Investigating the Role of Post-Event Processing in the Maintenance of Social Anxiety Symptoms

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Abstract

Individuals experience varying levels of anxiety in social situations. When intense and enduring, this anxiety can lead to difficulties in daily functioning. Considering the often-central roles that relationships and interactions play in people's lives, it becomes crucial to understand how unhelpful levels of social anxiety are maintained over time. According to cognitive theories of social anxiety disorder, post-event processing (PEP; e.g., the review of the negative aspects of past social situations), is one of the factors that can perpetuate symptoms of social anxiety. The objective of this dissertation was to investigate PEP and its relationship with other important cognitive and affective factors across two studies to better understand its role in social anxiety.

In Study 1, I assessed the temporal links between PEP, anticipatory processing (AP), anxiety, performance appraisals, and memory. Participants (n = 101) completed two speeches, four days apart. In between the two speeches, they answered ecological momentary assessment alerts to measure PEP about the first speech and AP about the second speech. I found that both PEP and AP decreased over the two-day assessment period. Feeling more anxious during the first speech also triggered a cascade of negative thinking and affect, including worse performance appraisals, increased PEP and AP, and higher anxiety levels in anticipation of the second speech. Contrary to expectations, PEP was unrelated to change in performance appraisals over time. There was also preliminary evidence that PEP might be linked to the phenomenological memory qualities of the first speech, namely its valence and emotional intensity.

In Study 2, I extended these findings by examining positive PEP and pleasant social interactions in addition to the typically studied negative PEP and stressful social interactions. Participants (n = 411) brought back to mind a recent stressful or pleasant social interaction, completed self-reported measures, and wrote a description of the recalled interaction. Participants who recalled a stressful interaction reported engaging in more negative PEP, and less positive

PEP, compared to those who recalled a pleasant interaction. I also observed that higher social anxiety was linked with more negative and less positive PEP irrespective of whether the PEP was following a stressful or a pleasant interaction. Moreover, participants' descriptions of the interactions contained more negative words when they also reported having engaged in more negative PEP. Negative PEP was also associated with a more negative emotionally intense self-reported memory of the interaction. In addition, descriptions contained more positive and less negative words when participants reported engaging in more positive PEP. Positive PEP's relationship with memory depended on whether the interaction was stressful or pleasant. For the former, positive PEP was related to a more positive memory; for the latter, it was related to increased emotional intensity.

Both studies help elucidate the complex nature of PEP. Their conclusions have many theoretical and clinical implications for the PEP and social anxiety field (e.g., how negative PEP evolves over time, how high social anxiety may be characterized by both more negative and less positive PEP). Considering methodological strengths and limitations provides additional questions and directions for future research examining negative and positive PEP.

Statement Regarding Contributions

I (L. Kane) took the lead on the study design, data collection, cleaning, and analysis, and manuscript writing. Study 1: Olivia Simioni and Amanda Dezenosky assisted with data collection. Study 2: Kirstin Beaudet assisted with reviewing the description texts for adherence to study instructions. Olivia Simioni was the primary coder, assisted with manuscript writing and is an author on the manuscript. Dr. Andrea Ashbaugh took an advisory role and is an author on both manuscripts. Study 1 was submitted to *Behaviour Research and Therapy* and is currently under review. Study 2 was submitted to the *Journal of Behavior Therapy and Experimental Psychiatry* and is currently under review. I received funding from a Frederick Banting and Charles Best Canada Graduate Scholarships Doctoral Award (2018-2021) and a Fonds de recherche du Québec-Santé Doctoral Training Award (2021-2022).

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Chapter 1:

General Introduction

Following social situations, people often review to some degree what happened. For example, someone might think back to what they said during an interview or a first date, and perhaps even wish that they had said or done something different. This tendency to rehearse the embarrassing and distressing events that occurred during social situations is called post-event processing (PEP)[1] and is the focus of this dissertation.

A repetitive negative thinking process, PEP is posited to be one of the main factors that maintain social anxiety symptoms over time (Clark & Wells, 1995). Indeed, people experience varying levels of anxiety when faced with social situations. Social anxiety exists on a continuum from small butterflies before a presentation that can help motivate preparation to a paralyzing fear that makes interviewing for a new job terrifying. When the fear leads to marked distress, avoidance, or functional impacts in a person's life (e.g., in relationships, at work or school), their symptoms may meet the diagnostic criteria for social anxiety disorder (SAD; American Psychiatric Association, 2013). With a lifetime prevalence rate of 11%, SAD is one of the most common anxiety disorders (Kessler et al., 2012). Its course tends to be chronic and functional impairment often increases over time (Wittchen & Fehm, 2003). Social anxiety is also an important issue in student populations when considered as a continuous construct. Approximately 22% of first-year undergraduate students reported very high levels of social anxiety (Strahan,

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[1] In the literature, PEP has also been referred to as "post-event rumination" (e.g., Abbott & Rapee, 2004; Edwards et al., 2003) and "retrospective brooding" (e.g., Rapee & Heimberg, 1997). The current dissertation will use the most common term "post-event processing" (e.g., Clark & Wells, 1995; Rachman et al., 2000; Wong, 2016).

2003). It therefore becomes crucial to examine the factors that maintain social anxiety symptoms, including PEP, to more fully understand how people function in interpersonal situations along the full spectrum of social anxiety symptoms, and potentially inform treatment for individuals on the more severe end of the spectrum of social anxiety.

As such, the overarching goal of this dissertation is to better understand PEP (e.g., its time course and nature) and the relationships between PEP and other factors that influence anxiety in social situations (e.g., anxiety, performance appraisals, memory). PEP has mainly been studied within the context of SAD. Therefore, it features within several cognitive and behavioural models that explain why symptoms persist over time (for a review, see Wong & Rapee, 2016). To provide a framework from which to understand PEP and the rationale for the current studies, I will begin by outlining these theoretical models of social anxiety and describe the role of PEP within these models. I will then review the research literature on PEP, including how it has been assessed, its definition, and our understanding to date of how it relates to other cognitive and affective factors that have been implicated in models of social anxiety.

Cognitive-Behavioural Models of Social Anxiety Disorder

Clark and Wells (1995)

Clark and Wells (1995) proposed that people with SAD hold unhelpful negative beliefs about social performance (e.g., everyone must like me), social evaluation (e.g., if I make mistakes, others will reject me), and themselves (e.g., I'm weird). Therefore, when they enter social situations, these assumptions are triggered and lead to increased perception of social danger and, consequently, anxiety. This anxiety then leads to behavioural, cognitive, and physiological symptoms. For example, people with SAD direct their focus of attention towards themselves, monitoring their feelings of anxiety and physiological reactions (i.e., self-focused attention). This self-focused attention also creates a view of self as a social object (i.e., their own

impression of what others perceive of them), can hinder the processing of social cues, and can lead to hypervigilance for the same anxiety responses that they fear. In addition, people with SAD engage in a variety of safety behaviours to try to prevent negative evaluation from others (e.g., avoiding eye contact, wearing dark clothing to try to hide sweating). These behaviours can inadvertently increase the chance that the feared outcome will happen (e.g., a sweater will make a person hotter and lead to sweating) and prevent people from disconfirming their unhelpful beliefs (e.g., that sweating would lead to rejection).

Furthermore, people with SAD engage in forms of repetitive negative thinking. For instance, before they enter a social situation, they may review what they think will happen, which usually includes predictions of rejection, poor performance, and failure. This process is called anticipatory processing (AP). As highlighted above, similar process occurs following social situations: people with social anxiety review the embarrassing and distressing events that occurred during the interaction, namely PEP. Both processes can lead to the avoidance of future social situations. These four factors (i.e., negative beliefs, self-focused attention, safety behaviours, and repetitive negative thinking) all interact and contribute to the maintenance of symptoms in SAD according to Clark and Wells.

Rapee and Heimberg (1997) and Heimberg and Colleagues (2010)

Rapee and Heimberg (1997) also contended that people with SAD operate in social contexts under assumptions, particularly that others are critical and that it is very important that others appraise them positively. As such, when a person with SAD enters a social situation, they form a mental image of themselves as seen by others, directing their attention to this mental image and to any potential signs of social threat (i.e., not meeting others' *high* standards and being negatively evaluated). Rapee and Heimberg placed fear of negative evaluation at the centre of their model of SAD. Likelihood of negative evaluation and the repercussion of such evaluation

are both overestimated, leading to anxiety. Since negative evaluation is so feared in social anxiety, positive information is more likely to be discounted. This discounting can prevent positive shifts in self-perceptions and anxiety, which is hypothesized to have cognitive, behavioural, and physiological components. A socially anxious person may engage in safety behaviours that, similarly theorized by Clark and Wells (1995), can lead to a self-fulfilling prophecy. There may also be performance deficits due to both anxiety and lack of social skills, as well as an outright avoidance of social situations.

Although not explicitly named, PEP and AP do feature within the Rapee and Heimberg model. For instance, the authors mentioned that there is a negative bias in how people with SAD process external feedback. They also theorized that attention towards threat can begin in anticipation of entering social situations and that anxiety can happen in anticipation of negative evaluation.

In an update to the Rapee and Heimberg (1997) model, Heimberg and colleagues (2010) further highlighted the role of imagery, PEP, cognitive biases, and emotion dysregulation in social anxiety. First, they noted that negatively biased imagery can contribute to anxiety in anticipation of and during social situations, potentially impacting performance appraisals and heightening physiological symptoms of anxiety. These images are also often of an observer's perspective when the social situation is highly anxiety provoking.

Second, Heimberg and colleagues now explicitly discuss PEP as an important aspect of their updated model. They describe PEP as a reconstruction of the event where the original memory of the social situation is taken apart and rehearsed repeatedly, involving imagery as well. The memory is then put back together according to all the negative biases, making it more negative and fear-inducing over time.

Third, they explored the role of the combined cognitive biases hypothesis (Hirsch et al., 2006). This hypothesis posits that cognitive biases influence one another, maintaining social anxiety over time in a synergistic effect. Heimberg and colleagues further discussed how negative imagery and biases in interpretation can interact, both impacting memory of social situations. Negative memory biases could then relate back to increased attention towards threat in future social situations.

Fourth, the authors highlight that socially anxious people fear both positive and negative evaluation. Indeed, positive evaluation could raise the bar of expectations, making future negative evaluation more likely. It could also increase conflict and competition with others. As such, the authors describe SAD as characterized by fear of evaluation in general, rather than of negative evaluation specifically.

Fifth, Heimberg and colleagues explored emotion dysregulation in SAD, particularly the role of expressive suppression. This emotion regulation strategy is the act of not expressing an emotion in social situations. Suppression's function would then be to prevent potential negative outcomes stemming from expression. However, it may, similar to safety behaviours, inadvertently contribute to the maintenance of anxiety over time by preventing disconfirmation of negative predictions and imagery.

Hofmann (2007)

In his cognitive-behavioural model of SAD, Hofmann (2007) posits that social apprehension stems from people with SAD feeling unable to meet the high expectations that they believe others have of them. This apprehension also leads to increased self-focused attention, which triggers multiple unhelpful thought processes. For example, they may hold negative perceptions of themselves and their social skills, overestimate the cost of social mistakes, and feel that they are unable to control their anxiety responses. Because negative outcomes are

anticipated, people with SAD are likely to avoid social situations, engage in safety behaviours, and engage in PEP, particularly after situations perceived as having high social costs. Although these behaviours reduce anxiety in the moment, they serve to maintain social apprehension in the long term, perpetuating the unhelpful cycle.

Moscovitch (2009)

Moscovitch (2009) proposed that people with SAD perceive themselves and their characteristics as deficient or going against norms and expectations. As such, the core fear is that these deficient self-attributes might be exposed to others who hold high standards. Scrutiny of these deficiencies would then cause negative evaluation, rejection, loss of social status, and embarrassment. Safety behaviours are then seen as concealment strategies that are attempting to prevent the exposure and therefore criticism of deficient self-attributes.

PEP does not feature within the Moscovitch model. However, it is important to review in the context of the current dissertation as it represents a subtle but important shift in our understanding of what individuals with SAD fear within social situations (i.e., belief of self as deficient and exposure of this deficiency to critical others, rather than fear of negative evaluation).

Wong and Rapee (2016)

The most recent model of SAD to my knowledge is called the integrated aetiological and maintenance (IAM) model (Wong & Rapee, 2016). This model brings together all the above maintenance models and integrates models of symptom aetiology. Wong and Rapee highlight how inherited tendencies, parent behaviours, peer experiences, life events, and culture all may contribute to the development of SAD. These aetiological factors influence how threatening social-evaluative stimuli become, which the authors call the social-evaluative threat (SET)

principle. The SET varies from low to high threat values and guides behaviours in social contexts.

Wong and Rapee then posited that people develop primary cognitive (i.e., attention towards self and threat) and behavioural processes (i.e., avoidance, escape) to detect and eliminate social-evaluative threat, respectively. These primary processes then maintain the threat value over time, contribute to performance deficits due to anxiety and lack of social skills, and lead to the development of secondary cognitive (i.e., AP, PEP, cognitive avoidance) and behavioural processes (i.e., safety behaviours). These secondary processes also maintain the threat value. A high threat value would then lead to more frequent and intense anxiety in social situations. However, this in and of itself is not sufficient for a diagnosis of SAD. The high levels of anxiety would also need to interfere with functioning or be linked with significant distress. As such, this model outlines maintenance factors for social anxiety and also specifies what would differentiate someone with social anxiety from someone with SAD (i.e., marked distress and functional impairments).

Post-Event Processing

Taken together, these cognitive-behavioural models of SAD show that our understanding of this disorder and of the impact of PEP in the maintenance of anxiety in social situations has grown over time. It is clear that PEP plays a substantial role in keeping people stuck in the vicious cycle described by these models. As we will discuss shortly, PEP is a complex cognitive process that involves attentional focus, memory, and various processing biases. It is also distressing to feel stuck and not feel able to move on after a social situation, especially a stressful one, has passed. Research on this repetitive negative thinking tendency, which I will now examine, has provided additional insight into why this might be, as well highlighted where gaps in knowledge remain.

The Nature of PEP

In their cognitive theory of social anxiety, Clark and Wells (1995) stated that people with social anxiety process their negative self-perceptions and feelings of anxiety in depth during social situations. These negative perceptions are then likely to be encoded strongly in their memory of the event and, therefore, are more easily recalled during PEP. These negative thoughts are intrusive, recurring, and can interfere with concentration (Rachman et al., 2000). Socially anxious individuals may also think back to past perceived social failures, to which the current perceived failure is added (Clark & Wells, 1995; Rachman et al., 2000).

In a nonclinical sample, higher levels of social anxiety are associated with the experience of more negative self-perceptions and regret-based thoughts during PEP (Makkar & Grisham, 2011). In addition, people with higher trait social anxiety think more about how the event could have played out differently or been avoided altogether, and about how any future similar events may be avoided (Rachman et al., 2000). Thus, these negative thoughts contribute to negative self-perceptions and to the avoidance of similar situations, which can further maintain social anxiety symptoms (Clark & Wells, 1995; Rachman et al., 2000). Although individuals with SAD hope to improve their social performance through PEP, they may only rarely obtain expected benefits, finding temporary solutions that ultimately prevent symptom improvement (Yoshinaga et al., 2020).

Despite PEP being key in the maintenance of social anxiety, little is known about how PEP evolves over time. One of the rare studies that examined time course of state PEP (i.e., following a specific situation) was in a nonclinical sample. Researchers found that PEP was at its highest the day after a conversation task, decreasing thereafter, regardless of fear of negative evaluation levels (Dannahy & Stopa, 2007). PEP was measured daily in this study, which may have hidden any hourly patterns. We also know that people who engage in more PEP following

one event may also tend to engage in more PEP following other events (i.e., trait PEP). For instance, individuals with SAD who completed two videotaped exposures (e.g., having a conversation, doing a job interview, refusing unreasonable requests) at sessions four and eight of group CBT reported similar degrees of PEP one week after each exposure (r = .68; Laposa & Rector, 2011). Similar results were obtained when comparing PEP after attending a first group CBT session and PEP after an exposure exercise at session 3 (Kocovski & Rector, 2008). Therefore, a person who often has high state PEP (i.e., high PEP in the moment in reaction to an event) may have higher levels of trait PEP (i.e., a general tendency to engage in PEP). A measure of trait PEP demonstrated excellent two-week test-retest reliability in a nonclinical sample (r = .80; Blackie & Kocovski, 2017), providing further evidence for the stability of trait PEP tendencies across time.

Specificity of PEP to SAD

Many disorders are characterized by repetitive negative thinking patterns (McEvoy et al., 2010). For instance, rumination is a cognitive factor that features prominently in CBT models of depression and refers to a tendency to repeatedly review the causes, meanings, and implications of sad mood and past events. Similarly, worry is a core feature of anxiety and reflects future-oriented thoughts. PEP, rumination, and worry all share a commonality in that they involve repetitively thinking about events. Measures of each have also been modified and combined to assess overall repetitive negative thinking (McEvoy et al., 2010), which can have great clinical utility particularly transdiagnostically.

However, others have argued that PEP is distinct from other repetitive negative thinking patters. For example, depressive rumination was unrelated to PEP following exposure exercises for social anxiety in a sample of individuals with SAD (Kocovski & Rector, 2008). Therefore, the thought content of PEP appeared specific to social anxiety and social situations. Similarly, PEP

was especially relevant when considering coping with social situations. In a study by Fehm and colleagues (2007), a nonclinical sample of participants were asked to describe both social events (e.g., talking in front of a group, beginning a conversation) and specific phobic events (e.g., being on an airplane, being on a bridge, encountering a spider) that had been followed by negative thinking. Social events caused more frequent and more intense PEP compared to phobic events. Moreover, fear of negative evaluation, a core feature of SAD, was associated with greater PEP following social events; conversely, overall anxiety levels were associated with greater PEP following phobic events (Fehm et al., 2007), highlighting the relevance of PEP for social anxiety-provoking situations in a nonclinical sample.

It remains unclear whether PEP may occur across a variety of psychological disorders beyond SAD. Participants with a range of anxiety disorders (i.e., SAD, obsessive-compulsive disorder, panic disorder, generalized anxiety disorder) reported similar levels of PEP one week following their first session of group CBT, suggesting that PEP is a transdiagnostic process (Laposa et al., 2014). In contrast, Perera and colleagues (2016) found that participants with a principal diagnosis of SAD reported the most PEP one week after their first group CBT session, while those with comorbid SAD reported intermediate levels and those with no comorbid SAD reported the least PEP. Thus, although evidence suggests that individuals with other anxiety disorders may report PEP, it appears to particularly impact those who experience higher anxiety levels in social situations (Perera et al., 2016).

As such, there is mixed evidence about whether there is conceptual overlap between PEP and other repetitive negative thinking processes, and whether PEP is SAD specific or transdisgnostic (Sluis et al., 2017). It therefore becomes important to identify which construct is of interest within research (Wong, 2016). Given that the goal is to better understand social anxiety and repetitive negative thinking in response to social situations, this dissertation will

focus on PEP because it has the most relevance and features most prominently within CBT models of social anxiety. That said, it is important to consider that not only people with SAD engage in PEP. In addition, people with SAD engage in other forms of repetitive negative thinking such as worry, particularly if they have comorbid generalized anxiety disorder (Fresco et al., 2003).

Methodological Considerations

Assessment Methods

Researchers have studied PEP using a variety of different methods, each with their own advantages and disadvantages. Self-report questionnaires have been widely used in correlational and experimental studies to assess retrospective accounts of PEP. Some measures focus on the nature and effects of the thoughts occurring during PEP (e.g., how distressing the thoughts were, how difficult it was to forget about the event), such as the Post-Event Processing Questionnaire (PEPQ; Rachman et al., 2000) and the Post-Event Processing Inventory – State and Trait Forms (PEPI-S and -T, respectively; Blackie & Kocovski, 2017). Conversely, another questionnaire (i.e., the Thoughts Questionnaire [TQ]; Edwards et al., 2003) assesses the thoughts themselves (e.g., I didn't make a good impression). Although easy to administer, self-report questionnaire results may be biased by the retrospective account of symptoms, which may therefore be under or over reported.

To try and circumvent this retrospective bias, researchers have also used experience sampling methods like daily diary and ecological momentary assessment (EMA; i.e., the repeated measure of participants' experiences in real time during their daily lives; Shiffman et al., 2008) approaches to study anxiety disorders, including SAD (for a review, see Walz et al., 2014). Various methods can be used in EMA, including event- and time-based sampling (Shiffman et al., 2008). In the former, participants complete an assessment only when particular events or

triggers occur. In the latter, participants are prompted at specific times or intervals to complete assessments, which is typically used for a phenomenon that varies continuously. Both sampling methods can also be combined depending on assessment needs. For a discussion on the methodological considerations of EMA, the interested reader may see Shiffman and colleagues (2008).

These repeated measurement strategies have also been used in the context of PEP specifically. Using a diary approach (i.e., one assessment per day), Lundh and Sperling (2002) found that undergraduate students who reported more negative PEP one day also reported more negative PEP the next day. Moreover, Campbell and colleagues (2016) found that, in first-year university students, fear of negative evaluation was associated with greater anticipatory and post-event processing, which then contributed to social withdrawal behaviours (i.e., trying to reduce the risk of social interactions like avoiding interactions altogether or focusing on one's own feelings instead of fully engaging in the interaction). In addition, researchers using EMA found that people with SAD who reported higher levels of PEP after distressing social events also reported greater trait social anxiety, greater self-focused attention, more safety behaviour use, and greater negative affect (Helbig-Lang et al., 2016). PEP was also higher for performance situations versus social interaction situations.

Although diary and EMA studies have great potential in assessing real-time PEP and will likely be fruitful in refining the conceptualization of this complex process, their caveats also need to be considered: they require increased participant time and effort, and they could facilitate more frequent and intense PEP than participants would have normally engaged in or reported (Sluis et al., 2017). This process of reactivity occurs when the assessment procedure impacts the topic of study (Shiffman et al., 2008). Reactivity may be more likely when the goal is behaviour change and the assessment occurs prior to engaging in the behaviour (e.g., logging food before

consuming it). Although more research is needed on this topic, there is no substantial evidence to suggest that EMA can lead to reactivity in other circumstances like assessing frequency of thoughts. Nonetheless, should the repeated measurements of EMA affect levels of PEP, they should do so for all participants who complete the procedure.

In this age of smartphone technology, the use of EMA will likely prove an informative avenue to collect data on repetitive negative thinking processes as the thoughts unfold in real time. A particularly innovative approach may be to use both retrospective measurements and experience sampling as in Katz and colleagues (2019). In their study, participants with SAD completed group CBT with multiple measurements of retrospective PEP. A subset of participants also reported on momentary PEP following social interactions during their daily lives as they completed therapy. This combined approach showed that group CBT helped decreased both general retrospective accounts of PEP and interaction-triggered PEP, and that the rate of decreased in PEP slowed over the course of therapy.

Social Situations

Regardless of how PEP is measured, social anxiety researchers typically assess it in response to a specific stressful social situation unless they are only interested in trait PEP. To achieve this, they either ask participants to report on a social situation from their daily life that was distressing (e.g., Helbig-Lang et al., 2016; Lundh & Sperling, 2002) or set up anxiety-inducing social situations like speeches and interactions (e.g., Blackie & Kocovski, 2016; Field et al., 2004; Kocovski et al., 2011; Potter et al., 2016; Rowa et al., 2014; Wong & Moulds, 2009). Relying on self-reported situations can be particularly useful in EMA studies given that they aim to examine phenomena as they occur naturally for each individual. However, researchers need to consider the possibility that socially anxious participants may be less likely to experience and report distressing social situations due to their avoidance and fear of negative evaluation. A

potential alternative is to have participants engage in anxiety-inducing social situations and use EMA to measure their impacts on PEP.

