 individual visual images of size 11.7 cm high (10^0 visual angle) and 15 cm (13^0 visual angle) wide. Each image was positioned in the centre of the monitor screen with its top border 5.4 cm from the top of the screen and its left border 8.6 cm from the left side of the screen. These images consisted of photographs depicting six winter scenes and six summer scenes with each scene being duplicated at three levels of luminance: low spatial-average luminance (5 cd/m^2), medium spatial-average luminance (30 cd/m^2) and high spatial-average luminance (65 cd/m^2). Using different levels of luminance enabled further discrimination between the effects of seasons versus effects of luminance on psychophysiological responses. The images were presented in a quasi-randomized fashion with no image from the same season category being presented more than twice consecutively to prevent an expectancy effect.

During this viewing task, facial electromyography (EMG) measurements were taken. Two sets of bipolar Ag-AgCl electrodes were attached with two-sided adhesive collars to the *musculus corrugator supercilii* and the *musculus zygomaticus major* regions 2.5 – 4.5 cm from the left lip corner, as well as the upper borders of the inner eyebrows (3 - 4 cm superior) (see Fridlund & Cacioppo, 1986; Genricke & Shapiro, 2000). A bipolar to touchproof adapter was used to transform each pair of electrodes into a set of bipolar electrodes. This allowed one electrode in each pair to act as a ground for the other electrode. A separate ground electrode was connected roughly 3 cm above the participant's nasion in the mid-forehead area. The two bipolar connectors and the ground electrode were connected to a single 64-channel Advanced Neuro Technology (ANT) amplifier (in BIP channels 65-68).

Standard EMG preparation protocol was followed (see Fridlund & Cacioppo, 1986) to attach the electrodes. The participant's skin was gently abraded in the appropriate facial areas with NuPrep gel in order to maximize the reduction of the skin's impedance levels. The bipolar electrode pairs were filled with a watersoluble conductance gel (Electrogel) and connected to the participant's face via two-sided adhesive collars and surgical tape. Once the electrodes were securely fastened, the participant was instructed to move his or her facial muscles (i.e., smile, frown, move eyebrows up and down, etc.) to ensure that the electrodes did not fall off, to help the participant become more comfortable with the electrodes, and to test that the EMG recording was functioning.

Before the EMG task began, the experimenter explained to the participant that s(he) would be viewing a number of images while the electrodes measured his/her reaction to the pictures via the activity of the sweat glands in his/her skin. This was a necessary deception to prevent the participant from being conscious of his/her facial muscle movements, which could have interfered with accurate facial EMG recording. They were also asked to refrain from unnecessarily moving around in their seats so as not to confound the recordings. Prior to beginning the EMG task, the lights were turned off in the laboratory in order to reduce the risk of potential distractions and to help the participant focus on the task. The researcher remained in the room during the task, but out of view of the participant.

The EMG task began with a set of instructions in the centre of a black screen that were presented in white font and read as follows:

> *You are about to be presented with a series of images. You are to respond to each image with the numbered keypad. On a scale of 1 (not at all) to 5 (very much), how much would you personally enjoy being in this scene?*

The printed instructions were reiterated verbally by the researcher, so as to ensure that the participant understood the task. The instructions were followed by a 5-s symmetrical 4 mm (.3^0 visual angle) grey crosshair in the centre of a black screen on which participants were instructed to fixate. This was followed by a 5-s image presentation, which was a winter or summer scene presented in either low, medium, or high luminance level. Presented below the image was a rating scale that had the participant rate the image on its degree of personal appeal on a scale of 1 (not at all) to 5 (very much). After the participant indicated his or her rating, (s)he was presented with another 5-s grey crosshair. The cycle then repeated itself for another 11 winter and summer images, each at three levels of luminance. Once all 36 images were completed, the words "*end of experiment*" appeared in white font in the centre of a black screen to indicate to the participant that the experiment was complete. EMG recordings were continuous throughout this task. The EMG readings during the crosshair period served as the baseline for the image trial period that followed immediately after.

The EEG/ERP and MEG analyzing package Advanced Source Analysis (ASA) was used in the recording and extraction of the EMG data. The EMG signal was continuously recorded at a sampling rate set at 256 Hz and amplified by a factor of 20,000. In preparation for statistical analysis, the raw EMG signals were divided into epochs each consisting of a 5-s baseline measurement period and a subsequent 5-s trial measurement period. This was followed by signal-averaging in order to increase the signal to noise ratio. The signals were also filtered with a high pass filter set at 30 Hz to reduce environmental noise. This is in keeping with the cutoff used in previous EMG studies (e.g., Veldhuizen, Gaillard, & de Vries, 2003). The signals were then rectified with the absolute value function in ASA to change any negative values on the waveform to their respective absolute value, and integrated with a time constant set at 10 *ms*. A macro was specifically written by ANT to enable the extraction of the area amplitude for each of the 36 images for each participant. The area amplitude of the trial period was first determined, followed by the area amplitude of its preceding baseline. The area amplitude is essentially the mean amplitude multiplied by the number of points in the time window (baseline or trial measurement period) being measured and constitutes one of the common methods to measure electrophysiogical data in ERP (event-related potential) experiments (Luck, 2005). The difference in area amplitude between each trial period and its preceding baseline served as the degree of facial activity in response to the stimulus image. Larger difference area amplitude indicated a greater degree of facial muscle activity.

Main Study Procedure

Recruitment

Following ethics approval for the study, participants were recruited from Lakehead University and from the general community. Recruitment efforts within the university consisted of a message (see Appendix I) sent out to students through their instructors and to the campus population through the Communications Bulletin, as well as postings on bulletin boards around campus and in the Student Health and Counseling Centre.

In order to reach the general community, permission to post recruitment posters was sought from physicians' offices and in public areas such as convenience stores, shopping centres, and supermarkets within Thunder Bay (see Appendix J). Notices about the study also appeared in the Chronicle Journal Helping Hands section.

Individuals who responded to the recruitment message were contacted within five days via telephone or email and invited to be scheduled for a laboratory session that included a screening questionnaire and three experimental tasks; a Stroop test, a recall task, and an EMG image viewing task. During the invitation contact, they were reminded about the nature of the study and informed that their participation was completely voluntary, that they were free to withdraw from the study at any time without penalty, that their responses were to be kept confidential, and that all collected data would be stored securely in the project supervisor's (Dr. Josephine Tan) laboratory for a period of five years, after which time it would be destroyed. They were also informed that there would be no psychological or physical risks or benefits to participating in the research study. In addition, they were notified that as a token of appreciation for their assistance in the study, they would be entered into a random prize draw for one of two $50 gift certificates redeemable at the Intercity Shopping Mall in Thunder Bay, and that Introductory psychology students who participate would also receive 1.5 bonus points towards his or her course mark. There was also an opportunity to ask questions before an appointment was made for those who chose to participate in the study.

Study Procedure

Participants who were interested in participating in the main study were scheduled for a lab session by the researcher. Prior to starting the study, the researcher went over the procedure with each participant. Participants were given a cover page (Appendix K) to read and follow along. They were then given a consent form to read and sign (Appendix L).

Following the informed consent process, participants were asked to fill out the screening research questionnaire (see Appendix H) in order to collect some basic information about them. Responses from the screening research questionnaire were later used to categorize participants into the three groups (SDS, NSDS, and control). Participants had the option of filling out an online screening research questionnaire or a hard copy version. The online questionnaire was created using secure web-based survey software called Opinio, which can be found at < http://cbtc.utoronto.ca/opinio/s?s=360 >. Opinio is a secure web-based survey construction, data-collection, and data-analyzing tool. All data collected using Opinio is stored securely in the Opinio main database. The hard copy and online versions of the screening research questionnaire were identical.

After completion of the screening questionnaire, participants engaged in the modified Stroop test, followed by the incidental recall task, and finally the EMG task (see section on Experimental Tasks). The session concluded with a debriefing (see Appendix M) during which time the researcher explained the objectives of the study in greater detail, and also answered any questions that the participant might have had. Participants were also given a list of therapy resources in Thunder Bay (see Appendix M). Finally, those participants who indicated interest in seeing the results of the study would be mailed a summary of the results after the study was completed.

Results

Overview of Statistical Analytic Design

The dependent variables derived from each experimental task (the modified Stroop test, the incidental recall task, and the facial EMG image viewing task) and the statistical analytic strategies used to analyze the data are described below.

Modified Stroop test. The dependent variables in the modified Stroop test were response latency and proportion error. Response latency was calculated as the difference in reaction time (*ms*) between a stimulus word and its yoked neutral word. Positive values for response latency indicate that the participants took longer to colour name the stimulus word than the yoked neutral word. Conversely, negative response latency values indicate that participants named the stimulus word more quickly than the yoked neutral word. Proportion error was calculated as the number of errors made in the Stroop response divided by the total number of words within a particular word category (winter, summer, happy, depressed, light, dark).

Given that there were three bipolar sets of word categories defined by Season word type (summer/winter), Light word type (light/dark), and Mood word type (happy/depressed) the analyses were carried out as follows:

1. A mixed design repeated measures ANOVA with Group (SDS, NSDS, Control) as the between-subject factor and Season word type (summer, winter) as the

within-subject factor was carried out on response latency as the dependent variable. The same analysis was repeated on proportion error.

2. A mixed design repeated measures ANOVA with Group (SDS, NSDS, Control) as the between-subject factor and Light word type (light, dark) as the within-subject factor was carried out on response latency as the dependent variable. The same analysis was repeated on proportion error.
3. A mixed design repeated measures ANOVA with Group (SDS, NSDS, Control) as the between-subject factor and Mood word type (happy, depressed) as the within-subject factor was carried out on response latency as the dependent variable. The same analysis was repeated on proportion error.

In cases where the assumption of compound symmetry was violated, the Hyundt-Feldt correction was applied when interpreting significant effects involving within-subject factors. Post-hoc Tukey tests were used to follow up on significant effects that involved more than two group comparisons.

Incidental recall task. The dependent variable in this task was proportion recall which was defined as the number of words recalled from a particular word list divided by the total number of words in that word list, expressed as a proportion. Six separate ANOVAs with Group (SDS, NSDS, Control) as the independent variable were performed on proportion recall of summer, winter, light, dark, happy, and depressed word list, respectively. Post-hoc Tukey tests were used to follow up on significant effects to look for pairwise means comparisons.

EMG task. To analyze the EMG data, a mixed design repeated measures ANOVA with Group (SDS, NSDS, Control) as between-subject factor and Seasons (summer, winter) and Luminance (low, medium, high luminance) as two within-subject factors were carried out on the area amplitude. The Hyundt-Feldt correction was applied in interpretations of significant within-subject effects in the event that the assumption of compound symmetry was violated. Post-hoc Tukey tests were used to follow up on significant effects to look for pairwise means comparisons.

Software Used in the Statistical Analyses

The computer software used to perform the statistical analyses was the Statistical Package for the Social Sciences: version 17.0 (SPSS – 17.0). This software program was used to carry out pre-analysis issues (see section below entitled *Pre-Analysis Issues*) as well as the Main Analyses (see section below entitled *Main Analyses*). Primary analytic strategies included bivariate correlations and mixed-design repeated measures ANOVA. Supplementary multiple regression analyses were also carried out using SPSS – 17.0 (see section below entitled *Supplementary Analyses*).

Pre-analysis Issues

Univariate outliers. In order to eliminate the undue influence of within-group univariate outliers on the results for the main study analyses, the data was screened for potential outliers. Univariate outliers are defined as cases (i.e., participants) with an extreme value on a single variable that stand out from the typical responses for that variable within the sample (Tabachnick & Fidell, 2007). Any value that is greater than a *z*-score of ± 3.29 is considered a potential univariate outlier. In the present study, standardized *z*-scores were computed for all within-group raw scores. The analysis revealed 19 cases of univariate outliers across all cases of the dependent variables. These outliers were evenly distributed and not associated with any variable in particular. In order to reduce their influence on the data, the scores that were identified as potential outliers were transformed into raw scores that were equivalent to $\pm$3.29 standard score (Tabachnick & Fidell).

Homogeneity of variances. Homogeneity of variances was assessed with F_{max}, which is the ratio of the largest to the smallest cell variance. With near equal sample sizes (ranging from 14 in Control to 16 in SDS), an F_{max} up to 10 is considered acceptable (Tabachnick & Fidell, 2007). An investigation revealed that the largest F_{max} with a value of 6.18 was found for the *zygomaticus major* area amplitude of summer images at the low luminance level, indicating no concerns with the assumption of homogeneity of variance.

Internal Consistency of Scales

In order to determine the degree to which the items on the classification measures were measuring the same construct, tests of internal consistency were carried out. The reader is referred to Table 11 for a summary of the internal consistency values on each measure (GSS, SIGH-SAD Total, SIGH-SAD Typical, and SIGH-SAD Atypical). As can be seen, the Cronbach's α were at least adequate, with coefficients ranging from .75 for SIGH-SAD Atypical to .85 for SIGH-SAD Total.

Main Analysis

Prior to statistical significance testing, a visual inspection of the data was carried out by examining histograms of group means with 95% confidence intervals (CI) bars for each of the dependent variables. The pattern of group means reveals trends whereas the CI bars can provide inferential information for graphically represented data and indicate a range of plausible values for population means of the dependent variable (Cumming & Finch, 2005). Findings from the visual inspection and statistical testing of the data are reported below.

Stroop response latency. The response latency for Season word type, Light word type, and Mood word type were examined separately. Table 12 presents the within-group, pooled-group, and total sample descriptive statistics.

Season word type. A graphical representation of the mean response latency for each group on summer and winter words is provided in Figure 1. A visual inspection of the histogram indicated that all three groups were slower in naming the summer words than the respective yoked neutral words, with Control being the most slow and NSDS being the least slow. The converse was seen for winter words where all three groups were faster in naming the stimulus word than its yoked neutral word. SDS showed the fastest response to winter words, followed by NSDS, and finally Control.

A mixed design repeated measures ANOVA with Group as the between-subjects factor and Season word type (winter, summer) as the within-subjects factor was performed on response latency. The findings revealed a significant overall effect for Season, $F(1, 42) = 8.28$, $p = .006$, $\eta^2 = .17$, power = .80. Participants responded more slowly to summer words ($M = 59.14$, $SD = 109.34$) than to winter words ($M = -65.01$, $SD = 189.01$).

Light word type. Figure 1 presents a graphical representation of mean response latency for light and dark words by Group. A visual examination of the histogram suggests that both Control and SDS groups showed slower response latency to light words compared to the yoked neutral words with Control being slower than SDS. However, NSDS essentially showed very little difference in response latency to light and yoked neutral words. For dark words, all three groups were slower in naming the yoked neutral words than the dark words. Control showed the slowest response, followed by NSDS and finally SDS.

A mixed design repeated measures ANOVA with Group as the between-subjects factor and Light word type (light, dark) as the within-subjects factor was performed on response latency. The findings revealed a significant overall effect for Light, $F(1, 42) = 7.439$, $p = .009$, $\eta^2 = .16$, power = .76. Participants responded more slowly to light words ($M = 27.13$, $SD = 100.48$) than to dark words ($M = -33.74$, $SD = 97.04$).

Mood word type. Figure 1 shows a graphical representation of the mean response latency for Mood word type (happy, depressed) by Group. A visual inspection of the histogram showed that generally, participants were slower in their response to happy stimulus words than to yoked neutral words, with NSDS being the slowest, and SDS being the fastest. SDS and NSDS were also slower in responding to depressed words than to the yoked neutral words with SDS taking longer. Control essentially showed very little difference in their response latency to depressed and yoked neutral words.

A mixed design repeated measures ANOVA with Group as the between-subjects factor and Mood word type (happy, depressed) as the within-subjects factor was performed on response latency. The results yielded no significant results.

Stroop proportion error. The Season word type, Light word type, and Mood word type were examined separately. Table 13 presents the within-group, pooled-group, and total sample descriptive statistics for the Stroop response proportion error.

Season word type. A graphical representation of summer and winter words by Group is presented in Figure 2. Upon examination of the pattern of group means in the histogram it was determined that all three groups made more errors in responding to summer words, with Control making the most errors and SDS the least. With respect to winter words, Control made the most errors and NSDS made the fewest errors.

A mixed design repeated measures ANOVA was carried out on proportion error with Group as the between-subjects factor and Season word type (summer, winter) as the within-subjects factor. No significant results were revealed.

Light word type. A graphical representation of proportion error means for each Light word type by Group is presented in Figure 2. A visual investigation of the histogram suggests that NSDS made more errors on light words, followed by SDS and then Control. SDS made more errors on dark words than Control who made more errors than NSDS.

A mixed design repeated measures ANOVA with Group as the between-subjects factor and Light word type (light, dark) as the within-subjects factor was performed on proportion error. No significant results were found.

Mood word type. Figure 2 presents a graphical representation of means for each mood word type by group. An examination of the pattern of group means in the histogram showed that control made more errors on happy words than either SDS or NSDS. NSDS made more errors on depressed words than either SDS or Control.

A mixed design repeated measures ANOVA with Group as the between-subjects factor and Mood word type (happy, depressed) as the within-subjects factor was carried out on proportion error. The results did not reveal any significant findings.

Incidental recall task. Table 14 presents the within-group, pooled-group, and total sample descriptive statistics for the proportion of accurate recall in the incident recall task for the different word types in the Stroop test.

Season word type. A histogram displaying mean groupwise proportion recall for each stimulus word category can be viewed in Figure 3. The histogram displays an interesting trend for summer word recall accuracy, in that the Control group appeared to recall more summer words than NSDS and SDS. NDSD in turn recalled more summer words than SDS.

A mixed design repeated measures ANOVA was carried out on proportion recall with Group as the between-subjects factor and Season word type (summer, winter) as the within-subjects factor. No significant results were revealed.

Light word type. A histogram displaying mean groupwise proportion recall for each stimulus word category can be viewed in Figure 3. A visual investigation into the pattern of group means displayed in the histogram suggests that NSDS recalled more light words than Control or SDS, whereas SDS recalled more dark words than Control or NSDS.

