

Université de Montréal

**Electrophysiological markers for hostile attribution bias among individuals with anxiety**

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*Ce mémoire intitulé(e)*

**Electrophysiological markers for Hostile Attribution Bias among individuals with anxiety**

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*A été évalué(e) par un jury composé des personnes suivantes*

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## Résumé

**Contexte :** Les troubles anxieux constituent un sous-groupe le plus répandu dans les conditions de santé mentales. Malgré cette prévalence, ils ne reçoivent pas la même reconnaissance en raison des comorbidités, une étiologie inconnue et un manque de traitement spécifique. Récemment, la littérature scientifique s'est concentrée sur la neuro-imagerie de l'anxiété. Par contre, une compréhension plus complète sur comment l'électrophysiologie et le stress interagissent et mènent aux symptômes de l'anxiété est requis. **Méthodologie :** À l'aide de données pré-recueillies auprès d'un échantillon de 68 participants, cette étude visait à étudier la déflexion N400 en utilisant le Paradigme de la Violation d'Espérance Hostile de Gagnon et al. (2016) chez les individus adultes présentant de l'anxiété. **Résultats :** dans la condition non-hostile, nous avons observé une déflexion négative significative du N400 chez les individus qui ont un score de BIAH plus élevée, en contrôlant pour l'agressivité. Les analyses de régressions ont démontré une déflexion négative du N400. En d'autres mots, les adultes qui ont plus d'anxiété étaient surpris suivant un contexte hostile et une intention non hostile car il s'attendait à un contexte hostile. Tandis que dans la condition hostile, le modèle global s'est avéré significatif, par contre l'agressivité réactive a tenu compte de l'effet global et n'ont pas les scores d'anxiétés. **Conclusion :** À notre connaissance, aucune article scientifique à explorer le BAIH avec des mesures électrophysiologique du cerveau, comme preuve des influences des symptômes d'anxiété sur la cognition. Cette recherche à augmenter notre connaissance sur la présence du BAIH chez les adultes avec des symptômes d'anxiété en examinant des marqueurs électrophysiologique du cerveau. Les implications et limites de l'étude sont également discutées. Reproduire ces résultats avec un échantillon cliniquement diagnostiqué de personnes souffrant de troubles anxieux, devrait donc être l'une des priorités de la recherche future.

*Mots-clés* : anxiété, agressivité, biais d'attribution d'intention hostile, électrophysiologie,  
EEG, N400, Hostile Expectancy Violation Paradigm

## Abstract

**Background:** Anxiety disorders constitute the most prevalent subgroup of mental health conditions. While anxious individuals are more widely known as being socially withdrawn and shy, recent research highlights a rather non-prototypical image, one that is aggressive. The main goal of this event-related brain potentials (ERPs) study is to augment our knowledge of the neurophysiological responding of hostile attribution biases of anxious individuals to ambiguous situations. **Methods:** Using pre-collected data from a sample of 68 undergraduate and community-based adult participants, this study aims to explore the N400 deflection utilising Gagnon et al.'s (2016) Hostile Expectancy Violation Paradigm with anxious individuals, and whether the N400 deflection persists after controlling for aggression. **Results:** A more negative amplitude was observed in response to a critical word that mismatched rather than matched with the character's expected hostile intention. Regression analyses revealed that anxiety scores negatively predicted the N400 following the mismatched expected hostile intention while controlling for reactive aggression suggesting that the violation of hostile expectancy about the intention behind an ambiguous provocative behavior is more pronounced among anxious participants. Conversely, in the hostile condition, the overall model was significant, although anxiety scores did not account for the overall effect, reactive aggression did. **Conclusion:** This study provides preliminary evidence that anxiety symptoms are uniquely related to hostile attribution bias independent of reactive aggression. Future research should aim to replicate these findings with a clinically diagnosed sample of individuals with anxiety disorders.

*Keywords:* anxiety, aggression, Hostile Attribution Bias, electrophysiology, EEG, N400, Hostile Expectancy Violation Paradigm





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## **List of Abbreviations & Acronyms**

DSM-5 : Diagnostic and Statistical Manual of Mental Disorders, 5th Edition

HPA : The hypothalamic–pituitary–adrenal axis

ERP : Event-related potentials

EEG : Electroencephalography

Hz : Hertz

ms : millisecond

HAB : Hostile attribution bias

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## **Chapter I – [General Overview]**

## **Theoretical Context**

### **Defining anxiety**

In 1998, Ricky Williams was awarded the best football player in the United States receiving the Heisman Trophy. He then received an 8\$ million contract to play for the Miami Dolphins in the National Football League; he had thousands of fans around the globe who idolized him and carried his name on their jersey. Often he conducted post-game interviews, with his helmet and tinted visor on, in efforts to avoid eye contact. No one knew that beneath his 2-meter figure and 225 pounds of muscle was a regular guy who suffered from social anxiety disorder. Although he could run across the football field in front of more than 80, 000 viewers, his fear of being ridiculed or looking foolish caused him great anxiety when making small talk with teammates or having conversations on camera (Kashdan & McKnight, 2010).

According to the World Health Organization (2017), anxiety disorders are ranked as the 6<sup>th</sup> largest contributor to global disability, in 2015 representing 3.4% of all years lived with disability. Anxiety disorders are the most prevalent mental health disorder, manifesting in nearly 3 million Canadians (11.6%) aged 18 years and older (Kessler et al., 2009). While around 11.6% suffer from anxiety disorders, and many consult a health professional, there still exists almost 23% who do not seek any kind of professional help. Yet from those who consult a health professional, fewer than 20% of sufferers experience complete remission. This is particularly tragic as anxiety disorders are associated with a substantial degree of social dysfunction (Wittchen, 2002).

The DSM-5, the most popular general medical disorders classification system in America, defines anxiety as the anticipation of future threats (Clark et al., 2017; Crocq, 2015). “Anxiety, fear and panic are emotions related to threat” (Graeff & Zangrossi, 2010). Anxiety is distinguished from

fear, in that fear is the response to the perception of a real imminent threat, while anxiety is the expectation of threat (Crocq, 2015). From an evolutionary standpoint, stress is an adaptive emotion, promoting survival by signalling danger in a particular surrounding. During a stressful situation, anxiety is essential for surmounting stressors and surviving, whereby it prepares the body both mentally and physically.

Mentally, anxiety biases attention on threatening stressors: where cognitive functions shy away from complex computations and resorts to automatic ones. This cognitive switch is characterized by hyperactive cognitive schemas of danger-relevant information (McEwen, 2007). Moreover, this shift in attention is maintained until the stress has passed (Gold, 2015).

Physiologically, much like this adaptive mental anxiety, there is adaptive physical anxiety created when faced with a stressor. The HPA axis is directly responsible for most of the anxiety relevant physical transformations. It directly promotes adaptive anxiety and fear-related behaviours. The release of cortisol by the HPA axis is responsible for most of the anxiety and arousal we experience during a stressor. Not only cortisol but corticotropin-releasing hormone which is secreted in the amygdala, hypothalamus and sympathetic nerve terminals, is also responsible for anxiety and fear-related behaviours (Gold, 2015).

However, very quickly can adaptive anxiety turn into a maladaptive habit when the individual begins to excessively worry. Adaptive arousal turns into dysphoric hyperarousal and anxiety, vigilance into hypervigilance and at times insomnia (Chrousos & Gold 1992). Assertiveness in fight or flight situations transforms into excessive cautiousness and anxiety.

Occasional anxiety is not an unusual feeling for many; however, anxiety disorders is when this feeling of worry is more than temporary. Anxiety disorders refers to a group of mental health

disorders often characterized by feelings of excessive worry or fear. These individuals at times express intense overblown anger and aggression (Kashdan et Collins, 2010; Moscovitch et al., 2008). Such individuals frequently misperceive rejection from others, engage in self-criticism and demonstrate difficulties opening up to others (Breen, & Kashdan, 2011). Many researchers have hypothesized that aggression is only evident in some anxious people and is a result of heightened physiological arousal due to excessive emotional suppression and biased social information processing mechanisms (Beard, 2011; Barrett, Rapee, Dadds et Ryan, 1996; Blanchette et Richards, 2003).

## **Literature Review**

### **Hostile and anxious individuals**

Every year many individuals are victims of aggression. Of those, over 700, 000 die due to assault, not including many more victims of domestic violence, terrorism, physical or psychological abuse (Bartolomeos et al., 2007; Berkowitz 1993). Very broadly defined, aggression is behaving with the intent to harm another (Coie and Dodge, 1998). Aggressive behaviour can take on different forms: physical and relational, while serving different, proactive or reactive functions. Physical and relational forms of aggression differ from each other by their method of harm and the goals they serve (Crick & Grotpeter 1995).

Physical aggression or also referred to as overt aggression, is defined as physical or verbal harming to another individual, such as pushing, kicking, hitting and threatening (Prinstein & Cillessen, 2003; Coie and Dodge 1998). In contrast, relational aggression, also referred to as covert aggression, is the direct or indirect harming of others via purposeful manipulation to damage social relationships, friendships, feelings of acceptance in a peer group (Loudin et al. 2003; Crick et al.

1999). Examples of relational-aggressive behaviour are: gossiping and excluding individuals from a group (Crick & Grotpeter 1995). Often indirect, relational, and social aggression are used interchangeably to denote subtle differences in harmful behaviours (Bjorkqvist, 2001; Underwood et al., 2000). Regarding aggressive behaviour functions, reactive aggression is often defined as angry, explosive and emotionally dysregulated responses to perceived threats or provocations (Card & Little, 2006; Dodge, 1991). Proactive aggression is unprovoked aggression used to either establish dominance over others or instrumental gain (Dodge 1991; Dodge and Coie 1987). The former is a more hostile form of aggression, while the latter is a controlled form of aggression (Loudin et al. 2003).

Many psychiatric disorders such as depression, post-traumatic stress disorder, alcohol abuse, and anxiety disorders are often associated with impaired social cognition and severe emotional disturbances at times leading to excessive aggression. It is more widely known of social anxiety disorders as being characterized by social withdrawal, shyness and discomfort in social situations (Galbraith, et al., 2014). However, recent research has demonstrated an entirely different array of behaviours than the previous prototypical image of socially anxious individuals; one that is counterintuitive: essentially aggressive. For example, Kashdan and Collins (2010) demonstrate in their research that individuals with anxiety disorders often express intense overblown anger and aggression. Similarly, does Moscovitch and colleagues (2008) discover that individuals with panic disorder reported significantly higher anger and aggression levels than the control group. Interestingly, Galbraith and colleagues (2014) have demonstrated that individuals with social anxiety exhibit risk-prone behaviours such as aggression, sexual impulsivity, and problematic substance abuse. Nevertheless, others have supported a link between social anxiety and aggression in general (Crick 1995; Storch et al. 2004; Crick et al. 2006; Pepler and Sedighdeilami 1998; Vitaro

et al. 2002) as well as relational aggression (Marsee, Weems, & Taylor, 2008). Nonetheless, the body of literature surrounding the associations between anxiety and aggression and their comorbidity is still underdeveloped.

Recent research has highlighted the hypothesis that adolescents use relational and overt aggression both reactively and proactively (Little et al. 2003; Marsee and Frick in press; Ostrov and Crick 2007; Prinstein and Cillessen 2003). A study by Storch and colleagues (2004) sought to examine the association between overt and relational aggression and psychosocial adjustment among undergraduate college students. Within psychosocial adjustment, they assessed social anxiety using a self-report measure. Authors concluded that overt and relational aggression were significantly linked to social anxiety among undergraduate women. More precisely, overt aggression significantly predicted social anxiety among women. However, for both genders, relational aggression predicted social anxiety. In the same manner, another study explored the relationship between social anxiety and relational aggression among college students aged 19-25 years old (Loudin et al., 2003). In this study, they defined social anxiety as fearing negative evaluations and others' avoidance (Watson and Friend, 1969). Social anxiety and relational aggression were both measured using self-report questionnaires. Loudin and colleagues (2003) found that students who feared negative evaluations were more likely to use relational aggression. In this study, the authors found that male students reported using more relational aggression than females; this may be due to the measures' nature. It may be that men are not accurate with their self-reporting of relational aggression. As in a study conducted by Loukas and a group of researchers (2005), the authors found that social anxiety among boys and girls aged 10-14 years old was positively associated with relational aggression.

Nevertheless, literature has exclusively examined the association between social anxiety and the different functions of aggression: reactive or proactive. Xu and Zhang (2008) sought to explore whether social anxiety was linked to either reactive or proactive aggression among Chinese school-aged children. The children sample was collected from three schools in Shanghai, and their mean age was ten years old. Their teachers reported proactive and reactive aggression on a 5-point scale, and social anxiety was assessed using the Interpersonal Concern Scale. The researchers found a positive relationship between reactive aggression and social anxiety, but no association between social anxiety and proactive aggression. Similarly, did Raine and his colleagues conclude in their study. The more adolescent boys were socially anxious, the more they reactively aggressed (Raine et al., 2006).

While the above research supports the link between aggression and anxiety more specifically social anxiety, other studies present conflicting findings. One study by Dewall and colleagues (2010) sought to examine whether there is a relationship between social anxiety, hostility and aggression among a sample of 2500 undergraduate students. They found that social anxiety was positively correlated with feelings of hostility towards others and hostile perceptions of others. However, contrary to other research, they found that social anxiety was negatively correlated with aggressive behaviour. In this study, aggression referred to intimate partner violence, measured with the intimate partner violence attitude scale-revised; Where participants were asked to rate scenarios of violence directed towards their partner. However, in most of the research mentioned above, aggression was measured by general self-report questionnaires, where scenarios provided were not directed at their intimate partner but rather to another unidentified individual. Thus, potentially accounting for Dewall et al.'s (2010) different findings. Conversely, a study by Moscovitch and colleagues (2008) demonstrated that individuals with obsessive-compulsive

disorder, panic disorder, and social phobia display higher anger levels than non-anxious individuals. Surprisingly, when depression is covaried, these anger experiences are no longer evident. Thus, pointing out that anger experiences are related to symptoms of comorbid depression among these types of anxiety disorders. This effect is not surprising due to the high percentage of depression and anxiety disorders' co-occurrence. In addition, they have many overlapping symptoms, as such individuals frequently meet the criteria for both diagnoses. For instance, sleep disturbances are seen in both generalized anxiety and major depressive disorders. Thus, supporting the importance of further research on anxious people to understand potential cognitive mechanisms that may explain such findings.