The choice of social situation to induce and the time interval between the situation and the PEP assessment can also influence results. For example, one study found that a speech produced greater self-reported PEP than a conversation task in a non-clinical sample (Makkar & Grisham, 2011). In contrast, Fehm and colleagues (2007) found that students retrospectively reported higher levels of PEP following interaction versus performance situations. In any case, it is important to ensure that the selected task is social anxiety-provoking enough to set the stage for negative PEP.

PEP research has focused largely on responses to stressful or distressing social situations. However, people encounter a wide range of situations in their daily lives (e.g., at work, at home, walking the family dog). There are a multitude of events and experiences, both negative and positive, that may fuel PEP. Highly socially anxious individuals tend to dampen positive events and experiences, and report less intense positive emotions in social situations and even when they are alone (Kashdan et al., 2011). They may fear not only negative evaluation from others, but also positive evaluation, which can make a person the centre of attention and add pressure for future interactions (Weeks & Howell, 2012). They may also disqualify positive events, reporting fewer positive events day to day and failing to benefit from potentially rewarding and pleasant situations (Kashdan et al., 2011).

The dampening of positive experiences may partially be explained by the self-control resource depletion model. This model posits that people with high social anxiety use much of their energy to manage their anxiety, thereby leaving their emotional resources depleted and less able to exploit rewarding positive opportunities (Kashdan et al., 2011). No study to our knowledge has examined how PEP might relate to this positive spectrum of functioning. Social

situations that are perceived as pleasant or positive could promote different PEP frequency, intensity, and content. Assessing PEP following positive situations may help round out our understanding of PEP and ultimately may inform how to help people with social anxiety have corrective emotional experiences.

Relationship with Other Affective and Cognitive Factors

In the following sections, I present findings from studies examining the correlates and effects of PEP, often using a combination of self-report questionnaires, daily assessment procedures, and experimental manipulations to help situate the reader within the PEP literature.

Anxiety

As one would expect, PEP is positively associated with self-reported trait social anxiety symptoms in clinical and nonclinical samples (e.g., Kocovski & Rector, 2008; Rachman et al., 2000). State anxiety before or during a social situation is also related to degree of PEP. For instance, participants with SAD who were more anxious before giving a speech reported more PEP (Rowa et al., 2014). In addition, anxiety in anticipation of a first group CBT session was positively linked with more PEP one week later, even when accounting for trait social anxiety (Perera et al., 2016). Similarly, state anxiety during videotaped exposures in a course of group CBT for SAD predicted more PEP even when controlling for baseline social anxiety symptoms (Laposa & Rector, 2011).

Thus, it appears that people who experience greater anxiety before or during a social situation report greater subsequent PEP, regardless of how socially anxious they tend to be. Degree of PEP following session 1 of group CBT for SAD was also related to state anxiety during an exposure task at session 3 (Kocovski & Rector, 2008), suggesting that PEP and state anxiety likely maintain each other over time. Similarly, greater levels of PEP following a speech

predicted greater anticipatory anxiety regarding a second speech (Blackie & Kocovski, 2016). Additional research may further examine interconnectedness of anxiety and PEP.

Performance Appraisals

An additional factor that interacts with PEP in complex ways is performance appraisals, or how well a person feels they think they did in a social situation. Participants with higher social anxiety rate their performance on laboratory tasks (e.g., social interactions, speeches) more poorly than participants with lower social anxiety (Brozovich & Heimberg, 2011; Cody & Teachman, 2011; Dannahy & Stopa, 2007; Gavric et al., 2017; Perini et al., 2006). Trait tendencies to engage in PEP also appear related to performance appraisals. Specifically, Brozovich and Heimberg (2011) found that socially anxious participants with greater trait PEP rated their performance on a social interaction task worse than those with lower trait PEP. Conversely, how individuals think they did on a task can also influence how much state PEP they engage in. For instance, participants who appraised their performance more negatively immediately after a conversation task reported more negative PEP relating to the conversation in a nonclinical sample (Dannahy & Stopa, 2007). Similarly, worse performance appraisals for a speech task mediated the relationship between social anxiety levels and negative PEP over the week following the speech, both in a sample with SAD and in a sample combining participants with and without SAD (Perini et al., 2006).

Additionally, performance appraisals may change over time depending on social anxiety severity, and degree of fear of negative evaluation and PEP. Abbott and Rapee (2004) asked individuals with and without SAD to rate their performance on a speech immediately after the speech and one week later. Participants with SAD rated their performance negatively both immediately and one week after the speech, showing no notable difference between both time points. Participants without SAD rated their performance more positively one week after the

performance compared to their ratings immediately after the speech. Another study found that the performance ratings on a conversation task worsened over the course of a week in participants high in fear of negative evaluation, but not in those low in fear of negative evaluation (Dannahy & Stopa, 2007). Likewise, ratings of global aspects of performance tended to worsen over time in high socially anxious participants, an effect that appeared to be mediated by increased PEP in the high social anxiety group versus the low social anxiety group (Cody & Teachman, 2011). Hence, engaging in PEP may make a socially anxious person's appraisal of their performance worse.

Memory

Memories can be described in terms of ten phenomenological qualities: 1) Vividness, or how detailed the memory is; 2) Coherence, or how orderly and specific the memory is; 3) Accessibility, or how easy it is to think of the memory; 4) Time perspective, or how clearly a person can remember the hour, day, or year when the event took place; 5) Sensory details, or being able to remember the sensations of the event; 6) Visual perspective, or whether a person remembers the event through their own eyes or as if from an observer's perspective; 7) Emotional intensity, or how emotionally arousing the memory is; 8) Sharing, or how much a person has shared the memory with others; 9) Distancing, or how similar or different the person feels they are from the person in the memory; and 10) Valence, or how negative or positive the memory feels (e.g., Luchetti & Sutin, 2016). These phenomenological qualities can also vary depending on the type of memory being recalled and the characteristics of the individual. For instance, people with social anxiety tend to have an observer perspective when they remember stressful social events and have intrusive social images, concentrating on themselves and how they appear as social objects (Ashbaugh et al., 2019; Clark & Wells, 1995; D'Argembeau et al., 2006). Similarly, when participants described intrusive social images and memories they had, participants high in social anxiety were more likely to report more negative images, less sensory

detail, less vividness, and more self-referential information compared to participants low in social anxiety (Ashbaugh et al., 2019; D'Argembeau et al., 2006; Moscovitch et al., 2011).

Individuals with social anxiety may also experience memory biases, but only when using externally valid stimuli and tasks relevant to social anxiety fears (Coles & Heimberg, 2002). Lundh and Öst (1996) found that participants with SAD had better recognition on a memory test for faces they felt were critical than for faces they felt were accepting, whereas participants without SAD recognized more accepting faces than critical ones. PEP may also contribute to the memory biases in social anxiety. Two studies found that PEP was correlated with better recall and recognition of negative self-relevant information (Cody & Teachman, 2010; Mellings & Alden, 2000), whereas one study found no such correlation (Edwards et al., 2003). It is important to note that the time between the social-evaluative situation and the assessment of memory and PEP was longer in the latter study, which may explain the discrepant finding.

Further research is warranted to determine whether PEP affects only self-relevant information given within a social event (e.g., feedback) or whether it could also affect how individuals remember the event itself (e.g., the vividness, coherence, and valence of the event). PEP could affect the memory of stressful social situations by allowing for more in-depth processing of negative information or by making the negative information more memorable or more familiar. Connolly and Alloy (2018) studied the effects of rumination following stress (i.e., stress-reactive rumination) on memory for the stressors in a nonclinical sample. They found that participants were more likely to recall negative life events two weeks later when the events had been followed by greater stress-reactive rumination. Although this study examined stress-reactive rumination and not PEP, their results highlight the role of stress-reactive rumination and its effect on the recall of negative events as a vulnerability factor for depression. Given that PEP also increases the processing of negative aspects of anxiety-provoking social situations, PEP may also

play a role in how socially anxious individuals remember social events, potentially making events that were followed by more PEP more salient in memory.

That said, all PEP may not be created equal. PEP's effect on memory may also depend on the response style used during PEP, which can consist of a ruminative response style (i.e., dwelling on the causes and consequences of feelings and on undesirable self-characteristics) or a reflective one (i.e., being open to exploring and accepting negative thoughts and feelings without judgment; Morgan & Banerjee, 2008). Socially anxious participants who were engaged in a ruminative response style, and were then asked to recall autobiographical memories, retrieved memories that provoked more anxiety compared to both socially anxious participants who used a reflective response style and low socially anxious participants who used either response styles (Morgan & Banerjee, 2008). Thus, a more negative response style during PEP may bring back to mind past anxiety-provoking situations and further contribute to negative affect in the moment, potentially further increasing PEP. In contract, a more reflective response style may help mitigate these negative effects, highlighting the importance of considering response style and thought content when studying repetitive thinking patterns.

Anticipatory Processing

Although both post-event and anticipatory processing are key factors in cognitive-behavioural models of social anxiety (Clark & Wells, 1995; Wong & Rapee, 2016), there is a paucity of research examining both of these processes together within the same study. In one study (Chiupka et al., 2012), participants completed a speech and were randomly assigned to an anticipatory condition (i.e., focusing on thoughts, feelings, and bodily sensations as they *anticipated* giving the speech) or a post-event processing condition (i.e., focusing on thoughts, feelings, and bodily sensations as they *remembered* giving the speech). The goal was to compare the nature and impact of images and memories generated during anticipatory and post-event

processing. Participants reported more negative images and memories during AP compared to PEP; however, the images and memories endorsed during PEP were associated with a more negative impact on self- and other-perceptions than those endorsed during AP. Thus, although PEP and AP are both repetitive negative thinking patterns, they may trigger different images and memories and may impact people differently.

Post-event and anticipatory processing may also be related to social anxiety in different ways. Modini and colleagues (2018) tested two mediational pathway models, one for the effect of social anxiety symptoms on PEP and one for the effect of social anxiety on AP. Individuals with SAD completed three laboratory sessions with self-report questionnaires and a speech at session 2. In the PEP model, the authors found that negative attentional focus (i.e., focusing on physical symptoms, past failures, and potential negative evaluation), greater perceived threat, higher levels of state anxiety, and worse performance appraisals all contributed to explain the relationship between social anxiety and PEP, with negative attentional focus being the strongest predictor of PEP in the model. In the AP model, worse performance appraisals, greater perceived threat, and higher levels of state anxiety were mediators, with biased performance appraisals being the strongest predictor of AP in the model. These results highlight that, although PEP and AP are both repetitive negative thinking processes, they may have different relationships with other cognitive and affective factors involved in the maintenance of social anxiety. Unfortunately, the PEP and AP mediation models were conducted separately. Therefore, the relative effects of PEP and AP and the relationship between both processes could not be examined in this study.

In the only study to have directly investigated the relationship between PEP and AP, participants with SAD who were participating in group CBT completed measures of AP and PEP before and after two separate videotaped exposures (Laposa & Rector, 2016). Results showed that greater levels of AP before the first exposure were associated with increased PEP during the

week following the exposure. In addition, greater PEP following the first exposure was associated with greater AP for the second exposure. These results suggest that AP and PEP are interdependent and feed into one another (Laposa & Rector, 2016). As such, AP and PEP, though overlapping, appeared to be conceptually distinct ruminative processes. Indeed, confirmatory factor analyses suggested that repetitive negative thinking in social anxiety was multidimensional and that assessing only general repetitive thinking would not capture the particular thinking patterns that emerged following social situations (Wong et al., 2019). More research is needed to examine the interconnectedness of post-event and anticipatory processing in clinical and non-clinical populations with other social anxiety-provoking tasks such as speeches and social interactions.

PEP in the Treatment of SAD

Given the pivotal role of PEP in SAD, individuals who undergo a successful course of treatment for this disorder should show improvement in PEP following treatment. Indeed, PEP decreased following group CBT for SAD (Abbott & Rapee, 2004; McEvoy et al., 2009; Modini, Rapee, Costa, et al., 2018; Price & Anderson, 2011; Wong et al., 2017; Katz et al., 2019; see Modini & Abbott, 2017 for an exception). Furthermore, symptom improvement following group CBT was mediated by decreases in PEP, AP, and self-focused attention, suggesting that these three processes may be mechanisms of symptom change (Hedman et al., 2013).

Various CBT protocols integrate PEP as an explicit target, either as a main component of therapy or as one to be integrated as needed (for an example with adults, see Leahy et al., 2012; for an example with adolescents, see Leigh & Clark, 2016). However, not all protocols do and yet participants in these studies nevertheless show improvements in PEP (e.g., Abbott & Rapee, 2004; Price & Anderson, 2011). It is currently unknown which components of therapy best contribute to reductions in PEP (Price & Anderson, 2011), and whether directly working on PEP

would yield greater reductions in social anxiety symptoms. Dismantling studies where the goal is to identify the components of therapy that are the drivers of change would be best suited to answer this question. However, no studies of this type exist to my knowledge. Better understanding PEP and how it could be addressed in therapy is therefore crucial, particularly if we consider the other potential impacts of PEP on the therapeutic process.

An additional reason to target PEP in interventions is that PEP can affect therapy progress. In a study examining the effects of group CBT for SAD, higher PEP was linked with higher social anxiety severity following group CBT for SAD (Katz et al., 2019). Similarly, the more PEP individuals engaged in between sessions of group CBT for SAD, the slower their social anxiety symptoms improved (Price & Anderson, 2011). Higher levels of PEP and maladaptive attentional focus at the beginning of group CBT also predicted a slower rate of speech-related and conversation-related improvement in AP.

Levels of PEP should also be considered in the treatment of other diagnoses. Peak state anxiety during a first group CBT session predicted greater levels of PEP one week later for participants with a variety of anxiety disorder diagnoses (Laposa et al., 2014). CBT session-related PEP was also associated with symptom severity in SAD, GAD, and PD, but not OCD. Hence, although targeting PEP is especially important in the treatment of SAD, it may be beneficial to target this ruminative process in other disorders given that individuals undergoing treatment may engage in PEP relating to the sessions themselves.

Positive Affect

Research in positive psychology suggests that experiencing positive emotional states may contribute to healthy beliefs and perceptions (Salovey et al., 2000). Fredrickson's Broaden-and-Build Theory of positive emotions (2001) further suggests that positive emotions can widen a person's habitual ways of thinking and behaving (e.g., urge to be creative, to play, to explore),

building psychological resilience and long-term wellbeing. Therefore, increasing positive emotional states may be a desirable effect of psychological interventions, and doing so has shown promising results for depression (Geschwind et al., 2019).

This goal is especially relevant considering that the tripartite model of emotional disorders describes social anxiety disorder as the only anxiety disorder that is associated with higher negative *and* lower positive affect, like depression (T. A. Brown et al., 1998; Watson et al., 1988). Both CBT and acceptance commitment therapy (ACT) have helped to decrease negative affect and increase positive affect in SAD (Sewart et al., 2019). Given its prominent role in maintaining symptoms within social anxiety models, PEP is likely to contribute to this higher negative and lower positive affect; however, researchers have yet to examine if PEP is related to positive affect.

Valence of PEP

In finding ways to reduce PEP, a potentially important characteristic, valence, may be overlooked in research. Essential in PEP's definition is that it consists of rumination about *negative* elements. It has been posited that individuals high in socially anxiety do not naturally ruminate on positive feedback following a speech (Cody & Teachman, 2010). Therefore, little is known about whether some individuals might also engage in positive PEP. However, fear of positive evaluation has been implicated in the maintenance of social anxiety (Heimberg et al., 2010), suggesting that there is likely to be some form of processing of positive information in social situations.

One questionnaire (i.e., the Thoughts Questionnaire [TQ]; Edwards et al., 2003) contains items assessing Positive PEP (e.g., "My speech was good") in addition to the regularly assessed Negative PEP (e.g., "I could have done much better"). The authors included the positive items to reduce negative response sets (Edwards et al., 2003). Given the inherent negative thought content

of PEP, many studies using the TQ have only utilized the Negative PEP subscale, omitting the potential information given by the Positive subscale (e.g., J. R. Brown & Kocovski, 2014; Çek et al., 2016; Chen et al., 2013; Perini et al., 2006; Wong et al., 2017).

If social anxiety is indeed linked with lower positive affect, then we might expect less focus on positive aspects of social situations during PEP in socially anxious individuals. However, this is not what research has found so far. The few studies that used both TQ subscales have shown that they are minimally correlated with one another (r = .10; Edwards et al., 2003) and that only the Negative PEP subscale correlated with social anxiety symptoms (r = .64; Abbott & Rapee, 2004). Additionally, following an anxiety provoking social situation, individuals with higher social anxiety or fear of negative evaluation reported more negative PEP, but similar levels of positive PEP, compared to individuals with lower social anxiety or fear of negative evaluation (Abbott & Rapee, 2004; Dannahy & Stopa, 2007; Edwards et al., 2003).

Based on these studies, one might conclude that socially anxious people seem to engage in more PEP overall, with a greater focus on the negative aspects of social situations but a similar focus on the positive aspects compared to non-socially anxious people. However, psychometrically the Positive PEP subscale of the TQ is shorter than the Negative PEP subscale. Indeed, a shorter scale may not have captured all relevant thoughts that might be considered positive PEP. The small number of studies that have assessed positive PEP also limits interpretations. Investigating the valence of PEP using a measure specifically intended to assess positive PEP may help inform interventions in the context of social anxiety.

Current Dissertation

Despite an increasing number of studies conducted on PEP, the relationship between PEP and other factors involved in anxiety in social situations remains unclear. We know that how anxious people feel in social situations and how they appraise their performance will affect levels

of negative PEP after the event (e.g., Cody & Teachman, 2011; Laposa & Rector, 2011; Rowa et al., 2014); however, research is equivocal as to whether performance appraisals change over time for individuals high in social anxiety and how PEP may contribute to this worsening (e.g., Abbott & Rapee, 2004; Cody & Teachman, 2011; Dannahy & Stopa, 2007). Moreover, PEP seems to influence the retrieval of performance feedback received during a stressful social situation (e.g., Cody & Teachman, 2010), but little is known about how PEP relates to other characteristics of memories (e.g., their valence, vividness, coherence). Additional research is also needed to understand PEP following a wider spectrum of human functioning, including positive PEP and PEP in reaction to pleasant social situations. Examining these factors may help elucidate how PEP maintains social anxiety symptoms to better inform treatments for SAD and enrich our understanding of how people function in social situations. As such, the studies outlined in this dissertation aimed to answer six main research questions: 1) how does negative PEP evolve over time? 2) how does negative PEP predict other affective and cognitive factors like anxiety, performance appraisals, and AP? 3) do people report engaging in PEP about positive aspects of a social situation (positive PEP)? 4) do stressful and pleasant situations trigger differing levels of negative and positive PEP? 5) is higher trait social anxiety linked with less positive PEP? and 6) how do negative and positive PEP relate to memory for social situations?

Study 1 aimed to answer research questions 1, 2, and 6 by exploring how negative PEP is related to other cognitive and affective processes involved in social anxiety using ecological momentary assessment in between two speech tasks. To my knowledge, this study was the first to use EMA to assess both repetitive negative thinking processes simultaneously and continuously over time as they relate to in-laboratory social events to examine how PEP evolves over time (Research Question 1). The longitudinal design enabled a detailed analysis of the progression of

PEP and AP, their relationship with one another, and how they related to anxiety, performance appraisals, and memory (Research Questions 2 and 6).

Study 2 answered research question 6, as did Study 1, as well as questions 3, 4, and 5 by measuring negative and positive PEP retrospectively following stressful and pleasant social interactions. Whereas Study 1 used standardized speeches to induce social anxiety, Study 2 allowed participants to ideographically recall a recent situation that was personally relevant to add richness and ecological validity. The focus was on the wider spectrum of social situations people can encounter in their daily lives (e.g., stressful and pleasant ones) and how these situations, and trait levels of social anxiety, might be related to repetitive thinking, including negatively and positively valenced thoughts (Research Questions 3, 4, and 5). In addition, I investigated how negative and positive PEP related to memory of the interactions (Research Question 6).

Optimizing treatment begins with a clear understanding of the reasons why social anxiety remains despite people's best efforts to move forward. We know that PEP maintains social anxiety over time. Yet, our knowledge of PEP has notable gaps. Investigating the predictors and effects of PEP using research designs that balance internal and ecological validity will further help increase personal and clinical relevance of results.

Chapter 2:

Ecological Momentary Assessment of Post-event Processing in Between Two Speech Tasks: Relationships With Cognitive and Affective Factors Involved in the Maintenance of Social Anxiety (Study 1)

Please note that a shorter version of this chapter was submitted for publication.

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Abstract

Socially anxious individuals tend to review past distressing social situations, a process called post-event processing. The goal of this 4-day study was to explore how post-event processing interacts over time with other cognitive and affective processes involved in social anxiety, including anticipatory processing, anxiety, performance appraisals, and memory. Students (n = 101) completed two speech tasks. Results from ecological momentary assessment showed that post-event and anticipatory processing decreased over time. Higher anxiety during the speech and poorer performance appraisals predicted more post-event processing, though post-event processing was unrelated to changes in performance appraisals over time. Post-event processing the day following the first speech was positively associated with anticipatory processing the day before the second speech. Participants who engaged in more post-event processing also remembered the first speech differently (e.g., more negative and emotionally intense). Implications for the cognitive-behavioural treatment of social anxiety are discussed.

Keywords: Rumination, social anxiety, ecological momentary assessment

Introduction[2]

In their cognitive theory of social anxiety, Clark and Wells (1995) proposed that individuals with social anxiety disorder review the embarrassing and distressing events that occurred during social situations, a repetitive negative thinking pattern called post-event processing. Consistent with this model, individuals who report being more socially anxious also report engaging in more post-event processing (for reviews, see Brozovich & Heimberg, 2008; and Wong, 2016). Various factors may contribute to a person's tendency to engage in post-event processing. For example, elevated levels of anxiety during social situations and beliefs about performance predicted increased subsequent post-event processing (e.g., Dannahy & Stopa, 2007; Laposa & Rector, 2011; Perini et al., 2006; Rowa et al., 2014).

By repeatedly focusing on the mistakes they made or the negative impressions they left, socially anxious individuals may also process this negative information more deeply. This negative focus may impact how they view themselves and how the situation went. For example, in Cody and Teachman (2011), ratings of global aspects of performance tended to worsen over time in participants high in social anxiety compared to those low in social anxiety, an effect that appeared to be explained by post-event processing. Participants in this study were assigned to high/low social anxiety groups based on their responses on the Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998). Given that dichotomizing practices can inadvertently have unpredictable effects (e.g., loss of information, varying choice of cutoffs; MacCallum et al.,

[2] Please note that formatting corresponds to the format requested by the journals to which we submitted the articles.

2002), examining whether post-event processing could account for this relationship using a continuous measure of social anxiety would be beneficial.

Furthermore, post-event processing may play a role in how people remember social situations given the in-depth review and processing that occurs. Indeed, social anxiety has been associated with changes in self-reported phenomenological features of autobiographical memory when remembering stressful social events or experiencing intrusive social images (e.g., having an observer perspective, reporting more negative images, less sensory detail, and less vividness; Ashbaugh et al., 2019; Clark & Wells, 1995; D'Argembeau et al., 2006; Moscovitch et al., 2011). As post-event processing may encourage more frequent recall of these negative memories, the frequency of post-event processing may contribute to how anxiety-provoking social situations are remembered. For instance, post-event processing might relate to the phenomenological experience of the memory (e.g., how vivid, coherent, and detailed the memory is; Luchetti & Sutin, 2016).

Research to date has relied mostly on retrospective self-report of post-event processing. Although easy to administer, results based on such measures may be biased by the retrospective account of symptoms, which may therefore be under or over reported. To try to circumvent this retrospective bias, researchers have also used experience sampling methods like daily diary and ecological momentary assessment (i.e., the repeated measure of participants' experiences in real time during their daily lives; Shiffman et al., 2008) to study post-event processing.