A mixed design repeated measures ANOVA was performed on proportion recall with Group as the between-subjects factor and Light word type (light, dark) as the within-subjects factor. A significant overall effect was found for Light, $F(1, 42) = 4.72$, $p = .036$, $\eta^2 = .10$, power = .56. Participants generally recalled more dark words ($M = .18$, $SD = .21$) than light words ($M = .10$, $SD = .16$).

Mood word type. A histogram displaying mean groupwise proportion recall for each stimulus word category can be viewed in Figure 3. An examination of the groupwise trends displayed in the histogram indicated that NSDS recalled more happy words than either SDS or Control, while both SDS and Control recalled more depressed words than NSDS.

A mixed design repeated measures ANOVA was carried out on proportion recall with Group as the between-subjects factor and Mood word type (happy, depressed) as the within-subjects factor. No significant results were revealed.

EMG activity: Area amplitude. The results for the *zygomaticus major* (*ZM*) and the *corrugator supercilii* (*CS*) area amplitude are reported separately below. Descriptive statistics are reported in Tables 15 and 16 for *ZM* and *CS* respectively.

Zygomaticus major. Figure 4 displays a graphical representation of area amplitude for *ZM* activity for each season image type by Group. A visual inspection of the histogram showed that as the image luminance increased from low to high, all three groups showed increased *ZM* activity for both summer and winter images. For low luminance summer images, Control had higher *ZM* activity than either NSDS or SDS. The same trend was observed for medium and high luminance summer images. For winter images, the more prominent trend is that Control had higher *ZM* activity than the other two groups for high luminance scenes. The same trend was observed for the low and medium luminance winter scenes except that the difference between Control and the other two groups were smaller.

A mixed design repeated measures ANOVA with Group as the between-subjects factor and Season images (summer, winter) and Luminance level (low, medium, high) as two within-subjects factors was performed on area amplitude for *zygomaticus major* (*ZM*) area activity. Several significant effects were found.

There was a significant main effect for Luminance, $F(1.14, 47.73) = 21.20$, $p = .001$, $\eta^2 = .17$, power = .94. Post-hoc Tukey tests revealed that participants displayed significantly higher *ZM* area amplitude to high luminance images ($M = 3.44$, $SD = 3.12$) than to low luminance images ($M = 2.06$, $SD = 1.61$).

There was also a significant Season x Group interaction effect, $F(2,42) = 5.63$, $p = .007$, $\eta^2 = .21$, power = .83. However, no significant pairwise means comparisons were found with post-hoc Tukey tests suggesting that a more complex pairwise means comparison might be in effect. The descriptive statistics for the *ZM* area amplitude for each Season by Group in ascending order were SDS on summer images ($M = 2.12$, $SD = 1.81$), NSDS on summer images ($M = 2.20$, $SD = 1.98$), NSDS on winter images ($M = 2.34$, $SD = 2.09$), SDS on winter images ($M = 2.45$, $SD = 2.10$), Control on winter images ($M = 3.44$, $SD = 2.29$), and finally Control on summer images ($M = 3.64$, $SD = 2.57$).

A significant Season x Luminance interaction effect was found, $F(1.72, 72.02) = 8.616$, $p = .001$, $\eta^2 = .17$, power = .94. Post-hoc Tukey analysis revealed that for winter images, *ZM* area amplitude was significantly greater for high luminance images (*M* = 3.68, *SD* = 3.33) than for medium luminance (*M* = 2.47, *SD* = 1.85) and low luminance (*M* = 2.00, *SD* = 1.55) images.

Finally, there was a significant three-way Group x Season x Luminance effect, $F(4,84) = 4.54$, $p = .002$, $\eta^2 = .18$, power = .932. Post-hoc Tukey tests indicated that for low luminance summer images, Control (*M* = 3.26, *SD* = 2.19) displayed significantly higher *ZM* area amplitude than both NSDS (*M* = 1.71, *SD* = 1.56) and SDS (*M* = 1.50, *SD* = .88).

Corrugator supercilii. Figure 5 displays a graphical representation of mean *CS* activity for each image type by Group. Several interesting patterns were revealed by a visual examination of the histogram. For low and medium luminance summer images, SDS displayed more *CS* activity than the other two groups, but the groups appear to respond similarly to high luminance summer images. For winter images, both SDS and NSDS showed similar pattern in that their *CS* activity increased as the luminance level of images increased but Control showed little variation in its response to the images of different luminance levels. NSDS had the lowest amount of *CS* activity for low luminance winter images compared to the other two groups.

A mixed design repeated measures ANOVA was performed on area amplitude for *CS* activity, with Group as the between-subjects factor and Season images (summer, winter) and Luminance (low, medium, high) as two within-subjects factors. The findings revealed a significant main effect for Luminance, $F(1.84, 77.40) = 8.65$, $p = .001$, $\eta^2 = 1.71$, power = .95. CS area amplitude for each level of Luminance was as follows, in ascending order: low Luminance (*M* = 6.34, *SD* = 6.34), medium Luminance (*M* = 7.02, *SD* = 7.70), and high Luminance (*M* = 7.99, *SD* = 8.42).

However, post-hoc Tukey analysis did not reveal any significant pairwise means comparisons.

The findings also revealed a significant Group x Season x Luminance effect, $F(4, 84) = 4.08$, $p = .005$, $\eta^2 = .16$, power = .90. Post-hoc Tukey tests were carried out, however no significant pairwise means differences were revealed (see Table 16 for cell means).

EMG activity: Image valence ratings. Figure 6 shows a graphical representation of group mean valence rating for each image type. The histogram suggests that overall image ratings were higher for winter images than for summer images. Within-group and pooled sample descriptive statistics for EMG valence ratings can be viewed in Table 17.

A mixed design repeated measures ANOVA with Group (SDS, NSDS, Control) as the between-subjects factor and Season images (summer, winter) and Luminance (low, medium, high) as two within-subjects factors was performed on mean image valence ratings. The findings revealed a significant effect for Season images, $F(1, 42) = 21.74$, $p < .001$, $\eta^2 = .34$, power = .99. Post-hoc Tukey analysis revealed that winter images ($M = 3.39$, $SD = .45$) obtained significantly higher valence ratings than summer images ($M = 3.0$, $SD = .48$). There was also a significant Season x Luminance effect, $F(2,84) = 5.14$, $p = .008$, $\eta^2 = .11$, power = .81. Post-hoc Tukey analysis was carried out to investigate pairwise means comparisons, however no significant results were revealed.

Correlations between EMG image valence ratings and area amplitude. In order to determine the association between EMG area amplitude and the subjective image valence ratings for the EMG task, within-group bivariate correlations were carried out (see Table 18). Two significant correlations were found for the SDS group. The magnitude of the *CS* area amplitude and the valence ratings of Summer images at low luminance correlated positively at $r = .66$, $p < .01$. The *CS* area amplitude also correlated positively with valence ratings of Summer images at high luminance, $r = .62$, $p < .01$. One significant negative correlation was found for the NSDS group and it involved *CS* area amplitude with valence ratings of Winter images at high luminance, $r = -.61$, $p < .01$.

When bivariate correlations were run on the three groups combined ($n = 45$), two significant findings emerged. The first was a positive correlation between *CS* area amplitude and the valence rating for Summer images at low luminance, $r = .38$, $p < .05$. The other was a positive correlation between *CS* amplitude and valence rating for Summer images at high luminance, $r = .36$, $p < .05$.

Supplementary Analyses

According to the extended dual vulnerability hypothesis, differential loadings on the seasonality and depression dimension distinguish seasonal depression from nonseasonal depression (Lam et al., 2001). Supplementary regression analyses were thus run on the total sample of 79 participants to determine how the seasonality scores and depression scores (typical, atypical, total) would predict performance on the Stroop and EMG tasks. Regression analysis offers a different perspective on the data from ANOVA testing. The former enables a dimensional interpretation whereas the latter adopts categorical approach that is standard practice in psychopathology research and assumes clinical homogeneity within the groups which is not necessarily the case in many situations. The descriptive statistics of the variables used in the regression analysis based on the total sample (N = 79) are presented in various tables. Table 10 shows the mean and standard deviation for the GSS and SIGH-SAD (Total, Typical, Atypical), Table 12 for the Stroop test response latency, Table 13 for the Stroop test proportion error, Table 14 for the accuracy recall on the incidental recall test, Tables 15 and 16 for the EMG area amplitude, and Table 18 for the valence rating of EMG images.

Prior to running regression analyses, the data for the total sample (N = 79) were examined for inter-relationships among the different variables. First, bivariate correlation analyses were carried out among the group classification variables. The results showed that GSS was significantly associated with SIGH-SAD Total, [$r(77) = .41$, $p < .001$], SIGH-SAD Typical, [$r(77) = .35$, $p = .001$], and SIGH-SAD Atypical, [$r(77) = .43$, $p < .001$].

Second, bivariate correlations were carried out on the group classification variables (GSS, the three SIGH-SAD variables) and the dependent variables on the Stroop test. Poorer recall of summer Stroop words were found to be significantly associated with higher SIGH-SAD Total, [$r(77) = -.26$, $p = .05$], SIGH-SAD Typical, [$r(77) = -.23$, $p = .05$], and SIGH-SAD Atypical, [$r(77) = -.25$, $p = .05$]. As well, higher SIGH-SAD Typical was significantly related to linked to longer response latency for depressed Stroop words, [$r(77) = .23$, $p = .05$].

Third, bivariate correlation analyses were conducted on the group classification variables with EMG recordings. There were several significant relationships involving the *CS* area and summer images. Greater *CS* activity for summer images at low luminance was related to higher scores on the SIGH-SAD Total, [$r(77) = .29$, $p = .05$], SIGH-SAD Typical, [$r(77) = .26$, $p = .05$], and SIGH-SAD Atypical, [$r(77) = .29$, $p = .05$]. Similarly, greater *CS* activity for summer images at medium luminance was related to higher scores on the SIGH-SAD Total, [$r(77) = .27$, $p = .05$], SIGH-SAD Typical, [$r(77) = .23$, $p = .05$], and SIGH-SAD Atypical, [$r(77) = .29$, $p = .05$]. Greater *CS* activity for summer images at high luminance was related to higher scores on the SIGH-SAD Total, [$r(77) = .24$, $p = .05$] and SIGH-SAD Atypical, [$r(77) = .24$, $p = .05$].

Quite similar observations were noted for *CS* area and winter images. Greater *CS* activity for winter images at low luminance was related to higher scores on the SIGH-SAD Total, [$r(77) = .23$, $p = .05$] and SIGH-SAD Atypical, [$r(77) = .24$, $p = .05$]. Greater *CS* activity for winter images at medium luminance was related to higher scores on the SIGH-SAD Total, [$r(77) = .28$, $p = .05$], SIGH-SAD Typical, [$r(77) = .24$, $p = .05$], and SIGH-SAD Atypical, [$r(77) = .28$, $p = .05$]. Greater *CS* activity for winter images at high luminance was related to higher scores on the SIGH-SAD Total, [$r(77) = .26$, $p = .05$], SIGH-SAD Typical, [$r(77) = .24$, $p = .05$], and SIGH-SAD Atypical, [$r(77) = .25$, $p = .05$]. No significant correlations were observed between any images and *ZM* activity.

Fourth, bivariate correlations were conducted on the group classification variables and the valence ratings of the EMG images. Only one significant correlation emerged involving the *CS* activity and valence rating for winter images at medium luminance, [$r(77) = .28$, $p = .05$].

Regression analyses. For each criterion variable defined by performance on the experimental task (see below), three sets of regression analyses with different predictors were carried out: GSS, SIGH-SAD Total, and their interaction term (set 1); GSS, SIGH-SAD Typical, and their interaction term (set 2); GSS, SIGH-SAD Atypical, and their interaction term (set 3). The typical and atypical scores of the SIGH-SAD were examined separately because atypical depression symptoms are more pronounced in seasonal depression than in nonseasonal depression. Thus, looking at the typical and atypical depression scores might provide different information.

The criterion variables derived from the Stroop test were response latency and proportion error to the different Stroop stimulus word types (i.e., summer words, winter words, light words, dark words, happy words, and depressed words). The criterion variable from the incidental recall task was proportion of words accurately recalled from the different Stroop stimulus word types (summer, winter, light, dark, happy, and depressed word lists). Finally, the criterion variables associated with the EMG image-viewing task were *ZM* and *CS* area amplitude and valence ratings for summer and winter images at each of the three luminance levels. Two significant findings were found and are reported below.

Criterion CS area amplitude for summer images at low luminance. The regression with predictors GSS, SIGH-SAD Total, and GSS x SIGH-SAD Total showed significant effect (ΔR^2 = .08, ΔF = 3.43, p = .037), with SIGH-SAD Total as a significant predictor (β = .17, t = 2.35, p = .022).

Criterion CS area amplitude for winter images at medium luminance. The regression with predictors GSS, SIGH-SAD Total, and GSS x SIGH-SAD Total showed significant effect (ΔR^2 = .08, ΔF = 3.43, p = .037), with SIGH-SAD Total as a significant predictor (β = .17, t = 2.35, p = .022).

Discussion

Overview of the Present Study

The present study examined cognitive specificity in individuals with seasonal depression symptoms by comparing their attentional bias and psychophysiological arousal in response to cognitive schema-relevant stimuli with those in individuals with nonseasonal depression symptoms and of nonseasonal and nondepressed individuals (Control). Attentional bias was measured with the modified Stroop test and the incidental recall task. The Stroop stimuli consisted of season word type (summer words, winter words), light word type (light words, dark words), and mood word type (happy words, depressed words). Response latency and proportion of accuracy were measured. Proportion of accurate recall from each of the different word types from the Stroop test was assessed with the incidental recall task. Finally, EMG recordings of the *zygomaticus major* and the *corrugator supercilii* areas were obtained as participants looked at a number of summer and winter images presented in three levels of luminance, and rated the valence (degree of appeal) of each image.

Attentional Bias

As previously mentioned, attentional bias in the depression literature is best conceptualized within the framework of cognitive theory, which puts forth that depressed individuals tend to focus their attention toward negative-content stimuli. This occurs because of their internal negative schemas (Williams, Mathews, &

MacLeod, 1996). The narrowing in on negative-content stimuli leaves the individual with an attentional bias towards said types of stimuli within their environment. Attentional bias is also implicated in Beck's Cognitive Theory (Beck et al., 1985). Recalling that Beck posited that individuals' negative thoughts about the self, the world, and the future shape their experiences, it would thus follow that an individual who is depressed and has a negative attributional style would have an increased likelihood of focusing in on negative-content stimuli, and would develop an attentional bias for such stimuli.

Two of the proposed hypotheses in the present study dealt with attentional biases in depression as measured with both the Stroop test and recall task. The first hypothesis stated that the two groups of depressed individuals (i.e., those with seasonal depression symptoms and those with nonseasonal depression symptoms) would display a greater attentional bias for depressed words compared to controls such that they would make more errors on the Stroop test and take longer to colour-name the depressed words. The third hypothesis posited that the two depressed groups of individuals (seasonal and nonseasonal) would recall more depressed words than the control group. Neither of these hypotheses was supported. An examination of the pattern of group means revealed that the individuals with seasonal depression symptoms and individuals with nonseasonal depression symptoms *did* take longer to colour-name depressed words than controls; however the difference among the groups were not sufficiently large to be statistically significant. The group means also showed a non-significant trend in which individuals with nonseasonal depression symptoms made more errors in colour-naming depressed words than individuals with seasonal depression symptoms or individuals in the control group. On the recall task, the group means did not differ statistically on the number of depressed words recalled.

The results relating to attentional bias for depressed words in the present study are surprising given findings from previous research that showed individuals take longer to colour name words on a modified emotional Stroop test when those words are congruent with their specific psychopathology (e.g., Cooper & Fairburn, 1992; Dalgleish, 1995; Spinks & Dalgleish, 2001; Williams, Mathews, & MacLeod, 1996). There are methodological differences that may account for this discrepancy in findings. The groups in the present study were sub-clinical in nature, and perhaps stronger findings would occur with groups that met diagnostic criteria for clinical depression. For example, several studies that found attentional bias in psychopathology utilized clinical samples (e.g., Sigmon et al., 2007; Spinks & Dalgleish, 2001). Even so, the patterns of group means in the present study showed a trend in the direction that was predicted by the hypotheses, i.e., the individuals who presented with seasonal depression symptoms and those who presented with nonseasonal depression symptoms did indeed take somewhat longer and made a greater number of errors than did control in colour-naming words related to depression. It might follow that, had the groups been defined at clinical levels, the differences between the groups on attentional bias toward depressed words may have been magnified and reached statistical significance.

Two other hypotheses were put forth to test the presence of a seasonality cognitive schema by ascertaining whether attentional bias towards dark-related and winter words would be observed among those with high seasonality. Compared to individuals with nonseasonal depression symptoms and control individuals, those with seasonal depression symptoms were expected to take longer and make more errors when colour-naming dark words and winter words (hypothesis 2) and to have better recall of the same words (hypothesis 4). Neither of these hypotheses was supported. The lack of significant findings was surprising given that previous literature has shown that individuals with seasonal depression tend to show increased response latency to words that represent seasonal constructs (see Spinks & Dalgeish, 2001) suggesting a seasonality schema. The literature has also reported increased interference (i.e., proportion error) for words on a Stroop test that have a dark-related nature (Sigmon et al., 2007) which would indicate that there may be an attentional bias toward dark-related words for individuals who experience high seasonality. However, the Sigmon et al. (2007) study might have been limited by a methodological confound in some of the words that were used, e.g., the word "bright" in their light-related list could mean radiating light or positive mood. The present study minimized the possibility of such confound by testing the Stroop words used for their degree of construct representativeness.

There were several significant findings from the Stroop test and incidental recall tasks that warrant discussion. Individuals in all group conditions generally took longer to colour-name summer words than winter words, and to colour-name light words than dark words. These findings indicate an attentional bias toward summer words and light words. This is in contrast to what has been found in previous research. For example, Sigmon et al. (2007) found that individuals who experienced seasonal and nonseasonal depression symptoms took longer than controls to colour-name dark words. In the present study, there were no group differences. Again, this may have been due to the subclinical nature of the two depressed symptoms groups in this study. Had clinical groups with stronger schemas for words relating to their psychopathology been used, clearer results indicating group differences might have emerged.