The body of evidence supporting the link between anxiety and aggression is further solidified by research that explores their comorbidity in children and adolescents. Although this topic is not often explored and inadequately understood, some researchers see merit for examining treatment options targeted at both anxious and aggressive individuals. Inevitably highlighting the importance that this topic warrants. Although small in amount, such comorbidities represent a significant percentage across epidemiological samples (Karyn, Hunt, & Hariot, 2007). In fact, in clinical settings, around 9% of anxious children also meet the criteria for oppositional defiant disorder (Levy, Hunt, & Hariot, 2007). With regards to the literature on anxious children and adolescents, aggression is often found in the form of Disruptive Behavior Disorders (Bubier & Drabick, 2009), oppositional defiant disorder (Levy, Hunt, & Hariot, 2007), intermittent explosive disorder (Keyes et al., 2016). Often anxiety concomitant with aggression puts the individual at considerable risk for functional impairment, increased symptomology, and higher psychosocial adversity. Despite their important clinical and nosological implications, research is still sparse at both a syndrome and symptom level of such comorbidity (Drabick, Gadow, & Loney, 2008;



Flannery-Schroeder, Suveg, Safford, Kendall, & Webb, 2004; Garland & Garland, 2001; Russo & Beidel, 1994).

A study done by Keyes and colleagues (2016) explored the co-occurrence of intermittent explosive disorder and anxiety disorders. Intermittent explosive disorder was characterized by recurring and exaggerated aggressive outbursts and anger attacks. In this study, the authors examined four specific anxiety disorders: social phobia, specific phobia, GAD, and panic disorder. Participants were either teenagers or adults and were diagnosed with intermittent explosive disorder if they experienced three or more anger attacks that were out of proportion to the stressor in their lifetime. Anxiety disorders were diagnosed using the DSM-IV. The authors found that adolescents with a lifetime anxiety disorder had a higher lifetime prevalence of intermittent explosive disorder at 23%, while non-clinically anxious adolescents had a more reduced prevalence rate of 8%. These findings were consistent across all four anxiety disorders. Although this demonstrated an overall lower prevalence among adults, anxious adults also had a prevalence rate of 13% versus non-clinically anxious adults at 3%. In other words, both adolescents and adults with anxiety disorders displayed more aggression than those without an anxiety disorder diagnosis. Authors decided to examine the comorbidity percentage of anxiety and intermittent explosive disorder with mood and other disorders, as such they did not control for depression. Social anxiety had the highest percentage of mental illness comorbidities (Keyes et al., 2016).

Examining impairment implications, adolescents with comorbid anxiety disorder and aggression had more significant impairments in work and interpersonal relationships associated with their anxiety than those without comorbidity. Similarly, we see the same severe disability among the comorbid adults than those without the anxiety disorder diagnosis (Keyes et al., 2016). To our surprise, despite poorer functioning and greater co-occurrence, comorbid individuals were

significantly less likely to utilize treatment services than those without the comorbidity. This is hypothesized to be a result of increased personal vulnerabilities. Symptoms associated with co-occurring mental health illnesses may exacerbate individual vulnerability and act as a barrier to treatment. Their mental health symptoms may further impede their level of functioning, emotional capacity, and ability to follow through with treatment (i.e., motivation; Priester, et al. 2016).

However, there exists scientific evidence regarding the effectiveness of Cognitive Behaviour Therapy (CBT) in reducing such symptoms. A study done by Levy and colleagues (2007) found that applying either CBT targeting comorbid anxiety and aggression or targeting mere anxiety demonstrated significant improvement in both internalizing and externalizing problems. These findings urge the importance of further research efforts dedicated to understanding the relationship that underlies these differences.

The evidence described in the preceding paragraphs highlights the relatively small body of literature that examines the co-occurrence of anxiety and aggression either at a syndrome or a symptom level. The body of evidence still demonstrates several gaps that limit the understanding of these comorbid conditions. Firstly, despite their surprisingly unintuitive high co-occurrence, there is limited literature that examines why this comorbidity occurs. Much of the literature examine their existence or potential clinical treatments. Yet, very few explore underlying cognitive, emotional, or physiological mechanisms to further understand their co-occurrence. Secondly, with regards to age, most of the research surrounding this comorbidity is examined among children and adolescents in the community, and in clinic-based samples, very little research is conducted on adults. Thus, a comprehensive conceptualization of the processes underlying such comorbidity is warranted among adults. Thirdly, most of the literature surrounding evidence for their co-occurrence presents a methodological limitation to our knowledge. Where aggression was always

measured via behavioural questionnaires, a method that gives the potential for numerous biases. To our knowledge, the link between anxiety and aggression has not been assessed utilizing physiological nor electrophysiological measures. Although questionnaires are an adequate and reliable measure, they are insufficient to explain underlying mechanisms for the co-occurrence of anxiety disorder and aggression. Thus, a more physiological measure is warranted to support alternative explanations. That said, the preliminary research described in the preceding paragraphs suggests that there may be underlying cognitive mechanisms and biases that can further explain the above findings.

### **Attribution biases and anxiety**

Social anxiety can be defined as a fear of negative evaluations; over time, this fear grows and intensifies, causing great distress and depression, which leads to problems with interpersonal functioning and causes personal suffering. At times, this fear can become so severe that it may lead to suicidal ideations, suicidal attempts, social isolation and substance abuse (Kashdan et Collins, 2010). Social anxiety is also a chronic fear of rejection indicative of distorted thought processes regarding how individuals perceive social interactions. Rapee and Heimberg (1997) explained social anxiety as individuals who often perceive social interactions as a competition they will ultimately lose. It becomes evident that social anxiety may cause feelings of hostility towards others and perceiving hostility in others (Rapee & Heimberg, 1997). According to Beck's (1986) theory of anxiety, specific distortions in cognition like the interpretation of threat and danger in social situations is associated with anxiety and aggression. In fact, anxious individuals are thought to have distorted danger signalling information regarding their world, others, and themselves (Beck, 1986). Recent research efforts have provided support for distorted social-information processing mechanisms among individuals with anxiety disorders. Social-information processing

mechanisms are how interactional situations and pre-existing thoughts are combined to determine behaviour (Kunimatsu, & Marsee, 2012). Crick and Dodge (1994) proposed a social information processing model by which a range of sequential mechanisms interact together to determine behaviour in social interactions. Of particular interest to us are the following mechanisms: encoding of social cues, social interpretations, attributions of intent, behavioural enactment. Thus, a social information processing bias may predispose anxious individuals to misinterpret others' behaviour in an overly hostile or antagonistic manner (Crick & Dodge, 1994; Lochman & Dodge, 1994). To date, relatively little research has investigated these possible processing biases in socially anxious individuals.

According to Beck's schema theory and Bower's associative network model, both anxious and depressed individuals should show cognitive biases in attention, memory and judgment (Beck, 1967, 1976; Beck & Clark, 1988; Beck & Emery, 1985; Bower's (1981). Although several studies have examined cognitive biases among different types of psychopathologies, none to our knowledge use electrophysiological measures to explore this relationship. To validate the theory posited by Beck and Bower, a body of literature must be examined. To date, we know those anxious individuals present with cognitive biases across all three modalities: attention, memory and judgment. Although such findings may have considerable implications in understanding anxiety's underlying cognitive processes, little effort has been directed towards examining the relationship between anxiety and cognitive processing biases.

In 1986, Macleod, Mathews and Tata sought to better understand anxiety encoding biases of emotionally threatening information. They constructed their hypothesis based on two sets of findings. The first concluded that anxious individuals detect more accurately fear-relevant words (Burgess et al., 1981; Parkinson & Rachman, 1981). The second body of findings demonstrated

that anxious subject's performance on a timed task was severely impaired when threat-relevant items are presented as distractors versus neutral items. Macleod and colleagues thus introduced a paradigm that allowed for direct measurement of the distribution of visual attention. The paradigm consisted of two words being simultaneously presented onto two different areas on a computer screen. Immediately after the two words disappeared, a visual probe appeared in either vicinity of those two words; subjects were then asked to press a button as soon as they detected the probe. Visual attention was measured via latency detection of the probe. Trials of interest contained one emotionally threatening term of the two words presented. By examining the term's impact on probe detection latency, they were able to see where visual attention was shifted. Subjects consisted of clinically anxious adults and non-clinically anxious adults as controls. Authors found that the anxious group significantly displayed a bias in selective attention favouring emotionally threatening information, while the control group displayed the exact opposite. However, the authors suspected that depression might be mediating this effect, so they sought to redo the experiment with depressed individuals, but results did not approach significance. They concluded with certainty that the anxious group was not mediated by these subjects' high levels of depression.

The paradigm used in this study presents two advantages because responses consist of both a neutral response and stimulus: a button press and dot-probe, eliminating potential response bias interpretations. Secondly, the presence of a threatening term allowed for freedom of either facilitating or hindering the subject's dot detection, depending on the word and probe placement. In fact, the authors state that other methods utilizing arousal or performance efficiency can provide freedom for such a directional effect.

Similarly, Barret et al. (1996) sought to discover social interpretations of anxious individuals. Not only did anxious individuals demonstrate a processing bias whereby they attend

more to emotionally threatening information, but they hypothesized that anxious individuals would also interpret ambiguous information as threatening. With a sample of 152 clinically anxious children and 26 non-clinically anxious children, children were presented with 12 ambiguous situations, half were physical threats, and the other half were social threats that could be either interpreted as threatening or not. Children were then asked three questions following the situational vignettes. The questions provided the child with a free-choice interpretation: two threat interpretations and two neutral interpretations, in random order. Findings concluded that compared to non-anxious children, anxious children are more prone to threat interpretations of ambiguous situations. These findings are also consistent with previous findings by Chorpita, Albano and Barlow (1993), where they utilized the same procedure and obtained the same findings as Barret and colleagues (1996). Note that Barret et al.'s study was conducted with children who also display syndromal aggression with oppositional defiant disorder. Results demonstrated that those children showed even higher levels of threat bias than anxious children. These findings demonstrate that both internalizing and externalizing disorders correlated with threat interpretations in social situations. Such results indicate that further research into social-information processing in clinically anxious and aggressive individuals is required to further understand the underlying differences among such disorders.

In the same manner Bell-Dolan (1995) conducted her research, examining social cognitive behaviour of anxious and non-anxious children. Children were either fourth or fifth graders, both anxious and non-anxious children were presented with videotaped peer interaction vignettes. Vignettes depicted peer behaviour that was either hostile, nonhostile or ambiguous. Following each vignette, children were asked questions to assess social-cue interpretation. Bell-Dolan's findings did not merely confirm the findings mentioned above: anxious individuals interpret ambiguous

situations as threatening and attribute hostile intention, they also extended those findings and demonstrated that anxious children tended to misinterpret nonhostile situations as hostile. These findings further confirm and extend existing literature that highlight anxious individual's over attendance to negative aspects of events and over perceived threat in mundane situations (Beck & Emery, 1985; Last, 1989; Leitenberg et al., 1986). One caveat to keep in mind is the subject's proposed behavioural responses to the peer interactions. Such predetermined questions may be limiting and not comparable to both children's and adult's real-life responses. Thus, a more real-life robust measurement of hostile intention is required.

In contrast, an interesting study by Reid and colleagues (2006) sought to examine social-information processing mechanisms in anxious, depressed and aggressive children. More specifically, they assessed attention and hostile attributions. Utilizing similar methodology as studies mentioned above, they assessed attention using a dot-probe task and attribution of hostile intent was assessed via vignettes and possible explanations for vignettes. Consistent with previous findings, children's preferential attention to threat words was significantly accounted for by anxiety scales, more than the effect of depression and aggression. Surprisingly, contrary to the findings mentioned above, hostile attributions were not significant. Meaning that anxiety, aggression and depression scores either combined or independent, did not account for children's hostile attributions (Reid et al. 2006). Nonetheless, these findings seem conflicting with the larger body of evidence that has been previously established, that provide evidence for negative interpretation biases among anxious and aggressive individuals (Chorpita, Albano & Barlow, 1993; Barret et al., 1996; Macleod, Mathews & Tata, 1986; Beck & Emery, 1985; Last, 1989; Leitenberg et al., 1986; Coccaro, Noblett, & McCloskey, 2009; Dodge, 1980; Dodge et al., 2015; Dodge & Newman, 1981;

Epps & Kendall, 1995; Gagnon et al., 2017; Guerra & Slaby 1989; Mathews & Norris, 2002; Nasby, Hayden, & Depaulo, 1980).

Other contrasting findings exist, like DeWall and colleague's study (2009), which sought to explore hostility and aggression among anxious undergraduate students. They assessed three questions in three separate studies: 1) whether anxious individuals displayed greater hostility toward others, (2) whether they had heightened perceptions of hostility in others, and (3) whether they were violent and aggressive. In the first study, anxiety was assessed with the Social Interaction Anxiety Scale and hostility and depression were assessed with the Brief Symptom Inventory (BSI). Both measures were administered online in a survey. The authors decided to measure depressive symptoms with the BSI because depression is often comorbid with anxiety. The BSI is a self-report measure of psychiatric symptomatology. It has previously shown high internal consistency, test-retest reliability, convergent validity in multiple normative samples (Derogatis & Melisaratos, 1983). Authors found that social anxiety did predict hostile feelings towards others. This significance remained after controlling for depression and gender. In fact, the relationship between anxiety and hostility was nearly twice as strong among the clinical sample versus the non-clinical sample. For the second research question, participants completed the well-validated Brief Fear of Negative Evaluation Scale, the Center for Epidemiological Studies-Depression Scale and the Aggression Questionnaire (hostility subscale). Results from the second study offered additional evidence that social anxiety predicted perceptions of hostility from others, even after controlling for depression. Similarly, in the third study, they measured anxiety and hostility with the same scales as the second study, and they measured aggression via an intimate partner violence attitude scale. Surprisingly, social anxiety was negatively correlated with positive attitudes toward engaging in violent acts with one's partner (DeWall et al., 2009).



The first and second findings from this large study confirm and extend the existing findings discussed above. However, this study's third conclusion does not support the recent research that explores the rather non-prototypical image of the standard anxious individual (DeWall et al., 2009). Those characterized by their expression of intense overblown anger and aggression (Kashdan & Collins, 2010; Moscovitch et al., 2008). In light, it is essential to note that this study presents certain limitations that can potentially account for such results. Firstly, each of the three studies was conducted on different individuals, thus within-subject consistency was not conserved between the three studies.