For example, using a diary approach, Lundh and Sperling (2002) found that the more post-event processing undergraduate students reported one day, the more post-event processing they reported the next day. In addition, post-event processing was at its highest the day after a conversation task, decreasing thereafter, regardless of social anxiety levels (Dannahy & Stopa, 2007). In addition, researchers using EMA found that people who reported higher levels of PEP

after distressing social events also reported greater trait social anxiety, greater self-focused attention, more safety behaviour use, and greater negative affect (Helbig-Lang et al., 2016). PEP was also higher for performance situations versus social interaction situations.

A particularly innovative approach may be to use both retrospective measurements and experience sampling as in Katz and colleagues (2019). Participants with SAD completed group CBT with multiple measurements of retrospective PEP. A subset of participants also reported on momentary PEP following social interactions during their daily lives as they completed therapy. This combined approach showed that group CBT helped decreased both general retrospective accounts of PEP and interaction-triggered PEP, and that the rate of decrease in PEP slowed over the course of therapy.

The combined use of retrospective accounts, experience sampling, and standardized social anxiety-provoking tasks is likely to provide greater insight into the correlates and time course of post-event processing in social anxiety. Using diary-style approaches would also allow for the examination of relationships between momentary affect and cognition. Indeed, affective states can impact memory and other cognitive processes (for a review, see Forgas & Eich, 2013). It may therefore be important to assess whether affect (e.g., state anxiety) at times of assessment relates to degree of engagement in repetitive negative thinking.

In addition to post-event processing, Clark and Wells (1995) also proposed that individuals with social anxiety disorder engage in another form of repetitive negative thinking: anticipatory processing. Before they enter a social situation, individuals with social anxiety may ruminate on what they think will happen, which usually includes predictions of rejection, poor performance, and failure. Though both post-event and anticipatory processing are hypothesized key factors in the maintenance of social anxiety symptoms (Clark & Wells, 1995), there is a paucity of research examining both processes together within the same study in relation to other

key considerations like anxiety levels and self-appraisals of performance. In one study of group CBT for social anxiety disorder, participants reporting greater post-event processing following a first exposure also reported greater anticipatory processing before a second exposure (Laposa & Rector, 2016), further highlighting the need to co-examine these repetitive negative thinking processes. The time course of anticipatory processing leading up to a stressful social situation is also unknown.

Current Study

The overarching goal of this study (registered through Open Science Framework prior to data analysis, available at https://osf.io/7c3az) was to explore how levels of post-event processing change over time and relate with other cognitive and affective factors involved in social anxiety like anticipatory processing, anxiety, performance appraisals, and memory. Participants gave two speeches, three days apart, for which they rated their peak anxiety levels and evaluated their performance. The phenomenological qualities of participants' memory for the first speech were also assessed twice (i.e., after the first speech and three days later) to assess for potential changes in memory qualities over time. On the two days separating the speech tasks, participants received ecological momentary assessment alerts to complete items measuring affect, post-event processing about the first speech, and anticipatory processing about the second speech. There were four main aims for the current study:

Aim 1: To examine the time courses and predictors of post-event and anticipatory processing

We were interested in examining the time course of post-event and anticipatory processing in between two speeches. We hypothesized that 1) post-event processing about the first speech would decrease over the two-day assessment period, whereas 2) anticipatory processing about the second speech would increase as the second speech approached.

We were also interested in assessing hypothesized temporal relationships between post-event and anticipatory processing. Specifically, we hypothesized that 3) participants who reported greater post-event processing at one time point would also report greater post-event processing at subsequent time points. Similarly, we hypothesized that 4) participants who reported greater anticipatory processing at one time point would also report greater anticipatory processing at subsequent time points. Given the temporal order of the speeches, we also hypothesized that 5) participants who reported greater post-event processing about Speech 1 would report greater anticipatory processing about Speech 2.

Furthermore, we wanted to examine if there was a relationship between momentary levels of anxiety and reported levels of post-event and anticipatory processing. We hypothesized that participants, when feeling more anxious at the time of the alert, would report 5) more post-event processing and 6) more anticipatory processing.

Aim 2: To examine if higher anxiety during the first speech triggers a cascade of negative thinking and anxiety

We hypothesized that 7) higher anxiety levels would trigger a cascade of relationships with other cognitive and affective factors involved in the maintenance of social anxiety. Specifically, we expected that participants who experienced greater peak anxiety during Speech 1 would subsequently appraise their speech more negatively. Participants who rated their performance more poorly would then engage in more post-event processing on Day 2 and in turn report more anticipatory processing on Day 3, which would then contribute to increased anticipatory anxiety before Speech 2.

Aim 3: To examine if post-event processing predicts changes in Speech 1 performance appraisals

We hypothesized that 8) higher social anxiety levels would predict greater post-event processing, which in turn would predict a worsening of Speech 1 global performance appraisals over time.

Aim 4: To examine if post-event processing predicts phenomenological memory qualities and changes over time

Lastly, we hypothesized that post-event processing would be related to the phenomenological memory qualities of Speech 1 and to changes in these qualities over time. Given that no one to our knowledge has examined the relationship between post-event processing and the phenomenological qualities of social anxiety-related memories, we did not have specific hypotheses and conducted these analyses in an exploratory manner.

Method

Participants

We recruited 126 participants[3] from the undergraduate participant pool and through flyers on the University of Ottawa campus. Participants received a ticket in the draw for one of four $50 Amazon gift cards for each EMA alert completed. Laboratory session attendance was compensated using additional draw tickets for community participants and course credit for undergraduate pool participants (i.e., leading to gaining up to 2% of their course grade for their

[3] We determined this target sample size using G*Power (Faul et al., 2007), which showed that for the serial mediation analysis, the study would require a total of 85 participants to achieve .80 power in detecting a medium-sized effect (f^2 = .15) with a .05 alpha. Thus, assuming that some participants would have unusable data given the longitudinal nature of the study, we recruited until we reached the desired number of participants with valid data. With over 50 participants in the hierarchical linear models, those estimates were likely to be unbiased and accurate (Maas & Hox, 2005).

participation). Twenty-five participants were excluded from analyses for various reasons.[4] The final sample consisted of 101 participants (M_{age} = 20.13; *SD* = 4.47), which included 36 people identifying as men, 64 as women, and one as gender fluid/queer. Of the 101 participants, 87 were from the participant pool and 14 were students from the University of Ottawa community. Participants were of diverse racial and ethnic backgrounds: 38.6% of participants identified[5] as Caucasian/White; 13.9% as Asian; 13.9% as African Canadian/Black; 9.9% as Middle Eastern; 3% as Hispanic; 2% as Other; 1% as European, 1% as Indian; 16.9% as multiple ethnicities. Regarding household annual income before taxes, the modal response was $80,000 or more (34.7% of the sample), followed by less than $20,000 at 25.7%. In addition, 29.7% of participants self-reported having been diagnosed with a mental disorder over their lifetime. The most common self-reported diagnoses were depressive disorders (15.8% of the sample) and anxiety disorders (16.8% of the sample), with 2.0% of the sample having reported being diagnosed with SAD.

Subsamples

We ran analyses on the highest number of participants with the required data for each analysis, creating subsamples, to preserve statistical power. We used the total sample (*n* = 101)

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[4] Reasons for participant exclusion were: EMA alerts not completed/not sent due to technical issues (*n* = 5); failure to show on Day 4 and not attending a debriefing session in person or via email to obtain consent for data use (*n* = 9); technical difficulties during in-person testing (Day 1: *n* = 3); not following experimenter instructions (*n* = 4); notable English fluency issues (*n* = 2); distress during testing (*n* = 1); dishonest response pattern on EMA alerts, as evidenced by single-answer responding (*n* = 1).

[5] Please note that these labels were the response options presented to participants for both studies at the time of data collection. Future iterations would use more inclusion and appropriate terminology to reflect the diversity within these groups and reduce stigma associated with some of the response options used.

for the longitudinal assessment of ecological momentary assessment data (Aim 1). *Subsample A* consisted of 83 participants who attended both laboratory visits and had sufficient ecological momentary assessment data to compute Day 3 anticipatory processing averages (Aim 2). *Subsample B* consisted of 90 participants who attended both laboratory visits and had sufficient ecological momentary assessment data to compute Day 2 post-event processing averages (Aims 3 and 4).

We ran Mann-Whitney *U* tests to verify whether participants who did not show for Day 4 laboratory testing (n = 11) differed from those who did (n = 90; subsample A). Participants who did not show for Day 4 reported similar levels of trait social anxiety (*Mdn* = 14) compared to those who attended Day 4 testing (*Mdn* = 20), U = 401.00, Z = -1.03, p = .31. Participants who did not show for Day 4 also reported similar levels of peak anxiety during speech 1 (*Mdn* = 5) compared to those who attended Day 4 testing (*Mdn* = 6), U = 433.50, Z = -0.68, p = .50). These results suggest that participants who dropped out of Day 4 testing did not do so because they were more anxious than those who continued the study.

Measures

Post-Event Processing Inventory – Trait Version (PEPI-T)

The PEPI-T (Blackie & Kocovski, 2017) is composed of 12 items assessing trait tendencies to engage in PEP (i.e., across various situations). We used the PEPI-T to assess the convergent validity of the post-event and anticipatory processing items used during the ecological momentary assessment (described below). Participants rated the extent to which they agreed or disagreed with statements such as “After social situations, I replay the event over in my mind” and “After social situations, my thoughts about the event interfere with my ability to concentrate” on a 5-point Likert-type scale (1 = *Strongly Disagree*, 5 = *Strongly Agree*). We generated the scale score by summing all items. Higher scores suggest greater tendencies to engage in PEP

across situations. The PEPI-T has demonstrated evidence of convergent validity with measures of rumination and PEP, and discriminant validity with measures of self-reflection (Blackie & Kocovski, 2017). It has also shown excellent internal consistency in an undergraduate student sample (α = .94; Blackie & Kocovski, 2017) and in the current study, α = .94.

Social Phobia Inventory (SPIN)

The SPIN (Connor et al., 2000) is a 17-item measure of trait social anxiety. Participants indicated how much the following problems had bothered them during the past week on a 5-point Likert-type scale (0 = *Not at all*, 4 = *Extremely*). Example items include "Parties and social events scare me" and "I avoid having to give speeches". We calculated the scale score by summing the items. Higher scores suggest more social anxiety symptoms. The SPIN has shown evidence of convergent validity with another measure of social anxiety, as well as discriminant validity (i.e., it was more correlated with a measure of social anxiety than with a measure of depressive symptoms; Radomsky et al., 2006). The SPIN has also shown acceptable to excellent internal consistency in social anxiety clinical samples (.87 ≤ α ≤ .94; Connor et al., 2000), undergraduate students (α = .93; Radomsky et al., 2006) and in the current study, α = .93.

Speech-Related Memories Experiences Questionnaire (SR-MEQ)

The SR-MEQ is a self-reported 21-item questionnaire adapted for this study from the short form of the Memory Experiences Questionnaire (MEQ; Luchetti & Sutin, 2016), which measures people's phenomenological experience of autobiographical memories. The original short form of the MEQ correlates strongly with the long form and demonstrates acceptable internal consistency in undergraduate samples (median α across the subscales = .79; Luchetti & Sutin, 2016). For the current study, we adapted items to assess the changes in phenomenological qualities of participants' memory of Speech 1. Given the recency of the memory being assessed in the current study, we deleted ten items that implied that a great length of time has elapsed

between the event and the assessment (e.g., “I feel like the person in this memory is a different person than who I am today”).

The modified SR-MEQ therefore assesses the following phenomenological qualities of memory, with higher scores suggesting more of the specified self-reported quality: Vividness (e.g., “My memory for the speech is very detailed”), Coherence (e.g. “This memory is a blending of many similar, related events rather than a specific memory about the speech [reverse scored]), Accessibility (e.g., “This memory was easy for me to recall”), Sensory Details (e.g., “As I remember the speech, I can hear it in my mind”), Visual Perspective (e.g., “I view this memory as if I was an observer to the experience”), Emotional Intensity (e.g., “The memory of the speech evokes powerful emotions”), and Valence (e.g., “The overall tone of the memory is positive”). Participants rated their level of agreement with each item on a 5-point Likert-type scale (1 = *Strongly disagree*, 5 = *Strongly agree*). We generated scores by taking the average of the items in each subscale, after appropriate reverse scoring.

As can be seen in Table 1, most subscales showed acceptable to excellent internal consistencies in the current study ($.79 \leq \alpha \leq .95$), except for the Coherence (αs = .61 for Day 1 and .49 for Day 4) and the Sensory Detail (αs = .36 for Day 1 and .60 for Day 4) subscales. We did not perform analyses on these two subscales given this very poor internal consistency.

Modified Perception of Speech Performance – Global Performance Rating (MPSP-G)

The MPSP-G (Cody & Teachman, 2011) is a 6-item measure of global evaluation of performance (e.g., “[I w]as a good public speaker”). The MPSP also has a local performance evaluation subscale (e.g., “Used sophisticated vocabulary”); however, we focused on global performance appraisals in the current study. Participants read performance descriptors and rated how they think they did for each descriptor using a 5-point Likert-type scale (0 = *Not at all*, 4 = *Very much*). We reverse scored negative items and computed the scale score by averaging the

items; thus, higher scores indicate better performance appraisals. The MPSP overall scale has shown acceptable internal consistency in an undergraduate student sample (α = .74; Stevens et al., 2018). The MPSP-G showed good to excellent internal consistency in the current study on Days 1 and 4, αs = .84 and .92, respectively.

Subjective Units of Distress Scale (SUDS)

We used SUDS (originally developed by Wolpe & Lazarus, 1966) to measure state anxiety at several time points throughout the study. Participants rated how anxious they felt on a scale from 0 (*not at all anxious*) to 10 (*the most anxious I have ever felt*).

Ecological Momentary Assessment Items

At every ecological momentary assessment check-in, participants provided anxiety ratings via the SUDS, and rated three items created for this study pertaining to the post-event processing of Speech 1 (i.e., "Currently, I worry I could have left a bad impression during the speech," "Currently, I think about how I could have done things differently during the speech," "Currently, I find it difficult to forget about the speech") and three items pertaining to the anticipatory processing of Speech 2 (i.e., "Currently, I worry about the speech I will be giving," "Currently, I think about all the mistakes I am likely to make during the speech," "Currently, I find it difficult not to think about the speech I will be giving") on a scale from 1 (*Do not agree*) to 7 (*Completely agree*).[6] We computed the weighted mean of the three post-event processing items at each alert (e.g., if participants only completed two of the three items, the weighted mean was computed

[6] We also included positively worded items to avoid a negative response set. Participants also rated how sad and irritable they felt using a scale from 0 (not at all sad /irritable) to 10 (the most sad/irritable I have ever felt) as part of the EMA alerts. These variables were not considered in the current, pre-registered hypotheses and analyses.

using those two items) to arrive at six post-event processing scores, one for each alert. These scores showed acceptable to excellent internal consistency in the current sample ($.69 \leq \alpha s \leq .94$). We similarly computed the weighted mean of the three anticipatory processing items at each alert to arrive at six anticipatory processing scores. These scores showed acceptable to good internal consistency in the current sample ($.76 \leq \alpha s \leq .88$). These scores were used in the hierarchical linear models. For all other analyses, we used averages. Specifically, we computed the weighted mean of the first three (Day 2) post-event processing scores and the weighted mean of the last three (Day 3) anticipatory processing scores to examine the temporal relationship between the two processes.

Procedure

Day 1 – in Laboratory Session

Procedures were approved by the University of Ottawa Research Ethics Board. Testing occurred at the INSPIRE Laboratory at the University of Ottawa. Participants were told by the experimenter that the purpose of the study was to better understand how people perform during speeches on controversial topics. After providing informed consent, participants gave an initial rating of anxiety. They then completed a sociodemographic questionnaire and the randomly presented symptom questionnaires (i.e., SPIN, PEPI-T)[7] using the online survey platform Qualtrics (2019). Next, participants had 3 minutes to prepare a 5-minute speech on one of two topics ("Discuss the voting rate in Canada and its implications" or "Discuss the cost of university

[7] Participants also completed the Depression Anxiety Stress Scales-21 (DASS-21; Lovibond & Lovibond, 1995) and the Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965) on Day 1. However, given the scope of the reported study and that these measures were not directly related to our hypotheses, we do not report on these measures in our sample.

tuition and its implications"), counterbalanced across participants, in front of the experimenter and a video camera. The experimenter informed participants that their speech would be recorded and evaluated by experts on public speaking who would rank them compared to other students and give them written feedback. To increase anxiety about the speech task, the experimenter presented the coding sheet that would supposedly be used by the experts to rank their performance. Participants were instructed that they could end their speech at any time but needed to wait in silence until the 5 minutes is up (as a way on controlling for time engaged in the task). Participants provided a second anxiety rating immediately before the speech; after the speech, they gave a third anxiety rating and rated their performance using the MPSP-G. Participants then took a 5-minute break to allow for time to pass before the assessment of the self-reported qualities of the memory for the speech using the SR-MEQ. To end the first session, the experimenter explained the ecological momentary assessment procedure to participants and completed a sample text message alert.

Days 2 and 3 – EMA Procedure

The following ecological assessment procedure is adapted from Connolly and Alloy (2018). We used a time-based design. On each of the two days following the first laboratory session, participants received three text message alerts from the online reminder service OhDontForget.com. We chose three alerts to balance participant burden and how rapidly we expected the processes of interest to change over time (Shiffman et al., 2008). Alerts were sent at pseudo-random times during a 9-hour period selected by participants (9am-6pm, 10:30am-7:30pm, 12pm-9pm, 1:30pm-10:30pm, or 3pm-12am), with the constraint that a minimum of 90 minutes occur between each alert and that one alert occur during the first, middle, and last 3 hours of the 9-hour period. The alerts contained a link to a Qualtrics survey presenting the EMA items. We asked participants to complete the survey within 60 minutes of receiving the alert;

surveys submitted after 60 minutes were considered missing and not included in the analyses. We chose the 60-minute window to balance data inclusion and specificity of the EMA procedure.

Day 4 – in Laboratory Session

Participants returned to the laboratory and gave an initial anxiety rating and, once again, rated their performance and completed the SR-MEQ about Speech 1. They then prepared their second speech, provided a second SUDS rating, and gave their 5-minute speech on the second counterbalanced topic. Following the speech, participants provided a third anxiety rating, rated their performance on Speech 2, and were debriefed.

Data Analysis

We used the Student Version of HLM8 (Raudenbush & Bryk, 2002) to run analyses involving hierarchical linear models. We conducted all other statistical analyses using IBM SPSS Statistics 24 (IBM Corp, 2016). For ease of reading, we present the data analytic strategy for each hypothesis immediately before the associated results.

Missing Data

No data were missing on the symptom inventories. Regarding ecological momentary assessment data (n = 101), participants submitted a total of 508 of the 606 scheduled alerts. For a more detailed description of missing data, please see Section 1 of the Supplemental Material.

Results

Descriptive statistics of the measures of interest are in Table 1.

Validity Checks

We conducted various validity checks that showed that 1) the speech tasks successfully induced anxiety in the average participant, 2) both speech topics induced similar levels of peak anxiety, irrespective of topic order, and 3) the scores representing the average levels of post-event and anticipatory processing measured constructs related to, but distinct from, trait tendencies to

engage in post-event processing. For a detailed description of these validity checks, please see Section 2 of the Supplemental Material available online. In addition, we computed Pearson correlations between PEP and AP scores at each alert to determine potential overlap between these scores. The correlations ranged from .80 to .88, *p*s < .001.

Aim 1: To examine the time courses and predictors of post-event and anticipatory processing

We conducted hierarchical linear models (nested within individuals) to examine how post-event and anticipatory processing levels changed over time and to assess factors associated with higher self-reported levels of both repetitive negative thinking processes. We log transformed post-event processing scores, anticipatory processing scores, and state anxiety scores to correct for positive skewness and kurtosis. However, issues with heteroscedasticity and non-normality of residuals remained within the models. We therefore examined the outputs with robust standard errors.

Time Courses of Post-Event and Anticipatory Processing

We entered "Time" as the independent variable, and post-event processing or anticipatory processing as the outcome variable in two separate models. To adequately represent the unequal spacing between alerts, we centered Time at the moment the participants began the first ecological momentary assessment alert such that each subsequent increase in one unit represented one hour since the participants' first alert.

For post-event processing, the fixed effect of slope showed that the average level of post-event processing decreased over time for the average participant, β = -0.01, robust *SE* = 0.001, $t(100) = -8.37$, $p < .001$ (see Figure 1 for individual participant model predicted regression lines). The random effects suggested that participants varied in the degree to which they reported engaging in post-event processing at the initial alert, $\chi^2(99) = 649.93$, $p < .001$. There was also

variability in the degree to which post-event processing changed over time across participants, $\chi^2(99) = 171.89$, $p < .001$. The model accounted for 32.78% of the variance in post-event processing.

For anticipatory processing, the fixed effect of slope showed that anticipatory processing decreased over time for the average participant, $\beta = -0.003$, robust SE = 0.001, $t(100) = -4.94$, $p < .001$ (see Figure 1). The random effects suggested that participants varied in the degree to which they reported engaging in anticipatory processing at the initial alert, $\chi^2(99) = 966.40$, $p < .001$. There was also variability in the degree to which anticipatory processing changed over time across participants, $\chi^2(99) = 172.87$, $p < .001$. The model accounted for 23.55% of the variance in anticipatory processing.

Temporal Effects Between Post-Event and Anticipatory Processing

To examine if temporal cascading relationships existed between post-event processing and anticipatory processing, we conducted two separate time-lagged hierarchical linear models. To assess the effects of post-event processing on subsequent post-event processing, we entered post-event processing at Alert *T* as the independent variable (person-mean centered) and post-event processing at Alert *T*+1 as the outcome variable in one time-lagged model. We allowed both the slope and the intercept to vary. To assess the effects of both post-event and anticipatory processing on anticipatory processing, we entered post-event processing and anticipatory processing at Alert *T* as the independent variables (person-mean centered) and anticipatory processing at Alert *T*+1 as the outcome variable in a second time-lagged model. We removed post-event processing's slope random effect due to convergence difficulties and low reliability of the random effect coefficient.

For post-event processing, the fixed effect of slope showed that participants who reported more post-event processing at any given alert *T* also reported more post-event processing at their

next alert *T*+1, β = 0.13, robust SE = 0.06, *t*(95) = 2.40, *p* = .02. The random effects suggested that, at their average levels of post-event processing at Alert *T*, participants varied in the degree to which they reported engaging in post-event processing at the next Alert *T*+1, $\chi^2(72) = 1210.51$, $p < .001$. There was also variability in the degree to which post-event processing predicted subsequent post-event processing across participants, $\chi^2(72) = 95.46$, $p = .03$. The model accounted for 11.09% of the variance in post-event processing at Alert T+1.

For anticipatory processing, the fixed effects indicated that levels of both post-event processing (β = 0.10, robust SE = 0.05, *t*(174) = 1.83, *p* = .07) and anticipatory processing (β = -0.04, robust SE = 0.08, *t*(95) = -0.52, *p* = .60) at Alert T were unrelated to levels of anticipatory processing at Alert T+1. Random effects suggested that, at their average levels of post-event and anticipatory processing at Alert *T*, participants varied in the degree to which they reported engaging in anticipatory processing at the next Alert *T*+1, $\chi^2(61) = 1611.76$, $p < .001$. There was also variability in the degree to which anticipatory processing predicted subsequent anticipatory processing across participants, $\chi^2(61) = 111.47$, $p < .001$. The model accounted for 16.96% of the variance in anticipatory processing at Alert T+1.

Momentary Effects of Anxiety on Post-Event and Anticipatory Processing

To examine if levels of anxiety at the time of alert completion was related to reported post-event processing, we entered "state anxiety" as the independent variable person-mean centered, and post-event processing and anticipatory processing as the outcome variables in two separate models. We removed the slopes' random effect in both models due to convergence difficulties and low reliability of the random effect coefficients.