It is also possible that the stimuli in the present study activated a positive (rather than negative) schema that caused participants in all three groups to experience an attentional bias for summer and light words. In other words, the summer and light words may have elicited positive schema in the participants that could have caused them to respond more slowly to those word categories. Participants were tested during the winter months when they may have been feeling a sense of longing for the warmer weather and longer hours of daylight. This could have made it more difficult for participants to ignore the semantic meaning of summer and light words when they were engaged in the Stroop task, thus making the response latency to these words longer. Past research by Mogg and Marden (1990) has demonstrated that participants can show interference on a Stroop task for both positive and negative valence words.

Another interesting finding was that in the recall task, participants in all three group conditions recalled significantly more dark words than light words. This finding implies that participants overall showed an attentional bias toward dark words over light words. This result contrasts with the present findings on response latency, where participants displayed an attentional bias toward light words. Given that the Stroop test was presented in a darkened laboratory, it is wondered whether the dark environment may have made the dark words more salient for recall.

Generally, the results failed to show group differences in attentional bias and recall. Perhaps, the quasi-randomized order of presentation of the Stroop words might be a factor. Although this type of word presentation is quite common in Stroop studies (e.g., Coffey et al., 2003; Markela-Lerenc et al., 2006), some investigations have shown that a greater degree of attentional bias can be elicited when the word categories (such as summer words, winter words, light words, dark words, happy words, and depressed words in the present study) are presented in blocks (see Braet & Crombez, 2003; Williams et al., 1996). The presentation of words in this block format might help to make a given construct (e.g., depression) more salient to the participant. Thus, more significant results may have been obtained in the present study had the words on the Stroop test been presented in blocks rather than in randomized fashion. However, the *a priori* decision to present the Stroop words in a quasi-randomized fashion instead of a block format to prevent an expectancy effect is defensible. Warren (1972, 1974) who used non-colour-word Stroop tests found that associative primes presented before target words increased the latency of color-naming the target words. For example, if a related prime (e.g., table) preceded a target word (e.g., chair), the latency to colour-name the target word would be greater than in a case where an unrelated prime (e.g., beach) were used. Therefore, the presence of associative primes such as those in a block format might influence the Stroop responses in the study.

It could also be argued that problems with the neutral words might explain the failure to detect group differences. The neutral control words that were matched to their respective Stroop word counterpart on the basis of part of speech and number of syllables were chosen by the researchers, and were not empirically tested. It is therefore quite possible that some of these neutral words might not have been viewed as neutral by the participants and were associated with the seasonality or depression schemas. If so, then these neutral words would have been tapping into salient schemas resulting in a smaller to null difference in reaction time between a given stimulus word and its yoked neutral word. However, an examination of the neutral words could not identify any words that could possibly be associated to the schemas that were being examined.

There are two other possible reasons for the absence of findings relating to group differences. The relatively low number of Stroop words used (four for the dark construct, six for the remaining constructs) might have prevented detection of significant differences especially if the effect sizes are low in magnitude. Furthermore, the emotional appeal of the Stroop words might not have been sufficiently strong to focus the participants' attention on the semantic meaning of the words during the colour-naming task. If so, it would not have been possible to detect the hypothesized attentional bias across the different groups in the Stroop test.

Psychophysiological Arousal

The final two proposed hypotheses in this study dealt with the activation of the *corrugator supercilii* (the facial muscle region located above the brow that is associated with frowning) in response to images presented in the facial electromyography task. It was expected that the individuals who presented with seasonal depression symptoms would respond with greater *corrugator supercilii* activity than the other two groups (those with nonseasonal depression symptoms and controls) when examining winter images (hypothesis 5) and low luminance images (hypothesis 6). Neither of these hypotheses was supported.

The lack of group differences in *corrugator supercilii* activity when viewing winter images (hypothesis 5) was surprising. It contradicts previous research by Sigmon et al. (2007) that found individuals with seasonal depression to exhibit greater frequency and amplitude of skin conductance recordings when viewing winter scenes, compared to those with nonseasonal depression symptoms and controls. The lack of group differences for *corrugator supercilii* activity when viewing low luminance images (hypothesis 6) was also surprising given that previous research has suggested that stimuli depicting low light conditions are perceived as unpleasant for individuals with a history of seasonal depression (see Bouhuys et al., 1994). It should be noted that the three levels of luminance in the present study were different enough to easily visually distinguish them from one another (see Appendix N for an example of one of the EMG images at the three luminance levels). An investigation into the group means revealed an interesting pattern in that for low and medium luminance summer images, the individuals with seasonal depression symptoms did appear to have increased *corrugator supercilii* activity (increased frowning) in comparison to the nonseasonal depressed group and controls, although the results were not statistically significant. Perhaps, the high seasonal individuals were reacting more negatively to the lower luminance images than the low seasonal individuals. Interestingly, all three groups responded similarly to the high luminance summer images. It is possible that the images at a high luminance were so bright that they caused participants across groups to react by squinting their eye muscles and increasing their *corrugator supercilii* activity. It should be noted that the EMG image valence ratings and the *corrugator supercilii* activity did not correspond for high luminance images. Thus it is difficult to determine whether the increased *corrugator supercilii* activity reflected an evaluation of these images as appealing or otherwise.

In addition to investigating facial muscle activity in the *corrugator supercilii* region, data was collected on activity in the *zygomaticus major* muscle region in response to the images in the EMG task. The *zygomaticus major* is a muscle located in the cheek that is used to elevate the lips when smiling. As such, increased facial muscle activity in the *zygomaticus major* area is associated with normal responses to pleasant stimuli (Achaibou et al., 2008; Dimberg et al., 2002; Larsen et al., 2003). Results from the analysis on *zygomaticus major* activity suggested that overall participants had higher *zygomaticus major* activity in response to high luminance images than to low luminance images. The findings also showed that for winter images, *zygomaticus major* activity was greatest for high luminance images, followed by medium, and finally low luminance images across all three groups. This finding indicates that in all groups, participants smiled the most when viewing high luminance winter images and smiled the least when viewing low luminance winter images. Another interesting finding was that for low luminance summer images, controls presented with greater *zygomaticus major* activity than both individuals with seasonal depression symptoms and those with nonseasonal depression symptoms. In other words, both of the depressed groups were less likely than controls to smile in response to summer images at low luminance.

The lack of group differences in the current study runs counter to previous research that demonstrated differences between individuals with seasonal depression and those with nonseasonal depression or control individuals in their psychophysiological reactions to various stimuli (Austen & Wilson, 2001; Rohan et al., 2003; Sigmon et al., 2007). This may be due to a methodological difference. Previous research utilized skin conductance recordings (e.g., Austen & Wilson, 2003; Rohan et al., 2003) whereas the present study used facial electromyography. Perhaps psychophysiological reactions to emotional stimuli are better detected by skin conductance measurements than by facial EMG recordings. However this is unlikely given that facial muscle movements are physiologically indicative of the facial expression of emotions (Fridlund & Cacioppo, 1986) including those that are subtle or fleeting (Dimberg et al., 2002; Harrigan et al., 2005). It is also possible that participants in the present study did not imagine themselves sufficiently well within the scenes they were viewing despite instructions. If so, it may have been difficult for them to experience an emotional reaction to the images. Alternatively, the images might not have been sufficiently powerful to elicit an emotional response. Both are plausible explanations in light of the inconsistent pattern of image valence ratings as a function of group or luminance level.

Another possible explanation for the lack of group differences may lie with the subclinical nature of the sample in the present study. Indeed, past studies have shown discrepancy in EMG activity results for clinical versus nonclinical populations (Gehricke & Shapiro, 2000; Sloan et al., 2001). Gehricke and Shapiro (2000) found that clinically depressed individuals presented with decreased *corrugator supercilii* activity compared to healthy controls in response to happy and sad imaginative situations. Conversely, Sloan et al. (2001) looked at a subclinical dysphoric population in comparison to healthy controls and found that the dysphoric and control groups did not differ in their electromyographic reactions to unhappy facial expressions. However, the subclinical dysphoric group had increased *corrugator supercilii* activity compared to the control group in response to happy facial expression imagery. In the present study both of the depressed groups (i.e., seasonal and nonseasonal) were primarily subclinical in nature. Given the facial muscle activity discrepancies in previous research for clinical versus subclinical populations, it is possible that different results may have been found had a clinical population been used. In a clinical population, the schemas for seasonal and nonseasonal depressed individuals may have been more activated, resulting in a greater bias and potential increased levels of psychophysiological arousal in contrast to the control group.

The relatively low number of stimulus images might also have led to the general findings of no differences among groups. There were six summer images and six winter images. Perhaps had more images per season been presented, a greater group effect might have been observed. The number of images becomes a more salient issue if the effect sizes are minimal.

Supplementary Findings

Supplementary regression analysis was carried out on the entire sample for 79 participants, which included those who did not meet the criteria for group classification, in order to determine the degree to which seasonality, typical and atypical depression symptoms, and overall depression symptoms might influence participants' performance on the different experimental tasks. Two interesting findings emerged.

The first was that increased *corrugator supercilii* area amplitude for summer images at low luminance was determined to be associated with higher overall depression scores. In other words, individuals with more severe depression symptoms frowned to a greater degree than those with less severe symptoms while viewing low luminance summer images. Surprisingly, degree of seasonality did not appear to influence *corrugator supercilii* area amplitude for summer images at low luminance. Previous research has shown that individuals with high seasonality have rated stimuli with dark backgrounds less positively than do controls (Bouhuys et al., 1994). However it is difficult to compare the present findings with previous research, as there has been a lack of studies to date that examine season and light-related stimuli in high versus low seasonal individuals on electromyography recordings. Additionally, the majority of previous studies on *corrugator supercilii* responses in depressed individuals have typically utilized positive or negative affective imagery (see Gehricke & Shapiro, 2000; Schwartz et al., 1976) rather than season or light-related imagery.

The second interesting result that emerged from the regression analyses was that increased *corrugator supercilii* area amplitude for winter images at medium luminance was associated with elevated overall depression scores but not with level of seasonality. In essence, this indicates that individuals with higher depression scores were more likely than those with low depression scores to engage in frowning while viewing medium luminance winter scenes. This finding was unexpected and difficult to explain. It could be argued that the winter scenes elicited a negative content schema in individuals with high depression scores due to their potentially negative content. However, the results from the valence ratings analysis showed that participants overall rated the winter images more positively than the summer images.

Strengths and Limitations of the Present Study

A strength in the study lies in the choice of measures that have been shown in the literature to have strong psychometric properties. In the present investigation, they had Cronbach's alpha equal to or exceeding .75. Another strength was in the detail and degree of precision that went into developing the stimuli for the experimental tasks. The stimuli used in the modified Stroop test and the facial EMG task underwent a careful selection process and pilot testing for construct validity prior to their adoption. Furthermore, the EMG images were calibrated at three levels of luminance to ensure that each image was presented at similar levels of spatial-average light intensity. The selection of specific parameters for each experimental task, such as the amount of time a stimulus would be presented on the screen, was also based on an extensive review of the literature.

Nevertheless, there were a number of limitations that needs to be addressed.

The most obvious drawback is the subclinical nature of the sample, which might mean that the participants had weaker cognitive schemas that required stronger stimuli to activate them in order to detect significant group differences. The majority of participants in the seasonal depressed and nonseasonal depressed groups did not meet the diagnostic criteria for major depression even though they scored high on the SIGH-SAD: the mean SIGH-SAD score for the NSDS group exceeded the moderate level of depression, and that for the SDS group exceeded a severe level of depression. These group means are comparable to the sample means in previous studies (see Angst et al., 1995; Bech et al., 1986; Müller et al., 2000).

A potential limitation with respect to EMG methodology is that participants were instructed not to move during the facial EMG task. The rationale behind this set of instructions was to avoid potential detachment of the electrodes and to reduce noise on the EMG signal. Due to this instruction, and the discomfort of the electrodes and medical tape, participants may have unknowingly inhibited their facial muscle movements. The other limitation associated with the EMG task is the absence of an experimental check to measure the degree to which participants were imaging themselves in the scenes that they were viewing. Although they were instructed to imagine themselves in each scene and to think about how much they would enjoy being in that scene, some may have just been engaged in passive viewing.

It should also be noted that viewing and rating of each image on the EMG task were contained within the same trial. In other words, participants were asked to rate the image on its degree of appeal at the same time that their EMG readings were being recorded. It is possible that this method of data collection could have influenced the results. The findings may have been clearer if the rating screen was presented separately from the image viewing screen, or if the image rating was undertaken separately from the EMG recording.

Summary and Conclusion

The expectation that individuals with seasonal depression symptoms would differ from those with nonseasonal depression symptoms by displaying greater adverse reaction to stimuli with winter and low luminance contents was not supported. Neither was the expectation that individuals with more severe depression symptoms would react more negatively than nondepressed individuals to stimuli with depressive contents (e.g., depressed words) corroborated. However, the results revealed several significant patterns. Overall, individuals were slower to colour-name summer words than winter words, slower to colour-name light words than dark words, recalled more dark words than light words, smiled more (*zygomaticus major*) when viewing high luminance than low luminance images, smiled more when viewing high luminance winter images than either medium or low luminance winter images, and rated winter images as more appealing than summer images. The two groups with elevated depression symptoms (seasonal and nonseasonal) smiled less than the control group when viewing low luminance images. The results do not show a convergence across the different experimental tasks, and do not support the notion that seasonal people with depressed symptoms would respond more negatively than nonseasonal people with depressed symptoms to winter or low luminance stimuli. The findings need to be considered within the limitations of the study as described above.

Implications for Future Research

The present study had several methodological issues that should be addressed in future research. The study needs to be replicated with a clinical population and a bigger sample size. The Stroop words could be presented in blocks as opposed to quasi-randomized order in order to elicit stronger attention biases in the two depressed groups although such a method risks the associative primes artificially enhancing the Stroop effect (Warren, 1972, 1974). In regards to the EMG image-viewing task, it may be informative to separate the EMG recording from the valence-rating task by delivering the image valence rating only after EMG recordings in response to those images had been taken. This would help to ensure that the act of rating each image would not interfere with the participants' expression of facial emotion. It may also increase reliability of the valence ratings, because there would be less potential interference and distraction resulting from the electrode attachments. Additionally it is possible that the very act of asking participants not to move very much while engaging in the image viewing task caused the participants to inhibit their facial expressions to some degree. It would therefore be prudent for future researchers to consider carefully the instructions that are given to participants prior to the EMG task. It would also be a good idea to look into alternative methods of attaching the electrodes themselves, as the combination of sticky adhesive collars and medical tape may have caused participants to attempt to move their face less, because of slight discomfort or for fear of the electrodes falling off.

Furthermore, it could be beneficial to include different types of images in the EMG task, such as neutral images to compare reactions or images that have been pre-rated as strongly appealing or aversive for each of the seasonal conditions. Also, it might be beneficial to alter the instructions for the EMG task to include a narrative that could help participants to really imagine themselves in each scene. This may help to elicit a stronger emotional reaction from participants that would then be evident in their facial muscle reactions. As well, other forms of psychophysiological recordings such as skin conductance readings could be employed, as they have been successful in previous studies in detecting group differences.

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Table 1
Means (Standard Deviations) of Construct Representativeness Rating for Stroop Words used in Summer and Winter Word Types

Stroop Word	Mean (Standard Deviation)
Word Type = Summer	
Beach	8.66 (.58)
Vacation	8.32 (1.32)
Camping	8.42 (1.13)
August	8.39 (1.28)
Sandals	8.26 (1.08)
Heat	8.32 (.96)
Word Type = Winter	
Snow	8.84 (.37)
Cold	8.70 (.78)
Christmas	8.68 (.67)
Ice	8.62 (.68)
December	8.54 (.90)
January	8.43 (1.41)

Note. N = 43. Construct representativeness ratings were on a scale of 1 (not representative at all) to 9 (extremely representative).

Table 2

Means (Standard Deviations) of Construct Representativeness Rating for Stroop Words used in Light and Dark Word Types

Stroop Word	Mean (Standard Deviation)
Word Type = Light	
Sun	8.46 (.84)
Bright	8.39 (1.20)
Shining	7.84 (1.44)
Daylight	7.95 (1.53)
Lightbulb	7.95 (1.53)
Daytime	7.84 (1.38)
Word Type = Dark	
Black	8.45 (.99)
Night	7.93 (1.14)
Dark	8.93 (.34)
Midnight	7.55 (1.42)

Note. *N* = 43. Construct representativeness ratings were on a scale of 1 (not representative at all) to 9 (extremely representative).

Table 3

Means (Standard Deviations) of Construct Representativeness Rating for Stroop Words used in Happy and Depressed Word Types

Stroop Word	Mean (Standard Deviation)
Word Type = Happy	
Love	8.61 (.65)
Smile	8.56 (.81)
Laughter	8.22 (1.05)
Ecstatic	8.09 (1.20)
Overjoyed	8.08 (1.16)
Jolly	8.03 (1.08)
Word Type = Depressed	
Suicidal	8.32 (1.18)
Sad	7.74 (1.66)
Dreary	7.69 (15.84)
Lonely	7.66 (1.34)
Miserable	7.37 (1.67)
Despair	7.35 (1.74)

Note. *N* = 43. Construct representativeness ratings were on a scale of 1 (not representative at all) to 9 (extremely representative).