Secondly, anxiety was measured with the Social Interaction Anxiety Scale. This scale demonstrates high levels of internal consistency (Heimberg, Mueller, Holt, Hope, & Leibowitz, 1992; Mattick & Clarke, 1998; Osman, Gutierrez, Barrios, Kopper, & Chiros, 1998), test-retest reliability (Heimberg et al., 1992; Osman et al., 1998), and the ability to distinguish individuals with social anxiety disorders from those who do not have the diagnosis (Brown et al., 1997). In addition, previous research has also demonstrated this scale's ability to correctly classify 82% of patients with social anxiety disorders. Indeed, authors used this cut-off to identify participants with clinically significant social anxiety. Nonetheless, it is important to mention most research surrounding this topic has used the DSM diagnostic criteria for anxiety disorders to classify subjects, as the DSM is the most popular general medical disorders classification system in America (Clark et al., 2017; Crocq, 2015).

Lastly, only the relational form of aggression was assessed within only one social setting: an intimate partner setting. In fact, the non-prototypical anxious individual described by research tends to display both relational and physical forms of aggression. Furthermore, the previously explored body of research surrounding the non-prototypical anxious individual has explored

relational aggression in all sorts of social settings and not merely an intimate one. Thus, it may be that socially anxious individuals are less violent within their intimate relationships but may well engage in violent acts in other social relationships (DeWall et al., 2009).

The above body of literature summarizes that anxious individuals, more specifically those with social anxiety often fear other's negative evaluations. This fear often points to a distorted thought process of how they perceive their social interactions, which may point to specific distortions in social information processing. In fact, anxious individuals tend to not only demonstrate a processing bias whereby they attend more to emotionally threatening information, but they also interpret ambiguous information as threatening (Macleod, Mathews and Tata, 1986; Barret et al., 1996). In addition, they also tend to misinterpret nonhostile situations as hostile (Bell-Dolan, 1995). It becomes evident that social anxiety may cause feelings of hostility towards others and perceived hostility in others. Although the relationship between attributions of hostile intent and externalizing problems like aggression is solidified in the literature, the link between internalizing problems such as anxiety is still unresolved. Yet, it is clear from the above-presented evidence maladaptive attributions of intent have been independently linked to anxiety. Although, instead, they are more often described as "defeated" (Fan et al. 2007), "threatening" (Miers et al. 2008), or generally "negative" (Chambless et al. 2010; Taylor and Wald 2003), rather than being characterized as "hostile". Very few articles have described these maladaptive attributions of intent as hostile. For instance, DeWall and colleague's (2009) research characterized this maladaptive attribution as being hostile. They concluded social anxiety predicted hostile feelings towards others and predicted perceptions of hostility from others. Yet, social anxiety was in fact not predictive of intimate partner aggression (DeWall et al., 2009). Even though a study conducted by Marsee et al. (2008) found that socially negative interpretation biases mediated the association between reactive

relational aggression and anxiety. It becomes clear that literature surrounding negative cognitive errors, specifically, the relationship between hostile attributions intent is unclear among anxious individuals. As unknown to the literature, not only are anxious individuals often aggressive, but they also demonstrate distorted processing of social information indicative of a "negative" or "threatening" interpretation bias (Macleod, Mathews and Tata, 1986; Barret et al., 1996; Beck & Emery, 1985; Last, 1989; Leitenberg et al., 1986). Thus, literature should attempt to solve the gap and explore the relationship between social anxiety and hostile attribution biases.

### **Hostile attribution bias**

Despite extensive research on negative cognitive interpretations and distorted social information processes among both clinical and non-clinical anxious individuals, little research examined Hostile Attribution Biases directly as a primary goal in their study. Hostile Attribution Bias (HAB), is the tendency to interpret ambiguous social context cues as negative or hostile (Gagnon et al., 2016). Although HAB has received much attention in individuals with aggression it has not nearly received the same attention in individuals who are not only aggressive but display anxious symptoms. Many researchers have expressed the importance of negative cognitive interpretations in individuals with anxiety but none to this date have explored HAB directly with individuals both aggressive and anxious.

In order to fully understand HAB we must examine and understand how attribution biases may occur. In 1967, a work by Ulric Neisser established the importance of information processing as a major tenet of cognitive psychology. Most information processing models assert a sequential order of events that an individual must go through in order to make sense of their surroundings and social interactions. It was hypothesized that in each step of this sequential order a conclusion is drawn, which would in turn influence the following stages. A model posited by Dodge (1986),

shortly after reformulated by Crick et Dodge (1994), became a leading model of social information processing (SIP), due to its fundamental framework often utilized and referenced in studies examining social cognition. This model although it was constructed initially to explain social competence in children, it has been repetitively used outside of developmental research. According to Dodge (1986), this model was formulated to explain how social cognitions are interwoven with social behaviors. More specifically, it attempted to understand why individuals choose aggressive responses. The model is based on the assumption that people have a set of determined storehouses based on past experiences, knowledge of social rules, and schemas. A schema involves a set of rules that act like a lens through which an individual views a certain situation. An individual's memories and information produced over time are located in the storehouse. Once social cues are received by an individual, the determined capabilities and memories of past experiences. In a series of six steps, the individual receives social cues and processes it utilizing his determined capabilities and memories of past experiences. This process often occurs rapidly, only when a situation is novel the process may be slower (See Appendix A).

There are six sequential steps of information processing that lead to social behavior. 1) encoding of social cues, 2) interpretation of social cues, 3) clarification of goals, 4) response access or construction, and 5) response decision, which leads to behavioral enactment. When each step is skillfully and adequately processed, competent and adaptive behaviour result. However, a deficient processing of one or more of these steps results in socially deviant behavior. The first step, encoding of social cues involves, receiving information through the senses and attending to it. Here heuristics often used to economically encode information. Here, distorted or inaccurate encoding of social cues can lead to deviant responses (Crick & Dodge, 1994; Dodge, 1986).

The second step involves the interpretation process of social cues. Here cues are integrated with existing schemas and past experiences to result in a meaningful and beneficial understanding of the current social situation (Dodge, 1986). At this step existing heuristics, schemas, scripts, and working models of relationships render processing much more efficient. Similarly, deficiencies in this step, such as an inability to adequately produce meaningful understanding of the social situation leads to cognitive interpretive biases (Crick & Dodge, 1994). One such example, is the hostile attribution error, which will be discussed in more detail subsequently.

The third step is clarification of goals, this is where the individual clarifies goals for the current social situation (Crick & Dodge, 1994). According to past situations, individuals begin with a certain goal and edit it to the current social demands. A goal may be internal, like self-surviving, or external, like obtaining a reward, with regards to the person. Inappropriate goals distort this stuff and thus have potential to affect the entire process by once again resulting in deviant behavior.

The fourth and fifth steps involve respectively, searching for and selecting possible behavioral responses. Searching and selection must suitably to how the social information was encoded, interpreted. Moreover, it needs to be in accord with the goal determined in the previous steps. Responses are constructed through socialization processes and is carefully selected with respect of potential consequences. The response is selected based on outcome expectations and self-efficacy evaluation. If the previous steps had distortions, deviant responses will be generated. Deviant responses may occur at this step if the individual has inadequate search skills or has conducted a biased search (Crick & Dodge, 1994; Dodge, 1986). For instance, if during step 2 the individual made a hostile attribution to the other person's intent, the chosen response will mirror his intent and will most likely be aggressive. Following the fifth and final step the behaviour will be enacted. In that social situation, other individuals involved will react accordingly, which

constitutes its own new SIP cycle. The other person's response will be registered into that initial individual's memories, in turn influencing the processing of future steps of the cycle (Crick & Dodge, 1994; Dodge, 1986).

Skillful processing at each step leads to competent social performance, whereas a biased or dysfunctional social interpretation could give rise to what Milich and Dodge (1984) referred to as Hostile Attribution Bias (HAB). A tendency to interpret other's intentions as hostile when social context cues in the environment are ambiguous (Milich & Dodge, 1984). While hostility is a person's cognitive component of aggression, attributions of hostile intent is the inference of his mental state and its underlying neural mechanisms (Buss, 1988; Gagnon et al., 2016). Dodge and Newman (1981) spent much of their research studying hostile attribution biases. More specifically among high-aggressive boys cue distortions were more likely to be made, particularly in ambiguous situations. This was in part due to the remembering of negative cues from their past experiences and linking them to the current situation (Dodge & Newman, 1981; see Appendix A for an example). The social information processing model has in fact been a hallmark in theoretical accounts of the development of HAB and aggressive behaviour (Orobio de Castro, 2004). More generally, research surrounding SIP has consistently shown that individuals who demonstrate a tendency to interpret other's behaviors as harmful in intent, are at an increased risk of engaging in aggressive acts (Dodge & Crick, 1990; Gagnon et al., 2016). This robust relationship between aggression and HAB has been consistently reported in research among children, adolescents, and adults, yet not with anxiety (Coccaro, Noblett, & McCloskey, 2009; Dodge, 1980; Dodge et al., 2015; Dodge & Newman, 1981; Epps & Kendall, 1995; Gagnon et al., 2016; Guerra & Slaby, 1989; Matthews & Norris, 2002; Nasby, Hayden, & Depaulo, 1980).

Examples of this robust relationship were demonstrated in Milich and Dodge's (1984) research. They managed to conclude that aggressive children attribute hostility to a provocateur's ambiguous act. Some argued such attribution of hostile intent is a result of bias in the second step of social information processing (Dodge, 1986). Yet others, concluded a hostile attribution bias occurs when social cues are selectively encoded for hostility. This type of processing occurs in the second step of the SIP cycle (Dodge & Newman, 1981). Dodge and Coie in 1987, were able to demonstrate that reactively aggressive boys had inaccurate interpretations of peer's cues. More specifically, reactively aggressive boys attributed a hostile intent to ambiguous situations, while the proactively aggressive group did not. Once again, research done by Slaby and Guerra (1988), documented that highly aggressive boys and girls were more likely to demonstrate biases in SIP than less aggressive children. In a more recent study, Orobio de Castro et al. (2005) were able to confirm previous results. They found a significant correlation between reactive aggression and HAB among boys aged 7-13, and once again proactive aggression was not significantly associated with HAB.

Most research revolving around HAB utilise clinically aggressive subjects. Often measures of attributional biases involved presenting vignettes depicting hypothetical conflict situations to each subject, and those subjects were asked to respond with open-ended or forced choice questions regarding the intentions of the provocateur's actions.

In Milich & Dodge's (1984) study, the aggressive group of boys were asked to nominate classmates who best fit behavioral associations with aggression, later they served as antagonists in the hypothetical vignettes read to each of them. Following the presentation of the vignettes, subjects were asked questions designed to assess their attributions of intentions of their peers in the vignettes. Peer's intentions were scored as hostile, benign, or benevolent. Similarly in a more recent

study by Arsenio, Gold, and Adams (2009), were they sought to examine HAB among adolescents. HAB was examined by presenting four situational vignettes recounting a story describing a potentially provocative situation resulting in negative outcomes for the participants, but with an ambiguous provocateurs intent. Adolescents were then asked open-ended questions regarding the scenarios and then specific intent attributions. Alternatively, Nasby, Hayden, & Depaulo, (1980) utilised photographs rather than situational vignettes. The photographs each depicted affectively charged interpersonal situations and subjects were presented with possible response appraisals for photographs. Response appraisals were then summed to determine subject's attributional intent.

Yet in another study by Dodge (1980), boys were presented with a puzzle to complete. After sometime, an audiotaped situational vignette where another boy (a fictitious audio taped boy) was thought to either: destroy their puzzle (hostile condition), comment on the puzzle and state he will help them finish it, a crashing voice followed and boy explains he didn't mean to drop the puzzle (benign condition), or comment on his progress in a nondescriptive voice followed by a long pause then crashing sound (ambiguous condition). The dependent measure were the boys behaviors following either one of these situations, behaviors were recorded with a video recorder.

In other research, HAB was assessed via merely questionnaires. More specifically, in Coccaro et al. (2009) study, they utilised the SIP-AEQ, which was then followed by four Likert-scaled questions, assessing: direct hostile intent, indirect hostile intent, instrumental non-hostile intent, and neutral intent. The SIP-AEQ, is a questionnaire consisting of a variety of written vignettes each presenting a "socially ambiguous situation in which an adverse action is directed at the person who the subject is asked to identify with", designed specifically for adults (Coccaro et al., 2009). The SIP-AEQ has been consistently reported as a valid and reliable measure of hostile



attribution biases in community-based adults and impulsive-aggressive patients (Coccaro et al., 2009).

Although researchers have been able to clearly establish, utilising self-report measures, that aggressive individuals typically demonstrate higher levels of HAB as well as a more negative interpretative style, there still exists limitations to such measures. The studies utilize auto-evaluations, and although they are easy to administer to large samples and score and provide adequate measures of individual's actual thoughts, they still present with numerous limitations. One such limitation is responses and interpretative biases. Research that utilizes self-evaluations give rise for individuals to responds in inaccurate ways, whether its intentional like social desirability bias where individuals often underreport bad behavior, or unintentional such as hostility bias. Another limitation is that questionnaire studies are often suitable for exploring cognitive content rather than underlying cognitive processes. In addition, these self-report measures are unlikely to adequately assess existing cognitive schemas and associative networks. Schemas and associative networks are often unconscious and activate automatically (Gotlib et al., 1998).

As mentioned above that the attribution of a hostile intent is the inference of an individual's mental state and their underlying neural mechanisms. It has been often reiterated in the literature that chronic activation of knowledge structures that represent aggressive schemas cause HAB in aggressive individuals. In addition, over time, aggressive individuals build a more rapid schema for the activation of aggressive thoughts and this is thought to lead to more hostile attributions (Anderson & Bushman, 2002). Therefore, a direct real time measure of attributional processes was warranted to further explore the underlying neural mechanisms. Which is why research turned to electrophysiological measures to examine HAB. Event-related potentials (ERP) have been

consistently studied as a measure of brain functioning related to mechanisms involved in social cognition.