For post-event processing, the fixed effect of slope showed that state anxiety at the time of the alerts was unrelated to post-event processing for the average participant, β = -0.06, robust SE = 0.04, *t*(405) = -1.53, *p* = .13. The intercept's random effect suggested that, at their average

levels of state anxiety, participants varied in the degree to which they reported engaging in post-event processing, $\chi^2(100) = 902.20$, $p < .001$. The model accounted for 0.36% of the variance in post-event processing.

For anticipatory processing, the fixed effects showed that participants reporting greater state anxiety at the time of the alerts reported less anticipatory processing, $\beta = -0.05$, robust SE = 0.02, $t(404) = -2.10$, $p = .04$. Examination of the intercept's random effect suggested that, at their average levels of state anxiety, participants varied in the degree to which they reported engaging in anticipatory processing, $\chi^2(100) = 1657.12$, $p < .001$. The model accounted for 0.54% of the variance in anticipatory processing.

Aim 2: To examine if higher anxiety during the first speech triggers a cascade of negative thinking and anxiety

To investigate if high anxiety levels during the first speech triggered a cascade of negative thinking and anxiety, we conducted a serial mediation analysis (10,000 percentile bootstrap samples) using the PROCESS 3.4 macro for SPSS (Hayes, 2018) in which Speech 1 peak anxiety was the independent variable and Speech 2 anticipatory anxiety was the outcome variable. Speech 1 global performance appraisals, Day 2 average post-event processing levels, and Day 3 average anticipatory processing levels were entered as the three serial mediators in this order. We performed log and inverse transformations on post-event and anticipatory processing, respectively, to correct positive skewness and standardized all variables into *Z* scores prior to analysis. We used the HC3 correction to correct for heteroscedasticity.

Overall, the model accounted for 31.13% of the variance in Speech 2 anticipatory anxiety. Specifically, peak levels of anxiety during Speech 1 were indirectly related to levels of anxiety in anticipation of Speech 2 through the effects of the three serial mediators. As can be seen in Figure 2, participants who reported experiencing greater peak anxiety during Speech 1 appraised

their speech more poorly (a_1 = -.51, HC3 *SE* = .09, $p < .001$); participants who appraised their speech more poorly then went on to engage in more post-event processing the next day (d_{21} = -.28, HC3 *SE* = .12, $p = .02$); participants who engaged in more post-event processing also engaged in more anticipatory processing[8] the day before Speech 2 (d_{32} = .77, HC3 *SE* = .07, $p < .001$); lastly, participants who engaged in more anticipatory processing reported experiencing greater anxiety immediately before performing Speech 2 (b_3 = .27, HC3 *SE* = .10, $p = .01$). A 95% percentile confidence interval based on 10,000 bootstrap samples indicated that the completely standardized indirect effect through performance appraisals, post-event processing, and anticipatory processing ($a_1d_{21}d_{32}b_3$ = 0.03; bootstrap *SE* = 0.02), holding all other effects constant, was entirely above zero (0.003 to 0.071).

Additionally, peak levels of anxiety during Speech 1 were indirectly related to levels of anxiety in anticipation of Speech 2 through the effects of only post-event and anticipatory processing (i.e., not passing through performance appraisals). As can be seen in Figure 2, participants who reported experiencing greater peak anxiety during Speech 1 reported engaging in more post-event processing the next day (a_2 = .36, HC3 *SE* = .11, $p = .003$). A 95% percentile confidence interval based on 10,000 bootstrap samples indicated that the completely standardized indirect effect through only post-event and anticipatory processing ($a_2d_{32}b_3$ = 0.07; bootstrap *SE* = 0.04), holding all other effects constant, was entirely above zero (0.016 to 0.172). We performed contrasts to compare the relative strength of the two above indirect effects. A 95%

[8] The inverse transformation of anticipatory processing meant that higher scores reflected less anticipatory processing. To facilitate interpretation of coefficients, we reversed the sign of the coefficients involving anticipatory processing such that a positive effect indicated more anticipatory processing.

percentile confidence interval based on 10,000 bootstrap samples indicated that the absolute difference between the indirect effects with and without performance appraisals (indirect effect contrast = 0.04, bootstrap *SE* = 0.04) was not different than zero (-0.016 to 0.144).

The confidence intervals for all other indirect effects were not different than zero (see Figure 2 for the effects associated with these pathways). Moreover, levels of peak anxiety during Speech 1 predicted greater anticipatory anxiety before Speech 2 even when taking into account peak anxiety's indirect effects through all mediators (*c*' = .52, HC3 *SE* = .13, $p < .001$).

Aim 3: To examine if post-event processing predicts changes in Speech 1 performance appraisals

To examine if post-event processing predicted a worsening in performance appraisals over time, we conducted a simple mediation analysis (10,000 percentile bootstrap samples) using the PROCESS 3.4 macro for SPSS (Hayes, 2018). We entered SPIN scores as the independent variable, a Performance Appraisal Change Score (MPSP-G Day 4 – MPSP-G Day 1; negative scores suggesting a decrease in appraisals) as the outcome, and Day 2 average post-event processing levels as the mediator variable, which was log transformed to correct for positive skewness. We winsorized one univariate outlier in the Performance Appraisal Change Scores. We standardized all variables into *Z* scores prior to analysis and used the HC3 correction to correct for heteroscedasticity.

The model explained only .67% of the variance in change in performance appraisals over time. Participants higher in trait social anxiety reported engaging in more post-event processing the day following Speech 1 (*a* = .42, HC3 *SE* = .09, $p < .001$; see Figure S1 in Section 3 of the Supplemental Material). However, post-event processing was unrelated to change in performance appraisals (*b* = -.24, HC3 *SE* = .13, *p* = .06). A 95% percentile confidence interval based on 10,000 bootstrap samples indicated that the completely standardized indirect effect of social

anxiety on changes in appraisals through post-event processing (*ab* = -0.10; bootstrap *SE* = 0.05) was not different than zero (-0.211 to 0.002). In addition, trait social anxiety was unrelated to changes in performance appraisal, holding post-event processing constant (*c*' = .02, HC3 *SE* = .11, *p* = .85).

Aim 4: To examine if post-event processing predicts phenomenological memory qualities and changes over time

To examine how post-event processing related to the phenomenological qualities of the memory for the speech and changes in these qualities over time, we conducted exploratory repeated-measure moderation analyses using the MEMORE 2.1 macro for SPSS (Montoya, 2019). We entered Day 2 average post-event processing levels (mean-centered) as the independent variable and Speech 1 SR-MEQ subscale scores from Days 1 and 4 as the outcome variables. We log transformed the post-event processing average scores and the Emotional Intensity subscale to correct for positive skewness. There were minor issues with normal estimation errors and homoscedasticity. Unlike PROCESS, no corrections for heteroscedasticity were available in MEMORE. We controlled for the false discovery rate using Benjamini-Hochberg (BH) procedure (Benjamini & Hochberg, 1995) for the 15 effects of interest. We present a summary of results containing only inferential statistics that were deemed statistically significant according to the BH procedure. Complete results and graphical depictions of effects can be found in Table S1 and Figure S2 in Section 4 of the Supplemental Material.

Self-Reported Phenomenological Memory Qualities on Days 1 and 4

Participants who engaged in more post-event processing reported that the memory of Speech 1 was less accessible on Day 1 (*B* = -1.30, *t*[88] = -3.07, *p* = .003, R^2 = .10), but not on Day 4. In addition, participants who engaged in more post-event processing reported that the memory of Speech 1 was more emotionally intense on both Day 1 (*B* = 0.57, *t*[88] = 7.11, *p* <

.001, R^2 = .36) and Day 4, B = 0.49, t[88] = 6.14, p < .001, R^2 = .30. Their memory of Speech 1 was also more negative on both Day 1 (B = -2.51, t[88] = -5.43, p < .001, R^2 = .25) and Day 4, B = 2.36, t[88] = -5.44, p < .001, R^2 = .25. Post-event processing was unrelated to memory Vividness or Visual Perspective on either Day 1 or Day 4.

Changes in Self-Reported Phenomenological Memory Qualities Over Time

Post-event processing predicted changes in Vividness over time, B = -1.18, t(88) = 2.54, p = .01, R^2 = .07. Specifically, participants reported that the vividness of their memory of Speech 1 decreased over time; however, the decrease in Vividness was less pronounced for participants who engaged in more post-event processing. Post-event processing was unrelated to changes in memory Accessibility, Visual Perspective, Emotional Intensity, or Valence over time, suggesting the post-event processing did not moderate changes in these memory qualities.

Discussion

Clark and Wells' cognitive model of social anxiety (1995) suggests that several processing biases are important in the maintenance of social anxiety, including tendencies to engage in post-event processing following social situations, beliefs about performance, and the tendency to ruminate about upcoming social situations during anticipatory processing. The goal of the current study was to better understand how these processing biases, particularly, post-event processing, change over time, and how post-event processing relates to other affective and cognitive factors in the context of social situations. We assessed both post-event and anticipatory processing in between two speech tasks through ecological momentary assessment. This fine-grained information enabled us to see changes in and relationships between these repetitive negative thinking processes as participants went about their daily lives.

Aim 1: To examine the time courses and predictors of post-event and anticipatory processing

The first aim of this study was to better understand how post-event processing and anticipatory processing levels evolved over time. Consistent with our initial hypothesis, we found that post-event processing decreased over the two-day assessment period following the first speech. Initial levels of post-event processing varied across individuals, suggesting that the speech induced varying levels of post-event processing. The rate of this decrease differed between participants, some showing a more rapid decrease than others. These findings are consistent with existing research showing that post-event processing is at its highest the day following a social anxiety-inducing task regardless of social anxiety levels (Dannahy & Stopa, 2007). However, contrary to our hypothesis, anticipatory processing also decreased on average, though there was variability across participants in changes in anticipatory processing over time.

Various theoretical and methodological reasons could explain the similar, downward time courses of both post-event and anticipatory processing. For example, the ecological momentary assessment items were identical at each alert, which might have contributed to habituation to the items or to the idea of having to give a second speech, almost acting as imaginal exposure. Another possibility is that these two negative thinking processes, though distinct, may covary such that when one decreases the other also decreases, though this may also be a by-product of measuring both processes concurrently. Indeed, both PEP and AP were assessed in the same manner and at the same time. Shared method variance may have therefore contributed to their similar reports and time courses. A potential way to circumvent the variance stemming from simultaneous assessment could be to measure PEP and AP at different time points, though this would have entailed adding assessments.

We were also interested in assessing temporal cascading relationships between post-event and anticipatory processing. Consistent with our hypothesis, participants who reported more post-event processing at any given alert also reported more post-event processing at their next alert,

indicating that some participants consistently reported more post-event processing compared to other participants. However, this was not the case for anticipatory processing, levels of which were unrelated from one assessment time point to the next. We also did not find the expected relationship between post-event processing and subsequent anticipatory processing, suggesting that anticipatory processing levels were independent from previous reports of repetitive negative thinking both about Speech 1 or the upcoming Speech 2.

In addition, we wanted to see whether general levels of anxiety experienced at the time of each alert was related to how much post-event and anticipatory processing they reported engaging in. We expected that when participants were feeling more anxious overall, they would also report engaging in more post-event and anticipatory processing. However, state anxiety at each alert was unrelated to post-event processing. Interestingly, participants who reported more anxiety during the assessments reported engaging in less anticipatory processing, the opposite direction of expected effect. However, the size of this effect was negligeable with the model only explaining 0.54% of the variance in anticipatory processing. Therefore, overinterpretation of these findings should be cautioned. The fact that the amount of variance accounted for between state anxiety and momentary levels of post-event processing and anticipatory processing was so small suggests that these negative thinking patterns are specifically part of the anxiety cascade associated with social anxiety rather than anxiety in general.

Aim 2: To examine if higher anxiety during the first speech triggers a cascade of negative thinking and anxiety

We aimed to determine how anxiety levels during the first speech and performance appraisals might have cascading effects on the likelihood of engaging in in post-event and anticipatory processing, and how this repetitive negative thinking might be related to anxiety levels in anticipation of a second speech. Consistent with our hypotheses, participants who were

more anxious during Speech 1 reported poorer performance appraisals and went on to report more post-event processing on average the day after the speech. Speech 1 peak anxiety was also directly related to post-event processing. These results add to the body of literature showing that tendencies to ruminate on past social situations are related to how anxious people were during the event and how they appraised their performance (e.g., Dannahy & Stopa, 2007; Laposa & Rector, 2011; Perini et al., 2006; Rowa et al., 2014).

This anxiety cascade also appeared to continue in relation to other mechanisms related to social anxiety. Participants who engaged in more post-event processing on average the day following Speech 1 also reported engaging in more anticipatory processing on average the day before Speech 2. Those who reported more anticipatory processing in turn reported feeling more anxious immediately before that speech, even when taking into account Speech 1 peak anxiety, performance appraisals, and post-event processing. Degree of anticipatory processing may therefore depend on how much post-event processing a person previously engaged in for similar situations more so than how anxious they were or their appraisal of their performance. Given the apparent link observed in the current study between post-event processing and anticipatory processing and anxiety, future research should examine if interventions focused on reducing negative post-event processing have downstream effects on anticipatory processing and anxiety levels in anticipation of similar events.

The reader may have noticed that results from Aim 1 showed that post-event processing at one assessment alert was unrelated to anticipatory processing at subsequent alerts. This finding appears to contrast with the above where average Day 2 post-event processing was related to average Day 3 anticipatory processing. These contradictory results could be explained by the fact that the former analysis used momentary levels of post-event and anticipatory processing whereas the latter used average levels of these processes. Moment-by-moment reports may have been

affected by random confounding factors (e.g., if a participant was in a class at the time of the alert, their self-report for that alert may have been impacted in unpredictable ways). By looking at average levels of post-event and anticipatory processing throughout day, the resulting scores may have been more robust to the influence of random confounding factors compared to the individual moment by moment levels. Taken together, results suggest that the relationship between post-event and anticipatory processing is complex and further nuanced by level of measurement (e.g., momentary versus averaged).

Aim 3: To examine if post-event processing predicts changes in Speech 1 performance appraisals

Previous research has shown that ratings of global aspects of performance tended to worsen over time in high socially anxious participants compared to participants low in social anxiety, with post-event processing accounting for this relationship (Cody & Teachman, 2011). In the current study, we aimed to extend these results using a continuous measure of social anxiety symptoms. Though participants higher in social anxiety symptoms reported engaging in more post-event processing on average the day following Speech 1, post-event processing was unrelated to change in performance appraisals, which contrasted with our hypotheses and the findings from Cody and Teachman (2011). Trait social anxiety symptoms were also unrelated to change in performance appraisals. One explanation for the differing results could be that participants' performance appraisals did not change over the course of 3 days. When examining

the mean global performance appraisals on Days 1 and 4, one can see that they remained stable.[9] Furthermore, different study methods were used in the current study and Cody and Teachman (2011), namely the dichotomized versus continuous measure of social anxiety and the use of a different measure of post-event processing and timeframe (i.e., the Post-Event Processing Questionnaire three days after a speech; Rachman et al., 2000). Results from the current study suggest that post-event processing in an unselected sample may be related to a person's performance appraisals without necessarily worsening those appraisals over time.

Aim 4: To examine if post-event processing predicts phenomenological memory qualities and changes over time

We also examined whether post-event processing might be related to changes in phenomenological memory qualities. Exploratory repeated-measure moderation analyses suggested that post-event processing was overall unrelated to changes in the self-reported phenomenological qualities of participants' memories of Speech 1, with the exception of memory vividness. Specifically, participants reported that the vividness of their memory of Speech 1 decreased over time; however, the decrease in vividness was less pronounced for participants who engaged in more post-event processing. Although post-event processing was unrelated to changes in other memory qualities over time, there was preliminary evidence that post-event processing might be related to a self-reported lower ability to access the memory mere moments after the speech. This lower reported accessibility could point towards increased attentional and

[9] To provide further support for this hypothesis, we conducted a paired-sample *t*-test, which further suggested that participants rated their performance on Speech 1 similarly on both Day 1 (*M* = 2.02, *SD* = 0.83) and Day 4 (M = 2.01, SD = 0.94), *t*(89) = -0.37, *p* = .97.

cognitive load being used by anxiety during and shortly after the speech. In addition, post-event processing was also linked with greater self-reported emotional intensity and negative valence of the memory, suggesting that negatively interpreted and distressing information may be more likely to trigger and figure within PEP. These results are consistent with Heimberg and colleagues' (2010) view of PEP as a reconstruction of the event where the original memory of the social situation is taken apart and rehearsed repeatedly. The memory is then put back together according to all the negative biases, making it more negative and fear-inducing over time. Current findings open further areas of investigation into the directionality of these relationships.

Limitations

Results must be considered within the study's limitations. First, although ecological momentary assessment may have reduced the impact of retrospective bias on study findings, probing for information may have cued participants to continue thinking about the speeches (Sluis et al., 2017). However, this cueing appears unlikely in the current study given that participants reported overall low levels of PEP and AP during the ecological momentary assessment.

Second, we did not conduct any suspicion checks around speech evaluation and feedback provision. As such, it cannot be ruled out that certain participants doubted the anxiety induction instructions and therefore may have experienced less anxiety.

Third, participants were students who displayed a wide range of social anxiety symptoms on the Social Phobia Inventory (see Table 1). This sample type may explain why participants reported overall low levels of post-event processing over the course of the two-day assessment period. It is also possible that the speeches provoked anxiety but did not provide sufficient triggers for the participants to continue thinking about the task in their everyday lives. Generalizations to populations other than educated young adults should also be made with

caution. Replicating and extending the current methods in clinical samples with social anxiety disorder or in a sample selected for speech anxiety may also help correct the floor effects. Obtaining more response variability in future study iterations would also likely help address the violated statistical assumptions in some analyses related to non-normality of residuals and heteroscedasticity, for which we used corrections when available.

Conclusions and Future Directions

Results shed light onto the evolution of post-event and anticipatory processing between two similar social evaluative situations in a student sample using ecological momentary assessment procedures. Anxiety levels during a speech and appraisals of performance appear to set off an anxiety cascade, increasing engagement in post-event processing. In this non-clinical sample, post-event processing decreased overtime, as did anticipatory processing. However, there was considerable variability across participants with regards to the intensity of both post-event processing and anticipatory processing. Our results shed light on factors that may predict who goes on to engage in post-event processing and anticipatory processing. Specifically, anxiety levels during a speech and poor appraisals of performance predicted increased engagement in post-event processing, which in turn predicted more engagement in anticipatory processing of a subsequent speech. Furthermore, engaging in more post-event processing was associated with reporting a more negative and intense experience of the memory and a slower decay in self-reported memory vividness over the course of four days. Next steps for post-event processing research may include investigating whether interventions focused on reducing anxiety in social situations and performance reappraisals also reduce post-event processing. It will also be important to determine whether reducing post-event processing could have downstream effects on thoughts and anxiety in anticipation of future similar situations. Repetitive negative thinking in social anxiety is complex and can be very distressing for individuals, particularly those who

live with social anxiety. Further research is needed to tease apart the complex relationship between post-event and anticipatory processing, particularly in clinical samples with social anxiety disorder.

Highlights: Anxiety levels during a speech appear to set off a cascade of negative thinking. Post-event and anticipatory processing decreased over time. Post-event processing may have downstream effects on thoughts and anxiety.

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Author contributions: L.K. developed the study concept. L.K. and A.R.A. contributed to the study design. Testing and data collection were performed by L.K. and volunteer research assistants. L.K. performed the data analysis and interpretation under the supervision of A.R.A. L.K. drafted the paper and A.R.A. provided critical revisions. All authors approved the final version of the paper for submission.

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Table 1

Descriptive Statistics for Sample *n* = 90

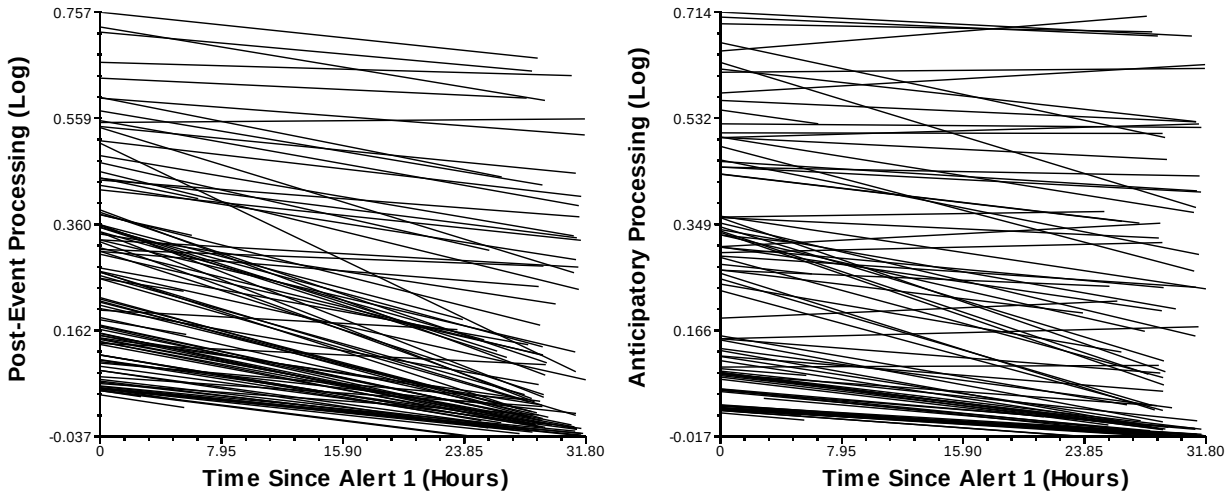
Measures	Day 1			Day 4		
	Mean (*SD*)	Min-Max[a]	Cronbach's Alpha	Mean (*SD*)	Min-Max	Cronbach's Alpha
Post-Event Processing Inventory – Trait	34.22 (10.97)	13-60	.94			
Social Phobia Inventory	21.06 (13.72)	0-56	.93			
Speech 1 Modified Perception of Speech Performance – Global Performance	2.02 (0.83)	0.17-3.67	.84	2.01 (0.94)	0-3.5	.92
Subjective Units of Distress						
Initial	3.23 (2.38)	0-10	N/A	3.32 (2.58)	0-10	N/A
Anticipatory	5.24 (2.36)	0-10	N/A	4.62 (2.62)	0-10	N/A
Peak	5.77 (2.48)	0-10	N/A	4.62 (2.57)	0-10	N/A
Speech 1-Related Memories Experiences Questionnaire						
Vividness	3.37 (0.97)	1.33-5	.83	2.75 (0.86)	1-4.67	.85
Coherence	3.52 (0.78)	2-4.75	.61	3.22 (0.69)	1.75-4.5	.49
Accessibility	3.87 (0.91)	1.67-5	.83	3.59 (0.90)	1.33-5	.79
Sensory Detail	3.34 (0.77)	1.67-5	.36	2.80 (0.85)	1-5	.60
Visual Perspective	3.64 (1.16)	1-5	.89	3.57 (1.29)	1-5	.94
Emotional Intensity	2.24 (1.06)	1-5	.92	2.04 (0.95)	1-5	.93
Valence	3.26 (1.09)	1-5	.95	3.22 (1.02)	1-5	.93
Ecological Momentary Assessment Measures						
Average Day 2 Post-Event Processing	2.12 (1.16)	1-6	.87[b]			
Average Day 3 Anticipatory Processing	1.76 (1.24)[c]	1-5.89[c]	.96[d]			

[a]Some scores are integer, while others are decimals. This is due to the procedure used to compute scale scores (i.e., sum and mean, respectively); [b]Alpha computed on *n* = 68 because of missing data deleted listwise; [c]Descriptives based on *n* = 83 because of missing data deleted listwise; [d]Alpha computed on *n* = 55 because of missing data deleted listwise.