Table 4

Summer and Winter Words for Modified Stroop Test Matched with Yoked Neutral Words on Length, Number of Syllables, and Part of Speech

Stroop Word	Length	Number of Syllables	Part of Speech	Yoked Neutral Word
Word Type = Summer				
Beach	5	1	Noun	Tower
Vacation	8	3	Noun	Reminder
Camping	7	2	Verb	Talking
August	6	2	Noun	Record
Sandals	7	2	Noun	Pencils
Heat	4	1	Noun	Dare
Word Type = Winter				
Snow	4	1	Noun	Cane
Cold	4	1	Adjective	Bare
Christmas	9	2	Noun	Blueprint
Ice	3	1	Noun	Lid
December	8	3	Noun	Relative
January	7	4	Noun	Oregano

Table 5

Light and Dark Words for Modified Stroop Test Matched with Yoked Neutral Words on Length, Number of Syllables, and Part of Speech

Stroop Word	Length	Number of Syllables	Part of Speech	Yoked Neutral Word
		Word Type = Light		
Sun	3	1	Noun	Two
Bright	6	1	Adjective	Curbed
Shining	7	2	Verb	Holding
Daylight	8	2	Noun	Mailbags
Lightbulb	9	2	Noun	Swordfish
Daytime	7	2	Noun	Balloon
		Word Type = Dark		
Black	5	1	Adjective	Plush
Night	5	1	Noun	Twigs
Dark	4	1	Adjective	Long
Midnight	8	2	Noun	Overhang

Table 6

Happy and Depressed Words for Modified Stroop Test Matched with Yoked Neutral Words on Length, Number of Syllables, and Part of Speech

Stroop Word	Length	Number of Syllables	Part of Speech	Yoked Neutral Word
Word Type = Happy				
Love	4	1	Noun	Brow
Smile	5	1	Noun	Cloak
Laughter	8	2	Noun	Thistles
Ecstatic	8	3	Adjective	Theatric
Overjoyed	9	3	Adjective	Exclusive
Jolly	5	2	Adjective	Minty
Word Type = Depressed				
Suicidal	8	4	Adjective	Satiable
Sad	3	1	Adjective	Lax
Dreary	6	2	Adjective	Plenty
Lonely	6	2	Adjective	Smokey
Miserable	9	4	Adjective	Incurious
Despair	7	2	Noun	Feather

Table 7

Means (Standard Deviations) of Construct Representativeness Rating for Summer Images Used in EMG Task

Summer EMG Image	Mean (Standard Deviation)
Image #52	8.38 (.83)
Image #54	8.34 (.74)
Image #60	8.59 (1.18)
Image #62	8.16 (.95)
Image #63	8.38 (1.16)
Image #80	8.22 (1.01)

Note. *N* = 35. Construct representativeness ratings were on a scale of 1 (not representative at all) to 9 (extremely representative).

Table 8

Means (Standard Deviations) of Construct Representativeness Rating for Winter Images Used in EMG Task

Winter EMG Image	Mean (Standard Deviation)
Image #86	8.75 (.51)
Image #92	8.03 (1.03)
Image #98	8.45 (.85)
Image #102	8.87 (.48)
Image #105	8.81 (.48)
Image #112	8.68 (.54)

Note. N = 35. Construct representativeness ratings were on a scale of 1 (not representative at all) to 9 (extremely representative).

Table 9

Demographic Characteristics of Participants

Characteristic	SDS (*n* = 16)	NSDS (*n* = 15)	Control (*n* = 14)	Pooled Group (*n* = 45)	Total Sample (*N* = 79)
Sex					
Male	0 (0.00%)	2 (13.33%)	9 (64.29%)	11 (24.44%)	20 (25.32%)
Female	16 (100.00%)	13 (86.67%)	5 (35.71%)	34 (75.56%)	59 (74.68%)
Age (years)	*M*=26.25	*M*=24.20	*M*=26.93	*M*=25.78	*M*=25.57
	SD=9.86	*SD*=8.37	*SD*=11.36	*SD*=9.80	*SD*=9.86
Marital Status					
Single	11 (68.75%)	13 (86.67%)	9 (64.29%)	33 (73.33%)	59 (74.68%)
Common-law	1 (6.25%)	0 (0.00%)	3 (21.43%)	4 (8.89%)	8 (10.13%)
Ethnicity					
Aboriginal	2 (12.50%)	0 (0.00%)	0 (0.00%)	2 (4.44%)	4 (5.06%)
White	12 (75.00%)	15 (100.00%)	14 (100.00%)	41 (91.11%)	71 (89.90%)
Black	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1 (1.27%)
Asian	1 (6.25%)	0 (0.00%)	0 (0.00%)	1 (2.22%)	2 (2.53%)
Latino or Hispanic	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Other	1 (6.25%)	0 (0.00%)	0 (0.00%)	1 (2.22%)	1 (1.27%)

Table 9 (Continued)

Demographic Characteristics of Participants

Characteristic	SDS (*n* = 16)	NSDS (*n* = 15)	Control (*n* = 14)	Pooled Group (*n* = 45)	Total Sample (*N* = 79)
Educational Status					
Student	15 (93.75%)	13 (86.67%)	12 (85.71%)	40 (88.89%)	65 (82.28%)
Non-student	1 (6.25%)	2 (13.33%)	2 (14.29%)	5 (11.11%)	14 (17.72%)
Program year					
First	2 (12.50%)	4 (26.67%)	5 (35.71%)	11 (24.44%)	24 (30.38%)
Second	5 (31.25%)	4 (26.67%)	4 (28.57%)	13 (28.89%)	20 (25.32%)
Third	3 (18.75%)	2 (13.33%)	2 (14.29%)	7 (15.56%)	10 (12.66%)
Fourth	4 (25.00%)	3 (20.00%)	1 (7.14%)	6 (13.33%)	10 (12.66%)
Fifth or higher	1 (6.25%)	0 (0.00%)	0 (0.00%)	1 (2.22%)	1 (1.27%)
Current Diagnosis					
Depression	4 (25.00%)	4 (26.67%)	0 (0.00%)	8 (17.78%)	8 (10.13%)
Seasonal depression	3 (18.75%)	0 (0.00%)	0 (0.00%)	3 (6.67%)	5 (6.33%)
Anxiety	4 (25.00%)	2 (13.33%)	0 (0.00%)	6 (13.33%)	8 (10.13%)
Medication					
Antidepressant	4 (25.00%)	3 (20.00%)	0 (0.00%)	7 (15.56%)	7 (8.86%)
Anxiolytic	1 (6.25%)	1 (6.67%)	0 (0.00%)	2 (4.44%)	3 (3.80%)

Table 10

Mean (Standard Deviation) of Classification Measures

Measure	SDS (*n* = 16)	NSDS (*n* = 15)	Control (*n* = 14)	Pooled Group (*n* = 45)	Total Sample (*N* = 79)
SIGH-SAD					
Typical subscale	19.50 (5.18)	18.20 (4.18)	3.87 (2.25)	14.21 (8.10)	12.30 (7.53)
Atypical subscale	10.94 (5.47)	6.53 (3.14)	1.14 (.95)	6.42 (5.47)	5.18 (4.73)
Total score	30.44 (9.12)	24.73 (6.60)	5.02 (2.41)	20.63 (12.74)	17.48 (4.44)
GSS	15.25 (2.38)	7.60 (3.00)	4.07 (2.92)	9.22 (5.46)	9.95 (4.77)
Degree of seasonal impairment	2.81 (.66) [moderate - marked]	.73 (1.22) [none – mild]	.00 (.00) [none]	1.24 (1.45) [mild – moderate]	.85 (1.28) [none – mild]

Note. Degree of seasonal impairment is rated in the SPAQ on a 6-point scale with the following anchor points: 0 = none, 1 = mild, 2 = moderate, 3 = marked, 4 = severe, 5 = disabling.

Table 11

Internal Consistency of Classification Measures

Measure	Cronbach's α
SIGH-SAD	
SIGH-SAD Total	.85
SIGH-SAD Typical	.79
SIGH-SAD Atypical	.75
GSS	.81

Table 12

Mean (Standard Deviation) Response Latency (ms) on Modified Stroop Test

Word Type	SDS (*n* = 16)	NSDS (*n* = 15)	Control (*n* = 14)	Pooled Group (*n* = 45)	Total Sample (*N* = 79)
Summer	66.68 (138.08)	27.59 (84.65)	84.32 (94.04)	59.14 (109.34)	48.21 (104.73)
Winter	-98.54 (254.94)	-56.53 (141.70)	-35.79 (148.02)	-65.01 (189.01)	-45.50 (160.76)
Light	14.29 (95.12)	-1.33 (134.91)	47.15 (98.84)	19.31 (110.29)	19.83 (105.09)
Dark	-62.08 (93.96)	-55.13 (164.72)	-6.70 (121.56)	-42.53 (128.88)	-43.18 (112.36)
Happy	30.07 (110.29)	74.26 (113.18)	46.49 (83.40)	49.91 (103.09)	46.94 (98.32)
Depressed	72.11 (95.24)	52.10 (150.02)	-1.37 (95.60)	42.58 (117.97)	25.39 (112.74)

Note. Response latency was calculated as the difference in response time (*ms*) for a stimulus word and its yoked neutral control word. Negative mean values indicate that the response time for the stimulus words was less than response time for yoked neutral words. Positive values indicate that the response time for the stimulus words was greater than the response time for yoked neutral words. Graphical representation of this table for the three groups can be found in Figure 1.

Table 13

Mean (Standard Deviation) Proportion Error on Modified Stroop Test

Word Type	SDS (n = 16)	NSDS (n = 15)	Control (n = 14)	Pooled Group (n = 45)	Total Sample (N = 79)
Summer	.03 (.07)	.04 (.08)	.07 (.13)	.05 (.09)	.05 (.09)
Winter	.03 (.07)	.01 (.04)	.04 (.07)	.03 (.06)	.03 (.07)
Light	.02 (.06)	.03 (.07)	.01 (.04)	.02 (.06)	.02 (.06)
Dark	.05 (.10)	.00 (.00)	.04 (.09)	.03 (.08)	.02 (.07)
Happy	.02 (.06)	.02 (.09)	.05 (.08)	.03 (.07)	.03 (.08)
Depressed	.01 (.04)	.03 (.09)	.01 (.04)	.02 (.06)	.03 (.08)

Note. Proportion error was calculated as the number of errors made in a given word category, divided by the total number of words within that category. The entry of zero values for NSDS group on Dark word type is accurate. Graphical representation of this table for the three groups can be found in Figure 2.

Table 14

Mean (Standard Deviation) Proportion of Words Accurately Recalled in Incidental Recall Task

Word Type	SDS (n = 16)	NSDS (n = 15)	Control (n = 14)	Pooled Group (n = 45)	Total Sample (N = 79)
Summer	.07 (.14)	.11 (.20)	.21 (.24)	.13 (.20)	.14 (.20)
Winter	.17 (.19)	.21 (.19)	.15 (.22)	.18 (.20)	.15 (.19)
Light	.08 (.15)	.13 (.17)	.10 (.16)	.10 (.16)	.11 (.17)
Dark	.20 (.23)	.17 (.18)	.18 (.23)	.18 (.21)	.17 (.19)
Happy	.08 (.15)	.13 (.17)	.10 (.16)	.10 (.16)	.11 (.17)
Depressed	.15 (.15)	.13 (.13)	.15 (.18)	.14 (.15)	.14 (.14)

Note. The proportion of words accurately recalled was calculated as the number of words accurately recalled in a given word category, divided by the total number of words within that category. Graphical representation of this table for the three groups can be found in Figure 3.

Table 15

Mean (Standard Deviation) of Zygomaticus Major EMG Area Amplitude (μV) on the Image-Viewing Task

Muscle Region/ Image Type	SDS (n = 16)	NSDS (n = 15)	Control (n = 14)	Pooled Group (n = 45)	Total Sample (N = 79)
Summer: low luminance	1.50 (.88)	1.71 (1.56)	3.26 (2.19)	2.12 (1.75)	4.78 (14.88)
Summer: medium luminance	2.01 (1.57)	2.01 (1.78)	3.73 (2.68)	2.55 (2.15)	4.54 (11.57)
Summer: high luminance	2.85 (3.02)	2.89 (2.67)	3.93 (3.16)	3.20 (2.93)	5.76 (13.78)
Winter: low luminance	1.86 (1.31)	1.68 (1.59)	2.51 (1.73)	2.00 (1.55)	4.26 (13.07)
Winter: medium luminance	2.29 (1.71)	2.09 (1.72)	3.08 (2.10)	2.47 (1.85)	4.58 (11.23)
Winter: high luminance	3.19 (3.41)	3.24 (3.09)	4.72 (3.50)	3.68 (3.33)	6.30 (13.97)

Note: The EMG area amplitude reported in this table reflects the difference in *zygomaticus major* EMG recordings during the stimulus presentation period and the baseline period activity. Graphical representation of this table for the three groups can be found in Figure 4.

Table 16

Mean (Standard Deviation) of Corrugator Supercilii EMG Area Amplitude (μV) on the Image-Viewing Task

Muscle Region/ Image Type	SDS (n = 16)	NSDS (n = 15)	Control (n = 14)	Pooled Group (n = 45)	Total Sample (N = 79)
Summer: low luminance	7.84 (8.51)	5.23 (4.72)	6.07 (5.03)	6.42 (3.36)	6.66 (7.07)
Summer: medium luminance	8.27 (10.90)	5.58 (5.54)	7.53 (6.28)	7.14 (7.98)	7.13 (7.91)
Summer: high luminance	7.96 (9.32)	7.91 (8.45)	7.99 (6.71)	7.95 (8.10)	7.99 (8.41)
Winter: low luminance	7.08 (8.87)	4.80 (4.06)	6.91 (5.41)	6.27 (6.47)	6.61 (7.11)
Winter: medium luminance	7.88 (10.10)	6.11 (5.97)	6.60 (5.60)	6.89 (7.48)	7.12 (7.74)
Winter: high luminance	8.55 (10.45)	8.13 (9.25)	7.29 (6.50)	8.02 (8.79)	8.16 (8.88)

Note: The EMG area amplitude reported in this table reflects the difference in EMG *corrugator supercilii* recordings during the stimulus presentation period and the baseline period activity. Graphical representation of this table for the three groups can be found in Figure 5.

Table 17

Mean (Standard Deviation) Valence Ratings of EMG Images

Image Type	SDS (n = 16)	NSDS (n = 15)	Control (n = 14)	Pooled Group (n = 45)	Total Sample (N = 79)
Summer: low luminance	2.92 (.83)	3.13 (.68)	3.12 (.54)	3.05 (.69)	2.94 (.75)
Summer: medium luminance	3.17 (.73)	3.19 (.55)	3.08 (.57)	3.15 (.61)	3.02 (.60)
Summer: high luminance	2.81 (.76)	2.81(.57)	2.75 (.55)	2.79 (.63)	2.74 (.71)
Winter: low luminance	3.23 (.63)	3.36 (.45)	3.15 (.26)	3.24 (.47)	3.27 (.43)
Winter: medium luminance	3.26 (.85)	3.33 (.79)	3.63 (.53)	3.40 (.75)	3.49 (.69)
Winter: high luminance	3.40 (.86)	3.74 (.40)	3.44 (.44)	3.52 (.62)	3.50 (.57)

Note. Images were rated on a scale ranging from 1 (*extremely unappealing*) to 5 (*extremely appealing*). Graphical representation of this table for the three groups can be found in Figure 6.

Table 18

Correlations Between EMG Valence Ratings and Area Amplitude

Image Type	SDS (n = 16)		NSDS (n = 15)		Control (n = 14)		Pooled Group (n = 45)	
	ZM	*CS*	*ZM*	*CS*	*ZM*	*CS*	ZM	CS
Summer: low luminance	.18	.66*	-.16	.29	.12	-.15	.06	.38*
Summer: medium luminance	-.26	.26	-.22	-.28	-.33	.06	-.27	.10
Summer: high luminance	.33	.62*	.10	.34	-.18	-.21	.11	.36*
Winter: low luminance	.00	.21	.20	.04	.11	.43	.05	.17
Winter: medium luminance	-.17	-.10	.43	.32	.38	.07	.21	.04
Winter: high luminance	-.18	.21	-.10	-.61*	.06	.08	-.11	-.00

* $p < .01$

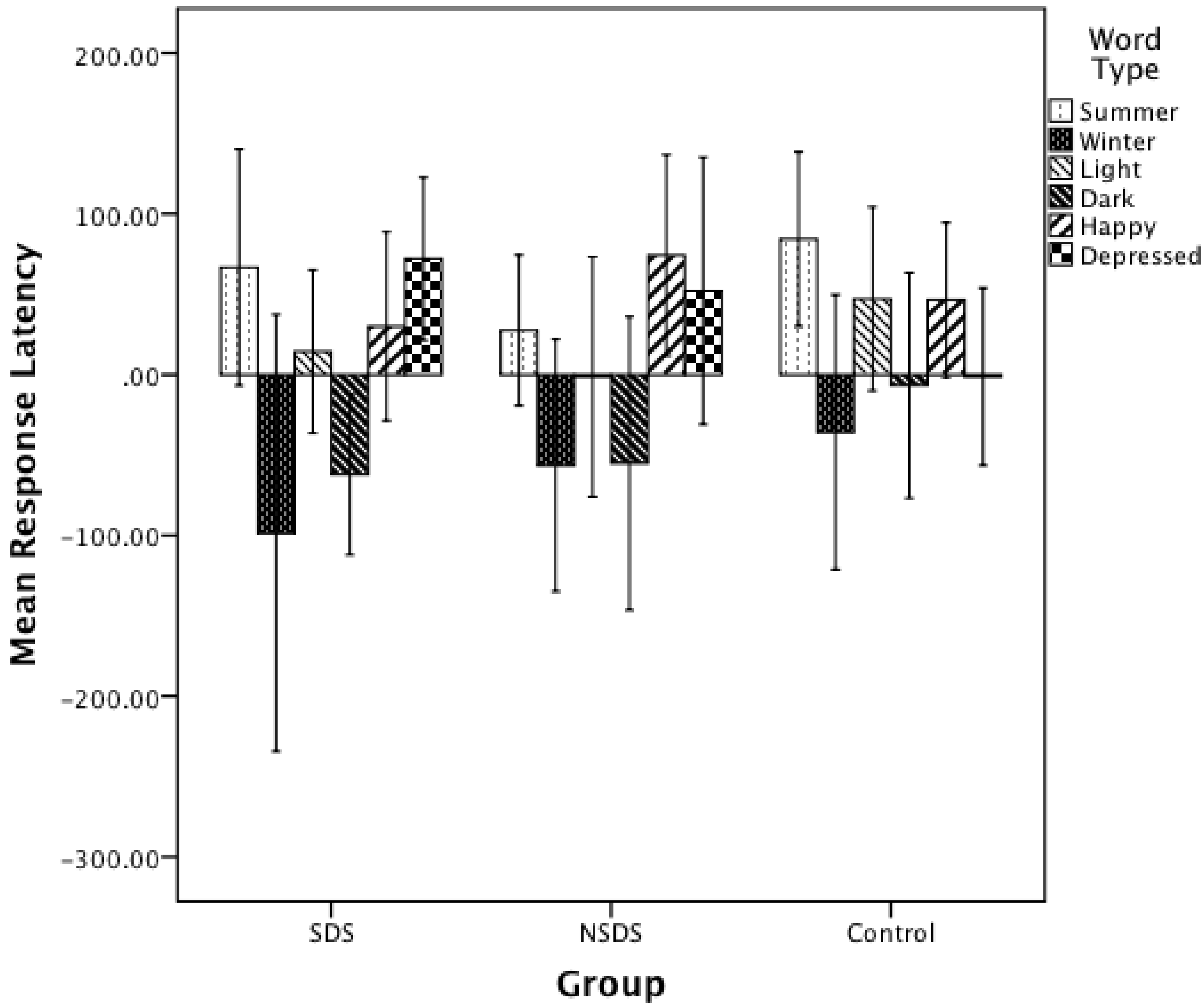

Figure 1. Mean response latency for each word category on the Stroop test by Group. Response latency was calculated as the difference between a response time in milliseconds (*ms*) for a stimulus word and its yoked neutral word. Positive values indicate longer response latency for a stimulus word compared to the yoked neutral words, while negative values denote shorter response latency. Error bars attached to each column represent 95% confidence intervals. Descriptive statistics associated with this figure can be found in Table 12.