Within the hostility literature, several ERP components have been explored. For example, a prolonged P300 latency (Bond and Surguy, 2000), as well as a reduced P300 amplitude (Harmon-Jones et al., 1997) has been associated with attitudinal hostility. Godleski et al. (2010), also found that a larger P300 amplitude was associated with HAB situations with relational provocations. While the feedback-related negativity and the nogo-P3 components were found to be associated with trait hostility and HAB (Yi et al., 2012). The N400 component was first reported by Kutas and Hillyard in 1980, it is a negative deflection in the ERP wavelength, it often reaches monophasic negativity between 200 ms and 600 ms and is largest over centroparietal electrodes (Kutas and Federmeier, 2011). The N400 is elicited by presenting a word that is unexpected or fits poorly with the context of a sentence or discourse (Leuthold et al., 2011). Accordingly, the N400 appears sensitively indicative of the assessment of script-related information and its integration into the context.

In 2012, Leuthold and colleagues conducted a study on the use of ERPs to investigate processing of socio-emotional information. Leuthold's et al., (2012) study will be of importance to the current study. In this study the team of researchers created a rather intelligent methodology to study the processing of socio-emotional information. They generated prototypical social scenarios in which two consecutive sentences were presented to each participant. The first sentence, was used to establish a social context. The second sentence was the target sentence in which a critical word (*italicized below*) informed the participants of the nature of the character's socio-emotional response to the initial situation. An example, of such scenarios:

“Abbey was a truthful coach, who informed the golf pro that he had a good chance of winning the next open.”

“The golf pro was *distraught*.” (Leuthold et al., 2012)

The response either matched or mismatched with what one might typically expect due to the initial context sentence. The above example, is a scenario where the response mismatched the initially posed context or expectation. Leuthold et al., (2012), concluded a larger negative-going ERP deflection was elicited when the critical words mismatched rather than matched with the character’s expected feelings, as established by the initial context. Given the topographic distribution and time-course of their ERP finding, authors suggested an N400-like effect. These findings do in fact reflect previous research, that found larger N400 effect to: unexpected words, words inconsistent with script-related knowledge, words that are a poorer fit the discourse context (Kutas and Federmeier, 2011; Leuthold et al., 2012; Van Berkum et al., 2008). Such findings, provide adequate evidence for individual’s ability to make quick inferences based on socio-emotional information.

Nevertheless, such ERP studies raised the question of whether “ERPs could be used to study the on-line evaluation of attribution of hostile intention” (Gagnon et al., 2016). That is exactly what a group of researchers sought to examine. In 2016 Gagnon and colleagues developed a new paradigm called the Hostile Expectancy Violation, which was adapted from Leuthold’s et al., (2012) paradigm. Rather than assessing violations of socio-emotional expectancies, this new paradigm aimed to directly assess hostile attribution biases. To my knowledge, this study was the first of its kind to utilize EEG recordings along with a designed task to assess attributions of hostile intentions. Gagnon et al., (2016), developed this paradigm to specifically examine neural activity associated with the violations of expectations in both a hostile and non-hostile context among

aggressive and non-aggressive individuals. The Hostile Expectancy Violation Paradigm consisted of three hundred and twenty initial scenarios that were based on daily life social interactions, scenarios were presented in French. Each scenario contained three sentences: (1) context sentence, used to indicate a hostile or non-hostile context. (2) Behavior sentence, where a character commits a social provocation directed towards the reader with ambiguous intentions. (3) Intention revealed, where the intention behind the provocateur's ambiguous behavior is revealed, in table 1 target words are italicised (Gagnon et al. 2017). Note that the last word in the third sentence is the target word which reveals the intention of the provocateur. There are four conditions: non hostile match (NHma), non-hostile mismatch (NHmi), hostile match (Hma), and hostile mismatch (Hmi; see Table 1, p.53). NHma, the context and the intention of the provocateur are both non hostile. NHmi, the context is hostile but the intention is non hostile. Hma, the context and the intention of the provocateur are both hostile. Hmi the context is non hostile and intention is hostile.

Participants were presented such scenarios during EEG recording; they were specifically asked to imagine the thoughts and feelings of the character in the scenarios as if they were themselves in the situations. Subjects then completed the SIP-AEQ (self-report questionnaire measuring HAB) to assess tendencies to make either one of the four attributions of intent: 1) HAB direct form, 2) HAB indirect form, 3) instrumental intent, 4) neutral intent (Gagnon et al. 2016). Findings indicated that critical words that violated hostile intention expectations in the NHmi elicited a larger negative-going ERP deflection, consistent with the N400 component. In addition, ERP effect sizes positively correlated with the SIP-AEQ, suggesting that this ERP effect is a valid indicator of individual's attributions of hostile intent (Gagnon et al. 2016). Gagnon and colleagues explored further those findings in a study in 2017. In other words, they decided to track neural activity associated with the violations of expectations of hostile intent among aggressive and non-

aggressive individuals. Note that aggression was measured through the symptoms of the hostility dimension scale from the BSI (Derogatis, 1993; see Appendix A). In other words, the authors are referring to hostility as being the cognitive component of aggression. Hostility is defined by feelings of irritability, urges to break or smash things, and uncontrollable outbursts of temper. This scale contains items that assess participant's thoughts, feelings, and actions that are characteristic of the negative affect state of anger. Authors assigned individuals scoring above the standard T-score of 65 in the aggressive group, whereas participants scoring below 65 were assigned to the nonaggressive group (Gagnon et al., 2017). Utilising their previously created paradigm, they were able to conclude that the N400 elicited following a violation of hostile expectation (NHmi condition), was in fact larger for aggressive compared to non-aggressive individuals (Gagnon et al., 2017). The findings by Gagnon and colleagues in both 2016 and 2017 are bases for the current study.

## **Theoretical Bases for the Current Study**

Gagnon et al. (2016), have demonstrated that ERPs can be used to study on-line evaluations of HAB, as well as among aggressive individuals (Gagnon et al., 2017). According to Gagnon and colleagues, the Hostile Expectancy Violation paradigm is a promising tool to investigate basic mechanisms of thought associated with aggression. We to believe that this paradigm has potential for not only externalized behaviours but also internalized behaviors and disorders such as anxiety. Despite the fact that comorbid anxiety with aggression has important clinical and treatment implications, research examining their association is scarce (Drabick, Gadow, & Loney, 2008; Flannery-Schroeder, Suveg, Safford, Kendall, & Webb, 2004; Garland & Garland, 2001; Russo & Beidel, 1994). Reasons for the dearth of literature involving co-occurring anxiety and aggression are unclear. One potential reason is that positive associations between anxiety and externalizing

behaviors seem counterintuitive. Moreover, it is difficult to reconcile their co-occurrence conceptually (Bubier & Drabick, 2009). Although it is more widely known of anxiety disorders as being characterized by an excessive worry and fear in situations not warranting this feeling, recent research has shown otherwise.

In the literature there is recurring evidence of anxious individuals expressing at least some sort of aggression (i.e., relational and/or physical aggression; Kashdan and Collins, 2010). Theoretically, this body of evidence has its warrants as, there exists a number of instances where anxiety may motivate children, adolescents and at times adults to act out using aggressive behavior (Galbraith et al., 2014). Moreover, there is also evidence that anxiety disorders and especially social anxiety often co-occur with risk prone behaviors and aggression (Galbraith et al., 2014; Keyes et al., 2016). Although, there is strong evidence of the link between social anxiety with the different forms and functions of aggression (Crick 1995; Storch et al. 2004; Crick et al. 2006; Pepler and Sedighdeilami 1998; Vitaro et al. 2002), this body of literature is still underdeveloped.

Not only do anxious individuals demonstrate aggressive behaviour and at times have a comorbid anxiety and aggression, but anxious individuals also demonstrate negative evaluations. These negative evaluations have a very similar profile to that demonstrated by aggressive people. Such negative evaluations are a result of specific distortions in cognition, like the interpretation of threat and danger in social situations (Beck, 1986). Signaling, a distorted social information processing mechanism (Chorpita, Albano & Barlow, 1993; Barret et al., 1996; Macleod, Mathews & Tata, 1986; Beck & Emery, 1985; Last, 1989; Leitenberg et al., 1986; Eysenck, Mogg, May, Richards, & Mathews, 1991; Eysenck, MacLeod, & Mathews, 1987; Mathews, Richards, & Eysenck, 1989).

Similarly does research surrounding aggression demonstrate. Specific forms of aggression have been consistently linked to attribution biases (Arsenio et al. 2009; Crick and Dodge 1994). For instance, aggressive individuals demonstrating specific distortions in cognition, like interpretations of threat and danger in social situations (Beck, 1986). In fact, relational aggression has been repetitively linked to the attribution of hostile intent in scenarios of relational provocation. Again, the robust relationship that exist indicating that aggressive children, adolescents and adults often demonstrate hostile attribution biases to ambiguous situations (Coccaro, Noblett, & McCloskey, 2009; Dodge, 1980; Dodge et al., 2015; Dodge & Newman, 1981; Epps & Kendall, 1995; Gagnon et al., 2017; Guerra & Slaby 1989; Mathews & Norris, 2002; Nasby, Hayden, & Depaulo, 1980). Both the anxious and aggressive individual's interpretation profiles point to a similar negative interpretation bias, more specifically to a hostile attribution bias. Although, instead they are more often described as “defeated” (Fan et al. 2007), “threatening” (Miers et al. 2008), or generally “negative” (Chambless et al. 2010; Taylor and Wald 2003; Clark & Beck, 2010), rather than being characterized as “hostile”. Thus, very few articles have described these maladaptive attributions of intent as hostile.

Evidently, this body of evidence still demonstrates several gaps that limit the understanding of these comorbid conditions. Firstly, despite their surprisingly unintuitive high co-occurrence, there is limited literature that explore directly underlying cognitive, emotional, or physiological mechanisms of anxious and aggressive individuals. In addition, despite extensive research on negative cognitive interpretations in individuals with anxiety, little research examined HAB directly as their primary goal of the research. To our knowledge only one study sought to examine HAB among anxious individuals (Deschenes, Dugas, and Gouin 2015), yet a self-report measure was used to assess HAB. In fact, most of the literature surrounding negative interpretation biases

and anxiety utilized behavioural questionnaires to assess social information processing. Although questionnaires are an adequate and reliable measure to explore cognitive content, is it not sufficient to explain underlying cognitive processes such as HAB. In addition, these self-report measures are unlikely to adequately assess existing cognitive schemas and associative networks, as Schemas and associative networks are often unconscious and activate automatically (Gotlib et al., 1998). As we have stated that HAB is widely seen as a social-information processing deficit (Milich & Dodge, 1984). And while hostility is a person's cognitive component of aggression, attributions of hostile intent is the inference of his mental state and its underlying neural mechanisms. Moreover, none to our knowledge examined brain electrophysiological measures as markers of specific interpretation biases in individuals with anxiety symptoms as it is repetitively researched with aggressive individuals. Therefore, a direct real time measure of attributional processes is required to further explore the underlying neural mechanisms between anxiety and HAB.

Being able to observe a negative deflection of the N400 in anxious individuals, raises the question whether there are components of hostile attributions bias that are specific to anxious individuals. This opens future doors to examining whether the hostile attribution bias is associated with anxiety score independently from aggression trait. Stated differently, gaining a better understanding of the link between anxiety, aggression, and hostile attribution bias and their neurophysiological underpinnings is crucial to improve the treatment of many psychopathologies. As such, recognizing the nature between anxiety and HAB, is essential for devising effective treatments for individualized anxiety symptoms.

## **Objective & Hypothesis**

The main goal of this research study is to augment our knowledge of the neurophysiological responding of hostile attribution biases in anxious individuals to ambiguous situations. The present



study first aimed to determine (1) the hostile group would present higher anxiety symptom levels than the non-hostile group. Next, we chose to determine 2) whether anxiety symptoms were uniquely related to the HAB, and whether the association existed in both the hostile and the non-hostile conditions of the paradigm described above. Note that hostility is the cognitive component of aggression. Therefore, we first predicted that (2a) anxiety symptom scores would correlate negatively with the N400 amplitude in the non-hostile mismatch condition, after controlling for reactive aggression. We anticipated that those presenting greater anxiety symptom levels would show greater levels of surprise following a non-hostile intention (resulting in a more negative amplitude of the N400), precisely because a hostile intention was expected. Second, we predicted that (2b) higher anxiety symptom scores would correlate positively with the N400 amplitude in the hostile condition, again, after controlling for reactive aggression. Here, if anxiety symptoms are independently related to the hostile bias, those presenting greater anxiety levels would show less surprise towards a hostile intention (resulting in a less negative amplitude of the N400), following a non-hostile context, precisely because a hostile intention was indeed anticipated. The HAB will be measured via EEG with a scenario of vignettes created by Gagnon et al. (2017). All data used in this research study were collected during another previous study on aggression and impulsivity (Gagnon et al., 2017).

## **Method**

### **Participants**

68 participants were recruited from university student population, the community, and placed in Kijiji, and from a personality disorders clinic. Respondents were then given a brief description of the study over the phone, followed by screening interview as well as questions to

assess inclusion and exclusion criteria. Those meeting the inclusion criteria were then informed of additional information pertaining to the study. Potential participants were told to abstain from consuming alcohol and any drugs for 24 hours and one week before each session. Monetary compensation of 40\$ was given to each participant at the end of the testing sessions. The exclusion criteria were: French was not a mother tongue, lower than 6<sup>th</sup> grade education, ever suffered a serious traumatic brain injury or had a history of psychosis.

### **Brief symptom inventory (BSI)**

The BSI is a self-reported questionnaire aimed at measuring clinical psychological symptoms in adolescents and adults. The BSI covers 9 symptom dimensions through the assessment of 53 items and uses a 5-point Likert (0 = not at all, to 4 = extremely) scale to score the items. The 9 symptom dimensions include: Somatization, Obsession-Compulsion, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobic anxiety, Paranoid ideation and Psychoticism. The BSI also assesses three global indices of distress which are: Global Severity Index, Positive Symptom Distress Index, and Positive Symptom Total. This questionnaire is in fact a shortened version of the SCL-R-90 (Derogatis, 1975, 1977). The participants also completed the entire questionnaire with all 9 dimensions online. For the purpose of this research, we will utilise the scores of the items in the anxiety dimension. The anxiety dimension included items: 1, 12, 19, 38, 45, and 49 (See Appendix A). A T-test will then be performed to determine whether the groups differ on their level of anxiety. We will be utilising the BSI because it has good psychometric support with previous research reporting its reliability and validity for all nine dimensions. Reporting good internal consistency reliability ranging from 0.71 to 0.85 and test-retest reliability ranging from 0.68 to 0.91 (Croog et al., 1986; Aroian & Patsdaughter, 1989 in Derogatis, 1993).