Figure 1

Model-predicted Time Course of Post-Event Processing (a) and Anticipatory Processing (b)

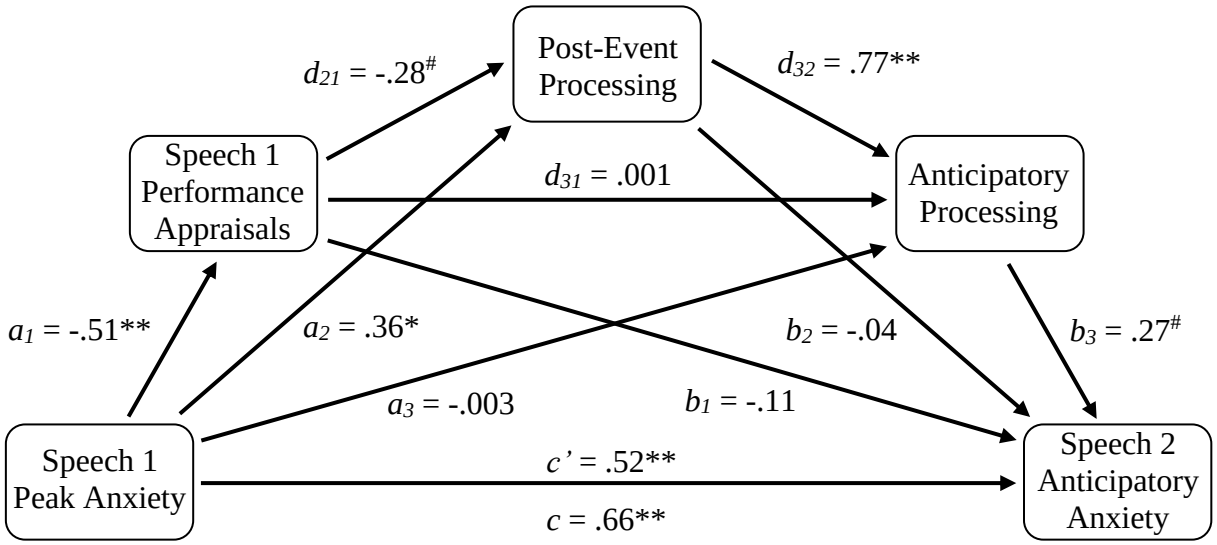
(a) (b)



Note. Each line represents an individual participant's model predicted regression line.

Figure 2

The Cascading Effects of Anxiety, Performance Appraisals, Post-Event Processing, and Anticipatory Processing



Note. Post-event processing was log transformed. Anticipatory processing was inverse transformed and signs reversed to facilitate interpretation of coefficients. Presented coefficients are standardized.

c = total effect of Peak Anxiety on Anticipatory Anxiety; c' = direct effect of Peak Anxiety on Anticipatory Anxiety; a_k = effect of Peak Anxiety on the mediators; b_k = effect of the mediators on Anticipatory Anxiety; d_{k1} = effect of mediator 1 on subsequent mediators; d_{32} = effect of mediator 2 on mediator 3.

# $p < .05$, * $p < .01$, ** $p < .001$

Supplemental Material

1. Missing Data

No data were missing on the symptom inventories. Regarding ecological momentary assessment data (N = 101), 606 alerts were scheduled (six alerts per participant). Participants submitted a total of 508 responses. Fifteen alerts were not received by participants due to technical issues on ohdontforget.com; 44 alerts were not completed by participants; 39 alerts were completed after the 60-minute limit and were therefore not considered in the analyses. Almost half of the participants (n = 48) completed all 6 alerts; 27 completed 5 alerts; 12 completed 4 alerts; 10 completed 3 alerts; 3 completed 2 alerts; 1 completed 1 alert. Alert response rate also decreased over time (e.g., 3.3% did not respond to Alert 1, whereas 27.8% did not respond to Alert 6). Of the 508 alerts that were submitted, 10 data points were missing. We did not impute missing ecological momentary assessment data points, but rather computed weighted means to calculate post-event and anticipatory processing scores as described in the Measures section to maximize available data.

2. Validity Checks

2.1. Anxiety Induction

To verify whether the speech tasks were successful in inducing anxiety, we ran two repeated-measure ANOVAs (one each for Speech 1 and 2) with Time (initial vs. anticipatory vs. peak) predicting SUDS ratings using Subsample B (n = 90; i.e., those who had completed both laboratory visits). We expected participants' anxiety to increase from initial ratings to anticipatory and peak ratings, with their highest anxiety ratings being during the speeches. We used Huynh-Feldt estimates to correct for violations of sphericity.

Results suggested that there was an effect of Time on Day 1 SUDS ratings, $F(1.84, 164.15) = 73.38$, $p < .001$, $\eta_p^2 = .45$. Pairwise comparisons using a Bonferroni adjustment showed

that participants were more anxious during the speech (peak; M = 5.77, SE = 0.26) compared to both at the start of the session (initial; M = 3.23, SE = 0.25) and right before the speech (anticipatory; M = 5.24, SE = 0.25), ps < .001 and .03. Participants were also more anxious right before the speech compared to initial ratings, p < .001.

There was an effect of Time on Day 4 SUDS ratings, $F(1.60, 142.75) = 23.55$, p < .001, η_p^2 = .21. Pairwise comparisons using a Bonferroni adjustment showed that participants were more anxious during the speech (peak; M = 4.62, SE = 0.27) compared to the start of the session (initial; M = 3.32, SE = .27, p < .001), but not compared to right before the speech (anticipatory; M = 4.62, SE = 0.28, p = 1.00). Taken together, results suggest that the speech task successfully induced anxiety in the average participant on both Days 1 and 4.

2.2. Speech Topics

To examine whether speech topics had any effect on peak anxiety, controlling for speech practice effects, we ran a 2 × 2 mixed ANOVA with Time (Speech 1 vs. 2) and Speech Topic Order predicting Peak SUDS using Subsample B (n = 90). We expected that order of speech topic would have had no impact on anxiety ratings. We further expected peak anxiety ratings to be lower during Speech 2 compared to Speech 1.

There was a main effect of Time on Peak SUDS ratings, $F(1, 88) = 17.95$, p < .001, η_p^2 = .17). Pairwise comparisons using a Bonferroni adjustment showed that participants were more anxious during Speech 1 (M = 5.77, SE = 0.26) compared to Speech 2 (M = 4.63, SE = 0.27), p < .001. Results further indicated that neither the main effect of Speech Topic Order (η_p^2 = .01) nor its interaction with Time (η_p^2 = .01) were notable, suggesting that both speech topics induced similar levels of peak anxiety, irrespective of topic order.

2.3. Post-Event and Anticipatory Processing

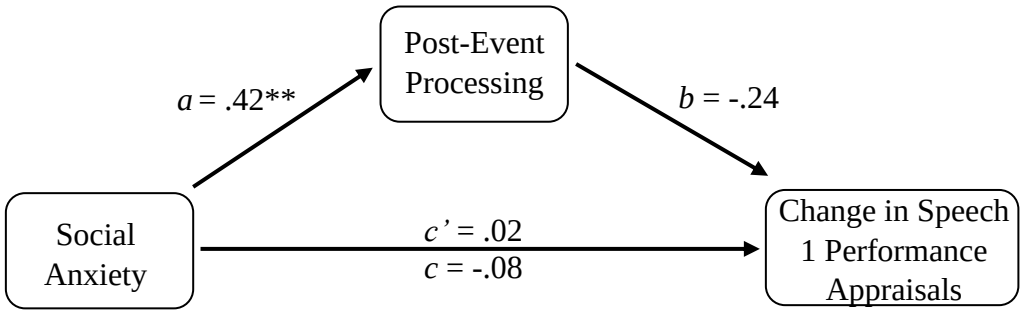
Lastly, to provide evidence of the post-event and anticipatory processing average scores' construct validity, we computed non-parametric Spearman's rho correlations between trait post-event processing (PEPI-T) and both the post-event and anticipatory processing average scores (given the non-normal distributions of the latter two) using Subsample B (n = 90). We expected positive relationships with moderate effect sizes.

Trait tendencies to engage in post-event processing (as measured by the PEPI-T) were moderately positively correlated with average levels of post-event processing on Day 2 (n = 90; rho = .33, p = .001) and with average levels of anticipatory processing on Day 3 (n = 83; rho = .33, p = .002). These results suggest that the scores representing the average levels of post-event and anticipatory processing measured constructs related to, but distinct from, trait tendencies to engage in post-event processing.

3. Changes in Performance Appraisals

Figure S1

The Effects of Social Anxiety and Post-Event Processing on Change in Performance Appraisals



Note. Presented coefficients are standardized.

c = total effect of social anxiety on change in performance appraisals; c' = direct effect of social anxiety on change in performance appraisals; a = effect of social anxiety on post-event processing; b = effect of post-event processing on change in performance appraisals.

** $p < .001$

4. Phenomenological Memory Qualities

Table S1

Summary of Exploratory Repeated-Measure Moderation Analyses of Post-Event Processing on Changes in Phenomenological Memory Qualities

	Statistics					
Analyses	*B*	*SE*	*t*	*p*	95% CI	R^2
			Vividness			
PEP predicting Change						.07
Intercept	-0.62	0.10	-6.14	< .001	-0.82, -0.42	
PEP	1.18	0.47	2.54	.01*	0.26, 2.11	
PEP predicting Day 1						.03
Intercept	3.37	0.10	33.18	< .001	3.17, 3.57	
PEP	-0.83	0.47	-1.77	.08	-1.77, 0.10	
PEP predicting Day 4						.01
Intercept	2.75	0.09	30.26	< .001	2.57, 2.93	
PEP	0.35	0.42	0.83	.41	-0.49, 1.19	
			Accessibility			
PEP predicting Change						.03
Intercept	-0.29	0.09	-3.09	.003	-0.47, -0.10	
PEP	0.72	0.43	1.70	.09	-0.12, 1.57	
PEP predicting Day 1[b]						.10
Intercept	3.87	0.09	42.13	< .001	3.69, 4.06	
PEP	-1.30	0.43	-3.07	.003*	-2.15, -0.46	
PEP predicting Day 4						.02
Intercept	3.59	0.09	38.19	< .001	3.40, 3.78	
PEP	-0.58	0.43	-1.34	.19	-1.45, 0.28	
			Visual Perspective			
PEP predicting Change[b]						< .001
Intercept	-0.07	0.09	-0.85	.40	-0.25, 0.10	
PEP	0.04	0.40	0.11	.92	-0.76, 0.85	
PEP predicting Day 1[b]						.01
Intercept	3.64	0.12	29.65	< .001	3.40, 3.88	
PEP	-0.56	0.57	-0.98	.33	-1.69, 0.57	
PEP predicting Day 4[b]						.01
Intercept	3.57	0.14	26.14	< .001	3.30, 3.84	
PEP	-0.51	0.63	-0.81	0.42	-1.77, 0.74	
			Emotional Intensity			
PEP predicting Change[a]						.01
Intercept	-0.04	0.02	-2.28	.03	-0.07, -0.005	
PEP	-0.08	0.07	-1.14	.26	-0.23, 0.06	

PEP predicting Day 1						.36
Intercept	0.30	0.02	17.34	< .001	0.27, 0.34	
PEP	0.57	0.08	7.11	< .001*	0.41, 0.73	
PEP predicting Day 4						.30
Intercept	0.27	0.02	15.43	< .001	0.23, 0.30	
PEP	0.49	0.08	6.14	< .001*	0.33, 0.65	
		Valence				
PEP predicting Change[a]						.002
Intercept	-0.04	0.08	-0.57	.57	-0.20, 0.11	
PEP	0.14	0.36	0.40	.69	-0.57, .86	
PEP predicting Day 1						.25
Intercept	3.26	0.10	32.71	< .001	3.06, 3.46	
PEP	-2.51	0.46	-5.43	< .001*	-3.42, -1.59	
PEP predicting Day 4						.25
Intercept	3.22	0.09	34.31	< .001	3.03, 3.40	
PEP	-2.36	0.43	-5.44	< .001*	-3.22, -1.50	

Note. Change in memory quality refers to Day 4 Quality – Day 1 Quality (i.e., positive scores indicate an increase in the memory quality; negative scores, a decrease). Degrees of freedom for all models = 88. PEP indices and Emotional Intensity scores were log transformed.

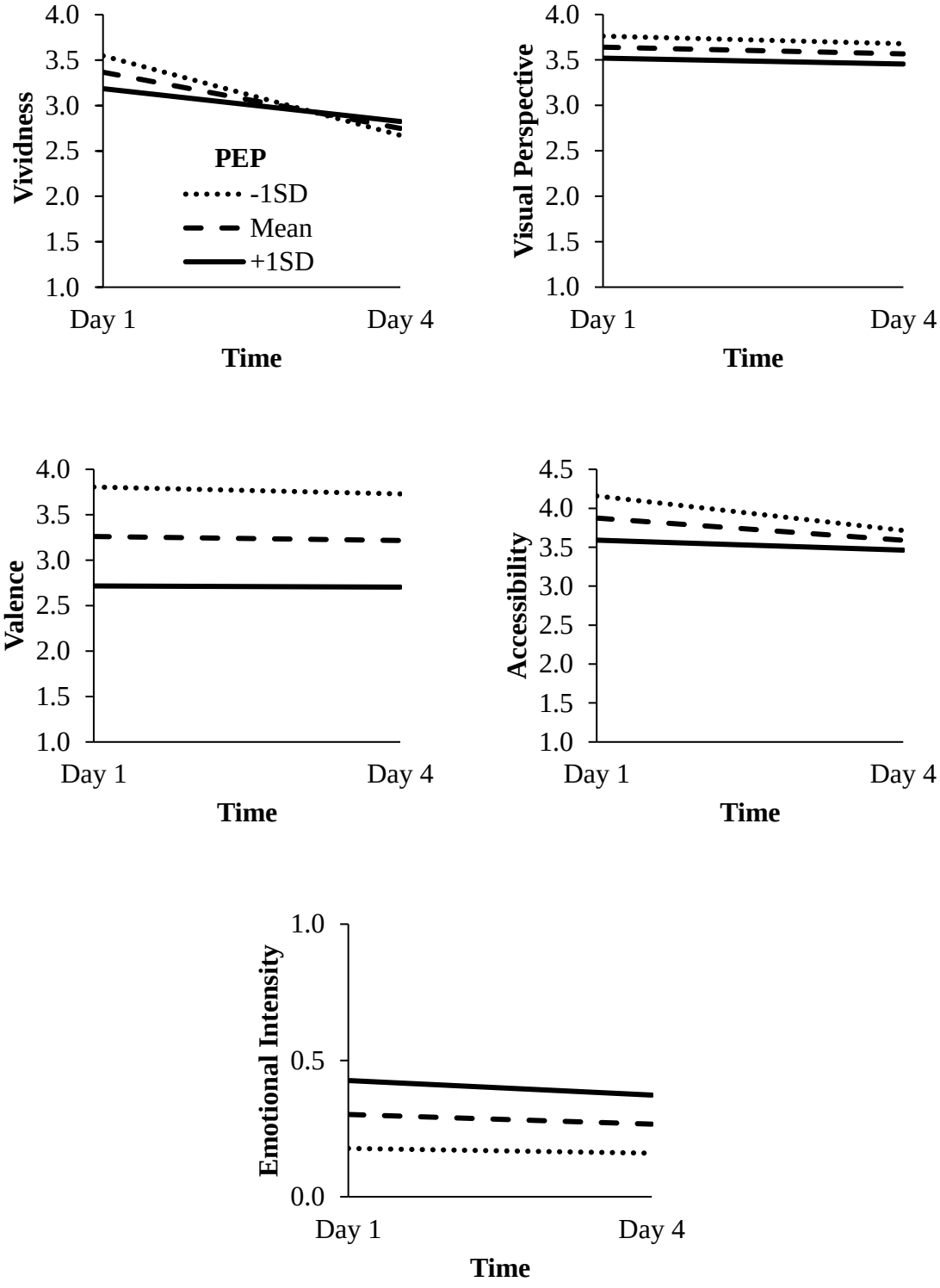
**p*-values were below the Benjamini-Hochberg critical values (false discovery rate = .05, number of effects adjusted for = 15), indicating statistical significance.

[a]Heteroscedasticity was present in the regression

[b]Non-normality of estimation error was present in the regression

Figure S2

The Relationships Between Post-Event Processing (PEP) and Speech 1 Phenomenological Memory Qualities



Chapter 3:

Bridge Between Studies

The overarching aim of my dissertation was to investigate the time course, predictors, and impacts of PEP. Study 1 used a standardized social anxiety-provoking task and ecological momentary assessment to examine how PEP evolved over time (Research Question 1) and related to other cognitive and affective factors that come into play in the experience of anxiety in social situations like anxiety, performance appraisals, anticipatory processing (AP), and memory (Research Questions 2 and 6). Results showed that PEP decreased over time in between two speeches. Greater average levels of PEP the day following the first speech were also related to greater average levels of AP the day before to the second speech, I also found cascading effects between anxiety, performance appraisals, and repetitive negative thinking. Lastly, preliminary evidence suggested that PEP may be related to how people remember anxiety-provoking social situations.

Study 2 aimed to address gaps in the social anxiety literature that were also highlighted in Study 1. First, measures of PEP often have a negative ruminative focus. Although some measures of PEP include items assessing positive PEP, researchers often omit these items in their analyses and hypotheses as they were essentially designed to reduce response bias rather than measure PEP. As such, little is known about the role of positive PEP within social anxiety. Second, PEP is examined almost exclusively in relation to stressful or anxiety-provoking events. However, individuals encounter a wide range of social situations in their daily lives (e.g., meaningful interactions with loved ones, positive feedback at work, significant life events) that might promote different levels and valence of PEP. Third, in Study 1 I used a highly controlled social stressor that may not have been relevant to all participants. The overarching purpose of Study 2 was to address some of the limitations by examining PEP across a wider spectrum of social

situations that people can experience in their daily lives. Specifically, I measured both negative and positive PEP retrospectively following stressful and pleasant social interactions. The goals were to assess whether people engaged in positive PEP (Research Question 3) and to see if different types of social interactions, particularly those experienced as either pleasant or stressful, might be associated with differentially valenced thoughts during PEP (Research Question 4). I was also interested in knowing whether trait social anxiety was related to positive PEP in addition to negative PEP (Research Question 5). This ideographic approach also enabled me to investigate how negative and positive PEP related to self-reported memory of the interactions to extend results from Study 1 regarding the relationship between PEP and phenomenological memory qualities (Research Question 6). The complementary methodologies of both studies helped provide a more complete picture of PEP and its relationship with other important factors involved in the maintenance of social anxiety. Learning more about the triggers and consequences associated with PEP has the potential to inform how clinicians consider and treat PEP in the context of social anxiety disorder.

Chapter 4:

A Retrospective Study of Negative and Positive Post-event Processing Following Stressful and Pleasant Social Interactions (Study 2)

Please note that a shorter version of this chapter was submitted for publication.

Kane., L., Simioni, O., & Ashbaugh, A. R. (2021). *Journal of Behaviour Therapy and Experimental Psychiatry Special Issue* (Status: Under review).

Abstract

Background and Objectives. Excessively ruminating about negative aspects of social situations after they occur is called negative post-event processing (PEP) and is a key factor that maintains social anxiety over time. The role of positive PEP in social anxiety is unclear and may be especially relevant considering that people encounter a variety of social situations in their daily lives including pleasant ones. The objective of the current study was to examine negative and positive PEP following stressful and pleasant social interactions. We were also interested in how participants remembered and described the interactions. *Method.* Young adults (n = 411) recalled a recent pleasant or stressful social interaction and indicated how much negative and positive PEP they engaged in since the interaction. They also completed questionnaires measuring social anxiety and the memory's phenomenological qualities, and wrote a description of the interaction. *Results.* Higher social anxiety was linked with more negative and less positive PEP, regardless of whether the interaction was perceived as stressful or pleasant. Participants reporting more negative PEP used more negative words in describing the interaction and their memory was more negative and emotionally intense. Those reporting more positive PEP used more positive and less negative words in their descriptions. For stressful interactions, positive PEP was related to a more positive memory; for pleasant ones, it was related to increased emotional intensity. *Limitations.* Limitations included the sample type (restricted age range, non-clinical) and the retrospective, cross-sectional nature of the study. *Conclusions.* Results provide insight into PEP following stressful and pleasant social interactions. We also found preliminary evidence that positive PEP may be helpful and protective. Future studies may benefit from longitudinal and mixed methods designs.

Keywords: Social Anxiety, Post-Event Processing, Memory.

1. Introduction

Social anxiety exists on a continuum from adaptive nervousness that can help prepare for a school presentation to severe distress contributing to social isolation. When distress and impairment is significant, a diagnosis of social anxiety disorder (SAD) may be considered (American Psychiatric Association, 2013). Understanding how symptoms perpetuate over time is crucial given that SAD impacts 11% of people at some point in their lives (Kessler et al., 2012).

Social anxiety is maintained by various cognitive factors including post-event processing (PEP), which is a tendency to review the embarrassing and distressing elements of past social situations (Clark & Wells, 1995). Essential in this definition is that PEP refers to rumination about *negative* elements of the social interactions. Indeed, it has been posited that socially anxious individuals do not naturally ruminate on positive feedback following a speech (Cody & Teachman, 2010), suggesting that the problematic nature of PEP stems from excessive focus on negative aspects of social situations, a view that is supported by studies using the Thoughts Questionnaire (TQ; Edwards et al., 2003).

The TQ contains items assessing both positive PEP (e.g., “My speech was good”) and the typically assessed negative PEP (e.g., “I could have done much better”). Edwards and colleagues (2003) included positive items to reduce negative response sets. Given the inherent negative thought content of PEP, many studies using the TQ have only utilized the negative PEP subscale, omitting the potential information provided by the positive subscale (e.g., J. R. Brown & Kocovski, 2014; Çek et al., 2016; Chen et al., 2013; Perini et al., 2006; Wong et al., 2017). Therefore, little is known about whether some individuals might also engage in positive PEP without specific prompts to do so (for an experimental PEP induction design, see Field et al., 2004). The few studies that used both TQ subscales have found that they are minimally correlated with one another (r = -.08 in Abbott & Rapee, 2004; r = -.10 in Edwards et al., 2003) and that

only the negative PEP subscale correlated with social anxiety symptoms (r = .64; Abbott & Rapee, 2004). Additionally, following a speech task, socially anxious individuals reported similar levels of positive PEP, but higher levels of negative PEP, compared to non-socially anxious individuals (Abbott & Rapee, 2004; Edwards et al., 2003).

However, psychometrically the Positive PEP subscale of the TQ is shorter than the Negative PEP subscale. Indeed, a shorter scale may capture all relevant thoughts that might be considered positive PEP. The small number of studies that have assessed positive PEP also limits interpretations. Investigating the valence of PEP using a measure specifically intended to assess positive PEP may help inform interventions in the context of social anxiety, particularly as social anxiety is the only anxiety disorder that is associated with higher negative *and* lower positive affect, like depression (T. A. Brown et al., 1998; Watson et al., 1988).

PEP also entails the repeated and in-depth recall of past social situations, and therefore involves memory. Preliminary research suggested that PEP might be related to the phenomenological memory qualities of stressful social situations (Kane & Ashbaugh, submitted manuscript). Specifically, PEP following a speech appeared to keep participants' memories of the speech more vivid for a longer period of time. Participants who engaged in more PEP found it more difficult to access the memory of the speech five minutes after it occurred, and reported that the memory was more fragmented, more emotionally intense, and more negative. These findings are largely consistent with research examining how individuals with social anxiety remember stressful social situations. On the one hand, participants high in social anxiety retrieved more negative images than positive ones during a task measuring the accessibility and properties of mental images and associated autobiographical memories (Moscovitch et al., 2011). On the other hand, participants low in social anxiety retrieved a more balanced mix of positive and negative images. Other studies also showed that socially anxious participants tended to take an observer

perspective when they remember stressful social events and to report less sensory detail, less vividness, and more self-referential information compared to participants low in social anxiety (Ashbaugh et al., 2019; Clark & Wells, 1995; D'Argembeau et al., 2006). Additional research is needed to extend these findings to further elucidate mnemonic processes in social anxiety.