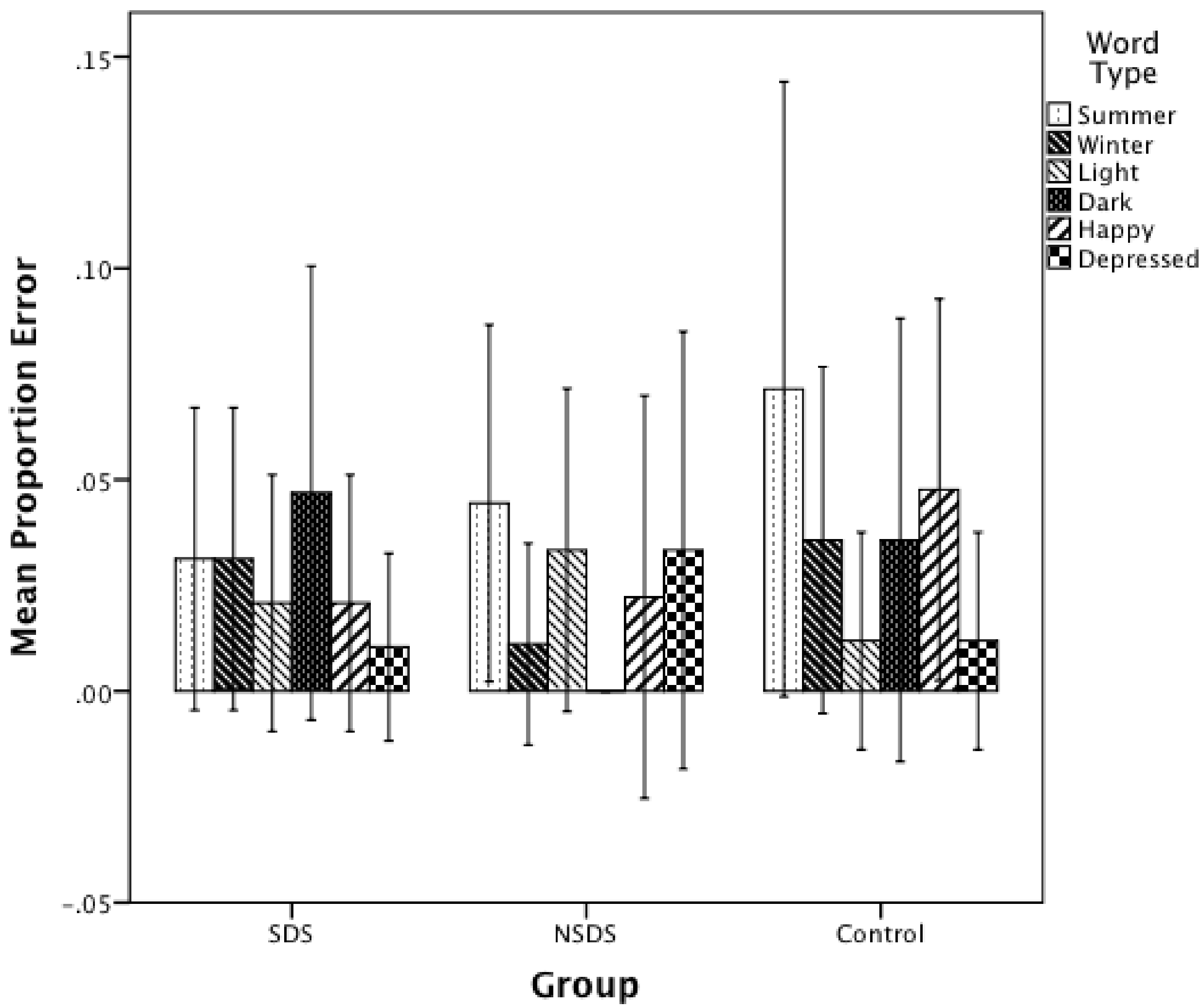

Figure 2. Mean proportion error for each word category on the Stroop test by Group. Proportion error was calculated as the number of incorrect responses in a stimulus word category divided by the total number of words within that category. Error bars attached to each column represent 95% confidence intervals. Descriptive statistics associated with this figure can be found in Table 13.

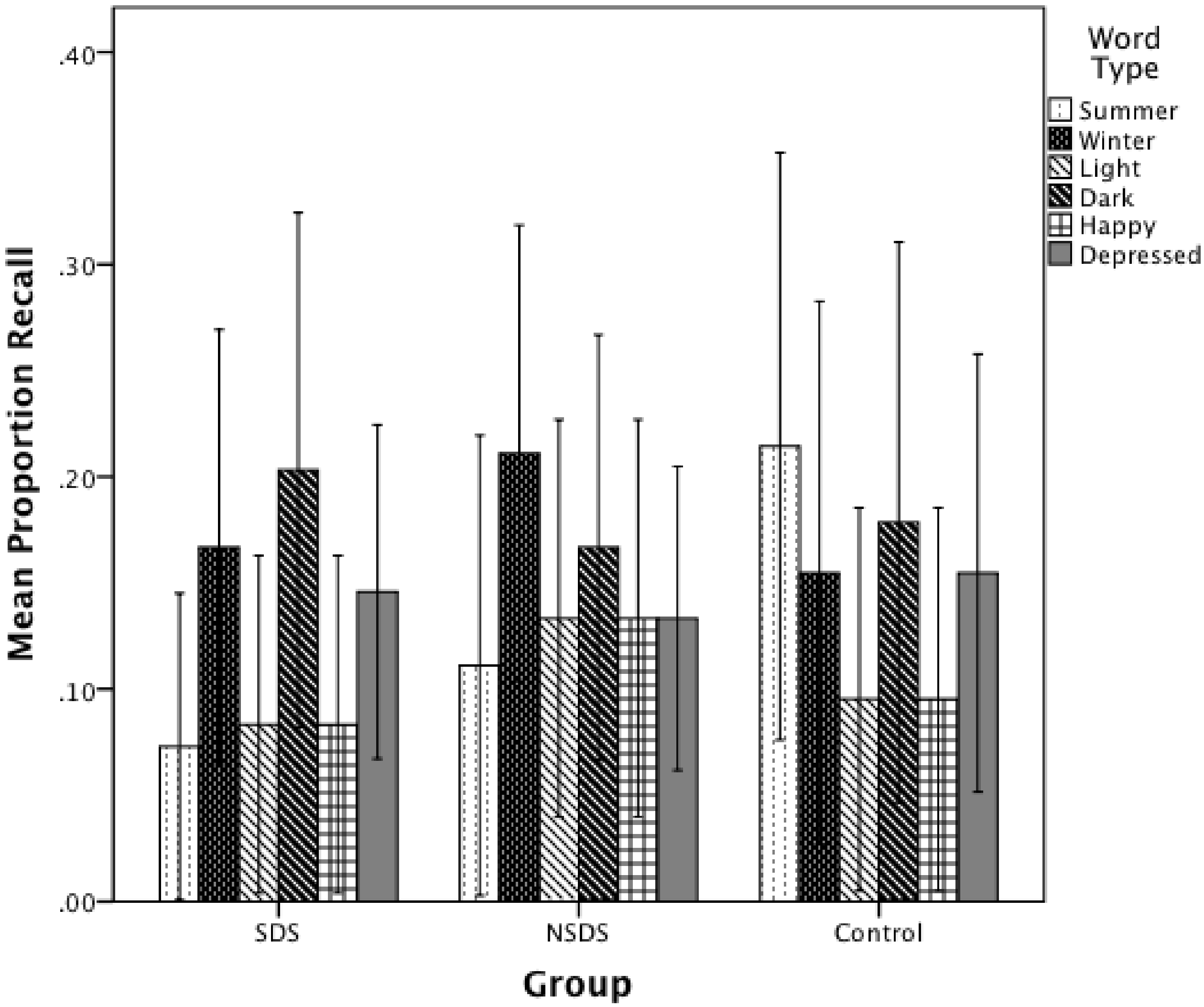

Figure 3. Mean proportion recall for each word type on the Stroop test by Group. Proportion recall was calculated as the number of words accurately recalled in a stimulus word category divided by the total number of words within that category. Error bars attached to each column represent 95% confidence intervals. Descriptive statistics associated with this figure can be found in Table 14.

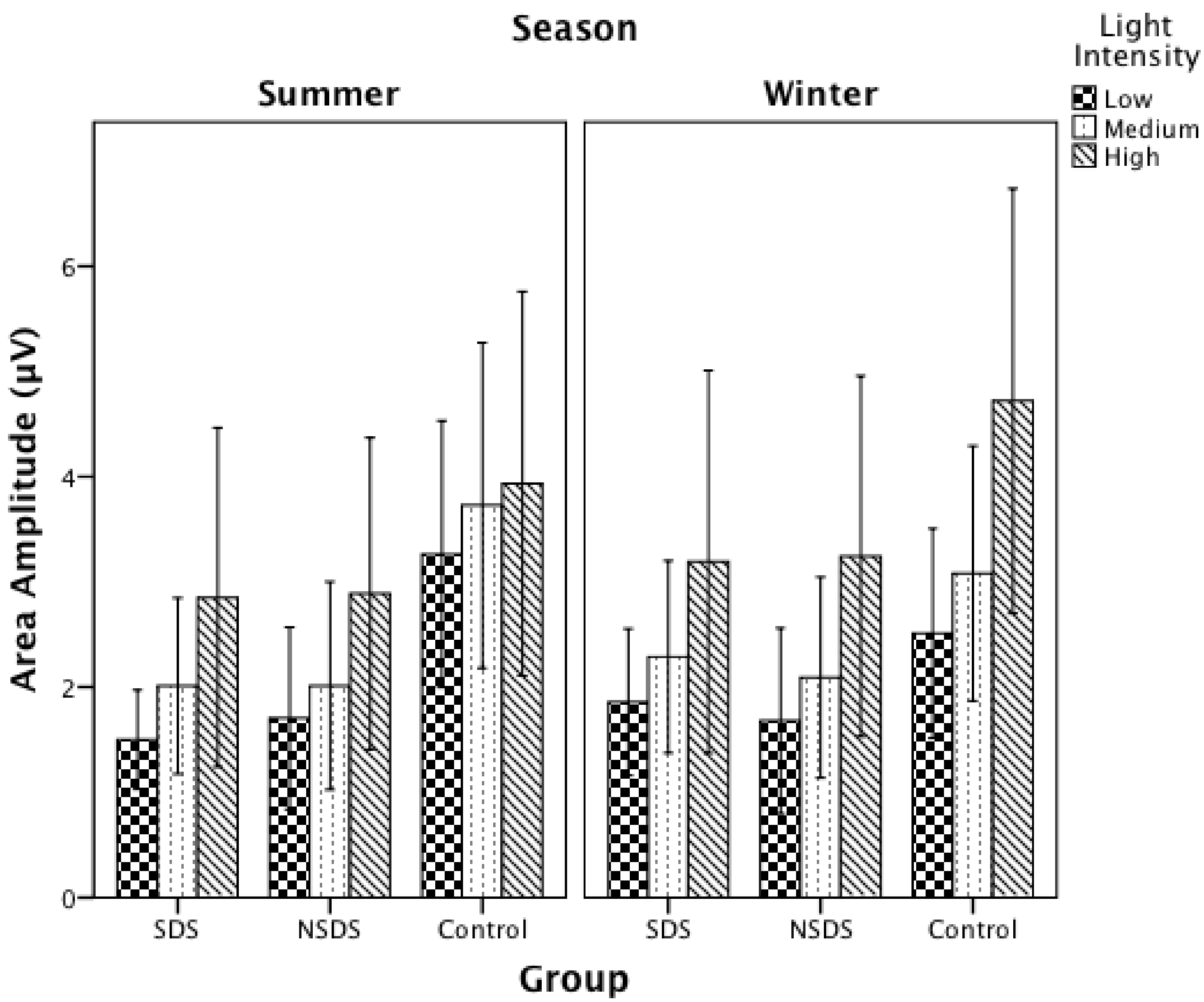

Figure 4. Zygomaticus major (*ZM*) area amplitude on the EMG task for each Season and level of Luminance by Group. *ZM* area amplitude was defined as the amount of muscle activity in microvolts (µV) during the stimulus presentation period minus the baseline period activity. Error bars attached to each column represent 95% confidence intervals. Descriptive statistics associated with this figure can be found in Table 15.

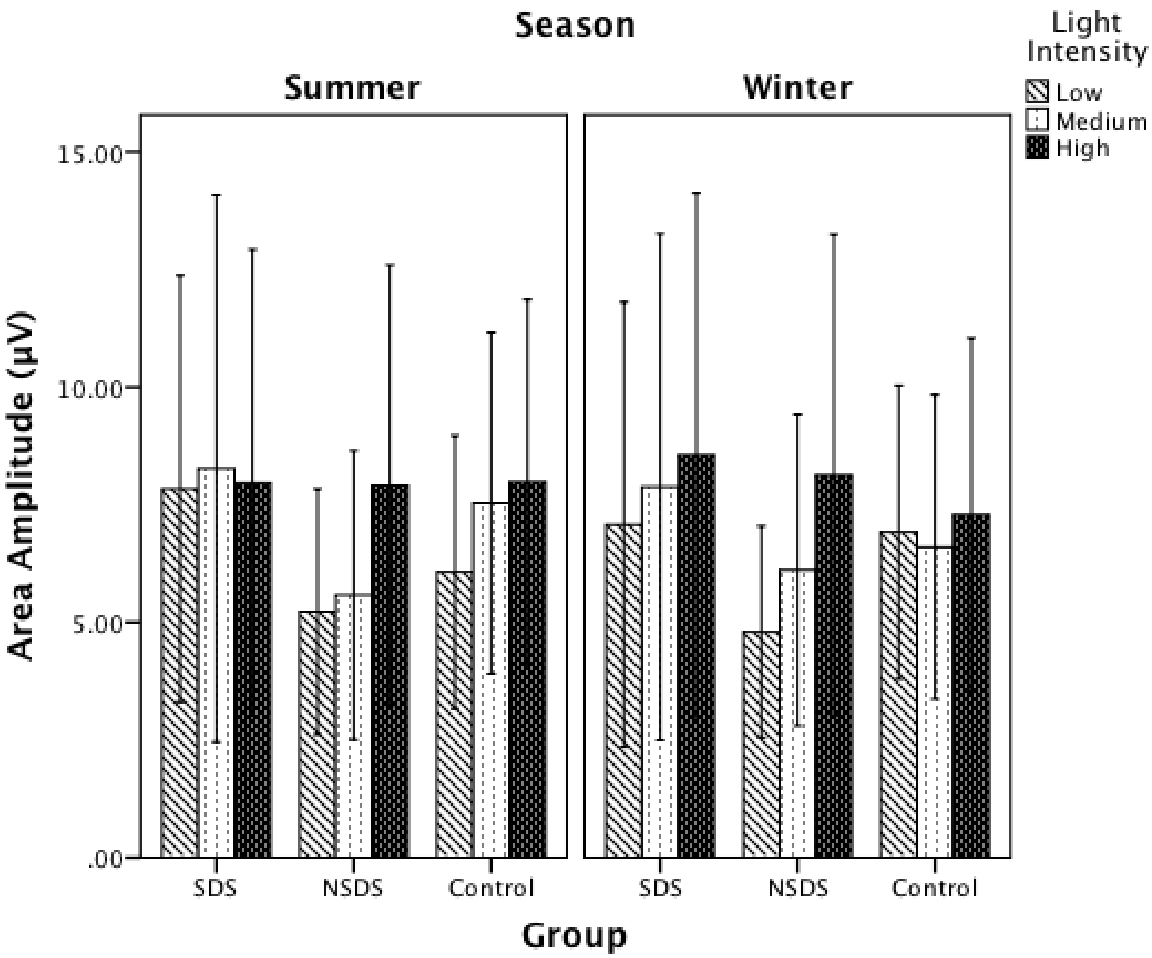

Figure 5. Corrugator supercilii (*CS*) area amplitude on the EMG task for each Season and level of Luminance by Group. *CS* area amplitude was defined as the amount of muscle activity in microvolts (µV) during the stimulus presentation period minus the baseline period activity. Error bars attached to each column represent 95% confidence intervals. Descriptive statistics associated with this figure can be found in Table 15.