In addition, the BSI has demonstrated high correlations of 0.92-0.99 with the Symptoms Checklist-90-Revised (SCL-R-90; Derogatis, 1993).

### **Reactive-proactive aggression questionnaire (RPQ)**

The RPQ developed by Raine et al, (2006) and its French adapted version by Gagnon & Rochat, (2016), is a self-reported questionnaire measuring individual's reactions to aggressive situations. It contains 23 items measured on a 3-point Likert scale from 0-2, 0 being never, 1 being sometimes and 2 being always. The RPQ contains a reactive and proactive aggression subscale, for the purpose of this study we will only utilise the reactive subscale. The reactive subscale contains 11 items and the higher the score the greater the level of aggression. The French adapted version of the RPQ (Gagnon & Rochat, 2017; See Appendix C) was used in this study. Through its repetitive use in numerous studies, this questionnaire was deemed a valid psychometric measure (Baker, Raine, Liu, & Jacobson, 2008; Gardner, Archer, & Jackson, 2012; Miller & Lynam, 2006; Raine et al., 2006).

### **Hostile expectancy violation paradigm**

We are going to use the Hostile expectancy violation paradigm developed by Gagnon et al. 2017 to explore the attribution of hostile intention among anxious and non-anxious individuals. Three hundred and twenty social scenarios were used, they were based on daily life social interactions. Each scenario contained three sentences: (1) was a context sentence, used to indicate a hostile or non-hostile context, (2) Behavior sentence, where a character commits a social provocation directed towards the reader with ambiguous intentions, (3) intention revealed, where the intention behind the provocateur's ambiguous behavior is revealed, in table 1 target words are italicised (Gagnon et al. 2017). The last word in the third sentence is the target word which reveals

the intention of the provocateur. There are four conditions: non hostile match (NHma), non-hostile mismatch (NHmi), hostile match (Hma), and hostile mismatch (Hmi; see Table 1). NHma, where the context and the intention of the provocateur are both non hostile. NHmi, where the context is hostile but the intention is non hostile. Hma, where the context and the intention of the provocateur are both hostile. Hmi where context is non hostile and intention is hostile. All scenarios shared the same ambiguous behavior (behavior sentence), they only differed on the intention either hostile or non-hostile. The context and behavior sentences had a maximum of 25 words and the intention sentence a maximum of 8 words. The intention sentence had two forms either affirmative or negative form those were distributed equally across all conditions. Example of an affirmative and negative intention sentence respectively are: “The stranger wants to provoke you” and “Your colleague does not want to help you”.

## **Procedure**

One-hundred and fourteen participants were initially recruited to participate in the study, thirty-seven of those were excluded due to an incomplete BSI questionnaire. Five participants selected in a personality disorder clinic were excluded in order to control for a potential selection bias where anxiety symptoms could already exist among participants recruited for their hostility. Four participants presented with higher than a 20% rejection trial rate, due to excessive eye movements and blinks as well as signal interference due to excessive bodily motion. The final sample was comprised of 68 participants.

Participants were informed of the entire experiment including the EEG procedure and informed consent was then obtained. Participants were placed in a Faraday’s cage and tested in a low-level ambient light. During the EEG component, all participants were instructed to read all scenarios carefully and to avoid making eye movements as this disrupts the waves recorded by the

EEG. Participants were told that the scenarios depict social interactions and they should imagine as if they were the ones in these interactions. Participants went through four practice trials prior to beginning 10 experimental blocks. Each trial presented the context and behavior sentence until participant pressed the space bar to continue. Followed by the intention sentence, which was presented word-by-word. To ensure participants were reading the sentences carefully and not merely skipping, there was one filler question presented at random in each block, which consisted of a true or false comprehension question. The mean correct response rate was 88%, indicating participants were reading for comprehension. Following the EEG procedure, all participants were given computerized versions of the RPAQ.

### **EEG recording**

Similarly, the EEG recording was adapted from Gagnon et al. (2017). An electroencephalogram with 64 Ag/AgCl electrodes (Biosemi Active Two system) was used, referencing to the right and left mastoids, which was placed according to the international 10-10 system (Sharbrough et al., 1991). Both the horizontal and vertical electrooculogram were used to detect eye movements and eye blinks. The horizontal electrooculogram (HEOG) recorded the voltage difference between electrodes placed laterally to the external canthi to record eye movements. To record eye blinks, the vertical electrooculogram (VEOG) recorded the voltage difference between two electrodes placed above and below the left eye. During recording, both electroencephalogram and electrooculogram were digitized at 512 Hz and low pass filtered at 134Hz. To correct the data and reduce artifacts, an independent component analysis (ICA) was used (see Drisdelle, Aubin, & Jolicoeur, 2016). Any trials that eye blinks with VEOG>50 mV on an interval of 150 ms were excluded from analysis. Similarly, trials with large horizontal eye movements of HEOG>35 mV on an interval of 300ms were also excluded.

## **EEG data analysis**

For the purpose of this study, signals at each electrode site were averaged for the four experimental conditions (NHmi, NHma, Hmi, Hma). This averaging was time-locked to the onset of the target word. To test our hypotheses, we conducted the following statistical analyses. An ANOVA was performed to determine regions of interest for the N400 effect. Correlational and ANOVA analysis were utilized in order to examine the relationship between the variables of interest. To verify our hypothesis, whether high anxious individuals demonstrate a hostile attribution bias independent from aggression trait, standard multiple regressions were performed to measure the combined effect of anxiety, reactive aggression, age on the N400 obtained on the regions of interest.

An ANOVA was performed to pinpoint which regions are promising for the N400. According to Gagnon et al. (2016, 2017), we created six brain regions that pooled electrodes with respect to their regions (anterior, central, posterior) and hemisphere (right and left). The following six regions pooled the following electrodes: 1) Left-anterior (AF3, AF7, F1, F3, F5, F7, FC1, FC3, FC5, FT7); 2) Left-central (C1, C3, C5, T7, CP1, CP3, CP5, TP7); 3) Left-posterior (P1, P3, P5, P7, PO3, PO7, O1); 4) Right-anterior (AF4, AF6, F2, F4, F6, F8, FC2, FC4, FC6, FT8); 5) Right-central (C2, C4, C6, T8, CP2, CP4, CP6, TP8); 6) Right-posterior (P2, P4, P6, P8, PO4, PO8, O2). Our independent variable was the level of anxiety and the dependant variable was the HAB as measured by the N400 amplitude. Concerning the six regions, statistical Analysis were performed by means of Huynh-Feldt corrected repeated measures ANOVA with variables: condition (hostile, non-hostile), consistency (match, mismatch), hemisphere (right, left), region (anterior, central, posterior).

## **Chapter II – [Scientific Article]**

## Page Title

Electrophysiological markers for Hostile Attribution Bias among individuals with anxiety

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## Abstract

**Background:** Anxiety disorders constitute the most prevalent subgroup of mental health conditions. While anxious individuals are more widely known as being socially withdrawn and shy, recent research highlights a rather non-prototypical image, one that is aggressive. The main goal of this event-related brain potentials (ERPs) study is to augment our knowledge of the neurophysiological responding of hostile attribution biases of anxious individuals to ambiguous situations. **Methods:** Using pre-collected data from a sample of 68 undergraduate and community-based adult participants, this study aims to explore the N400 deflection utilising Gagnon et al.'s (2016) Hostile Expectancy Violation Paradigm with anxious individuals, and whether the N400 deflection persists after controlling for aggression. **Results:** A more negative amplitude was observed in response to a critical word that mismatched rather than matched with the character's expected hostile intention. Regression analyses revealed that anxiety scores negatively predicted the N400 following the mismatched expected hostile intention while controlling for reactive aggression suggesting that the violation of hostile expectancy about the intention behind an ambiguous provocative behavior is more pronounced among anxious participants. Conversely, in the hostile condition, the overall model was significant, although anxiety scores did not account for the overall effect, reactive aggression did. **Conclusion:** This study provides preliminary evidence that anxiety symptoms are uniquely related to hostile attribution bias independent of reactive aggression. Future research should aim to replicate these findings with a clinically diagnosed sample of individuals with anxiety disorders.

*Keywords:* anxiety, aggression, Hostile Attribution Bias, electrophysiology, EEG, N400, Hostile Expectancy Violation Paradigm

## Introduction

In 1994 Ricky Williams was considered one of the top running backs in the country, already a senior with over 25 touchdowns. Later in 1998, he solidified his career in college football history and was awarded as the best football player in the United States receiving the Heisman Trophy. He often conducted post-game interviews with his helmet and tinted visor on in efforts to avoid eye contact. What no one knew was that beneath his 6-foot figure and 225 pounds of muscle was a regular guy who suffered from social anxiety disorder. Although he was able to run across the football field in front of more than 80 000 viewers, his fear of being ridiculed caused him great anxiety when making small talk with teammates or participating in interviews (Kashdan & McKnight, 2010). According to the World Health Organization (2017), anxiety disorders are ranked as the 6<sup>th</sup> largest contributor to global disability, while manifesting in nearly 3 million Canadian adults (11.6%; Statistics Canada, 2015). Often times patients carry their symptoms for 5 to 10 years before they are diagnosed and treated yet fewer than 20% of them experience complete remission (Ustun & Sartorius, 1995).

Anxiety disorders are more widely characterized by social withdrawal, shyness and discomfort in social situations, yet recent research has demonstrated a non-prototypical aggressive image (Galbraith, et al., 2014). In fact, individuals with anxiety disorders were found to express intense overblown anger and aggression (Kashdan & Collins, 2010), and significantly higher levels of anger and aggression compared to non-anxious individuals (Moscovitch et al., 2008; Galbraith et al., 2014). Surprisingly, some researchers have supported a link between social anxiety and aggression (Storch, Bagner, Geffken, and Baumeister, 2004; Crick et al. 2006) as well as relational aggression (Marsee et al., 2008). Nonetheless, this body of literature is still underdeveloped and the literature that exists presents conflicting findings (Dewall et al., 2010). Thus, supporting the

importance of further research on anxious individuals to understand potential cognitive mechanisms.

Social anxiety is not merely a fear of negative evaluations, but a chronic fear of rejection indicative of a distorted cognitive thought process. This fear of rejection often times giving rise to feelings of hostility towards others as well as perceiving hostility in others (Rapee & Heimberg, 1997). According to Beck's (1985) theory of anxiety, specific distortions in cognition like the interpretation of threat and danger in social situations are associated with both anxiety and aggression. Recent research efforts have provided support for distorted social-information processing among anxiety disorders (Beck & Emery, 1985). For instance, anxious individuals detect more accurately fear-relevant words (Burgess et al., 1981; Parkinson & Rachman, 1981), and are more prone to threat interpretations of ambiguous situations (Barret et al., 1996; Chorpita, Albano and Barlow, 1993). In fact, anxious individuals not only demonstrate a processing bias whereby they attend to more emotionally threatening information, rather they also interpret ambiguous information as threatening (Macleod, Mathews and Tata, 1986; Barret, et al., 1996).

Although the relationship between hostile attributions of intent and externalized behaviors like aggression is solidified in the literature, this link remains unresolved with internalized behaviors such as anxiety (Coccaro et al., 2009; Dodge, 1980; Gagnon et al., 2017; Mathews & Norris, 2002). Furthermore, very few articles have described this maladaptive attribution of intent as being hostile in nature (DeWall, et al. 2010). Such findings confirm the presence of maladaptive cognitive distortions but more importantly they signal the presence of potential underlying aggression-related maladaptive schemas such as Hostile Attribution Bias (HAB).

Hostile Attribution Bias is the tendency to interpret ambiguous social context cues as negative or hostile in nature (Gagnon et al., 2016). Although HAB has received much attention in

individuals with aggression it has not nearly received such attention in individuals who are not only aggressive but display anxiety symptoms. Many researchers have expressed the importance of negative cognitive interpretations in individuals with anxiety but none to this date have explored HAB directly with individuals both aggressive and anxious. Most of the research revolving around HAB utilise clinically aggressive subjects and measures of HAB often involve presenting social vignettes followed by open-ended or forced choice questionnaires.

While hostility is a person's cognitive component of aggression, attributions of hostile intent is the inference of his mental state and its underlying neural mechanisms (Buss, 1988; Gagnon et al., 2016). As such the use of Event-related potentials (ERP) have been consistently studied as a measure of brain functioning related to mechanisms involved in social cognition (Gagnon et al., 2016; Gagnon, & Rochat, 2017). More specifically, the N400 component has been consistently used to explore violations of socio-emotional expectancies (Leuthold et al., 2012). In other words, a larger N400 effect occurs when individuals are presented with unexpected words (Kutas and Federmeier, 2011), words inconsistent with script-related knowledge (Leuthold et al., 2012), and words that are a poorer fit to the discourse context (Van Berkum et al., 2008). The current study attempted to directly assess HAB rather than explore violations of socio-emotional expectancies by utilizing the Hostile Expectancy Violation Paradigm developed by Gagnon and colleagues (2016). According to Gagnon and colleagues, the Hostile Expectancy Violation paradigm is a promising tool to investigate basic mechanisms of thought associated with aggression. As authors managed to find that critical words that violated hostile intention expectations in the non-hostile condition elicited a larger N400 deflection among aggressive individuals compared to their non-aggressive counterparts. We to believe that this paradigm has

potential for not only externalized behaviours but also internalized behaviors (i.e., anxiety). The current study is also based on findings from Gagnon and colleagues in both 2016 and 2017.

To our knowledge only one study sought to examine HAB among anxious individuals (Deschenes, Dugas, & Gouin, 2015), yet self-report measures were used to assess HAB. Self-report measures are unlikely to adequately assess existing cognitive schemas and associative networks, as they are often unconscious and activate automatically (Gotlib et al., 1998). Therefore, a direct real time measure of attributional processes is required to further explore the underlying neural mechanisms between anxiety and HAB. Gaining a better understanding of the electrophysiological underpinnings between anxiety and aggression-related maladaptive schemas (i.e HAB) is essential for devising effective treatments for anxiety symptoms and to improve existing treatments of other psychopathologies.