Social anxiety researchers typically either ask participants to report on social situations that were distressing (e.g., Helbig-Lang et al., 2016) or induce stressful social situations like speeches and interactions (e.g., Blackie & Kocovski, 2016; Field et al., 2004; Kocovski et al., 2011; Potter et al., 2016; Rowa et al., 2014; Wong & Moulds, 2009). Following distressing situations like these, individuals with higher social anxiety report engaging in more negative PEP compared to individuals lower in social anxiety (e.g., Abbott & Rapee, 2004; Cody & Teachman, 2011; Edwards et al., 2003; Helbig-Lang et al., 2016; Kane & Ashbaugh, submitted manuscript). However, people encounter a wide range of situations in their daily lives (e.g., at work, at home, walking the family dog), some of which may be stressful, but others neutral or pleasant. There are a multitude of events and experiences, both negative and positive, that may fuel PEP. Highly socially anxious individuals also tend to dampen positive events and experiences, and report less intense positive emotions (Kashdan et al., 2011). Seeing how much PEP individuals engage in after positive situations may help round out our understanding of PEP and ultimately may inform how to help people with social anxiety have corrective emotional experiences.

1.1. Current Study

The goal of the current study (registered through Open Science Framework (OSF) prior to data analysis, available at https://osf.io/f5vph) was to measure negative and positive PEP retrospectively following stressful and pleasant social interactions. A secondary aim was to investigate how negative and positive PEP relate to memory of the interactions. After answering questions to promote recall of a recent stressful or pleasant interaction, young adults reported

how much negative and positive PEP they engaged in since the interaction. Participants also completed a questionnaire to measure the phenomenological qualities of the recalled memory and wrote a description of the interaction to assess if the amount of detail (i.e., number of words used to describe the interaction) and valence (i.e., number of positive versus negative phrases) differed across valenced interactions.

We hypothesized that 1) participants in the stressful interaction recall condition would report more negative PEP than those in the pleasant interaction recall condition, especially among participants reporting high social anxiety, and that 2) participants in the pleasant interaction recall condition would report more positive PEP than those in the stressful interaction recall condition, especially among participants reporting low social anxiety. In addition, we expected that participants who reported more negative PEP following the described interaction would 3) describe the interaction using more words, 4) employ more negative, and less positive, words in their description, and 5) report that their memory of the interaction was less vivid, less accessible, more emotionally intense, more negative, and from an observer perspective. We also hypothesized that 6) the recall condition (i.e., stressful vs. pleasant interaction) would moderate these relationships. For example, the effect of negative PEP on memory might be stronger when the recalled situation was stressful (versus pleasant). Given the limited research on positive PEP, we did not have any set hypotheses regarding the relationship between positive PEP and other variables of interest.

2. Method

2.1. Participants

We recruited 596 young adults (286 from the undergraduate participant pool at the University of Ottawa and 310 from Qualtrics Panels Online Sample).[10] Participants were required to be aged 18-25, fluent in English and, for the Panel participants, currently living in Canada. Compensation was in the form of course credit or other incentives for Qualtrics Panels participants (i.e., either cash, gift cards, or reward points depending on participant preferences). We excluded 185 participants from analyses for failing the attention checks according to criteria outlined in Section 2.3 Procedure (n = 81); not providing an event description according to instructions (n = 52); not submitting data (n = 26); withdrawing data (n = 25); or not meeting age inclusion criteria (n = 1). The final sample consisted of 411 participants (n = 207 from the undergraduate participant pool, n = 204 from Qualtrics Panels; M_{age} = 20.28; SD = 2.29), which included 210 people identifying as women, 194 as men, four as transmen, two as nonbinary, and one as two spirit. Participants were of diverse racial and ethnic backgrounds: 43.6% of participants identified[11] as Caucasian/White; 17.5% as Asian; 13.4% selected multiple ethnicities; 6.1% as Middle Eastern; 5.6% as African Canadian/Black; 5.1% as Indian; 2.2% as Native

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[10] We ran power analyses for the main analyses of the study using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). The analysis requiring the largest sample size was the independent samples t-tests, which would require a total of 428 participants to achieve .95 power in detecting a small- to medium-sized effect (d = .35) with a two-tailed .05 alpha. The analysis requiring the smallest sample size was the moderation analyses. Specifically, to detect a R^2 increase in the Situation Type and PEP moderation analyses, the study would require a total of 191 participants to achieve .95 power in detecting a small- to medium-sized interaction (f^2 = .069; based off of estimations from a measure validation study) with a .05 alpha. To balance statistical power and feasibility of data collection, we planned to recruit participants until we reached approximately 400 participants with complete and valid data sets.

[11] Please note that these labels were the response options presented to participants for both studies at the time of data collection. For future iterations would use more inclusion and appropriate terminology to reflect the diversity within these groups and reduce stigma associated with some of the response options used.

Canadian; 1.9% as Other; 1.5% as Hispanic; 1.2% as European; .7% as Pacific Islander; 1.2% preferred not to answer. The modal household income was $80,000 or more (26.3% of the sample); 23.8% preferred not to answer. In addition, 32.6% of participants self-reported having been diagnosed with a mental disorder over their lifetime. The most common self-reported diagnoses were depressive disorders (16.5% of the sample) and anxiety disorders (24.6% of the sample), with 2.9% of the sample reported having been diagnosed with SAD.

2.2. Measures

See Table 1 for all descriptive statistics and alphas of all measures.

2.2.1. Depression Anxiety Stress Scales-21

The DASS-21 (Lovibond & Lovibond, 1995) is a 21-item measure of depression, anxiety, and stress. We used the DASS Depression subscale (DASS-DEP) to verify that any group differences found were not due to differences in depressive symptoms. Participants rated how much each statement applied to them over the past week on a 4-point Likert-type scale (0 = *Did not apply to me at all*, 3 = *Applied to me very much, or most of the time*). An example item is "I felt that I had nothing to look forward to." We generated the scale score by computing the sum of items for the subscale, and then by doubling the obtained subscale score to ensure the scores were comparable to the original 42-item version of the DASS (Lovibond & Lovibond, 1995). The DASS-DEP (21 item version) demonstrates good convergent and discriminant validities with measures of depression and anxiety and good internal consistency (α = .88; Henry & Crawford, 2005). The DASS-DEP also demonstrated excellent internal consistency in the current sample.

2.2.2. Memories Experiences Questionnaire–Short Form (MEQ-SF)

The MEQ-SF (Luchetti & Sutin, 2016) measures phenomenological qualities of autobiographical memories, with higher scores suggesting more of the specified self-reported quality. Given the recency of the memory being assessed for the current study, we removed ten

items that implied that a great length of time has elapsed between the event and the assessment (e.g., “I feel like the person in this memory is a different person than who I am today”), leaving 21 items forming seven subscales, namely Vividness (e.g., “My memory for the speech is very detailed”), Coherence (e.g. “This memory is a blending of many similar, related events rather than a specific memory about the speech [reverse scored]), Accessibility (e.g., “This memory was easy for me to recall”), Sensory Details (e.g., “As I remember the speech, I can hear it in my mind”), Visual Perspective (e.g., “I view this memory as if I was an observer to the experience”), Emotional Intensity (e.g., “The memory of the speech evokes powerful emotions”), and Valence (e.g., “The overall tone of the memory is positive”). Participants rated their level of agreement with each item on a 5-point Likert-type scale (1 = *Strongly disagree*, 5 = *Strongly agree*). We generated scores by taking the average of the items in each subscale, after appropriate reverse scoring. The short form of the MEQ showed strong correlations with the long form of the scale and demonstrated acceptable internal consistency in undergraduate samples (median α across the subscales = .79; Luchetti & Sutin, 2016). As can be seen in Table 1, most subscales showed acceptable to excellent internal consistencies in the current study, except for the Coherence and Sensory Detail subscales that showed poor to unacceptable internal consistencies. Analyses pertaining to these two subscales were conducted at the item level, as described in Section 2.4.

2.2.3. Post-Event Processing Inventory – State Version (PEPI-S)

The PEPI-S (Blackie & Kocovski, 2017) is a 12-item measure of state PEP (i.e., in reference to a specific situation). We used the PEPI-S to provide additional evidence for the construct validity of the Social Interaction Thoughts Questionnaire, described in section 2.2.4. Participants rated the extent to which they agreed or disagreed with statements such as “After the event, I kept replaying the situation over in my mind” and “My thoughts about the event interfered with my ability to concentrate” on a 5-point Likert-type scale (1 = *Strongly Disagree*, 5

= *Strongly Agree*). We generated the scale score by summing all items. Higher scores suggest more PEP related to the recalled situation. The PEPI-S has demonstrated evidence of convergent validity with measures of rumination and PEP, and discriminant validity with measures of self-reflection, as well as excellent internal consistency in an undergraduate sample (α = .96; Blackie & Kocovski, 2017), and in the current sample.

2.2.4. Social Interaction Thoughts Questionnaire (SITQ)

The SITQ was modified from the Thoughts Questionnaire (TQ; Edwards et al., 2003) to assess frequency of negative and positive thoughts following the recalled social interaction. The original TQ demonstrated acceptable internal consistency in an undergraduate sample (α's = .94 and .79 for the negative and positive subscales, respectively; Edwards et al., 2003). The original Negative PEP subscale was also positively correlated with measures of social anxiety and fear of negative evaluation, whereas the original Positive PEP subscale was not (Edwards et al., 2003). Specific modifications we made included rewording items to increase consistency across subscales and generating new positive thoughts to obtain equal numbers of positive (14 items) and negative thoughts (14 items; see Table S1 available in Supplemental Materials for the SITQ items).

To assess initial psychometric properties of the SITQ, we conducted a pilot study of 95 undergraduate students from the University of Ottawa who were compensated with course credit (Kane & Ashbaugh, 2021). Participants completed self-reported questionnaires and answered the SITQ using the prompt "For the next section, we will ask you to remember a social interaction you had in the past week where you felt anxious and stressed." Both the SITQ Negative PEP subscale and the Positive PEP subscale demonstrated excellent internal consistency (α's = .93 and .94, respectively). A confirmatory factor analysis using MLR estimation showed that two of five fit indices used suggested good model fit to the data (RMSEA = .093; SRMR = .079), while the

other three fit indices suggested poor model fit, χ^2 (349, N = 95) = 639.677, $p < .001$; CFI = .823; TLI = .808. The oblique model estimated a strong relationship between both factors (estimate = -.75, *SE* = .08). The model parameters were also all significant ($p < .001$), ranging from .47 to .84 on the Negative PEP subscale and from .57 to .86 on the Positive PEP subscale. The Negative PEP subscale was positively related to measures of social anxiety, trait PEP, state PEP, and state anxiety. The Positive PEP subscale was also positively related to a measure of self-efficacy. Although we had hypothesized null correlations, the Negative PEP subscale correlated negatively with self-efficacy and the Positive PEP subscale correlated positively with social anxiety.

For the current study, participants completed the SITQ by indicating how often they had specific thoughts (e.g., "I said the wrong things," "I felt at ease during the interaction") since the recalled interaction on a 5-point Likert-type scale (0 = *Never*, […] 4 = *Very often [more than 6 times]*). We generated the subscale scores by summing relevant items, with higher scores indicating more frequent PEP. Both the SITQ Negative PEP (SITQ-NEG) and the Positive PEP (SITQ-POS) subscales showed excellent internal consistency in the current sample, and moderate to strong correlations with the PEPI-S in the current sample, SITQ-NEG: $r = .79$, $p < .001$; SITQ-POS: $r = -.37$, $p < .001$. The SITQ subscales were also moderately correlated with one another, $r = -.33$, $p < .001$.

2.2.5. Social Phobia Inventory (SPIN)

The SPIN (Connor et al., 2000) is composed of 17 items measuring social anxiety symptoms. Participants rated how much problems had bothered them during the past week on a 5-point Likert-type scale (0 = *Not at all*, 4 = *Extremely*). An example item is "Parties and social events scare me." We obtained the scale score by summing the items, with higher scores suggesting more social anxiety symptoms. The SPIN has shown evidence of convergent validity with another measure of social anxiety and of discriminant validity with a measure of depressive

symptoms (Radomsky et al., 2006). The SPIN has also shown acceptable to excellent internal consistency in undergraduate students (α = .93; Radomsky et al., 2006) and in the current study.

2.2.6. Attention Checks

Two directed attention checks were included throughout the survey questionnaires (e.g., "Please select '2 Disagree' for this item"). At the end of the study, participants also rated how much effort they put towards the study, how much attention they gave, and if they thought we should use their data. Participants who reported giving almost no, very little, or some effort/attention, or those who indicated that we should not use their data, were considered to have failed those self-report checks. We excluded from analyses participants who failed both directed checks or two of the three self-report checks.

2.3. Procedure

Procedures were approved by the University of Ottawa Research Ethics Board. Participants completed an online survey using Qualtrics (2020). After providing informed consent, participants completed a sociodemographic questionnaire and the SPIN.[12] Next, participants were randomly assigned using block randomization to recall either a stressful or a pleasant interaction they had over the past week. Participants reported on when, where, with whom, and how the interaction occurred. Participants indicated how strongly they felt anxious, content, and joyful during the interaction using a 0 (no emotion)-100 (very intense emotion) visual slider scale. Next, participants completed the SITQ, the PEPI-S, and selected subscales of the MEQ-SF. They then described the interaction in a text box within the survey in as much

[12] Participants also completed the Post-Event Processing Inventory – Trait Version (PEPI-T; Blackie & Kocovski, 2017). However, we did not report on this measures in our sample.

detail as possible for a minimum of two minutes using a built-in timer. They were then debriefed. The median survey duration was approximately 19 minutes.

2.4. Data Analysis

We conducted statistical analyses using IBM SPSS Statistics 28 (IBM Corp, 2021). One data point was missing on the SITQ. The content and joyful variables also had one and three data points missing, respectively. A Little's MCAR Test was not statistically significant, $\chi^2(339) = 357.90$, $p = .23$, suggesting that the data were missing at random. We imputed the missing data point on the SITQ using expectation maximization (EM). We decided to use pairwise deletion for the missing data on the content and joyful variables given that these were single item measures.

2.4.1. Manipulation Checks

To verify whether the interactions remembered in each condition differed in emotional valence, we ran three nonparametric Mann-Whitney tests because the emotion variables (anxiety, content, and joyful) were platykurtic. Specifically, we entered the interaction recall condition (stressful vs. pleasant) as the independent variable and the emotion variables as the dependent variables. We expected that participants in the stressful recall condition would report having felt more anxious, less content, and less joyful during the recalled interaction compared to participants in the pleasant recall condition.

To verify that there were no differences in baseline levels of social anxiety and depressive symptoms, we conducted an independent samples *t*-test with interaction recall condition as the independent variable and SPIN scores as the dependent variable. We also conducted a Mann-Whitney test with interaction recall condition as the independent variable and the DASS-DEP scores as the dependent variable due to bimodality on the latter variable.

2.4.2. Post-Event Processing

To test the hypotheses that social anxiety and interaction recall condition would interact to predict PEP related to the recalled interaction, we ran two moderation analyses using the PROCESS 3.5 SPSS macro (Hayes, 2018). We entered recall condition as the independent variable (0 = stressful; 1 = pleasant), SPIN scores as the moderator variable (mean centered), and the SITQ-NEG and -POS scores as the dependent variables. We used HC3 to correct for heteroscedasticity.

2.4.3. Phenomenological Memory Qualities

To test the hypotheses that interaction recall condition and PEP would interact to predict the phenomenological memory qualities of the recalled interaction, we ran eight moderation analyses using the PROCESS 3.5 SPSS macro (Hayes, 2018). We entered recall condition as the independent variable, SITQ-NEG and -POS scores as moderator variables (mean centered), and the MEQ-SF subscales as the dependent variables. Given poor internal consistency of the Coherence and Sensory Detail subscales, as in Kane and Ashbaugh (submitted manuscript), we conducted analyses on two items of the Coherence subscale, one item assessing Fragmentation (item 6: “This memory comes back to me in bits and pieces, not as a logical, coherent story”) and one item assessing Blending (item 7: “This memory is a blending of many similar, related events rather than a specific memory about the speech”), and on one item of the Sensory Detail subscale assessing Sensory Information (item 12: “My memory for the speech does not involve a lot of sensory information (sounds, smells, tastes, etc.”; reverse-scored). The Sensory Information regression showed abnormality of estimation error, which could influence accuracy of inference tests. In addition, we winsorized three scores on the Accessibility subscale to correct for univariate outliers. We identified eight multivariate outlying cases using Mahalanobis distance. They appeared to be outliers due to their interaction term scores, seven of the eight belonging to the pleasant recall condition. We believed these were an artifact of the dichotomous 0-1 coding of

the recall condition variable, as they occurred only on the interaction term and not for the variables composing the interaction. We found no other evidence to suggest that the outliers should be removed and therefore conducted all analyses using these independent variables with these cases. We used HC3 to correct for heteroscedasticity where appropriate. Given the large number of MEQ-SF analyses, we controlled for the false discovery rate using Benjamini-Hochberg (BH) procedure (Benjamini & Hochberg, 1995) for the 40 effects (five effects per analysis).

2.4.4. Social Interaction Descriptions

One coder (second author) blind to experimental condition coded the descriptions for words (e.g., *nice*) or phrases (e.g., *didn't like*) that conveyed either negative valence and positive valence using the software NVivo (QSR International, 2021). The first author also coded a random subset of the descriptions (approximately 20%), which showed moderate agreement (kappas = .73 for both negative and positive coding references). We solved disagreements on this 20% subset by consensus between the coder and the first author. We then counted the number of negative and positive coding references using NVivo (henceforth referred to as the number of negative and positive phrases, respectively). Lastly, we counted the total number of words written by participants using Excel (Microsoft, 2021). In separate negative binomial regressions, we entered recall condition, SITQ-NEG and -POS scores (mean centered), and interaction terms (SITQ-NEG × recall condition and SITQ-POS × recall condition) as independent variables, and 1) total number of words, 2) number of positive phrases, and 3) number of negative phrases as the dependent variables. Given that the phrases could be more than one word, we decided to use number of phrases rather than a ratio of phrases over total number of words to prevent longer phrases from having bigger weight in the ratio (e.g., *didn't like* versus *bad*). We winsorized 10

scores on the total words variable, six scores on the positive phrases variable, and nine scores on the negative phrases variable to correct for univariate outliers.

3. Results

3.1. Descriptive Statistics

Descriptive statistics of the measures of interest are in Table 1. We provide information on the types of interactions reported by participants in Table 2.

3.2. Manipulation Checks

A Mann-Whitney test showed that participants in the stressful interaction recall condition reported retrospectively feeling more anxious (*Mdn* = 60) during the interaction compared to participants in the pleasant interaction recall condition (*Mdn* = 20), $U(N_{\text{stressful}} = 212, N_{\text{pleasant}} = 199) = 11{,}154.00$, $Z = -8.26$, $p < .001$. They were also less content (*Mdn* = 30) than those in the pleasant recall condition (*Mdn* = 70), $U(N_{\text{stressful}} = 211, N_{\text{pleasant}} = 199) = 9{,}957.50$, $Z = -9.21$, $p < .001$, as well as less joyful (*Mdn* = 20) than those in the pleasant recall condition (*Mdn* = 73), $U(N_{\text{stressful}} = 210, N_{\text{pleasant}} = 198) = 8{,}026.00$, $Z = -10.73$, $p < .001$. Therefore, it appeared that participants brought back to mind interactions that evoked emotions consistent with the condition instructions.

An independent samples *t*-test showed that participants in the stressful interaction recall condition reported similar social anxiety levels (*M* = 31.27; *SD* = 15.88) compared to those in the pleasant interaction recall condition (*M* = 29.38; *SD* = 16.98), $t(409) = 1.17$, $p = .24$, Cohen's $d = .12$. The group randomization appeared to have worked appropriately, producing groups of similar social anxiety severity to avoid confounding effects of social anxiety severity on group differences. A Mann-Whitney test also showed that participants in the stressful interaction recall condition reported similar levels of depressive symptoms (*Mdn* = 12) compared to those in the pleasant interaction recall condition (*Mdn* = 12), $U(N_{\text{stressful}} = 212, N_{\text{pleasant}} = 199) = 20{,}481.00$, *Z*

= -0.51, p = .61, producing groups of similar depressive symptom severity to avoid confounding effects of depressive symptom severity on group differences.

3.3. Post-Event Processing

Participants who recalled a stressful interaction reported engaging in more negative PEP (as measured by the SITQ-NEG) compared to those who recalled a pleasant interaction, B = -7.63, HC3 SE = 1.08, p < .001 (see Figure 1). In addition, higher levels of social anxiety were linked to more negative PEP, B = 0.48, HC3 SE = 0.05, p < .001. The interaction between recall condition and social anxiety was unrelated to negative PEP, B = -0.09, HC3 SE = 0.07, p = .22. The model accounted for 38.42% of the variance in negative PEP.

Participants who recalled a pleasant interaction reported engaging in more positive PEP, as measured by the SITQ-POS, compared to those who recalled a stressful interaction, B = 8.64, HC3 SE = 1.16, p < .001 (see Figure 1). In addition, higher levels of social anxiety were associated with less positive PEP, B = -.18, HC3 SE = 0.05, p = < .001. The interaction between recall condition and social anxiety was also unrelated to positive PEP, B = -0.03, HC3 SE = 0.07, p = .63. Overall, the model accounted for 18.79% of the variance in positive PEP.

3.4. Phenomenological Memory Qualities

Inferential statistics are available in Table 3. Graphical illustrations of effects deemed notable according to the BH procedure are available in Figure 2.

3.4.1. Valence

Participants who recalled a pleasant interaction reported overall that the memory was more positive than those who recalled a stressful interaction. Those who reported more positive PEP overall also reported that the memory was more positive. This effect interacted with recall condition. Participants who recalled a pleasant interaction reported similar memory valences regardless of positive PEP levels; however, those who recalled a stressful interaction reported

that the memory was less positive if they engaged in less positive PEP. Participants who reported more negative PEP also reported that the memory was more negative. The interaction between negative PEP and recall condition was unrelated to valence. Overall, the model accounted for 59.86% of the variance in valence.

3.4.2. Emotional Intensity

Interaction recall condition was unrelated to emotional intensity. However, participants who reported more positive PEP overall also reported that the memory was less emotionally intense. This effect appeared to interact with recall condition. Participants who recalled a pleasant interaction and engaged in more positive PEP reported that the memory was more emotionally intense. Participants who reported more negative PEP overall also reported that the memory was more emotionally intense. The interaction between negative PEP and recall condition was unrelated to emotional intensity. Overall, the model accounted for 19.02% of the variance in emotional intensity.

3.4.3. Fragmentation (Coherence Item 6, Reverse Scored)

Participants who recalled a pleasant interaction reported that the memory was more fragmented (i.e., came back in bits and pieces) compared to those who recalled a stressful interaction. Positive PEP and its interaction with recall condition were unrelated to memory fragmentation. Participants who reported more negative PEP reported that the memory was more fragmented. The interaction between negative PEP and recall condition was unrelated to fragmentation. Overall, the model accounted for 8.45% of the variance in fragmentation.

3.4.4. Blending (Coherence Item 7, Reverse Scored)

Recall condition, positive PEP, and the interaction between the two were unrelated to memory blending. Participants who reported more negative PEP reported that the memory was a blending of many similar events. The interaction between negative PEP and recall condition was

unrelated to fragmentation. Overall, the model accounted for 12.87% of the variance in memory blending.