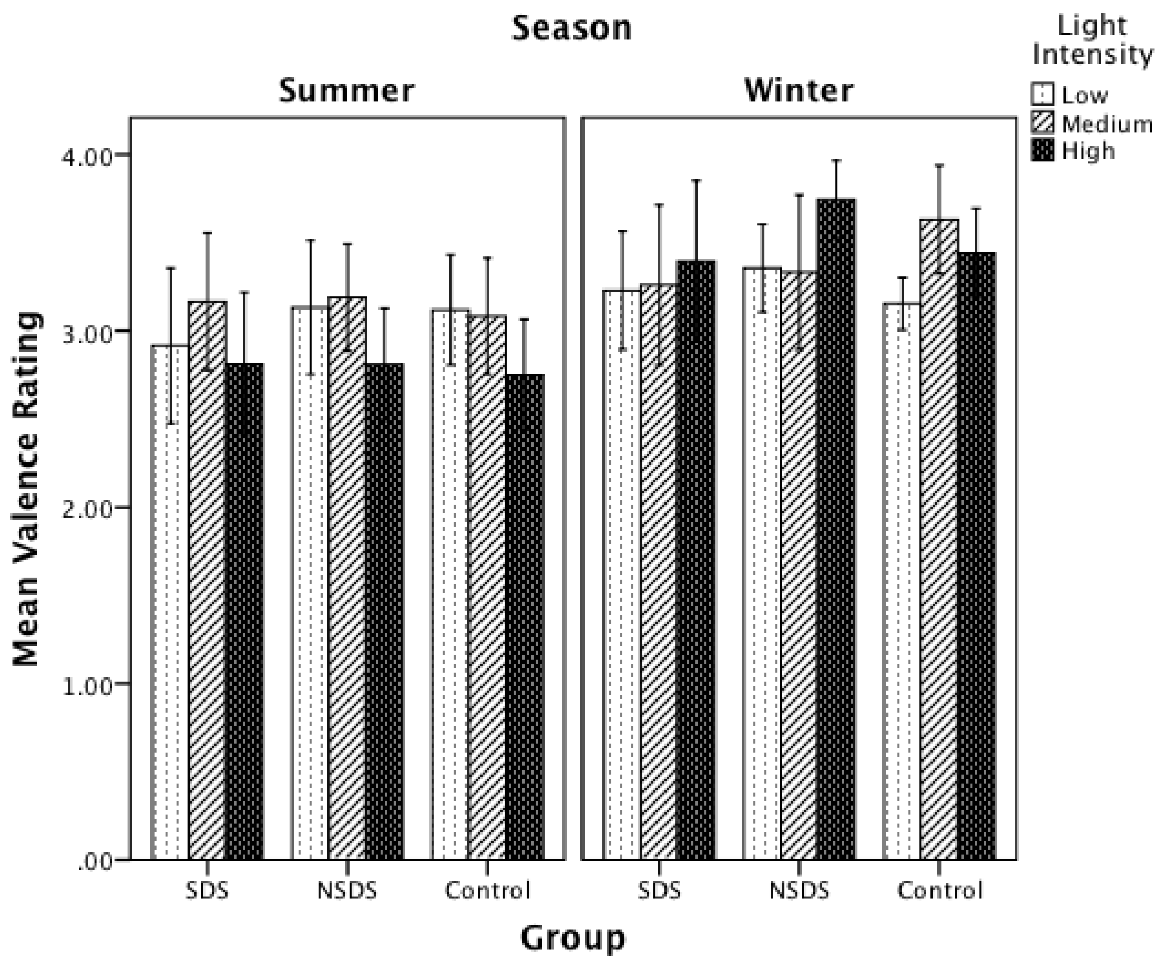

Figure 6. Mean valence ratings of EMG images for each Season and level of Luminance by Group. Higher scores indicate greater appeal of the images. Error bars attached to each column represent 95% confidence intervals. Descriptive statistics associated with this figure can be found in Table 16.

Appendix A

DSM-IV Criteria for Major Depressive Episode

and Seasonal Pattern Specifier

DSM-IV-TR Criteria for Major Depressive Episode and Seasonal Pattern

Criteria for Major Depressive Episode

A. Five (or more) of the following symptoms have been present during the same 2-week period and represent a change from previous functioning; at least one of the symptoms is either (1) depressed mood or (2) loss of interest or pleasure.

Note: Do not include symptoms that are clearly due to a general medical condition, or mood-incongruent delusions or hallucinations.

(1) depressed mood most of the day, nearly every day, as indicated by either subjective report (e.g., feels sad or empty) or observation made by others (e.g., appears tearful). **Note**: In children and adolescents, can be irritable mood.

(2) markedly diminished interest or pleasure in all, or almost all, activities most of the day, nearly every day (as indicated by either subjective account or observation made by others)

(3) significant weight loss when not dieting or weight gain (e.g., a change of more than 5% of body weight in a month), or decrease or increase in appetite nearly every day. **Note**: In children, consider failure to make expected weight gains.

(4) insomnia or hypersomnia nearly every day

(5) psychomotor agitation or retardation nearly every day (observable by others, not merely subjective feelings or restlessness or being slowed down)

(6) fatigue or loss of energy nearly every day

(7) feelings of worthlessness or excessive or inappropriate guilt (which may be delusional) nearly every day (not merely self-reproach or guilt about being sick)

(8) diminished ability to think or concentrate, or indecisiveness, nearly every day (either by subjective account or as observed by others)

(9) recurrent thoughts of death (not just fear of dying), recurrent suicidal ideation without a specific plan, or suicide attempt or a specific plan for committing suicide.

B. The symptoms do not meet criteria for Mixed Episode (see p. 365)

C. The symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

D. The symptoms are not due to the direct physiological effects of a substance (e.g., a drug of abuse, a medication) or a general medical condition (e.g., Hypothyroidism).

E. The symptoms are not better accounted for by Bereavement, i.e., after the loss of a loved one, the symptoms persist longer than 2 months or are characterized by marked functional impairment, morbid preoccupation with worthlessness, suicidal ideation, psychotic symptoms, or psychomotor retardation.

Criteria for Seasonal Pattern Specifier

Specify if:

With Seasonal Pattern (can be applied to the pattern of Major Depressive Episode in Bipolar I Disorder, Bipolar II Disorder, or Major Depressive Disorder, Recurrent)

A. There has been a regular temporal relationship between the onset of Major Depressive Episodes in Bipolar I or Bipolar II Disorder or Major Depressive Disorder, Recurrent, and a particular time of the year (e.g., regular appearance of the Major Depressive Episode in the fall or winter).

Note: Do not include cases in which there is an obvious effect of seasonal-related psychosocial stressors (e.g., regularly unemployed every winter).

B. Full remissions (or a change from depression to mania or hypomania) also occur at a characteristic time of the year (e.g., depression disappears in the spring).

C. In the last 2 years, two Major Depressive Episodes have occurred that demonstrate the temporal seasonal relationships defined in Criteria A and B, and no nonseasonal Major Depressive Episodes have occurred during that same period.

D. Seasonal Major Depressive Episodes (as described above) substantially outnumber the nonseasonal Major Depressive Episodes that may have occurred over the individual's lifetime

Appendix B

Questionnaire for Test Material Development

for the Modified Stroop Test

Section A: This section asks for your demographic information. This is for statistical purposes so that we may know the composition of the people in this pilot project.

Age: ________ Sex: Male / Female

Marital Status:

Single / Common-law / Married / Divorced / Separated / Widowed

Are you a student? Yes / No

- if yes, what year of your program are you in? ______________________

Please check the highest level of education that you have completed:

___ Eighth grade or less
___ High school graduate
___ College graduate
___ University graduate
___ Graduate school
___ Other, please specify ____

Ethnicity, check one:

___ Aboriginal
___ White, not of Hispanic origin (origins in Europe, North Africa, Middle East)
___ Black, not of Hispanic origin (origins in Africa)
___ Asian/Pacific Islander (origins in Far East, Southeast Asia, India Subcontinent, Pacific Islands)
___ Latino or Hispanic (Mexican, Puerto Rican, Cuban, Central or South America, or other Spanish culture or origin)
___ Other, please specify ____

Section B: Think of the concept **DARK** (referring to a lack of luminance). On a scale of 1 to 9, where 1 = *not relating to the concept at all* and 9 = *extremely representative of the concept*, to what degree would you rate each of the following words as reflecting the concept **DARK**. If you do not recognize or understand the word, write DK for *Don't Know*. Please consider each word carefully before making your choice.

1	2	3	4	5	6	7	8	9	DK
Does not relate to the concept at all				*Neutral*				*Is extremely representative of the concept*	*Don't know*

Black	_______	Lightless	_______
Low visibility	_______	Murky	_______
Night	_______	Misty	_______
Colourless	_______	Lurid	_______
Shadowy	_______	Opaque	_______
Twilight	_______	Sunless	_______
Blindness	_______	Mine	_______
Dark	_______	Deep	_______
Dusk	_______	Inky	_______
Overcast	_______	Midnight	_______
Foggy	_______	Gloomy	_______
Dull	_______	Dim	_______
Drab	_______	Unlit	_______
Dingy	_______	Dreary	_______
Hole	_______	Eclipse	_______
Cave	_______	Smoggy	_______
Power outage	_______	Thunderstorm	_______
Cloudy	_______	Nocturnal	_______
Evening	_______	Shade	_______
Ill-lighted	_______		

Section C: Think of the concept **DEPRESSION**. On a scale of 1 to 9, where 1 = *does not relate to the concept at all* and 9 = *is extremely representative of the concept*, to what degree would you rate each of the following words as reflecting the concept **DEPRESSION**. If you do not recognize or understand the word, write DK for *Don't Know*. Please consider each word carefully before making your choice.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	DK
Does not relate to the concept at all				*Neutral*				*Is extremely representative of the concept*	*Don't know*

Alone	_______	Pessimism	_______
Sad	_______	Miserable	_______
Pointless	_______	Unhappy	_______
Tired	_______	Pout	_______
Morose	_______	Negative	_______
Hopeless	_______	Anhedonia	_______
Joyless	_______	Hurt	_______
Crying	_______	Guilt	_______
Lonely	_______	Sobbing	_______
Meaningless	_______	Melancholy	_______
Empty	_______	Downcast	_______
Bored	_______	Doleful	_______
Grim	_______	Low	_______
Endless	_______	Glum	_______
Blackness	_______	Dispirited	_______
Darkness	_______	Alone	_______
Down	_______	Dejected	_______
Despair	_______	Dull	_______
Mistakes	_______	Failure	_______
Misery	_______	Isolation	_______
Abandon	_______	Disheartened	_______
Doom	_______	Rejected	_______
Lost	_______	Sorrow	_______
Sorry	_______	Heartbreak	_______
Console	_______	Loss	_______
Defeated	_______	Avoidance	_______
Desolate	_______	Heartache	_______
Disappointment	_______	Restless	_______
Let down	_______	Dysphoria	_______
Unmotivated	_______	Suffer	_______
Lethargic	_______	Alienated	_______
Ennui	_______	Apathy	_______
Dissatisfaction	_______	Bleak	_______
Suicidal	_______	Pity	_______
Frown	_______	Burdened	_______
Grey	_______	Shame	_______
Worthless	_______	Troubled	_______
Scowl	_______	Mourn	_______
Broke	_______	Insomnia	_______

Quiet	_______	Dread	_______
Boring	_______	Wistful	_______
Feeling blue	_______	Irritable	_______
Pain	_______	Unfortunate	_______
Stress	_______	Worry	_______
Death	_______	Moody	_______
Injury	_______	Illness	_______
Upset	_______	Sleep	_______
Unwanted	_______	Dreary	_______
Ache	_______	Sluggish	_______
Tears	_______	Gloomy	_______
Weep	_______	Languid	_______
Tragedy	_______	Slow	_______
Mope	_______	Grief	_______
Somber	_______	Regret	_______
Remorse	_______	Despondent	_______
Crestfallen	_______	Angry	_______
Tense	_______		

Section D: Think of the concept of **SUMMER**. On a scale of 1 to 9, where 1 = *is not related to the concept at all* and 9 = *is extremely representative of the concept*, to what degree would you rate each of the following words as reflecting the concept **SUMMER**. If you do not recognize or understand the word, write DK for *Don't Know.* Please consider each word carefully before making your choice.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	DK
Does not relate to the concept at all				*Neutral*				*Is extremely representative of the concept*	*Don't know*

Warmth	_______	Thirst	_______
Relaxing	_______	Shorts	_______
Adventure	_______	Water	_______
Vacation	_______	T-shirt	_______
Swimming	_______	Golf	_______
Biking	_______	Bathing suit	_______
Camping	_______	Humid	_______
Long days	_______	Dry	_______
Sunlight	_______	Sunglasses	_______
Beach	_______	Cold drinks	_______
Sunburn	_______	Sand	_______
Sweat	_______	Mosquitoes	_______
Bright	_______	Volleyball	_______
Suntan	_______	Olympics	_______
Heat	_______	Sports	_______
Scorching	_______	Surfing	_______
Heat wave	_______	Popsicle	_______
Sweltering	_______	Sandals	_______
Fishing	_______	June	_______
Boating	_______	Active	_______
Waterskiing	_______	Barbeque	_______
Muggy	_______	July	_______
Sunny	_______	Lazy	_______
Breezy	_______	Grass	_______
Balmy	_______	Flowers	_______
August	_______	Fireworks	_______
Sunshower	_______	Ice cream	_______
Gardening	_______	Tropical	_______
Blooming	_______		_______

Section E: Think of the concept **LIGHT** (referring to luminescence rather than weight). On a scale of 1 to 9, where 1 = *is not related to the concept at all* and 9 = *is extremely representative of the concept*, to what degree would you rate each of the following words as reflecting the concept **LIGHT**. If you do not recognize or understand the word, write DK for *Don't Know.* Please consider each word carefully before making your choice.

1	2	3	4	5	6	7	8	9	DK
Does not relate to the concept at all				*Neutral*				*Is extremely representative of the concept*	*Don't know*

Bright	_______	Lamp	_______
Shining	_______	Blaze	_______
Beacon	_______	Sunny	_______
Flame	_______	Fluorescent	_______
Candle	_______	Iridescent	_______
Lightbulb	_______	Photoperiod	_______
Luminance	_______	Morning	_______
Glowing	_______	Radiating	_______
Sun	_______	Dazzling	_______
Sunrise	_______	Ray	_______
Daytime	_______	Flashing	_______
Fire	_______	Reflecting	_______
Glitter	_______	Daylight	_______
Illuminate	_______	Beam	_______
Sparkle	_______	Vibrant	_______
Blinding	_______	Glimmer	_______
Brilliance	_______	Daybreak	_______
Lantern	_______	Glint	_______
Vivid	_______	Dawn	_______
Gleam	_______	Glare	_______
Ignite	_______	Incandescent	_______

Section F: Think of the concept **WINTER**. On a scale of 1 to 9, where 1 = *is not related to the concept at all* and 9 = *is extremely representative of the concept*, to what degree would you rate each of the following words as reflecting the concept **WINTER**. If you do not recognize or understand the word, write DK for *Don't Know.* Please consider each word carefully before making your choice.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	DK
Does not relate to the concept at all				*Neutral*				*Is extremely representative of the concept*	*Don't know*

Cold	_______	Winter sports	_______
Snow	_______	Windy	_______
Ice	_______	Dreary	_______
Short days	_______	Shiver	_______
Snow boots	_______	Fireplace	_______
Frost	_______	Toque	_______
Skiing	_______	Mittens	_______
Frostbite	_______	Dull	_______
Christmas	_______	Woodstove	_______
Blizzard	_______	Frigid	_______
Darkness	_______	Sleet	_______
Toboggan	_______	Iceberg	_______
Snowball	_______	Skating	_______
Storm	_______	Hot chocolate	_______
Snowhill	_______	Blustery	_______
Flurries	_______	Sweater	_______
Avalanche	_______	Snowboarding	_______
Snowfall	_______	Scarf	_______
Shoveling	_______	Bobsled	_______
Snowplow	_______	Olympics	_______
White	_______	Snow day	_______
Frozen	_______	November	_______
Snowmobile	_______	Snowman	_______
Hockey	_______	December	_______
Freezing	_______	Glacier	_______
Rosy cheeks	_______	Snowflake	_______
Winter tires	_______	February	_______
Snowshoe	_______	Chill	_______
Hypothermia	_______	Hibernation	_______
Snowsuit	_______	Bitter	_______
January	_______	Arctic	_______
Igloo	_______	Slush	_______
Polar bear	_______	Penguin	_______
Ice fishing	_______	Slippery	_______
March	_______	Sleigh ride	_______
Snowdrift	_______	Snow bank	_______
Brisk	_______	Goosebumps	_______
Cool	_______	Nippy	_______
Glacial	_______	Polar	_______

Section G: Think of the concept **HAPPY**. On a scale of 1 to 9, where 1 = *is not related to the concept at all* and 9 = *is extremely representative of the concept*, to what degree would you rate each of the following words as reflecting the concept **HAPPY.** If you do not recognize or understand the word, write DK for *Don't Know.* Please consider each word carefully before making your choice.

1	2	3	4	5	6	7	8	9	DK
Does not relate to the concept at all				*Neutral*				*Is extremely representative of the concept*	*Don't know*

Smile	_______	Excitement	_______
Lively	_______	Grin	_______
Nice memories	_______	Peaceful	_______
Mirth	_______	Secure	_______
Amusement	_______	Rich	_______
Merriment	_______	Positive	_______
Clown	_______	Delight	_______
Family	_______	Optimism	_______
Glad	_______	Achievement	_______
Winning	_______	Blithe	_______
Love	_______	Confidence	_______
Good fortune	_______	Elation	_______
Bliss	_______	Euphoria	_______
Enthusiasm	_______	Gay	_______
Warmth	_______	Overjoyed	_______
Victory	_______	Playful	_______
Carefree	_______	Glowing	_______
Lucky	_______	Friends	_______
Chipper	_______	Infectious	_______
Bubbly	_______	Jubilant	_______
Laughter	_______	Holidays	_______
Exuberant	_______	Fulfillment	_______
Fun	_______	Satisfaction	_______
Childhood	_______	Yellow	_______
Vibrant	_______	Peppy	_______
Comfortable	_______	Pleasant	_______
Children	_______	Gleam	_______
Life	_______	Possibilities	_______
Jovial	_______	Radiant	_______
Loved ones	_______	Joy	_______
Jolly	_______	Meaningful	_______
Exaltation	_______	Ecstatic	_______
Exhilarate	_______	Success	_______
Felicity	_______	Sunny	_______
Good-tempered	_______	Bright	_______
Gratified	_______	Cheerful	_______
Enjoyment	_______	Humour	_______
Good	_______	Pleasure	_______
Blesses	_______	Utopia	_______

Rejoice	________	Glee	________
Thrilled	________	Giddiness	________
Perky	________	Intoxicated	________
Upbeat	________	Content	________
Money	________		

Thank you for completing this questionnaire. Your participation is greatly appreciated. If you have any further questions do not hesitate to contact any of the researchers.