This study aims to augment our knowledge of the neurophysiological responding of hostile attribution biases in anxious individuals to ambiguous situations. First, we examined whether anxiety symptoms were uniquely related to the HAB, above and beyond aggressive traits. Therefore, it was expected that anxiety symptom scores would negatively predict the N400 amplitude in the non-hostile mismatch condition, after controlling for reactive aggression. Second, we predicted that higher anxiety symptom scores would positively predict the N400 amplitude in the hostile mismatch condition, after controlling for reactive aggression. HAB was measured via electroencephalography with a scenario of vignettes created by Gagnon et al. (2017). The data used for this project was gathered as part of a larger study entitled “Cognitive and neurophysiological mechanisms associated with the "Urgency" personality trait: theoretical and empirical integration.” (Gagnon & Jolicoeur, 2014).

Table 1. – Examples of possible scenario sentences

<b>First Sentence (social context)</b>	<b>Second (ambiguous behavior)</b>	<b>Third sentence (intention)</b>	<b>Context</b>
<u>Non-hostile</u> Before the exam, the class is quiet.	A friend walks by you and does not speak to you.	<u>Non-hostile</u> He does not want to <i>distract</i> you.	<u>Non-hostile</u> <u>match</u> (NHma)
<u>Hostile</u> Before the exam, the students stare jealously at each other.	A friend walks by you and does not speak to you.	<u>Non-hostile</u> He does not want to <i>distract</i> you. <sup>a</sup>	<u>Non-hostile</u> <u>mismatch</u> (NHmi)
<u>Hostile</u> Your co-worker is vengeful.	is He comes to your desk.	<u>Hostile</u> He wants to <i>annoy</i> you.	<u>Hostile match</u> (Hma)
<u>Non-hostile</u> Your co-worker is working.	He looks at you.	<u>Hostile</u> He wants to <i>annoy</i> you.	<u>Hostile</u> <u>mismatch</u> (Hmi)

Note. Sentences were written in French. The target word is located at the end of the sentence in the French language. In French the pronoun "you" precedes the verb which is describing the character's intention, resulting in the target sentence to finish with the critical word (i.e., <sup>a</sup> translates into "Il ne veut pas vous distraire")

## **Method**

### **Participants**

One-hundred and fourteen participants were initially from university the student population, the community, adds placed in Kijiji. Respondents were then given a brief description of the study over the phone, followed by screening interview as well as questions to assess inclusion and exclusion criteria. Those meeting the inclusion criteria were then informed of additional information pertaining to the study.

### **Measures**

The Brief Symptom Inventory (BSI) was used to assess clinical psychological symptoms, specifically we utilised the scores of the items in the anxiety dimension. The Reactive-Proactive Aggression Questionnaire RPAQ developed by Raine et al, (2006) and its French adapted version by Gagnon & Rochat, (2016), was used to assess individual's reactions to aggressive situations. For the purpose of this study, we utilised the reactive subscale. The hostile expectancy violation paradigm developed by Gagnon et al. (2017) was used to explore HAB, it consisted of multiple scenarios that were based on daily life social interactions. Each scenario contained three sentences: (1) Context sentence, used to indicate a hostile or non-hostile context; (2) Behavior sentence, where a character commits a social provocation directed towards the reader with ambiguous intentions; and (3) Intention revealed sentence, where the intention behind the provocateur's ambiguous behavior is revealed. There were four conditions (see Table 1, p.59).

### **Procedure**

One-hundred and fourteen participants were initially recruited to participate in the study. Forty-six participants were excluded due to: an incomplete BSI questionnaire and higher than a

20% rejection trial rate. The final sample was comprised of 68 participants who were informed of the EEG experiment and their consent was obtained. Participants were placed in a Faraday's cage and tested in a low-level ambient light. Participants were instructed to read all scenarios carefully and encouraged to avoid making eye movements. Participants were told that the scenarios depict social interactions and they should imagine as if they were the ones in these interactions. Participants went through four practice trials prior to beginning 10 experimental blocks. To ensure participants were carefully reading, a filler true or false comprehension question was randomly presented in each block. The mean correct response rate was 88%, indicating participants were reading for comprehension. Following the EEG procedure, all participants were given computerized versions of the RPAQ.

### **EEG Recording**

The EEG recording was adapted from Gagnon et al. (refer for more details; 2017).

### **Data analysis plan**

For the purpose of this study, signals at each electrode site were averaged for the four experimental conditions (NHmi, NHma, Hmi, Hma). This averaging was time-locked to the onset of the target word. An ANOVA was performed to determine regions of interest for the N400 effect. Correlational and ANOVA analysis were utilized in order to examine the relationship between the variables of interest. To verify our hypothesis, standard multiple regressions were performed to measure the combined effect of anxiety, reactive aggression, and age on the N400 obtained on the regions of interest. We examined the same six regions as Gagnon et al. (2016, 2017): Left and Right, -anterior, -central, -posterior. Statistical analysis were performed by means of Huynh-Feldt



corrected repeated measures ANOVA with variables: condition (hostile, non-hostile), consistency (match, mismatch), hemisphere (right, left), region (anterior, central, posterior).

## **Results**

All analyses were reconducted on 68 participants. A preliminary visual inspection of the global ERP trace displayed a pronounced ERP negative deflection, found between 450 and 650 ms for the non-hostile condition. According to Kutas and Federmeier (2011), this negative deflection falls within the N400 time window. Data analyses showed an N400 effect in the non-hostile condition, indicating a violation of the expected hostile intention following a hostile context. N400 ERP amplitude was measured as the difference between the mean mismatch and the match conditions.

In Figure 1, the mean ERP waveforms of the six regions and the midline for the match and mismatch, and hostile and non-hostile conditions are presented. In Figure 2, the mean ERP difference waveforms (ERP mismatch minus ERP match) for the hostile and non-hostile conditions are displayed. Figure 3 displays the topographic voltage maps: mean amplitude ranging from 400 to 600 ms relative to the onset of the critical word. When these ERP waveforms, that words that violate hostile intention expectations (mismatch condition) in the non-hostile condition elicit a clear N400 effect evident near 400 ms after the onset of the critical word.

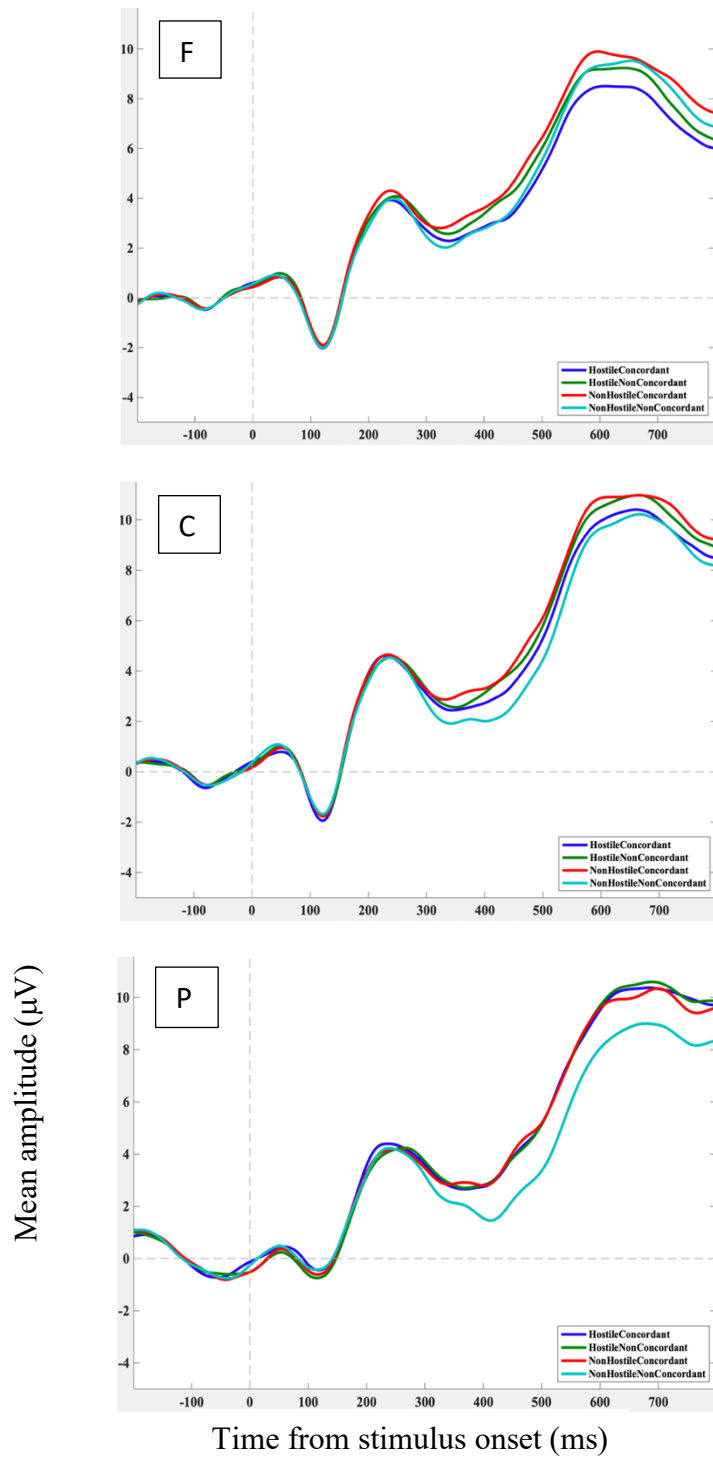


Figure 1. – ERP signal of anterior, central and posterior electrode sites of the midline for the match and mismatch, and hostile and non-hostile conditions.

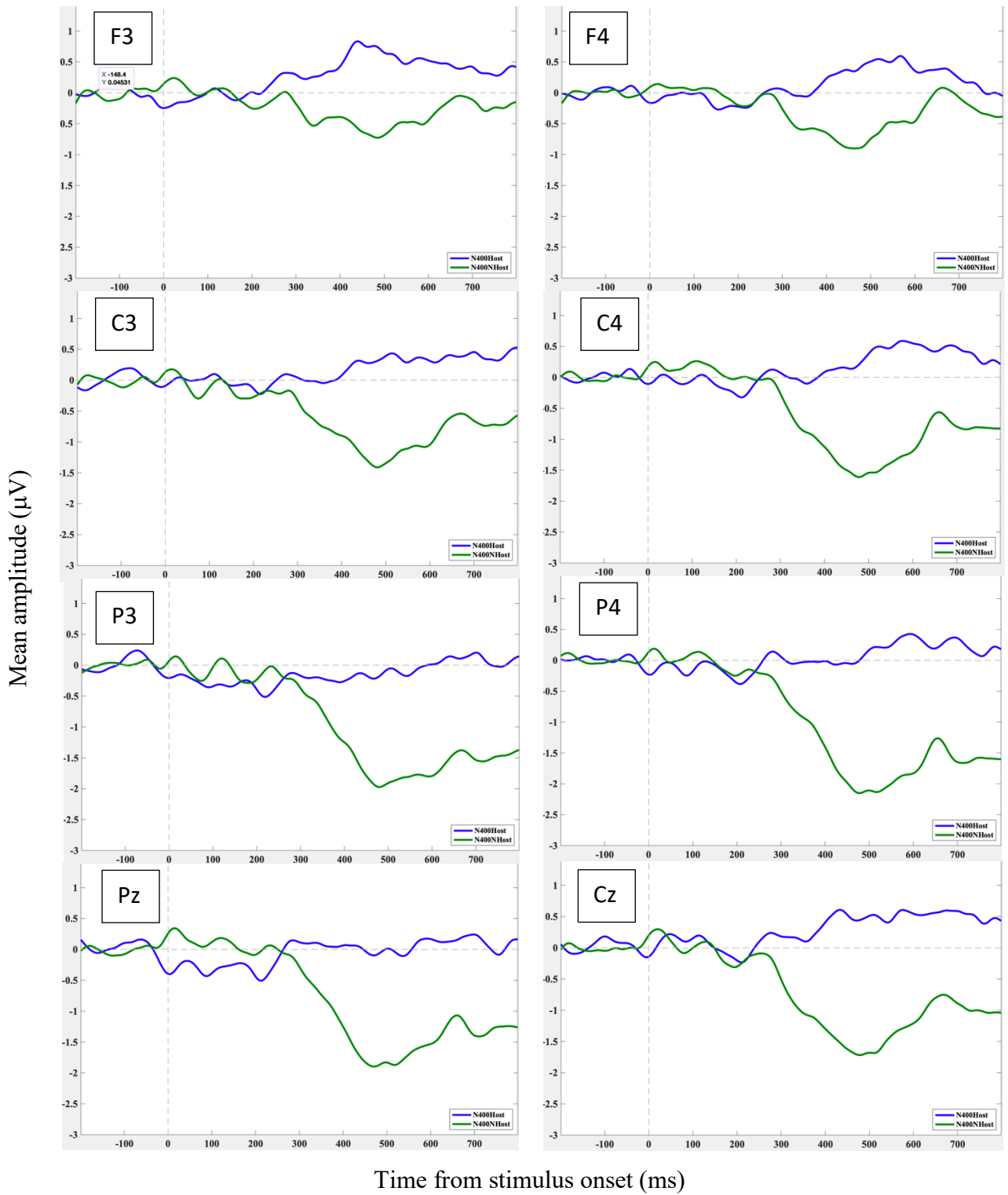


Figure 2. – Mean ERP difference waveforms (ERP mismatch minus ERP match) for the hostile and non-hostile conditions.