3.4.5. Accessibility, Vividness, Visual Perspective, and Sensory Information

Recall condition, positive PEP, negative PEP, and the interactions were unrelated to memory accessibility, vividness, visual perspective, or sensory information. The model accounted for only 7.83% of the variance in memory accessibility; 4.34% of the variance in memory vividness, 3.52% of the variance in visual perspective; and 1.29% of the variance in sensory information.

3.5. Social Interaction Description

3.5.1. Total Number of Words

The overall model failed to provide an improved fit over an intercept-only model, Likelihood Ratio χ^2 (5) = 6.64, p = .25. Recall condition, positive and negative PEP, and the interactions with recall condition were unrelated to the total number of words written by participants (see Table 4 for all model coefficients).

3.5.2. Positive Phrases

The overall model appeared to provide an improved fit over an intercept-only model, Likelihood Ratio $\chi^2(5) = 79.23$, $p < .001$. Incidence rate ratio suggested that, holding other effects constant, pleasant interaction descriptions contained 2.12 times the rate of positive phrases compared to the stressful interaction descriptions (note: a rate ratio of 1 would indicate equal rates in both groups). In addition, for every one unit increase on the SITQ-POS, the rate of positive phrases in the descriptions increased by a factor of 1.02 holding all other effects constant. The SITQ-NEG and the interaction terms were unrelated to the number of positive phrases.

3.5.3. Negative Phrases

The overall model appeared to provide an improved fit over an intercept-only model, Likelihood Ratio χ^2 (5) = 153.17, $p < .001$. Incidence rate ratios showed that, holding other effects constant, pleasant interaction descriptions contained 0.37 times the rate of negative phrases compared to the stressful interaction descriptions. In addition, for every one unit increase on the SITQ-POS, the rate of negative phrases in the descriptions decreased by a factor of 0.99 holding all other effects constant. Moreover, for every one unit increase on the SITQ-NEG, the rate of negative phrases increased by a factor of 1.01 holding all other effects constant. The interaction terms were unrelated to the number of negative phrases.

4. Discussion

The objective of the study was to assess negative and positive PEP following recent stressful and pleasant interactions in young adults using an experimental, retrospective research design. We also examined the relationship between reported PEP and how participants remembered the interactions. As expected, participants who recalled a stressful interaction reported engaging in more negative PEP compared to those who recalled a pleasant interaction. Participants higher in social anxiety also reported more negative PEP, which is consistent with the extant literature (for a review, see Wong, 2016). However, this effect was not moderated by recall condition. These results suggest that social anxiety was linked to increased negative PEP following situations that were perceived as either stressful or pleasant, highlighting the importance of assessing negative PEP across a variety of situations – even those perceived as positive overall.

Regarding positive PEP, we found that, as expected, participants who recalled a pleasant interaction reported engaging in more positive PEP compared to those who recalled a stressful interaction. In addition, participants higher in social anxiety reported less positive PEP. We did not detect the expected interaction between recall condition and positive PEP, suggesting that

social anxiety is linked to decreased positive PEP regardless of whether the situation was pleasant or stressful. These results contrast with previous research suggesting that the positive PEP subscale was unrelated to social anxiety symptoms (Abbott & Rapee, 2004). The modifications we made to the TQ (i.e., rewording items to increase consistency across subscales and generating new positive PEP items) likely altered (and improved) its psychometric properties for the assessment of positive PEP. Further investigation into the nature of positive PEP (e.g., using qualitative or mixed methods studies) may help clarify this phenomenon.

Consistent with hypotheses, increased negative PEP was associated with a more negative memory of the interaction. Negative PEP was also linked with increased emotional intensity. However, negative PEP was unrelated to memory accessibility, perspective taking, or vividness. We also did not find the expected interaction between negative PEP and recall condition for any of the phenomenological qualities we assessed. Although we were not able to assess effects on memory coherence and sensory detail due to low subscale internal consistency, we found that negative PEP was related to increased memory fragmentation and blending, but unrelated to sensory information. Kane and Ashbaugh (submitted manuscript) also obtained low reliability for these subscales in a similar short-term study, suggesting that the MEQ-SF may benefit from additional validation for recent memories. Nevertheless, evidence converges on the role of negative PEP on alterations in the valence, emotional intensity, and coherence of memories of social interactions. It remains to be seen whether individuals' memories of the interactions were more negative, emotionally intense, and less coherent because they engaged in negative PEP, or if these memory qualities promoted increased negative PEP.

Exploratory analyses suggested that positive PEP was unrelated to memory accessibility, perspective taking, vividness, fragmentation, blending, or sensory detail. Positive PEP was also unrelated to memory valence for pleasant interactions – participants generally remembered those

events as positive regardless of self-reported positive PEP. However, participants who recalled a stressful interaction reported that the memory was less positive only if they engaged in less positive PEP. Increased positive PEP seemed to protect the memory against the stressful nature of the interactions. Though positive PEP was related to decreased emotional intensity across conditions, it appeared to make the memory of pleasant interactions more emotionally intense, suggesting that focusing on the positive in positive social interactions could potentiate the intensity of those emotions.

Research in positive psychology suggests that experiencing positive emotional states may contribute to healthy beliefs and perceptions (Salovey et al., 2000). Fredrickson's Broaden-and-Build Theory of positive emotions (2001) further suggests that positive emotions can widen a person's habitual ways of thinking and behaving (e.g., urge to be creative, to play, to explore), building psychological resilience and long-term wellbeing. Therefore, increasing positive emotional states may be a desirable effect of psychological interventions. Evidence is mounting that self-compassion eliciting mindfulness, common humanity, and self-kindness may help reduce negative PEP (Blackie & Kocovski, 2018a, 2018b). Future studies could benefit from evaluating the usefulness of self-compassion in increasing positive PEP to help cope with unhelpful emotions and promote helpful ones.

We also asked participants to describe the interaction to assess detail and valence of the information they chose to share during the task. Contrary to expectations, negative PEP was unrelated to how many words participants used to describe their recalled interaction. When examining the valence of the words, we hypothesized that participants who reported more negative PEP would use more negative and fewer positive phrases in their descriptions. We saw that negative PEP was linked with more negative, but not less positive, phrases within the descriptions, regardless of if they were about pleasant or stressful interactions. Similarly,

participants who reported engaging in more positive PEP also wrote more positive words and fewer negative words in their descriptions. Though these effects appeared to be small (incidence rate ratios of 0.99-1.02), results suggest that engaging in repetitive thinking, negative or positive, may be related to the valence of the information individuals chose to share within the context of this study.

4.1. Limitations

The results must be considered within the study's limitations. First, participants were young adults aged 18-25 years, either undergraduate students or voluntarily part of a research panel. It is possible that these samples have characteristics that separate them from the general population of young adults. Generalizations should be made with caution until results are replicated in more diverse samples (e.g., adults, clinical samples). Second, 80% of the interaction descriptions were coded by a single coder due to the large sample size, which provided appropriate statistical power, though inter-rater reliability was moderate for the 20% that was double coded. However, future studies would benefit from double coders given the subjective nature of this task. Third, the retrospective cross-sectional research design cannot disentangle causality between PEP and variables of interest and makes the assessment of other potential cognitive factors at play more difficult (e.g., limits in memory and recall bias, interpretation, cognitive biases). Though allowing participants to ideographically recall a situation that was personally relevant added richness and ecological validity, this approach may also have added intra-group variance in the recall conditions (e.g., some interactions being more or less pleasant/stressful than others within the same condition). Within-person design may help further elucidate the predictors and impacts of PEP.

4.2. Conclusions

Results extend our understanding of the role of both negative and positive PEP in recalling personally relevant stressful and pleasant social interactions. Participants with higher social anxiety reported engaging not only in more negative PEP but also less positive PEP compared to those with lower social anxiety following a recent interaction, regardless of whether it was perceived as stressful or pleasant. We also found preliminary evidence that positive PEP may be helpful and protective by potentially influencing memory valence of stressful situations and emotional intensity of pleasant ones. Future studies will benefit from expanding the current methodology using longitudinal and mixed methods designs to further elucidate the role of PEP in how people experience and remember social situations. Examining the impacts of positive PEP in clinical samples with social anxiety disorder may be particularly fruitful and informative.

Highlights: We retrospectively assessed negative and positive post-event processing (PEP). Higher social anxiety was linked with more negative and less positive PEP. Negative and positive PEP were related to how social interactions were remembered. Preliminary evidence suggests that positive PEP may be helpful and protective.

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Table 1

Descriptive Statistics for Measures of Interest Separated by Recall Condition

Measure	Stressful Interaction Recall Condition (n = 212)				Pleasant Interaction Recall Condition (n = 199)			
	Mean	*SD*	Range	Cronbach's Alpha	Mean	*SD*	Range	Cronbach's Alpha
Social Interaction Thoughts Questionnaire								
Negative Post-Event Processing	23.25	12.78	0-56	.93	14.79	12.94	0-52	.95
Positive Post-Event Processing	26.01	12.04	0-56	.92	35.04	12.24	0-56	.93
State Post-Event Processing Inventory	36.30	12.56	12-60	.95	28.75	13.12	12-60	.96
Social Phobia Inventory	31.27	15.88	0-68	.94	29.38	16.98	0-68	.95
Memory Experiences Questionnaire-Short Form								
Valence	2.83	1.15	1.00-5.00	.88	4.06	0.97	1.00-5.00	.85
Emotional Intensity	2.82	1.11	1.00-5.00	.87	2.71	1.01	1.00-5.00	.83
Coherence	3.62	0.75	1.50-5.00	.64	3.58	0.78	1.50-5.00	.58
Accessibility[a]	3.84	0.76	2.00-5.00	.63	3.92	0.89	1.38-5.00	.82
Vividness	3.55	0.92	1.00-5.00	.84	3.69	0.92	1.00-5.00	.86
Visual perspective	3.53	1.01	1.00-5.00	.79	3.60	0.97	1.00-5.00	.77
Sensory Detail	3.16	0.77	1.00-5.00	.41	3.20	0.83	1.00-5.00	.45
State emotions during interaction (retrospective)								
Anxiety	52.95	27.89	0-100	N/A	28.37	28.23	0-100	N/A
Contentment	35.84[b]	29.90[b]	0-100[b]	N/A	64.31	25.17	0-100	N/A
Joy	29.72[c]	30.17[c]	0-100[c]	N/A	65.93[d]	27.17[d]	0-100[d]	N/A
Total number of words written by participants[a]	88.71	54.68	5-264	N/A	82.82	48.29	6-264	N/A
Number of positive phrases[a]	1.00	1.57	0-8	N/A	2.49	2.02	0-8	N/A
Number of negative phrases[a]	3.72	2.99	0-11	N/A	1.08	1.73	0-11	N/A

Notes. [a]Statistics were computed on the winsorized variables; [b]n = 211; [c]n = 210; [d]n = 198.

Table 2

Descriptive Statistics on the Stressful and Pleasant Social Interactions Recalled by Participants

	Stressful Interaction Recall Condition (n = 212)		Pleasant Interactions Recall Condition (n = 199)	
Response Options	Frequency	Percent	Frequency	Percent
In the past week, when did this social interaction occur?				
0 days ago (today)	16	7.55%	32	16.08%
1 day ago (yesterday)	50	23.58%	57	28.64%
2 days ago	32	15.09%	32	16.08%
3 days ago	20	9.43%	28	14.07%
4 days ago	30	14.15%	13	6.53%
5 days ago	17	8.02%	11	5.53%
6 days ago	13	6.13%	8	4.02%
7 days ago	34	16.04%	18	9.05%
Where did you have this social interaction?				
At home	100	47.17%	119	59.80%
At work	39	18.40%	15	7.54%
At school	13	6.13%	10	5.03%
At the store	21	9.91%	38	19.10%
Other	39	18.40%	17	8.54%
How did you have this social interaction?				
In person	148	69.81%	143	71.86%
Over videoconferencing	36	16.98%	25	12.56%
Over the phone/audioconferencing (no video)	22	10.38%	25	12.56%
Other	6	2.83%	6	3.02%
With whom did you have this social interaction? [multiple answers allowed]				
A romantic partner	18	8.49%	35	17.59%
A family member (other than my partner)	26	12.26%	33	16.58%
A friend	43	20.28%	76	38.19%
A co-worker	30	14.15%	14	7.04%
A stranger	45	21.23%	26	13.07%
A figure of authority (e.g., a boss, a superior)	30	14.15%	9	4.52%
Other	31	14.62%	16	8.04%

Table 3

The Effects of Interaction Recall Condition and Post-Event Processing on Phenomenological Memory Qualities of the Recalled Social Interaction

Effects	Statistics							
	B	*SE*	*t*	*p*	*B*	*SE*	*t*	*p*
	Valence[a]				Emotional Intensity			
Intercept	3.19	0.07	49.04	< .001	2.61	0.07	36.22	< .001
Recall Condition	0.61	0.09	6.50	< .001*	0.12	0.10	1.13	.26
Positive PEP	0.06	0.005	11.18	< .001*	-0.01	0.01	-2.62	.01*
Positive PEP×Recall Condition	-0.04	0.01	-6.07	< .001*	0.04	0.01	4.52	< .001*
Negative PEP	-0.03	0.01	-5.23	< .001*	0.04	0.01	6.60	< .001*
Negative PEP×Recall Condition	-0.02	0.01	-2.27	.02	-0.01	0.01	-0.82	.41
	Fragmentation				Blending[a]			
Intercept	2.33	0.09	26.55	< .001	2.37	0.08	30.15	< .001
Recall Condition	0.40	0.13	3.16	.002*	0.09	0.12	0.72	.47
Positive PEP	0.004	0.01	0.60	.55	0.01	0.01	1.39	.17
Positive PEP×Recall Condition	-0.01	0.01	-1.45	.15	-0.01	0.01	-0.50	.61
Negative PEP	0.03	0.01	4.65	< .001*	0.03	0.01	4.69	< .001*
Negative PEP×Recall Condition	-0.01	0.01	-1.18	.24	0.002	0.01	0.16	.87
	Accessibility				Vividness			
Intercept	3.88	0.06	64.91	< .001	3.52	0.07	51.63	< .001
Recall Condition	-0.11	0.09	-1.24	.22	0.08	0.10	0.86	.39
Positive PEP	0.01	0.005	1.14	.25	0.004	0.01	.75	.45
Positive PEP×Recall Condition	0.01	0.01	1.44	.15	0.01	0.01	1.72	.09
Negative PEP	-0.01	0.004	-1.14	.25	0.01	0.01	2.04	.04
Negative PEP×Recall Condition	-0.01	0.01	-1.70	.09	-0.01	00.1	-1.67	.10
	Visual Perspective				Sensory Information[a]			
Intercept	3.59	0.07	48.76	< .001	2.73	0.09	28.83	< .001
Recall Condition	-0.07	0.11	-0.63	.53	0.06	0.14	0.45	.65
Positive PEP	0.003	0.01	0.52	.60	0.004	0.01	0.55	.58
Positive PEP×Recall Condition	0.002	0.01	0.26	.79	-0.004	0.01	-0.32	.75
Negative PEP	-0.01	0.01	-2.37	.02	-0.01	0.01	-0.91	.37
Negative PEP×Recall Condition	< 0.001	0.01	0.04	.97	-0.004	0.01	-0.35	.73

Note. PEP = Post-event processing; Degrees of freedom for all models = 5, 405.

*p-values were below the Benjamini-Hochberg critical values.

[a]HC3 heteroscedastic consistent standard error was used for this analysis.

Table 4

The Effects of Recall Condition and Post-Event Processing on Interaction Description Word Content

Effects	*Statistics*					
	B	*SE*	Wald χ^2	*p*	*Exp(B)*	*Exp(B)* 95% Wald CI
	Total Number of Words					
Intercept	4.46	0.04	10,497.58	< .001	86.54	79.46-94.25
Recall Condition	-0.03	0.06	0.19	.66	0.97	0.86-1.10
Positive PEP	-0.01	0.003	3.31	.07	0.99	0.99-1.00
Positive PEP×Recall Condition	0.001	0.005	0.09	.77	1.00	0.99-1.01
Negative PEP	-0.001	0.003	0.15	.70	1.00	0.99-1.01
Negative PEP×Recall Condition	< 0.001	0.005	0.004	.95	1.00	0.99-1.01
(Negative Binomial)	0.32	0.02	–	–	–	–
	Positive Phrases					
Intercept	0.08	0.09	0.83	.36	1.08	0.91-1.29
Recall Condition	0.75	0.12	41.16	< .001	2.12	1.69-2.67
Positive PEP	0.02	0.01	5.31	.02	1.02	1.00-1.03
Positive PEP×Recall Condition	-0.01	0.01	2.25	.13	0.99	0.97-1.00
Negative PEP	-0.01	0.01	2.58	.11	0.99	0.97-1.00
Negative PEP×Recall Condition	< 0.001	0.01	< 0.001	.99	1.00	0.98-1.02
(Negative Binomial)	0.51	.09	–	–	–	–
	Negative Phrases					
Intercept	1.18	0.07	294.36	< .001	3.26	2.85-3.73
Recall Condition	-1.01	0.11	80.56	< .001	0.37	0.29-0.46
Positive PEP	-0.02	0.01	7.89	.01	0.99	0.98-1.00
Positive PEP×Recall Condition	-0.01	0.01	0.80	.37	0.99	0.97-1.01
Negative PEP	0.01	0.005	4.14	.04	1.01	1.00-1.02
Negative PEP×Recall Condition	0.01	0.01	2.78	.10	1.01	1.00-1.03
(Negative Binomial)	0.51	0.08	–	–	–	–

Note. PEP = Post-event processing; CI = Confidence Interval; Degrees of freedom for all Wald $\chi^2 = 1$.

Figure 1

Relationship between interaction recall condition, social anxiety, and negative and positive post-event processing

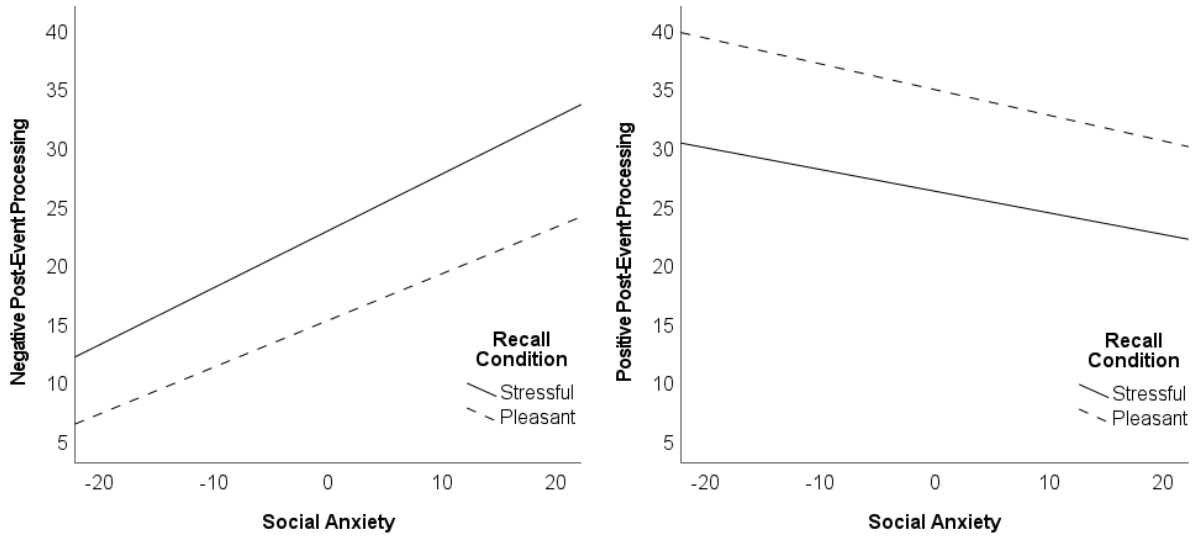
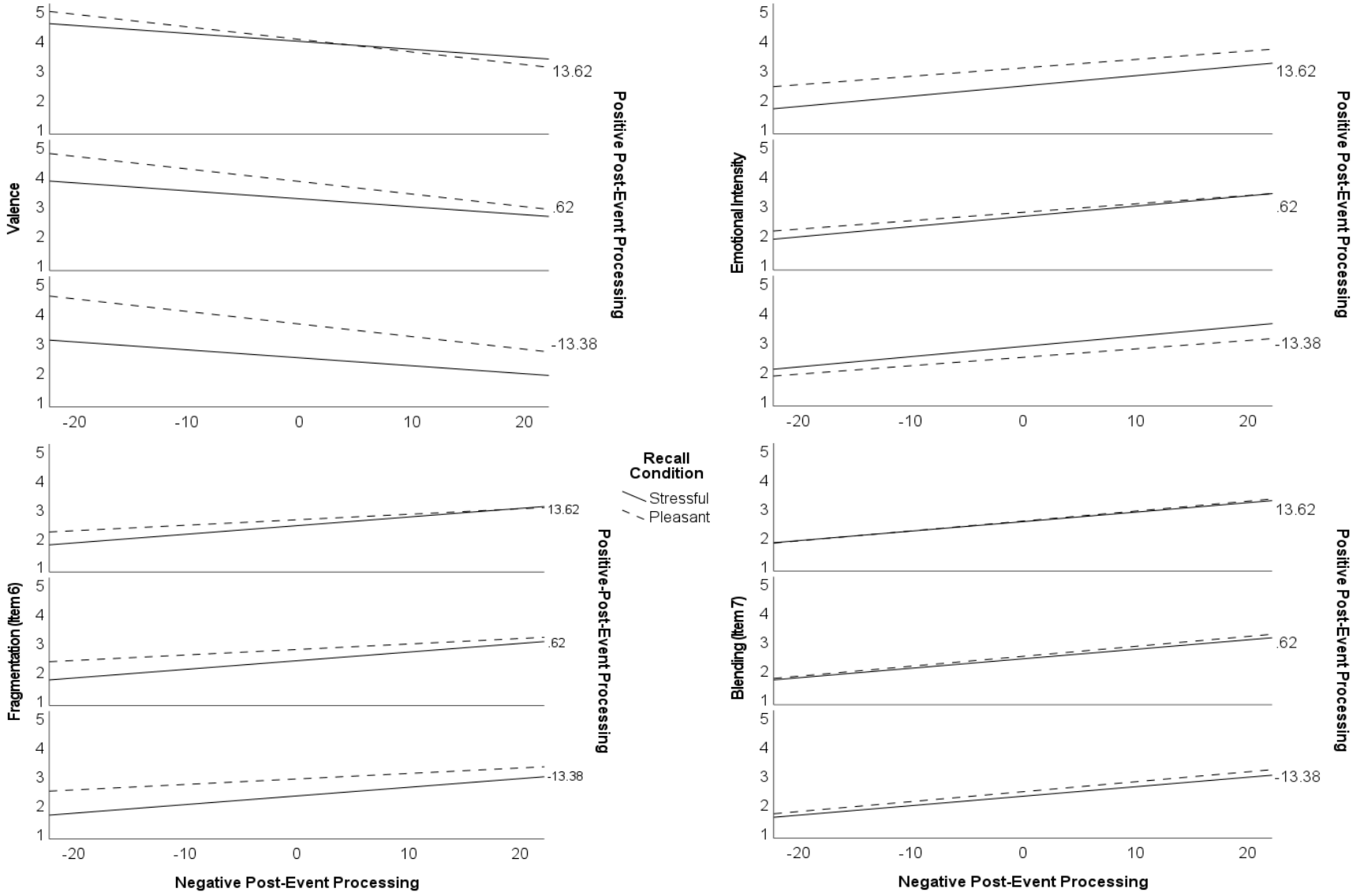


Figure 2

Relationship Between Interaction Recall Condition, Post-Event Processing, and Phenomenological Memory Qualities



Chapter 5:

General Discussion

The purpose of this dissertation was to investigate post-event processing (PEP) following social situations to better understand its time course and nature, as well as its relationships with other factors that come into play in the experience of anxiety in social situations. Understanding how PEP functions in social situations is important, as the tendency to ruminate on the distressing and embarrassing aspects of social situations after they occur is a key factor hypothesized to maintain anxiety over time in social anxiety disorder (SAD; Clark & Wells, 1995; Heimberg et al., 2010; Wong & Rapee, 2016). The negative focus that has inherently defined this process has been linked with various negative consequences, including interfering with concentration, the maintenance of negative self-perceptions, and the prevention of symptom improvement (Clark & Wells, 1995; Rachman et al., 2000; Yoshinaga et al., 2020).