Appendix C

Cover Letter for Test Material Development

for the Modified Stroop Test

PILOT STUDY QUESTIONNAIRE (2009)

Project Title: Rating Words on How Accurately They Describe a Given Concept

Researchers: Kylie Prystanski (MA candidate)

Dana Dupuis (MA candidate)

Dr. Josephine Tan (project supervisor)

Nature of study: This pilot study looks at the different words that people use to describe a variety of concepts. The purpose of this study is to gain an understanding regarding which words people tend to rate as most accurately describing a specific concept. The data from this pilot study will be used to develop the materials to be used in future research carried out by Dr. Tan and her students. Two projects that are planned for the immediate future involve examining how different people react to a variety of stimuli, and are being undertaken as MA theses by Kylie and Dana. Your participation in this pilot study is completely voluntary and you are free to withdraw without penalty at any time. All of your responses will be kept confidential and anonymous. Your responses will be kept in Dr. Tan's lab under secure storage for a period of 7 years. There are no psychological or physical risks or benefits to you for participating in this pilot study. This questionnaire will take approximately one hour to complete.

Completing the questionnaire: You may choose to complete the questionnaire in either one of two ways. Online copies can be filled out at <http://cbtc.utoronto.ca/opinio/s?s=302> or paper copies can be obtained from any of the researchers. Please slide the completed paper questionnaire under the door of room SN 1003. Please drop it off as soon as you have completed the questionnaire. We ask that all questionnaires be returned no later than June 15, 2009.

Questions? Any of the researchers would be pleased to answer your questions. Miss Prystanski can be reached at kmprysta@lakeheadu.ca, Miss Dupuis at ddupuis@lakeheadu.ca, and Dr. Tan can be reached at jtan@lakeheadu.ca or 346-7751.

If in agreement with all of the terms covered on this page, please proceed to the next page ..

Appendix D

Cover Letter for Test Material Development for the EMG Task

PILOT STUDY QUESTIONNAIRE (2009)

Project Title: Rating Images on How Accurately They Represent a Given Concept

Researchers: Kylie Prystanski (MA candidate)
Dana Dupuis (MA candidate)
Dr. Josephine Tan (project supervisor)

Nature of study: This pilot study looks at how people react toward a variety of images. The purpose of this pilot study is to gain an understanding regarding which images people tend to rate as most accurately describing a specific concept. The data from this pilot study will be used to develop the materials to be used in future research carried out by Dr. Tan and her students. Two projects that are planned for the immediate future involve examining how different people react to a variety of stimuli, and are being undertaken as MA theses by Kylie and Dana. Your participation in this pilot study is completely voluntary and you are free to withdraw without penalty at any time. All of your responses will be kept confidential and anonymous. Your responses will be kept in Dr. Tan's lab under secure storage for a period of 7 years. There are no psychological or physical risks or benefits to you for participating in this pilot study. This questionnaire will take approximately 30 minutes to complete.

Completing the questionnaire: We ask that all questionnaires be completed no later than August 25, 2009.

Questions? Any of the researchers would be pleased to answer your questions. Miss Prystanski can be reached at kmprysta@lakeheadu.ca, Miss Dupuis at ddupuis@lakeheadu.ca, and Dr. Tan can be reached at jtan@lakeheadu.ca or 346-7751.

If in agreement with all the terms covered on this page, please proceed to the next page by clicking on "BEGIN SURVEY" below.

BEGIN SURVEY

Appendix E

Demographics Questionnaire for Test Material Development for the EMG Task

Section A: This section asks for your demographic information. This is for statistical purposes so that we may know the composition of the people in this pilot project.

Please indicate your age: ________

Please indicate your sex:

___Male
___Female

Please select your current marital status:

___ Single
___ Common-law
___Married
___Divorced
___Separated
___Widowed

Are you a student? Yes / No

- if YES, what year of your program are you in? ______________________________

Are you a graduate student? Yes / No

- if YES, what program are you in?____________________________________

Please check the highest level of education that you have completed:

___ Eighth grade or less
___ High school graduate
___ College graduate
___ University graduate
___ Graduate school
___ Other, please specify____

Ethnicity, check one:

___ Aboriginal
___ White, not of Hispanic origin (origins in Europe, North Africa, Middle East)
___ Black, not of Hispanic origin (origins in Africa)
___ Asian/Pacific Islander (origins in Far East, Southeast Asia, India Subcontinent, Pacific Islands)
___ Latino or Hispanic (Mexican, Puerto Rican, Cuban, Central or South America, or other Spanish culture or origin)
___ Other, please specify____

Place of birth: ____

Place of permanent residence:____

Appendix F

Summer Images for EMG Task

Summer images for use in the EMG task.

Image #52

Image #54

Image #60

Image #62

Image #63

Image #80

Appendix G

Winter Images for EMG Task

Winter images for use in the EMG task.

Image # 86

Image # 92

Image # 98

Image # 102

Image # 105

Image # 112

Appendix H

Screening Research Questionnaire

SCREENING RESEARCH QUESTIONNAIRE

Section A: This section asks for your demographic information. This is for statistical purposes so that we may know the composition of the people in the project.

Age: ________ Sex: Male / Female Program Year: ______________

Marital Status: Single / Common-law / Married / Divorced / Separated / Widowed

Ethnicity, check one:

___ Aboriginal

___ White, not of Hispanic origin (origins in Europe, North Africa, Middle East)

___ Black, not of Hispanic origin (origins in Africa)

___ Asian/Pacific Islander (origins in Far East, Southeast Asia, India Subcontinent, Pacific Islands)

___ Latino or Hispanic (Mexican, Puerto Rican, Cuban, Central or South America, or other Spanish culture or origin)

___ Other, please specify ____

Place of birth (city, country): ____

Place of permanent residence: ____

How long have you lived at your permanent address: ___ years and ___ months

Where do you spend your summer? ____

Do you use alcohol on a regular basis? Yes / No

- if yes, how often do you use alcohol? ______________________

Do you use mood-altering drugs on a regular basis? Yes / No

- if yes, *what drug* and how *often*? __________________________

Please select any and all prescribed medications, over-the-counter drugs, and *supplements (e.g., St. John's Wort)* that you have had in the last 8 weeks:

☐ Hormonal contraceptives (E.g., injectables, vaginal ring, contraceptive patch or implants, hormonal IUD, birth control pill, etc.)

☐ Anti-depressant medication.

☐ Anxiolytics (anti-anxiety medication).

☐ Other prescribed medications (please specify) ____

Tick off the diagnoses below that currently apply to you (the diagnoses have to be provided by a health professional, not by your own self).

Depression ___ Seasonal depression ___ Anxiety ___

Other (please specify): ____

Section B: The purpose of this form is to find out if and how your mood and behaviour change over time. Please fill in all the relevant circles. Note: We are interested in <u>your</u> experience, <u>not</u> <u>others</u> you may have observed.

1. In the following questions, fill in circles for all applicable months. This may be a single month 0, a cluster of months, e.g., 0 0 0, or any other grouping. At what time of the year do you...

	J	F	M	A	M	JN	JL	A	S	O	N	D	No particular month stands out as extreme
A. Feel best	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Tend to gain most weight	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Eat most	0	0	0	0	0	0	0	0	0	0	0	0	0
D. Sleep least	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Feel most energetic	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Socialize least	0	0	0	0	0	0	0	0	0	0	0	0	0
G. Crave carbohydrates most	0	0	0	0	0	0	0	0	0	0	0	0	0
H. Feel worst	0	0	0	0	0	0	0	0	0	0	0	0	0
I. Eat least	0	0	0	0	0	0	0	0	0	0	0	0	0
J. Sleep most	0	0	0	0	0	0	0	0	0	0	0	0	0
K. Lose most weight	0	0	0	0	0	0	0	0	0	0	0	0	0
L. Crave carbohydrates least	0	0	0	0	0	0	0	0	0	0	0	0	0
M. Feel least energetic	0	0	0	0	0	0	0	0	0	0	0	0	0
N. Socialize the most	0	0	0	0	0	0	0	0	0	0	0	0	0

2. Please check the year(s) in the past 6 years which <u>had the same pattern</u> as above:

_ Sept. 2006/Aug. 2007 __ Sept. 2005/Aug. 2006 __ Sept. 2004/Aug. 2005
__ Sept. 2003/Aug. 2004 __ Sept. 2002/Aug. 2003 __ Sept. 2001/Aug. 2002

3. To what degree do you change with the seasons on the following? (Circle only one answer per item)

	No Change	Slight Change	Moderate Change	Marked Change	Extremely Marked Change
A. Sleep length	0	1	2	3	4
B. Social activity	0	1	2	3	4
C. Mood (overall feeling of well being)	0	1	2	3	4
D. Weight	0	1	2	3	4
E. Appetite	0	1	2	3	4
F. Energy level	0	1	2	3	4

4. If your experiences in question 3 changes with the seasons, do you feel that they are a <u>problem</u> for you?

Yes / No

If yes, is this problem:

__ mild __ moderate __ marked __ severe __ disabling

5. Do you experience any regular occurring, seasonally linked stressors in your life, for example, seasonal unemployment, anniversary of the death of a loved one, etc.? Yes / No

If yes, please specify what the stressor is and the months you experience it:

6. (For students) Is starting school a seasonal stressor for you? Yes / No
If yes, when does it become a stressor for you? (specify the months):

7. By how much does your weight fluctuate during the course of the year?

_	0-3 lbs	_	4-7 lbs
_	8-11 lbs	_	12-15 lbs
_	16-20 lbs	_	over 20 lbs

8. Approximately how many hours of each 24-hour day do you sleep during each season, including naps? (Circle only one answer per question)
WINTER (Dec 21-Mar 20)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 18+
SPRING (Mar 21-June 20)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 18+
SUMMER (June 21-Sept 20)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 18+
FALL (Sept 21-Dec 20)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 18+

9. Do you notice a change in food preference during the different seasons, for example a preference for salts, sweets, fats, or carbohydrates? Yes / No
- If yes, please specify the type of craving and the months they typically occur in:

10. Using the scale below, indicate how the following weather changes make you feel (fill in only one circle per question):
-3 = in very low spirits or markedly slowed down
-2= moderately low/slowed down
-1= mildly/slowed down
0= no effect
+1= slightly improves your mood or energy level
+2= moderately improves your mood or energy level
+3= markedly improves your mood or energy level

	-3	-2	-1	0	+1	+2	+3	Don't know
A. Cold weather	0	0	0	0	0	0	0	0
B. Hot weather	0	0	0	0	0	0	0	0
C. Humid weather	0	0	0	0	0	0	0	0
D. Sunny weather	0	0	0	0	0	0	0	0
E. Dry weather	0	0	0	0	0	0	0	0
F. Grey and cloudy	0	0	0	0	0	0	0	0
G. Long days	0	0	0	0	0	0	0	0
H. High pollen	0	0	0	0	0	0	0	0
I. Foggy and smoggy	0	0	0	0	0	0	0	0
J. Short days	0	0	0	0	0	0	0	0

11. Do you believe you have the seasonal blues (ie. periods of feeling down, or blue, that are linked to specific seasons)?
Yes / No

12. If you answered "yes" to question 11, please continue with the items below:

- Please specify the months you are typically blue in: ______________________________

- How old were you when you started having the seasonal blues? ______________________

- Counting only the years from when you started having the seasonal blues until now, what proportion of the years would you say you have the seasonal blues? ____________________________

- How do you know that you have the seasonal blues? What changes, if any, do you notice occurring in yourself, emotionally, psychologically, mentally, and physically? _____________________
____

- Do you think you are having the seasonal blues NOW? Yes / No

If you are not having the seasonal blues now, when do you think it will start this year?______

Section C:
SELF-REPORT SUMMARY
***Name* ______________________ *I.D. #* ____________*Date* ___ ___ / ___ ___ / ___ ___**

Have you been physically ill in the past week? Circle one: ***yes / no.*** If yes, please explain:

____

Have you taken any medications in the past week? Circle one: ***yes / no.*** If yes, what medications?

____

Have you had treatment(s) of any other kind in the past week? Circle one: ***yes / no.*** If yes, please describe:

____

Females (pre-menopausal): About when did your last period begin? ___ ___ / ___ ___ / ___ ___

In the questions that follow, please circle the number of one alternative in each set that best describes how you have been during the past week. If you have changed during the last few days, circle the alternative that best describes how you are today. Before you select an alternative in each set, read all of the choices to make sure you pick the most accurate one. Each new set of alternatives that you should consider begins with a pointer sign, ☞.

DURING THE PAST WEEK . . .

☞ (H1/ 4 x)

0 - I have ***not*** been feeling down or depressed at all. (max H↑ A↑)
1 - I have been feeling somewhat down or depressed.
2 - I have been feeling quite down or depressed.
3 - I have been feeling and looking very depressed (or others have said so).
4 - I haven't been able to think about anything except how bad or depressed I feel.

☞ (H2/ 4 x)

0 - I have been keeping busy and have been interested in the things I've been doing.
1 - I haven't been quite as interested in doing things as I used to be.
2 - I have definitely not been as interested in things as I used to be, and I have had to push myself to do them.
3 - I have not been doing much because I feel so bad.
4 - I have stopped doing nearly everything — I just sit or sleep most of the day.

Note: When an item refers to how you "normally" are, it means when you are feeling OK, or as close to OK as you get.

☞ (A1/ x 4)

0 - I have been interested in socializing with others as much as normal.
1 - I have still been interacting with others but am less interested in doing so.
2 - I have been interacting less with other people in social situations.
3 - I have been interacting less with others at home or at work.
4 - I have become quite withdrawn at home or at work.

☞ ***(This question is about your interest in sex, not your actual sexual activity.)*** (H3/ 2 x)

0 - My interest in sex has been about the same as it was before I became depressed, or greater than normal.
1 - I have not been quite as interested in sex as I was before I became depressed.
2 - I have been much less interested in sex than I was before I became depressed.

DURING THE PAST WEEK . . .
Remember, "normal" means how you're feeling when you're OK.

☞ (H4/ 2 x)
0 - My appetite has been normal or greater than normal.
1 - I have had less appetite than normal, but I eat without anyone having to urge me.
2 - I have had so little appetite that I have not been eating regularly unless someone urges me to.

☞ ***(Circle "0" for this question if you have lost weight due to dieting, or have lost weight that you had previously gained when you were depressed.)*** (H5/ 3 x)
0 - I don't think I have lost any weight since I became depressed, or if I have lost weight I have started to gain it back.
1 - I have probably lost some weight (that I haven't gained back at all) because I haven't felt like eating.
2 - I have definitely lost weight (that I haven't gained back at all) because I haven't felt like eating.

☞ (A2/ x 2)
0 - I have ***not*** gained weight above my normal level in the past week.
1 - I have probably gained weight (two or more pounds) in the past week, and my current weight is above normal for me.
2 - I have definitely gained weight (two or more pounds) in the past week, and my current weight is above normal for me.

☞ ***(This question is about your appetite, not what you have actually been eating.)*** (A3/ x 3)
0 - My appetite has been normal or less than normal.
1 - I have wanted to eat just a little more than normal.
2 - I have wanted to eat somewhat more than normal.
3 - I have wanted to eat much more than normal.

☞ ***(This question is about what you have actually been eating.)*** (A4/ x 3)
0 - I have ***not*** been eating more than normal.
1 - I have been eating a little more than normal.
2 - I have been eating somewhat more than normal.
3 - I have been eating much more than normal.

☞ (A5/ x 3)
0 - I have ***not*** been craving or eating sweets or starches any more than when I feel normal.
1 - I have been craving or eating sweets or starches somewhat more than when I feel normal.
2 - I have been craving or eating sweets or starches much more than when I feel normal.
3 - I have had an irresistible craving for sweets or starches.
If you circled "1", "2" or "3" for the question above, please also answer the following:
The craving or eating has focused mainly on:
1 – sweets
2 – starches
3 - both sweets and starches

List any specific foods you have been craving: ________________________
Which of the following describes you best?
1 - I have been craving sweets or starches, but have been able to control eating them.
2 - I have actually been eating sweets or starches excessively.

DURING THE PAST WEEK . . .
At what time of day has the craving or eating usually occurred?
0 - It can occur at any time — it comes and goes.
1 - It usually occurs in the morning.
2 - It usually occurs in the afternoon or evening.
3 - It has been nearly all the time.

☞ (H6/ 2 x)
0 - I have ***not*** had any difficulty falling asleep at night.
1 - Some nights it has taken me longer than half an hour to fall asleep.
2 - I have had trouble falling asleep every night.

☞ (H7/ 2 x)
0 - I have ***not*** been waking up in the middle of the night, or if I have gotten up to go to the bathroom, I have fallen right back asleep.
1 - My sleep has been restless and disturbed during the night.
2 - I have been waking during the night without being able to get right back to sleep, or I've been getting out of bed in the middle of the night (not just to go to the bathroom).

☞ (H8/ 2 x)
0 - I have been oversleeping ***or*** waking up at a reasonable hour in the morning.
1 - I have been waking up very early in the morning, but I have been able to go back to sleep.
2 - I have been waking up very early in the morning without being able to go back to sleep, especially if I've gotten out of bed.

Remember, "normal" means how you're feeling when you're OK.

☞
When I am feeling normal, I usually sleep about ___ hours each day, including naps.
0 - I have been sleeping no more than I usually do when I feel normal. (A6/ x 4)
1 - I have been sleeping at least one hour more than I usually do when I feel normal.
2 - I have been sleeping at least two hours more than I usually do when I feel normal.
3 - I have been sleeping at least three hours more than I usually do when I feel normal.
4 - I have been sleeping at least four hours more than I usually do when I feel normal.