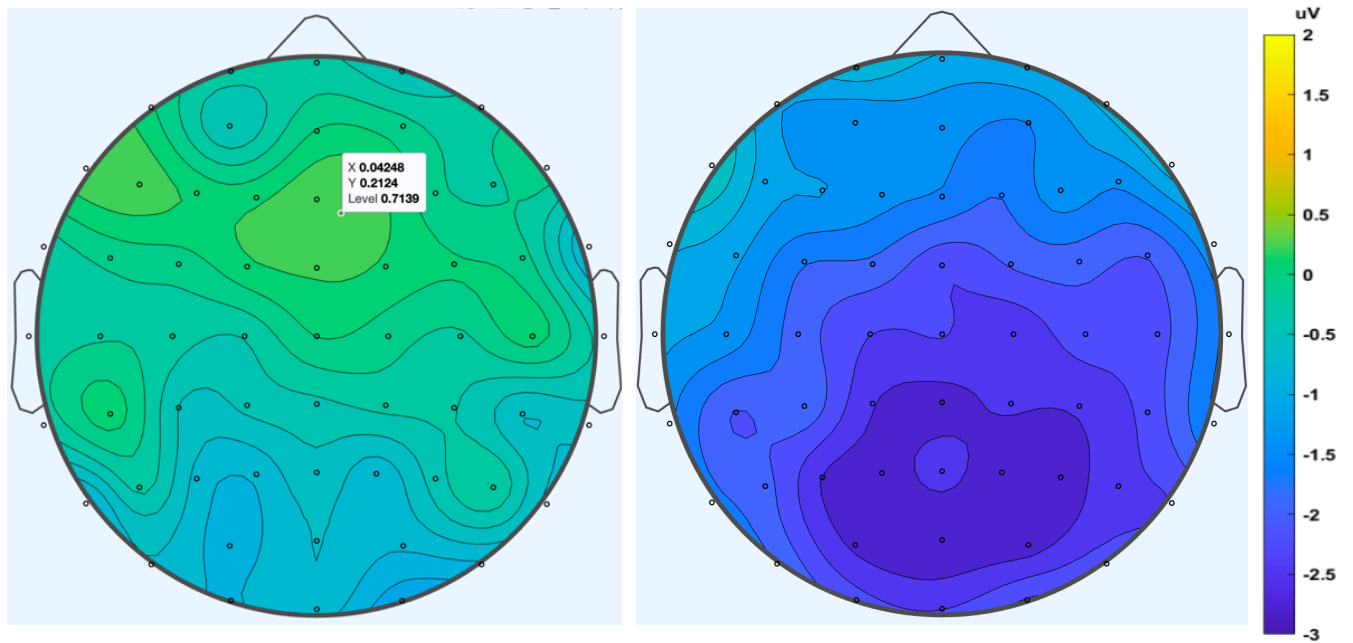


Figure 3. – Topographic maps of mean ERP difference waveforms..

Note. The left map is a violation of non-hostile intention expectancy. The right map is the violation of hostile intention expectancy.

### **Analysis of variance (ANOVA)**

Since we were interested in the impact of violations of intention expectations, we examined the main effects of ANOVAs and interactions with regards to the consistency factor and condition. Initially, the repeated measures ANOVA revealed a significant main Consistency effect. There was a significant interaction between Condition and Consistency (Huynh-Feldt = 152.5,  $F(1, 67) = 21.7$ ,  $p = .000$ ), as well as condition, hemisphere and region (Huynh-Feldt = 6.6,  $F(2, 66) = 18.2$ ,  $p = .000$ ). Such results are indicative of the presence of the N400 expected in the non-hostile condition.

For the current study, we chose to comparatively examine the N400 amplitude for the hostile and non-hostile conditions of the ERP task, using the right hemisphere electrodes that are centrally, posteriorly and anteriorly located, according to research literature that states that the

N400 effect is largest over centro-parietal sites, with a slightly right hemisphere bias for written words in sentences (Kutas & Federmeier, 2011). In addition, Gagnon et al., (2017) have obtained greater component amplitudes for the non-hostile condition (non-hostile intent) than for the hostile condition (hostile intent), but also for the central and posterior electrode sites than for the anterior sites, and for the hostile group than for the non-hostile group (Gagnon et al., 2017). Since this study is utilizing the same data used in a prior study on aggression and impulsivity (Gagnon & Jolicoeur, 2014) and the more recent study by Gagnon et al., (2017), we decided to examine N400 amplitude for both conditions, for the right hemisphere electrodes.

### Correlations

A correlation table revealed correlations between, BSI anxiety subscale scores, reactive RPAQ scores, and the non-hostile N400 right central. In addition, age was positively correlated with the non-hostile N400 right central but not sex. There was no correlation between BSI anxiety and Hostile N400 for any of the six regions (see Table 2).

Table 2. – Means, Standard Deviations, and Correlations

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5
1. BSI anxiety score	.90	.89					
2. Reactive RPAQ score	9.68	4.31	.52**				
3. Non-hostile right central N400 ( $\mu$ v)	-1.23	1.58	-.26*	-.15			
4. Hostile right central N400 ( $\mu$ v)	.21	1.85	.13	.36**	-.20		
5. Sex			.19	.05	.01	-.06	

6. Age	26.23	7.84	-.01	-.01	.29*	.00	-.12
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Note. M = mean and SD = standard deviation. \* indicates  $p < .05$ . \*\* indicates  $p < .01$ .

### Multiple regression

We first tested for multicollinearity in the regression models, our collinearity statistics tolerance ranged from 0.73 to 0.74, thus indicating our models were not multicollinear. For the first analysis, we examined the non-hostile condition, specifically used the right anterior N400 effect size. An overall significant effect was observed ( $F = 2.48, p = .07$ ), in which anxiety was a significant predictor of the N400 effect ( $\beta = -.29, t = -2.05, df = 63, p = .04$ ), whereas reactive aggression ( $p = .28$ ) and age ( $p = .07$ ) were not (see Table 3). Similarly, a multiple regression was conducted with the right central N400 for the non-hostile condition and found a significant overall effect ( $F = 3.46, p = .02$ ). While age ( $\beta = -.06, t = 2.43, df = 63, p = .02$ ) was a significant predictor of the N400 effect, Anxiety ( $\beta = -.27, t = -1.98, df = 63, p = .05$ ) demonstrated tendency for significance, while reactive aggression ( $p = .70$ ) was not (see table 4). Finally, a third multiple regression was performed using the right posterior N400 for the non-hostile condition. Results revealed no significant overall effect ( $F = 1.40, p = .25$ ).

For the hostile condition, we examined the right anterior, central and posterior. For the right anterior an overall significant effect was observed ( $F = 2.94, p = .04$ ), in which only reactive aggression ( $\beta = .19, t = 2.84, df = 63, p = .01$ ) significantly predicted the N400 effect whereas anxiety scores ( $p = .11$ ) and age ( $p = .42$ ) did not. Similarly, in the right central an overall significant effect was observed ( $F = 3.61, p = 0.2$ ), where reactive aggression ( $\beta = .44, t = 3.17, df = 63, p = .00$ ), was the predictor of the N400 effect. In the same manner, we found no significant overall effect in the right posterior ( $F = 2.45, p = 0.72$ ).

Table 3. – Multiple Regression Using Non-hostile Right Anterior N400

Variables	Standardized Coefficients				Overall Model Fit				
	<i>B</i>	<i>SE</i>	$\beta$	<i>t</i>	<i>Adj.</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>
Right anterior N400	-1.65	.82		-2.02	.07	63	5.87	2.48	.07
Age	.04	.03	.22	1.79					.07
BSI anxiety Scores	-.93	.06	-.29	-2.05					.04
Reactive RPAQ	.07	.06	.17	1.20					.28

Note. *B*=unstandardized coefficient, *SE*=standard error,  $\beta$ = standardized regression coefficient, *MS*= mean square.

Table 4. – Multiple Regression Using Non-hostile Right Central N400

Variables	Standardized Coefficients				Overall Model Fit				
	<i>B</i>	<i>SE</i>	$\beta$	<i>t</i>	<i>Adj.</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>
Right central N400	-2.22	.81		-2.75	.11	63	7.95	3.46	.02
Age	.06	.02	.29	2.43					.02
BSI anxiety Scores	-.88	.45	-.27	-1.98					.05
Reactive RPAQ	.02	.06	.05	.39					.70

Note. *B*=unstandardized coefficient, *SE*=standard error,  $\beta$ = standardized regression coefficient, *MS*= mean square.

## Discussion

A previous study showing that aggressive individuals infer more hostile intentions from others in ambiguous scenarios (Gagnon et al., 2017), raised the question of whether anxious individuals also demonstrate hostile attribution biases in ambiguous situations. In addition, Deschenes, Dugas and Gouin's findings (2015), that individuals with GAD demonstrated more threatening interpretations and hostile attributions than their less anxious counterparts, sparked interest in examining HAB with robust methods in a complementary manner to questionnaires. The goal of this study was to examine neurophysiological responding of hostile attribution biases in relation to anxiety symptoms to ambiguous situations independent of reactive aggression. More specifically our first hypothesis was confirmed, in that BSI anxiety symptom scores negatively predicted the N400 amplitude in the non-hostile mismatch condition, even after controlling for reactive aggression. This effect was observed in the right anterior region in the non-hostile condition, when reactive aggression was factored in as a covariate. In addition, in the non-hostile condition, anxiety scores had a tendency to predict N400 scores in the right central region, with a p-value near significance.

Such results are in fact in line with aggression literature mentioned above that suggests a more pronounced N400 effect in the non-hostile condition, although stronger in centroparietal sites, and with slight right hemisphere bias for written words in sentences (Kutas & Federmeier, 2011; Gagnon et al. 2017). A potential explanation is that chronic activation of knowledge structures that represent aggressive schemas cause HAB in aggressive individuals. Over time, aggressive individuals build a more rapid schema for the activation of aggressive thoughts and this is hypothesized to lead to more hostile attributions (Anderson & Bushman, 2002). Another potential explanation for our findings is that aggressive individuals can potentially be remembering negative



cues from their past experiences and linking them to the current situation (Dodge & Newman, 1981). Similarly, can we speculate with our anxious participants, during the presentation of social scenarios, participants linked them to negative cues from past experiences, resulting in cue distortions.

Our findings are also in line with anxiety research that report negative interpretation biases (i.e. detect fear relevant words, prone to threat interpretations) among anxious individuals (Beck & Emery, 1985). More specifically, anxious individuals often fear other's negative evaluations (Kashdan & McKnight, 2010). This fear often points to a distorted thought process of how they perceive their social interactions. Which may point to specific distortions in the processing of social information. Potentially accounting for the fact that they interpret ambiguous situations as more hostile than less anxious individuals. Similarly, many anxiety studies have reported that anxious individuals often demonstrate hyper-vigilance for threat in ambiguous situations or attention bias to threatening information (Eysenck et al., 1987; Mathews et al., 1989; Reid, Salmon, & Lovibond, 2006). In fact, core feature of social anxiety is hyper-vigilance to sources of potential social rejection and negative evaluations (Rapee & Heimberg, 1997). Thus, our findings that more anxious individuals interpret ambiguous social situations as hostile, is consistent with the idea that the observed HAB among anxious individuals is explained by their hyper-vigilance for threat in the ambiguous situations and potential rejection or negative evaluations. However, the relation between HAB and anxiety can be explained the other way around, where negative consequence of aggression on social interactions can maintain HAB as well as anxious symptoms in aggressive individuals. More research is needed to disentangle the causal relationship between HAB and anxiety.

To our best knowledge, this is the first study to examine electrophysiological markers for HAB among anxious individuals utilizing Gagnon et al., (2016)'s Hostile Expectancy Paradigm. Only one previous study has attempted a similar research question, where they explored the information processing styles of individuals with GAD (Deschenes, Dugas & Gouin, 2015). Similarly, to our findings, authors concluded that individuals with GAD attributed greater hostile intent to provocateurs, where intent of the provocateur was ambiguous in the social scenarios. The use of questionnaires in Deschenes et al.'s study (2015) to assess HAB are more suitable for exploring cognitive content rather than underlying cognitive processes. Our study attempted to bridge this gap and assess on-line social information processes utilizing ERPs which are proven effective in studying attributions of hostile intent (Gagnon et al., 2016).

According to previous research on the N400 and HAB, the N400 is expected in the right central and posterior sites (Gagnon et al., 2016; Gagnon et al., 2017). However, in our study the presence of the ERP component was found in the right anterior region. A potential explanation for such findings is that anxiety may be associated with additional effort to integrate non-hostile stimuli in a hostile context (Van Berkum et al., 2008). Further research is needed to explore further if HAB in anxious individuals is specifically associated with the anterior rather than posterior region.

Our second hypothesis, that higher anxiety symptom scores would correlate positively with the N400 amplitude in the hostile condition, after controlling for reactive aggression, was not confirmed. Contrary to our hypothesis, the overall model was significant, although anxiety scores were not significantly correlated with the N400 amplitude. Nonetheless, reactive aggression accounted for the overall significance which is consistent with Gagnon et al. (2016) results that explained the observed N400 effect in the hostile condition to be associated with reactive aggression.

A noteworthy limitation is the use of a self-report measure to assess BSI anxiety symptoms scores. Although individuals differed on anxiety symptoms, they showed relatively low scores on the BSI anxiety subscale. This may be partly explained by the small non-clinical sample that was selected on hostility. Such a sample may differ from a clinical sample in anxiety symptom severity and aggression, depending on the anxiety disorder. Greater anxiety symptom levels could be anticipated in a larger clinical sample, potentially validating our results and conclusions further. This study provides preliminary evidence that anxious individuals interpret ambiguous situations as more hostile than less anxious individuals, independently of reactive aggression. Our findings suggest that anxious individuals not only interpret ambiguous situations as threatening, but also as hostile. Future research should aim to replicate these findings with a clinically diagnosed sample of individuals with anxiety and whether this effect is specific to types of anxiety disorders.

This study provides preliminary evidence that anxious individuals interpret ambiguous situations as more hostile than less anxious individuals, independently of reactive aggression. Our findings suggest that anxious individuals not only interpret ambiguous situations as threatening, but also as hostile. Future research should aim to replicate these findings with a clinically diagnosed sample of individuals with anxiety and whether this effect is specific to types of anxiety disorders.



## **Chapter III – [General Conclusion]**

## Conclusion

To our best knowledge, this is the first study to examine electrophysiological markers for HAB among anxious individuals utilizing Gagnon et al., (2016)'s Hostile Expectancy Paradigm. Only one previous study has attempted a similar research question, where they explored the information processing styles of individuals with GAD (Deschenes, Dugas & Gouin's findings, 2015). Similarly, to our findings, authors concluded that individuals with GAD attributed greater hostile intent to provocateurs, where intent of the provocateur was ambiguous in the social scenarios. Yet there exists methodological constraints, in that authors utilized questionnaires to assess HAB. Questionnaire studies are more suitable for exploring cognitive content rather than underlying cognitive processes. Our study attempted to bridge this gap and assess on-line social information processes utilizing ERPs. As ERPs have proven effective in studying the on-line evaluation of attributions of hostile intent (Gagnon et al., 2016), our results provide robust findings that anxiety symptoms are in fact uniquely related to attributions of hostile intent in ambiguous situations, independent of reactive aggression.