The following question asks about how difficult it has been waking up in the morning:
0 - Usually I have been waking up on time and quickly feeling wide awake.
1 - Although I've had to depend on an alarm clock to wake up on time, I've usually felt wide awake within 30 minutes.
2 - I've been feeling sleepy for 30 minutes or longer after I wake up.
3 - It's been a major effort to get out of bed, and I've continued to feel sleepy for at least three hours after I wake up.
4 - I've been falling back asleep after the alarm, or feeling sleepy for at least five hours after I first wake up.
If you have been using an alarm, what time is it set for? ____:____ AM / PM (circle)

☞ (H9a)
0 - I have ***not*** had a heavy feeling in my limbs, back or head. ↓
1 - I have had a heavy feeling in my limbs, back, or head, some of the time.
2 - I have had a heavy feeling in my limbs, back, or head, a lot of the time.

☞ (H9b)
0 - I have ***not*** been bothered by backaches, headache, or muscle aches. ↓
1 - I have been bothered some of the time by backaches, headache, or muscle aches.
2 - I have been bothered a lot of the time by backaches, headache, or muscle aches.

DURING THE PAST WEEK . . .
Remember, "normal" means how you're feeling when you're OK.

☞ (H9c,A7/ 2+ 4)
0 - I have ***not*** been feeling more tired than normal. (lrgst ↑ H9a-c after
1 - I have felt slightly more tired than normal. recoding 2 to 1, and
2 - I have been more tired than normal for at least a few hours per day. 3 and 4 to 2, on item H9c)
3 - I have felt tired much of the time most days.
4 - I have felt an overwhelming fatigue all of the time.

☞ (H10/ 4 x)
0 - I have ***not*** been putting myself down, or feeling like a failure or that I have let other people down, or feeling guilty about things I have done.
1 - I have been feeling like a failure or that I have let other people down.
2 - I have been feeling very guilty or thinking a lot about bad things I have done, or bad mistakes I have made.
3 - I believe that my being depressed is a punishment for something bad that I've done.

4 - I have been hearing voices accusing me of bad things, or seeing things that are scary, that others said were not really there.

☞ (H11/ 4 x)

0 - I have ***not*** had any thoughts about dying or about hurting or killing myself, or that life is not worth living.
1 - I have had thoughts that life is not worth living, or that I'd be better off dead.
2 - I have thought about dying, or wish I were dead.
3 - I have thought about killing myself, or I have done something to hurt myself.
4 - I have tried to kill myself.

☞ (H12/ 4 x)

0 - I have ***not*** been feeling especially tense or irritable, or worrying a lot.
1 - I have been feeling somewhat tense or irritable.
2 - I have been worrying about little unimportant things — that I wouldn't ordinarily worry about — or I have been excessively tense or irritable.
3 - Other people notice that I look or sound tense, anxious, or fearful.
4 - I feel tense, anxious, or fearful all of the time.

☞ ***Check off all the following physical symptoms that have bothered you in the past week.***

_dry mouth	*_cramps*	*_hyperventilating*
_gas	*_belching*	*_sighing*
_indigestion	*_heart palpitations*	*_having to urinate frequently*
_diarrhea	*_headaches*	*_sweating*

If you checked off any of the symptoms listed above, please also answer the following:

(H13/ 4 x)
(0 if none)

1 - Altogether, the symptom(s) have only been bothering me a little bit.
2 - Altogether, the symptom(s) have been bothering me somewhat.
3 - Altogether, the symptom(s) have been bothering me a lot.
4 - Altogether, the symptom(s) have been making it difficult for me to function.

Circle one of the following:

0a - These symptoms bother me only when I am depressed.
0b - These symptoms bother me from time to time, but they get worse when I'm depressed.
2 - In my experience, these symptoms occur whether or not I am depressed.
3 - I think these symptoms are due to physical illness or a medication that I am taking.

If you circled "3" above, what illness or medication? ___________________________

DURING THE PAST WEEK . . .

☞ (H14/ 4 x)

0 - I have ***not*** been thinking much about my physical health.
1 - I have been worrying about being or becoming physically ill.
2 - I have been spending most of my time worrying about my physical health.
3 - I have been complaining frequently about how I feel physically, or asking for help a lot.
4 - I am sure that I have a physical disease, even though the doctors tell me that I don't.

Have you had a specific medical problem this week? If yes, please describe:
____

☞ (H15/ 2 x)

0a - Although previously I was depressed, this past week I have felt distinctly better. (recode 2 to 0?)
0b - I have become depressed, or have continued feeling depressed, in the past week.

If neither 0a nor 0b is true, circle 1 or 2 below:

1 - I haven't been feeling very good, but it's not because of depression — rather, I ate something bad, or overworked, or had a virus, or just have been needing a rest.
2 - Depression has not been a problem of mine, now or before.

Remember, "normal" means how you're feeling when you're OK.

☞ (H16/ 4 x)

0 - My rate of speech and thought are normal.
1 - My speech and physical movements are slightly slowed down, or my thoughts are slightly slower, which has made it difficult for me to concentrate.
2 - My physical movements, speech or thoughts are somewhat slow compared to normal, and other people have noticed this.
3 - My physical movements are markedly slower, or my speech or thoughts are so slow that it has been hard to have a conversation with me.
4 - My physical movements are greatly slowed down, or my speech and thoughts are so slow that it has been difficult for me to think or talk at all.

☞ (H17/ 4 x)

0 - I have ***not*** been restless or fidgety.
1 - I have been somewhat restless, or sometimes have been playing with my hands, hair, or other things.
2 - I have been very restless, or often have been playing with my hands, hair, or other things.
3 - I have trouble sitting still, and need to keep moving about a lot of the time.
4 - I am unable to sit still, or have been wringing my hands, biting my nails, pulling my hair, or biting my lips, nearly all the time.

(Total H1-H17 = ____)
(HAM-D 17-item subscore)

☞ (H18a)
↓

0 - Overall, the problems I have been asked about in this questionnaire have bothered me equally in the morning and in the late evening.
1 - Overall, these problems have bothered me more in the morning.
2 - Overall, these problems have bothered me more in the late evening.

If you circled "1" or "2" for the question above, please also circle one of the following:

(H18b/ 2 x)
(0 if none)

1 - I have been feeling only a little worse in the mornings (***or*** evenings).
2 - I have been feeling much worse in the mornings (***or*** evenings).

DURING THE PAST WEEK . . .

☞ ***In the following question, a "slump" means a temporary reduction in mood or energy from which you recover, at least partially, later in the day.***

0 - I have ***not*** regularly had a slump in my mood or energy in the afternoon or evening.
1 - I have regularly had a slump in my mood or energy in the afternoon or evening.

If you circled "1" for the question above, please also answer the following:

The slumps usually begin about ___ p.m. and end about ___ p.m.

Please specify:

0 - Once these slumps occur, they usually last till bedtime.
1 - I usually come out of these slumps at least an hour before bedtime.

If you usually come out of these slumps at least an hour before bedtime, please also circle one of the following: (A8/ x 3) (0 if none)

1 - Usually, the slumps have been only mild in intensity.
2 - Usually, the slumps have been moderate in intensity.
3 - Usually, the slumps have been severe in intensity.

How would you characterize the slumps?

0 - They are mostly in my mood.
1 - They are mostly in my energy.
2 - They are in both mood and energy.

☞ (H19/ 4 x)

0 - I have ***not*** been having any sensation that things around me are unreal, or that I'm in a dream.
1 - I have been having only very mild sensations of unreality.
2 - I have been having some definite sensations of unreality or of being in a dream.
3 - I have been having sensations of unreality a lot of the time.
4 - I have been so bothered by sensations of unreality that it has been hard for me to function.

☞ (H20/ 3 x)

0 - I have ***not*** thought that anyone was trying to give me a hard time or hurt me.
1 - I have been suspicious of people.
2 - I have noticed certain things that probably mean that someone is trying to harm me.
3 - I am sure someone is trying to get me or hurt me.

☞ (H21a) ↓

0 - I have ***not*** had things that I've had to do over and over again, like checking the locks on the doors several times, or repeatedly washing my hands.
1 - I have been compelled to check certain things repeatedly — more than should be necessary.
2 - I have been spending excessive amounts of time checking certain things repeatedly.

☞ (H21b)

0 - I have ***not*** been bothered by thoughts that run over and over in my mind ↓ but don't make any sense to me.
1 - I have been a little bothered by thoughts that keep running through my (H21/ 2 x) mind but don't make any sense to me. (lrgst↑ 21a-b)
2 - I have been very bothered by thoughts that keep running through my mind but don't make any sense to me.

($T_{29} = H_{21} + A_8$)
(SIGH-SAD 29-item total)
[(A_8 / T_{29}) °— 100 = ____ %]
(Atypical balance score)

Appendix I

Short Recruitment Advertisement for Screening

Seeking Research Volunteers* --** The Department of Psychology at Lakehead University is currently recruiting individuals ***18 years or older to participate in a short screening study. The data from this screening will be used to select potential participants for a main project that looks at individual's attention and reaction time to a set of computerized psychological stimuli. For more information on the screening and main study, please visit this weblink: http://cbtc.lakeheadu.ca/research/rcvs0910.html which will also lead you to the screening questionnaire.

Otherwise, please contact Dana Dupuis (ddupuis@lakeheadu.ca).

Appendix J

Long Recruitment Advertisement for Screening

SEEKING RESEARCH VOLUNTEERS

The Department of Psychology at Lakehead University is currently recruiting individuals ***18 years or older*** to participate in a short screening study. The data from this screening will be used to select potential participants for a main project that looks at individual's attention and reaction time to a set of computerized psychological stimuli.

For more information on the screening and main study, please visit this weblink http://cbtc.lakeheadu.ca/research/rcvs0910.html which will also lead you to the screening questionnaire. Otherwise, please contact Dana Dupuis (ddupuis@lakeheadu.ca) or leave a message at 343-8168.

Individuals who complete the Main Study will be entered into a random prize draw for 1 of 2 $50 Intercity Shopping Mall gift certificates.

Appendix K

Cover Page for Main Study

Date: ________________

REACTIONS TO COMPUTERIZED VISUAL STIMULI 2009-2010

Thank you for your interest in our study. This main study is being conducted by Dana Dupuis (ddupuis@lakeheadu.ca) who is an MA Clinical Psychology student at Lakehead University and by her thesis advisor, Dr. Josephine Tan (jtan@lakeheadu.ca, 346-7751).

The objective of the main study is to compare people's evaluative judgment and reaction time to images and words on verbal and physiological levels. Participants will be invited to come into the lab to engage in a computerized task that will measure reaction times. Following this part of the testing session, non-invasive electrodes will be placed on the face of the participant to measure their physiological reactions towards images presented on a computer screen.

This testing session will take approximately one hour to complete. Your participation in this main study is strictly voluntary. You are free to withdraw from the study any time you wish without explanation or penalty. Your responses will be kept confidential and anonymous. There are no foreseeable physical or psychological risks or benefits to you for participating in this study. All of the data collected will remain in secure storage in Dr. Tan's lab for a period of 5 years after which time they will be destroyed.

To thank you for participating in our main study, we will be carrying out two random prize draws for $50 gift certificates for the Intercity Shopping Mall. Also, Introductory Psychology students who complete the main study will receive 1.5 bonus points toward their final mark. These prize draws will be done in the spring and you will be contacted in the event that you win.

Once again, we would like to thank you for your time and interest in this study. It is greatly appreciated.

Appendix L

Consent Form for Main Study

INFORMED CONSENT FORM (2009-2010)
Main Study

Title of research: REACTIONS TO COMPUTERIZED VISUAL STIMULI 2009-2010

Researchers: Dana Dupuis (MA student)
Dr. Josephine Tan (supervisor)

Aim of Study: The aim of this study is to measure participants on their attention and reaction time while viewing computerized sets of images. This will help us to understand what types of stimulus are more meaningful to different people.

Procedure: In this study, you will be viewing words presented in different colours on a computer screen and naming the colour of the words as quickly and accurately as you can. You will also be viewing and rating different images while your physiological responses are measured by a machine.

Risks / Benefits: There are no foreseeable physical or psychological harm to you as a result of participating in the study. The physiological recordings that will be undertaken are surface recordings and therefore are not invasive and are painless. All participants in the main study will be entered into 1 of 2 random prize draws for an Intercity Shopping Mall gift certificate, and will be able to request for a copy of the summary of the results when the main study has been completed. Lakehead University Introductory Psychology students will receive 1.5 bonus points towards their course marks for participating in the main study.

Confidentiality: All your responses will be kept confidential and identifiable only with the personal code that was developed during the screening. All data will remain in secure storage in Dr. Tan's lab for a period of 5 years after which time they will be destroyed.

Voluntary Nature: Your participation is strictly voluntary. You are free to withdraw from the screening any time you want without explanation or penalty.

If you have read and understood the above and wish to participate in this study, please sign below to indicate your full informed consent.

________________________	________________________	______________
Print name here	Sign name here	Date here

We need your name and contact information so that we can reach you in the summer of 2010 if you win a gift certificate in the random prize draw:

Name: ____

*Mailing address:*____

____

____

*Postal code:*____

*Tel number we can reach you at:*____

*Email address we can reach you at:*____

If you are an Introductory Psychology student at Lakehead University, you are entitled to 1 bonus mark towards your course. Please provide us with the information below so that we can make sure that you receive your credit:

What is the name of your Introductory Psychology professor? ______________________________

or

On what day and time is your Introductory Psychology class? ______________________________

Appendix M

Debriefing Form for Main Study and

Therapy Resources in Thunder Bay

DEBRIEFING FORM FOR THE MAIN STUDY (REACTIONS TO COMPUTERIZED VISUAL STIMULI 2009-2010)

Firstly, we would like to thank you for completing this study. Without participants like you who are willing to volunteer your time and share information with us, it would not be possible for psychological research to advance. We would like to offer you additional information about the study now that you are done so that you can understand further what we are doing in this project. We were not able to offer you a lot of detailed information before because we did not wish to influence your responses in anticipation of what you believed we expected to find.

The objective of our research is to measure people's reaction time and psychophysiological responses to sets of psychological stimuli. We selected people who experienced winter depression, those who had depression that is not linked to the seasons (regular depression) and finally, a group of people who did not experience any depression or any health problems (control). The study involves comparing those with winter depression, regular depression and control.

The symptoms of winter depression are similar to those in regular depression except that in winter depression, there is a seasonal pattern to it and the symptoms are more vegetative-somatic in nature such as carbohydrate craving, increased appetite and eating, weight gain, fatigue, and oversleeping. Given that there is overlap between winter depression and regular depression we developed this research design specifically to see if we could find differences between the groups.

Research suggests that people with different types of problems tend to have different cognitive profiles and are more sensitive to picking up cues that relate to their problems. For example, in regular depression, people tend to be more sensitive to negative and pessimistic cues. We hypothesized that in winter depression, people might be sensitive to winter cues.. Furthermore, researchers believe that the shorter photoperiod (i.e., shorter length of daylight hours) is linked to winter depression but not to regular depression. Therefore, we reasoned that people with winter depression are probably more sensitive to cues that relate to light exposure compared to those with regular depression.

In the project, we gave our research participants computerized tasks that expose them to different types of cues in the form of a word or an image. Those cues would be season-related (summer, winter), light-related (light, moderate luminance, dark), and mood-related (happy, sad).

To see how they react to those cues, we measured the participants' reaction time to colour-naming cue words. Research shows that when a word has more meaning to a person, he is slower to colour name the word. By measuring people's reaction time in the colour-naming task, we could measure which words the different groups were sensitive to. For example, people with winter depression would be slower to colour-name winter words.

We also asked people to recall the words that they saw in the colour-naming task. We believe that people will be more likely to recall words that have more meaning to them. Hence people with winter depression would recall more winter words.

Finally, we showed images to people while hooking them up to a machine that measured their psychophysiological responses in the form of their facial activity level which can give us information about the strength of a person's emotional reaction to what he saw. To prevent people from becoming self-conscious about their facial activity, we said that we were measuring their galvanic skin response. We apologize for this little deception but it was necessary so that people would not be uncomfortable and control their facial reactions during the task. We think that people with winter depression might be more reactive to dark or light images than those with regular depression, and we had the participants rate how appealing they found each image. That way, we could correlate the strength of their facial responses with the valence (positive/negative) of their rating.

We do not yet know how the results of this study will turn out. If you are interested in the outcome of this study and have requested a summary of the findings, we will send it to you by late summer. You will also be contacted in the event that you win the one of the random prize draws for a $50 gift certificate that you can redeem at the Intercity Shopping Mall, which will be held when the study is complete. If you are an Introductory Psychology student, you will be given 1.5 bonus points toward your final course mark.

People who have winter depression may benefit from professional assistance to help them through the difficult time. If you or anyone you know is psychologically distressed or feeling depressed, there is help available. We have provided a list of resources below. If you have any questions, please feel free to contact Dr. Tan at 346-7751 or jtan@lakeheadu.ca.

Please do not mention this study to anyone. Many people have not yet participated in this study and we do not wish to contaminate their answers with prior information. Our results will not be accurate in such a case, and the data will not be usable. We hope that you will cooperate with us in this regard. Do you have any questions? Thank you.

Resources for Counselling and Therapy

Sometimes when experiencing life problems, seeking professional assistance becomes necessary in order to bring one's life to a better balance. This is particularly important if one's life has become affected by stress or mood changes (e.g., withdrawal from friends or family, work and/or academic performance becomes impaired, self-grooming deteriorates, personal relationships become strained, there are thoughts/ intentions of harming one's self, etc.).

The city of Thunder Bay has therapy and counseling services that are accessible. If you or someone you know could use some assistance, please consider the following options:

- Lakehead University Health and Counselling Services – free to all LU students: (807) 343-8361
- Lakehead University Native Student Support Services: (807) 343-8085
- Family Services Thunder Bay: (807) 626-1880
- Catholic Family Development Centre: (807) 345-7323
- Thunder Bay Counseling Centre: (807) 684-1880
- Emergency services are available from the Thunder Bay Regional Health Sciences Centre
- See your family physician or walk-in clinic for a referral or refer yourself to any mental health professional in private practice (look up the Yellow Pages under *Psychologists and Psychological Associates; Psychotherapy; or Marriage, Family & Individual Counsellors*).
- Get more information from the Thunder Bay Canadian Mental Health Association: (807) 345-5564.

Appendix N

EMG Image Example at

Three Luminance Levels

EMG winter image # 98 at 5 cd/m²

EMG winter image # 98 at 30 cd/m²

EMG winter image # 98 at 65 cd/m²