According to previous research on the N400 and HAB, the N400 is expected in the right central and posterior sites (Gagnon et al., 2016; Gagnon et al., 2017). However, in our study the presence of the ERP component was found in the right anterior region. A potential explanation for the presence of an ERP component in the right anterior region is that anxiety may potentially be associated with additional effort to integrate non-hostile stimuli in a hostile context (Van Berkum et al., 2008), yet further studies would need to account for such results and explore if HAB in anxious individuals is specifically associated with the anterior rather than posterior region.

Our second hypothesis, that higher anxiety symptom scores would correlate positively with the N400 amplitude in the hostile condition, after controlling for reactive aggression, was not

confirmed. Contrary to our hypothesis, the overall model was significant, although anxiety scores were not significantly correlated with the N400 amplitude. Nonetheless, reactive aggression accounted for the overall significance which is consistent with Gagnon et al. (2016) results that explained the observed N400 effect in the hostile condition to be associated with reactive aggression.

While our study addresses important gaps in the literature, several limitations are noteworthy. First, we utilized a self-report measure to assess BSI anxiety symptoms scores. Although individuals differed on anxiety symptoms, they showed relatively low scores on the BSI anxiety subscale. This may be partly explained by the small non-clinical sample that was selected on hostility. Such a sample may differ from a clinical sample in anxiety symptom severity and aggression depending on anxiety disorder type. Greater anxiety symptom levels could be anticipated in a larger clinical sample, potentially validating our results and conclusions further. In fact, many of the reported studies in the literature explored individuals with social anxiety and their reported social information processing biases seemed to favor this group of individuals. As such it is expected that individuals with social phobias would further demonstrate markers for HAB. This study provides preliminary evidence that anxious individuals interpret ambiguous situations as more hostile than less anxious individuals, independently of reactive aggression. Our findings suggest that anxious individuals not only interpret ambiguous situations as threatening, but also as hostile.

Such effects may prove to be stable and intransient, yet further research is required. Future research should aim to replicate these findings with a clinically diagnosed sample of individuals with anxiety and examine whether this effect is specific to types of anxiety disorders. It would also be of interest to investigate whether recovered anxious patients no longer display this hostile

attribution bias and whether this change of interpretations of ambiguous stimuli would follow or precede anxious mood changes. If there is a change in interpretation which precedes anxious mood reduction, then it is possible that altering interpretations aids with anxiety symptom recovery. Our research findings increase understanding regarding the relationship between HAB and anxiety. Our research also renders it easier to develop intervention programs that address externalizing behaviors (e.g. aggression) among anxious patients. For instance, therapy programs such as cognitive behavioural therapy or mindfulness should aim to reduce or alter hostile interpretation biases in order to reduce anxiety. Perhaps including a section on cognitive restructuring specifically tailored to address aggressive thoughts and interpretations. More specifically, by alter aggressive thoughts by which the individual is encourage to replace negative thoughts with positive ones, and more importantly focus on increasing sound interpretations. Even dedicating a week for restructuring hostile interpretations. This study is one of very few that opens doors for the possibility of exploring more thoroughly cognitive processes that are hostile in nature as they may provide key information on better tailoring treatment for those with bias interpretations in order to reduce anxiety symptoms.

Therefore, therapy programs such as CBT or mindfulness should be aimed at reducing or altering hostile interpretation biases in order to reduce anxiety.



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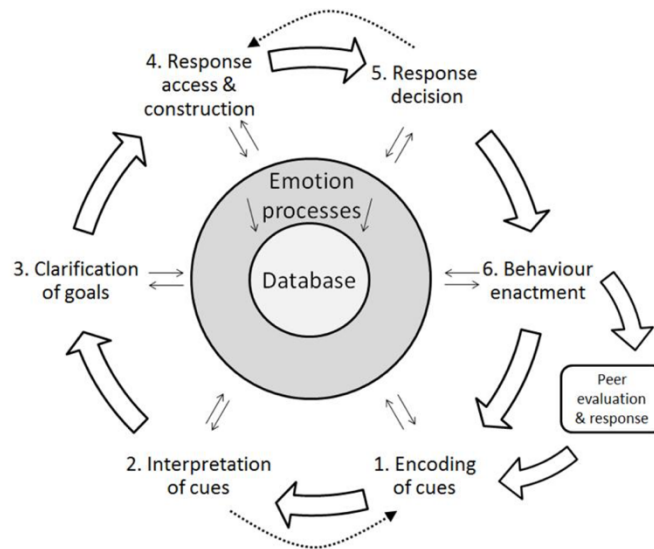
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# Appendix A



## Step 1: Encoding of cues

In this step the anxious individual encodes information through his sensation, perception and directing his attention to the important stimulus. For instance an anxious individual may pay more attention to threatening stimuli that surround him.

## Step 2: Interpretation of cues

Here the anxious individual integrates cues and applies his decision rules and comes up with their own interpretation. According to the literature anxious individuals demonstrated higher tendencies to interpret social cues in a more negative manner.

## Step 3: Clarification of goals

Generation of response is involved in this step along with the application of decision rules. Similarly, deficiencies in this step, such as an inability to adequately produce meaningful understanding of the social situation leads to cognitive interpretive biases, like the hostile attribution error (Crick & Dodge, 1994).

#### Step 4: Response access & construction

The individual then plays out potential consequences and evaluates their respective outcome. Feedback is then provided to response generation and the selection of the response deemed appropriate occurs.

#### Step 5: Response decision

The individual employs the protocols and scripts accordingly and monitors the feedback received, this will then be used to self-regulate.

# Appendix B

BSI: Inventaire abrégé de symptômes

## INSTRUCTIONS

Le test BSI consiste en une liste de problèmes que peuvent avoir certaines personnes. Lisez attentivement chaque ligne et encerclez le nombre qui décrit le mieux, selon vous, À QUEL POINT CE PROBLÈME VOUS A TROUBLÉ AU COURS DES SEPT (7) DERNIERS JOURS, Y COMPRIS AUJOURD'HUI. Encerclez uniquement un nombre par problème (0 1 2 3 4). N'oubliez aucun item, les pages sont recto-verso. Si vous changez d'avis, barrez la réponse originale avec un X et encerclez votre nouvelle réponse (0 1 2 3 4). Lisez l'exemple ci-dessous.

<b>EXEMPLE</b>	
0 = Pas du tout    1 = Un peu    2 = Modérément    3 = Beaucoup    4 = Intensément	
<b>CE PROBLÈME VOUS A-T-IL TROUBLÉ?</b>	
<b>Douleurs corporelles.....</b>	○ 0 1 2 3

4

0 = Pas du tout    1 = Un peu    2 = Modérément    3 = Beaucoup    4 = Intensément

**CE PROBLÈME VOUS A-T-IL TROUBLÉ?**

1. Nervosité ou impression de tremblements

intérieurs..... 0 1 2 3 4

2. Évanouissements ou

étourdissements..... 0

1 2 3 4

3. L'idée que quelqu'un d'autre puisse contrôler vos

pensées..... 0 1 2 3 4

4. L'impression que ce sont les autres qui sont responsables de la plupart de vos problèmes..... 0  
1 2 3 4
5. Troubles de  
mémoire.....  
..... 0 1 2 3 4
6. Tendance à vous sentir facilement agacé (e) ou contrarié  
(e)..... 0 1 2 3 4
7. Douleurs au cœur ou à la  
poitrine..... 0  
1 2 3 4
8. Peur des grands espaces ou dans les  
rues..... 0 1 2 3 4
9. Pensées d'en finir avec la  
vie..... 0  
1 2 3 4
10. Sentiment que vous ne pouvez pas faire confiance à la plupart des gens.....  
0 1 2 3 4
11. Manque  
d'appétit.....  
..... 0 1 2 3 4
12. Tendance à vous sentir effrayé sans raison  
..... 0 1 2 3 4
13. Crises de colère  
incontrôlables.....  
.. 0 1 2 3 4
14. Sentiment de solitude même en compagnie  
d'autres..... 0 1 2 3 4

15. Sentiment d'être incapable de compléter des

tâches..... 0 1 2 3 4

16. Sentiment de

solitude.....

..... 0 1 2 3 4

17. Avoir le

cafard.....

..... 0 1 2 3 4

18. Manque d'intérêt pour

tout..... 0

1 2 3 4

19. Sentiment d'avoir

peur.....

..... 0 1 2 3 4

20. Sentiment d'être facilement

blessé..... 0 1 2 3 4

**0 = Pas du tout    1 = Un peu    2 = Modérément    3 = Beaucoup    4 = Intensément**

**CE PROBLÈME VOUS A-T-IL TROUBLÉ?**

21. Sentiment que les gens ne sont pas amicaux ou qu'ils ne vous aiment pas.....

0 1 2 3 4

22. Sentiment d'infériorité vis-à-vis des

autres..... 0 1 2 3 4

23. Nausée ou maux

d'estomac.....

.... 0 1 2 3 4

24. Sentiment qu'on vous observe ou qu'on parle de  
vous..... 0 1 2 3 4
25. Difficulté à  
s'endormir.....  
..... 0 1 2 3 4
26. Besoin de vérifier et de revérifier ce que vous  
faites..... 0 1 2 3 4
27. Difficulté à prendre des décisions..... 0 1 2 3 4
28. Avoir peur de voyager en autobus, en métro ou en  
train..... 0 1 2 3 4
29. Difficulté à reprendre son  
souffle..... 0  
1 2 3 4
30. Bouffées de chaleur ou  
frissons..... 0  
1 2 3 4
31. Besoin d'éviter certains endroits, choses ou activités parce qu'ils vous font peur..... 0  
1 2 3 4
32. Trous de  
mémoire.....  
..... 0 1 2 3 4
33. Engourdissements ou picotements dans certaines parties du  
corps..... 0 1 2 3 4
34. L'idée que vous devriez être puni(e) pour vos  
péchés..... 0 1 2 3 4
35. Vous sentir sans espoir face à  
l'avenir..... 0 1 2 3 4

36. Difficulté à vous  
concentrer.....  
.. 0 1 2 3 4
37. Sentiment de faiblesse au niveau de certaines parties du  
corps..... 0 1 2 3 4
38. Sentiment de tension ou de  
surexcitation..... 0 1 2 3 4
39. Pensées sur la mort ou le fait de  
mourir..... 0 1 2 3 4
40. Avoir envie de frapper, de blesser ou de faire du mal à  
quelqu'un..... 0 1 2 3 4

**0 = Pas du tout    1 = Un peu    2 = Modérément    3 = Beaucoup    4 = Intensément**

**CE PROBLÈME VOUS A-T-IL TROUBLÉ?**

41. Avoir envie de briser ou de fracasser des  
objets..... 0 1 2 3 4
42. Fort sentiment d'embarras face aux  
autres..... 0 1 2 3 4
43. Sentiment de malaise dans la foule, au centre commercial ou au cinéma.....  
0 1 2 3 4
44. Ne jamais se sentir proche de  
quelqu'un..... 0 1 2 3 4
45. Épisodes de terreur ou de  
panique..... 0  
1 2 3 4



46. Vous laisser facilement entraîner dans des discussions  
animées..... 0 1 2 3 4
47. Sentiment de nervosité quand vous êtes seul(e).....  
..... 0 1 2 3 4
48. Impression que les autres ne reconnaissent pas vos accomplissements à leur juste valeur..... 0  
1 2 3 4
49. Vous sentir tellement agité(e) que vous ne pouvez rester en  
place..... 0 1 2 3 4
50. Sentiment que vous ne valez  
rien..... 0 1 2 3 4
51. Sentiment que les autres vont profiter de vous si vous les laissez faire.....  
0 1 2 3 4
52. Sentiments de  
culpabilité.....  
..... 0 1 2 3 4
53. L'idée que quelque chose ne va pas dans votre  
tête..... 0 1 2 3 4

## Appendix C

### Questionnaire sur l'agressivité réactive-proactive

Il y a des fois où la plupart d'entre nous se sentons en colère, ou avons fait des choses que nous n'aurions pas dû faire. Coter chaque item plus bas en encerclant 0 (jamais), 1 (parfois) ou 2 (souvent). Ne prenez pas trop de temps à réfléchir à propos des items – donnez simplement votre première réponse. Assurez-vous de répondre à tous les items.

A quelle fréquence...

		0	1	2
		Jamais	Parfois	Souvent
1	Avez-vous crié après des gens lorsqu'ils vous ont énervé?	0	1	2
2	Vous êtes-vous battu avec des gens pour montrer qui était supérieur?	0	1	2
3	Avez-vous réagi avec colère lorsque des gens vous ont provoqué?	0	1	2
4	Avez-vous pris des choses qui appartaient à d'autres étudiants personnes ?	0	1	2
5	Vous êtes-vous mis en colère lorsque vous étiez frustré?	0	1	2
6	Avez-vous vandalisé quelque chose pour le plaisir?	0	1	2
7	Avez-vous eu des crises de colère?	0	1	2
8	Avez-vous endommagé des choses parce que vous étiez fâché?	0	1	2

9	Avez-vous eu une bagarre de gang pour avoir l'air cool?	0	1	2
10	Avez-vous blessé les autres pour gagner un jeu/match?	0	1	2
11	Vous êtes-vous mis en colère ou vous êtes-vous fâché quand les choses n'allaient pas dans le sens que vous vouliez?	0	1	2
12	Avez-vous utilisé la force physique pour contraindre les gens à faire ce que vous vouliez?	0	1	2
13	Vous êtes-vous mis en colère ou vous êtes-vous fâché lorsque vous aviez perdu à un match/un jeu	0	1	2
14	Vous êtes-vous mis en colère lorsque des gens vous ont menacé?	0	1	2
15	Avez-vous utilisé la force pour obtenir de l'argent ou des choses d'autres personnes?	0	1	2
16	Vous êtes-vous senti mieux après avoir frappé quelqu'un ou crié après quelqu'un?	0	1	2
17	Avez-vous menacé et intimidé quelqu'un?	0	1	2
18	Avez-vous fait des appels (téléphones) obscènes pour le plaisir?	0	1	2
19	Avez-vous frappé des gens pour vous défendre?	0	1	2
20	Avez-vous amené des personnes à se liguer contre quelqu'un?	0	1	2

21	Avez-vous porté une arme pour l'utiliser dans une bagarre?	0	1	2
22	Vous êtes-vous mis en colère ou vous êtes-vous fâché ou avez-vous frappé les autres lorsqu'on s'est moqué de vous?	0	1	2
23	Avez-vous crié après des personnes pour qu'elles fassent des choses pour vous?	0	1	2