Limitations of research designs (e.g., retrospective bias, reduced ecological validity) have made the study of PEP challenging, particularly considering the idiosyncratic nature of this ruminative process. Understanding how PEP relates to other cognitive and affective factors involved in social anxiety will help inform research and clinical practice. Examining how people function in interpersonal situations along the full spectrum of social anxiety symptoms can help illuminate how to reduce this often-unhelpful coping strategy. Increasing the ecological validity of studies on PEP will further elucidate this process and increase clinical relevance by studying repetitive negative thinking as it unfolds. To this aim, the studies comprising this dissertation investigated 1) how negative PEP evolves over time, 2) how negative PEP relates to other affective and cognitive factors like anxiety, performance appraisals, and anticipatory processing (AP), 3) if people report engaging in PEP about positive aspects of a social situation (positive PEP), 4) whether stressful and pleasant situations trigger differing levels of negative and positive

PEP, 5) if higher trait social anxiety is linked with less positive PEP, and 6) how negative and positive PEP relate to memory for social situations.

Study 1 examined how levels of PEP evolved over time (Research Question 1) and how it related to AP, anxiety, performance appraisals, and memory for a speech (Research Questions 2 and 6). Participants completed two speeches three days apart. PEP about the first speech and AP about the second speech were measured using ecological momentary assessment strategies. Results from this first study were partially consistent with my hypotheses. Levels of PEP decreased over time; however, levels of AP also decreased over time, suggesting that both repetitive negative thinking processes covaried to some degree in this study. In addition, experiencing higher anxiety during the first speech set up a cascade of poor performance appraisals and increased PEP about the first speech, and AP and anxiety in anticipation of the second speech. Though poorer performance appraisals were linked with increased PEP the day after the first speech, PEP did not predict a worsening in performance appraisals over time. Preliminary evidence also suggested that PEP may be associated with differential phenomenological experience of the first speech (e.g., the memory being more negative and emotionally intense).

Study 2 investigated whether stressful and pleasant social situations triggered varying levels of negative and positive PEP depending on people's social anxiety symptom severity (Research Questions 3, 4 and 5), as well as how PEP related to memory for these social interactions (Research Question 6). Participants recalled a recent stressful or pleasant social interaction and completed self-reported measures of negative and positive PEP, social anxiety, and the memory's phenomenological qualities. Participants also wrote a description of the interaction. Consistent with initial hypotheses, participants who recalled a stressful interaction reported engaging in more negative PEP, and less positive PEP, compared to those who recalled a

pleasant interaction. In addition, higher social anxiety was linked with more negative and less positive PEP for both stressful and pleasant social interactions. I also found that participants reporting more negative PEP used more negative words in describing the interaction and their memory was more negative and emotionally intense. In addition, participants reporting more positive PEP used more positive and less negative words in their descriptions. For stressful interactions, positive PEP was related to a more positive memory; for pleasant ones, it was related to increased emotional intensity.

The interesting and complementary findings of both studies have implications for how we understand and conceptualize the role of PEP in the maintenance of social anxiety symptoms. Below I outline how results of this dissertation can be framed within, and extend from, current research and clinical practices. I also discuss this dissertation's limitations and explore potential future directions for research examining the nature, predictors, and impacts of PEP.

Theoretical Implications

In the following sections, I discuss the dissertation's research questions and the implications of results as they pertain to PEP and theoretical models of social anxiety.

Research Question 1: How Does Negative PEP Evolve Over Time?

One of the main strengths of this dissertation was the use of ecological momentary assessment in Study 1 to ascertain how PEP evolved over time in between two standardized speech tasks. This assessment approach enabled real-time measurements of PEP, AP and momentary affect, which can help reduce bias from retrospective recall. Results were consistent with a study by Dannahy and Stopa (2007) where daily assessments of PEP suggested levels decreased over five days. Overall, these findings indicate that PEP is likely to be at its highest the day following a stressful social task, decreasing thereafter daily and even hourly according to Study 1 results. The short assessment period precludes any predictions regarding long-term

evolution of PEP regarding a specific task. A longitudinal examination may provide further insight into how PEP evolves over time, particularly since future social situations are likely to bring forth PEP about past social failures (Clark & Wells, 1995).

In addition, participants showed varying levels of PEP at initial assessment the day after the first speech task. They also showed varied rates of change over time. These fluctuations across participants indicated that factors other than time likely played a role in determining how much PEP a person engaged in at a given time. I hypothesized that when participants were feeling more anxious overall, they would also report engaging in more PEP. However, state anxiety at each alert was unrelated to PEP. It is possible that factors not assessed in Study 1 could have contributed to variability in PEP like self-focused attention and attention towards social threat in the environment. Both of these primary cognitive processes are posited to relate to PEP in the integrated aetiological maintenance (IAM) model of social anxiety (Wong & Rapee, 2016).

One might also wonder whether trait social anxiety symptom severity could impact temporal patterns of PEP. Though I did not examine if changes in PEP were correlated with social anxiety, I did find that average levels of PEP the day after the first speech were positively correlated with social anxiety. Conversely, Dannahy and Stopa (2007) observed similar PEP temporal patterns in both individuals high and low in fear of negative evaluation, a key fear reported by people with high social anxiety (Weeks & Howell, 2012). Specifically, PEP levels were highest the day after a conversation task in both the high and low fear of negative evaluation groups. Future research should consider assessing other elements that might predict momentary levels of PEP (e.g., presence of reminders of the event, engagement in attention encompassing tasks, other unrelated stressors).

Overall, results of Study 1 suggested that levels of PEP decreased over time in between two similar social situations like speeches. Replicating this pattern in samples more likely to

report repetitive negative thinking (e.g., clinical samples with SAD) will be important to further tease apart how PEP evolves over time.

Research Question 2: How Does Negative PEP Relate to Other Affective and Cognitive Factors Like Anxiety, Performance Appraisals, and Anticipatory Processing?

In Study 1, I examined the relationships between initial anxiety during a speech and subsequent thought processes and anxiety in anticipation of a second upcoming speech. Findings showed cascading relationships between affect and thought processes in between the two speech tasks. Specifically, higher anxiety during the first speech was linked with poorer appraisals of performance and more PEP on average the day after the speech. More PEP was also related to more AP on average the day before the second speech, which in turn was related to higher anxiety levels in anticipation of giving the second speech. These results add to other studies showing associations between PEP, state anxiety, and performance appraisals (e.g., Dannahy & Stopa, 2007; Laposa & Rector, 2011; Perini et al., 2006; Rowa et al., 2014). The components of this anxiety cascade were interlinked, which is consistent with cognitive-behavioural models that outline a vicious circle where anxiety triggers unhelpful negative thoughts and attempts to cope that perpetuate anxiety over time (e.g., Clark & Wells, 1995; Heimberg et al., 2010; Hofmann, 2007).

Wong and Rapee (2016) include both PEP and AP within their model as secondary cognitive processes stemming mainly from unhelpful attentional focus, but also from negative social-evaluative cognitions. The current findings provide further support for this theory in that participants who had negative thoughts about their performance then went on to engage in repetitive negative thinking, potentially as a way of detecting any further evaluative threat. Results also suggest that PEP about a particular social event might promote more AP about upcoming similar events. Given that AP about a particular event has also been linked with

increased PEP following that same event (Laposa & Rector, 2016), it is likely a bidirectional relationship.

Furthermore, Study 1 provided first insights into the time course of AP. I expected that AP would increase as the anticipated second speech approached. Though this hypothesis had never been formally tested to my knowledge, it stemmed from Rapee and Heimberg's (1997) model stating that attention towards threat and anxiety can begin in anticipation of entering social situations, potentially leading to or coming from engagement in AP. To the contrary, AP followed a similar time course to PEP and decreased over the two-day assessment period, as well as varied initial levels of AP and rates of change over time. It appeared that, in the current study, as the speech approached, participants did not experience an increase in future threat-oriented thought frequency. Instead, these future-oriented thoughts seemed to occur shortly after the first speech. Multiple reasons could explain these results. First, PEP and AP, though distinct, may have covaried such that when one decreased the other also decreased, perhaps because they both represent two repetitive negative thinking processes. Second, the assessment methods used could explain the similar, downward time courses of both PEP and AP. Indeed, the ecological momentary assessment items were identical at each alert. With each additional measure completion, participants may have been reminded that they had to give a second speech and could have gotten used to this eventuality, decreasing the need to ruminate on how it might unfold. Third, PEP and AP were assessed on Days 2 and 3 of the study, which may have masked any increases in repetitive negative thinking that might have occurred immediately before the second speech. It would therefore be interesting to include an assessment of PEP and AP the morning before the second laboratory visit in any future iterations of this paradigm.

Next steps for PEP research may include investigating whether interventions focused on reducing anxiety in social situations and performance reappraisals also reduce PEP. In addition,

Study 1's findings highlight that PEP and AP are interlinked and show similar time courses in between two similar social situations close in time. It will also be important to determine whether reducing PEP, targeting it directly or indirectly through other anxiety-reducing strategies, could have downstream effects on thoughts and anxiety in anticipation of future similar situations.

Research Question 3: Do People Report Engaging in PEP About Positive Aspects of a Social Situation (Positive PEP)?

Most researchers have examined the effects of negative PEP. Though measures of positive PEP have be developed, little is known about the degree to which individuals engage in positive PEP following a social situation. By assessing both negative and positive PEP in Study 2, I aimed to determine whether people engaged in positive PEP. Results showed that participants did report having positive thoughts about a recent social interaction, as evidenced by their responses on the Positive PEP subscales of the Social Interaction Thoughts Questionnaire (SITQ). The scores varied across the full score range of the subscale. This variability suggests that some participants reported engaging in more positive PEP than others. It is therefore important to understand what situational and individual factors might explain this variability.

Research Question 4: Do Stressful and Pleasant Situations Trigger Differing Levels of Negative and Positive PEP?

Research on PEP has, to my knowledge, focused on reactions to stressful or anxiety-provoking social situations even though people encounter a wide range of social situations in their daily lives. A novel approach within this dissertation was to inquire about both social situations that were perceived as stressful and as pleasant and any subsequent reported negative and positive PEP. Findings indicated that both situation types were associated with differing levels of negative and positive PEP. Specifically, participants who recalled a stressful interaction

reported having engaged in more negative and less positive PEP compared to those who recalled a pleasant interaction, highlighting how thought processes can vary based on context.

Given the cross-sectional nature of the study, direction of these effects cannot be inferred. Indeed, it is possible that people engaged in more or less negative or positive PEP because they perceived the interactions as pleasant or stressful (i.e., perception of the interaction led to PEP). A step towards testing this hypothesis could include a survey study where participants rate vignettes of social interactions on how pleasant or stressful they perceive them to be, as well as how likely they would be to engage in PEP after these imagined events.

Conversely, it is also possible that PEP played a role in how the situations were perceived at the time of measurement (i.e., amount of negative or positive PEP impacted perception of the interaction). This hypothesis could be examined using a well-designed experiment that involves standardized social tasks, instructions that promote or inhibit PEP (e.g., Blackie & Kocovski, 2016; Field et al., 2004; Kocovski et al., 2011; Potter et al., 2016; Rowa et al., 2014; Wong & Moulds, 2009), and assessing overall perception of pleasantness and stressfulness before and after a PEP manipulation.

Cognitive-behavioural models of social anxiety like the Wong and Rapee integrated aetiological and maintenance model (2016) place the interpretation of external stimuli as threatening at the centre of their understanding of anxiety in social situations. If social-evaluative stimuli are perceived as threatening, various cognitive and behavioural coping mechanisms are then used to help reduce this threat, which has long-term emotional consequences (i.e., maintains anxiety in social situations over time). When participants were asked to recall a stressful interaction, the recalled interactions were likely perceived as more threatening. It therefore makes sense within a CBT framework that stressful interactions would be associated with higher reported negative PEP and even less positive PEP.

Pleasant interactions, on the other hand, would seemingly have a lower threat value and, therefore, be associated with less reported negative PEP than stress interactions. This result is indeed what was found in Study 2. However, pleasant interactions were also linked with higher reports of positive PEP than were stressful interactions. The assumed low threat value of pleasant interactions is, in my opinion, is not entirely sufficient for positive PEP to occur. Indeed, interactions perceived as pleasant should, by definition, be *pleasant* and not only not-threatening. It is possible that this appraisal as pleasant, rather than the absence of threat, might be linked with increased positive PEP. However, we know that people with social anxiety experience less positive affect in response to situations (T. A. Brown et al., 1998; Watson et al., 1988). It is therefore important to understand how social anxiety symptoms might be linked with positive PEP in the context of pleasant social interactions.

Research Question 5: Is Higher Trait Social Anxiety Linked With Less Positive PEP?

Research is clear that trait social anxiety symptoms are associated with higher reports of negative PEP both in clinical and nonclinical samples (e.g., Kocovski & Rector, 2008; Rachman et al., 2000). Given the focus of social anxiety research on negative PEP, little is known about whether people with higher trait social anxiety also engage in positive PEP. Results of Study 2 showed that people with higher levels of social anxiety reported engaging in less positive PEP regardless of whether the situations were perceived as stressful or pleasant overall. PEP may therefore be another example of how social anxiety contributes not only to biases towards negative information, but also to biases away from positive information.

Indeed, other cognitive processes have shown similar patterns (e.g., memory, attention, interpretation). Higher levels of social anxiety, for example, have been linked with worse memory performance for positive, but not negative, social scenarios (Romano et al., 2020). Attention away from positive social information has also been shown to explain the link between

social anxiety symptoms and state anxiety during a stressful social task, even when controlling for anhedonia (Taylor et al., 2010).

Additionally, there is a well-documented relationship between negative interpretation bias and social anxiety, particularly when using subjective measures (Chen et al., 2020). As such, it is likely that positive information, as well as negative information, is processed differently in the context of social anxiety, which can be observed via several cognitive mechanisms. With regards to PEP, an increased negative, and lack of positive, ruminative focus could, along with other cognitive and behavioural factors like safety seeking behaviours (Clark & Wells, 1995; Rapee & Heimberg, 1997), prevent opportunity for disconfirmation of unhelpful negative beliefs. Results add to our understanding of the combined cognitive biases hypothesis (Hirsch et al., 2006) positing that cognitive biases influence one another and compound each other's effects. If socially anxious people have a bias towards ruminating on more negative *and* less positive information, cognitive biases could be further maintained.

Study 2 suggested another subtle way that these cognitive biases could translate to behaviour. When describing their recalled social interactions, participants who reported more negative PEP were more likely to use negatively-valenced words in their descriptions. The opposite occurred for those who reported more positive PEP, and these people were also more likely to use positively-valenced words. Therefore, engaging in repetitive thinking, negative or positive, was related to the valence of the information individuals chose to share within the context of this study. It is possible that participants included what was most salient to them in the moment, which may have been related to how much PEP they engaged in or to other cognitive processes not accessed in this study (e.g., willingness to share information, social desirability, attentional biases). It may be interesting for future research to consider investigating these possibilities, and whether PEP might impact the information people choose to disclose to others

around them. For example, if someone who engages in more negative PEP, would they report more negative elements to a friend when describing the same situation? Creative experimental studies may help answer this research question and extend current findings.

Social anxiety-related cognitive biases may have also come into play when participants decided which social interaction to use for the study. Study 2 relied on participants' appraisals of the social interactions as either stressful or pleasant, which begs the question of what would make a social interaction stressful or pleasant for people who might be higher or lower in social anxiety. The situations recalled by participants higher in social anxiety may have differed from those recalled by those lower in social anxiety. For example, a person low in social anxiety may have thought that receiving positive feedback at work or attending a party were pleasant experiences, but those same situations may have been perceived as stressful by someone with higher social anxiety. This possibility has particular implications in the use of standardized social tasks if one were to attempt to recreate a pleasant social situation in the lab, as well as in the study of positive affect in social anxiety. Inquiring about reasons why participants perceived the recalled situation as pleasant or stressful might help elucidate this question. Factors to consider may include threat perception, fear of negative and positive evaluation, and reward perception (Heimberg et al., 2010; Hudd & Moscovitch, 2022).

One factor in particular that could contribute to the findings of this dissertation is reduced social reward responsivity or drive. Indeed, the pleasant interactions recalled by participants may have included forms of social reward. Therefore, understanding how people react in the context of reward perception may be especially illuminating. Recent research on reward responsivity and drive suggests that people with high social anxiety experience less approach motivation towards activities that could present social rewards and positive affect (e.g., Hudd & Moscovitch, 2020, 2022). Hudd and Moscovitch (2022) also proposed that people with SAD may hold beliefs

related to low drive to social reward (e.g., believing that a future social situation is unlikely to bring any positive effects or affect). These types of thoughts could feature within repetitive negative thinking in social anxiety. For example, someone engaging in AP might have thoughts like "It's useless for me to go to this party. I won't have any fun. It's not worth the anxiety," and someone engaging in negative PEP after this party might have thoughts like "See, it wasn't fun. I was so anxious the whole night. I'm not doing this again." These types of thoughts could prevent someone from responding to social reward and from seeking it out in the future. Therefore, it would be interesting to assess the potential roles of negative PEP and AP in sustaining this reduced responsiveness and drive for social reward and, therefore, positive affect. Positive PEP (including, for example, thoughts like "I was able to stay at the party despite feeling anxious. It was nice to connect with friends again") could also be studied as a potentially helpful strategy to promote reward responsivity and positive affect.

Taken together, results highlight that it is important to consider valence of thoughts in PEP. Current theoretical models of social anxiety have focused mainly on explaining the maintenance of negative affect but not on the lack of positive affect that is also characteristic of this disorder (Watson et al., 1988). Continuing to explore the role of reduced positive PEP and reward responsivity and drive in the maintenance of anxiety may help bridge this gap.

Research Question 6: How Do Negative and Positive PEP Relate to Memory for Social Situations?

The final goal of both dissertation studies was to examine the relationship between PEP and memory for social situations. The main facet of memory that was assessed was self-reported phenomenological memory qualities. Evidence from both studies converged to suggest that participants who engaged in more negative PEP following a social situation also reported remembering the situation as more negative and emotionally intense. Study 1 also suggested that

people who reported engaging in more PEP also reported a slower decay in memory vividness compared to those who reported less PEP, though this effect would require further replication. PEP was unrelated to change in other phenomenological qualities, suggesting that negative PEP did not contribute to making the memories more negative or emotionally intense. Instead, results suggest a correlational relationship such that increased PEP was associated with a more negative and emotionally intense memory.

If we consider the results within Wong and Rapee's model of social anxiety (2016), it is possible that individuals engaged in negative PEP because they remembered the event as negative and, therefore, as salient and dangerous. Indeed, higher perceived threat at the time of the speech could have contributed to increased attention towards this threat, leading to further perceived need for PEP after the fact. Alternatively, the speech may have been remembered as more negative because participants engaged in negative PEP (or less positive PEP). This hypothesis is consistent with Heimberg and colleagues' (2010) view of PEP as a repetitive reconstruction of the memory, making it more and more negative over time. It is likely that the relationship between reported memory valence and PEP is a bidirectional one.

In contrast to negative PEP, positive PEP had more complex relationships with phenomenological memory qualities. Specifically, participants who recalled a stressful interaction reported that the memory was less positive, but only if they engaged in less positive PEP. In addition, participants who recalled a pleasant interaction and engaged in more positive PEP found that the memory was more emotionally intense, suggesting that focusing on the positive in positive social interactions could potentiate the intensity of those emotions, almost as a positive reconstruction instead of a negative one. These findings further indicate that positive PEP may have protective and desirable effects on memory and affect, particularly if we consider that positive emotional states have various benefits for flexible thinking, psychological resilience,

and wellbeing (Fredrickson, 2001). If individuals higher in social anxiety do not tend to engage in positive PEP, then they may not benefit from these effects (e.g., potentiating positive thoughts and affect). Experimentally manipulating negative and positive PEP and assessing memory qualities over longer periods may help tease apart the impacts of PEP on phenomenological memory qualities of social events, particularly in clinical or high socially anxious groups.

PEP as a Meeting Place

In summary, the results of this dissertation add to our understanding of PEP and its relationships with other affective and cognitive factors maintaining and perpetuating anxiety in social situations. A key implication of these studies is that PEP does not operate on its own in perpetuating social anxiety. Rather, it achieves this maintaining role in conjunction with other cognitive processes and biases, which is consistent with Heimberg and colleagues' revised cognitive-behavioural model of SAD (2010) and the combined cognitive biases hypothesis (Hirsch et al., 2006). Indeed, I have come to view PEP as the "meeting place" where various cognitive biases (e.g., self-focused attention, interpretation biases, memory biases, positive information processing biases) come to light and are repeatedly rehearsed in an attempt to make sense of past social situations and prevent future evaluation. PEP as measured within the dissertation consisted of thoughts (there may also be an imagery component that was not assessed). These thoughts came from somewhere, and these studies suggested that they might stem from anxiety or other thoughts like performance appraisals. This conceptualization fits within a cognitive-behavioural understanding of emotions where there are bidirectional relationships between emotions and thoughts. Future research is needed to examine how the third arm of the cognitive-behavioural model fits in – that is how behaviours (e.g., focusing on the self, cognitive avoidance, overt avoidance, safety behaviours) interact with PEP.

If PEP is indeed a "meeting place," it has the potential to strengthen core beliefs about the self, others, and the world and increase engagement in unhelpful thinking patterns. This rehearsal may also add to conditional beliefs (e.g., "If I focus more on myself next time, maybe I won't make mistakes," "If I review what happened, I can find where I made mistakes"). However, if we promote focusing on positive elements and encourage revisiting positive aspects of social situations, perhaps what could be rehearsed and strengthened is alternative beliefs (e.g., "I can find something positive about a situation even when I'm feeling anxious"). In doing so, the anxiety cascade could be diverted over time.

As such, it is crucial for future research to investigate multiple cognitive processes within the same study (Heimberg et al., 2010; Hirsch et al., 2006). Their interactive and self-perpetuating effects may be masked otherwise, providing a more limited picture. This dissertation was able to integrate both PEP and AP, as well as self-reported memory experiences. However, many more cognitive and behavioural processes are involved in the maintenance of social anxiety, such as imagery, negative self-perceptions, self- and threat-focused attention, (cognitive) avoidance, safety behaviours, social skills deficits, and emotion regulation difficulties (Clark & Wells, 1995; Heimberg et al., 2010; Hofmann, 2007; Moscovitch, 2009; Wong & Rapee, 2016). Broadening our focus to include positive PEP is also likely to add to our understand of how people function in interpersonal situations.

Clinical Implications

Results of this dissertation provide suggestions for clinical implications when considering the treatment of social anxiety. Cognitive-behavioural therapy (CBT), particularly based on the Clark and Wells (1995) or the Heimberg and colleagues (2010) models, is the first-line treatment for social anxiety recommended by the National Institute for Health and Care Excellence (2013). Almost a decade of research has added great richness to our understanding of its

conceptualization and maintaining factors, including PEP, since the publication of these recommendations in 2013. Considering how more recent findings fit within recommendations would be beneficial. Although efficacy effect sizes in meta-analyses are large, not everyone will show improvements or a return to normative levels of social anxiety following a course of CBT (Mayo-Wilson et al., 2014; McEvoy et al., 2012). As such, it remains important to look to new research and clinical knowledge that can further refine evidence-based treatments, with the goal of helping individuals living with social anxiety lead more meaningful lives. Two approaches suggested by the results of this dissertation include both reducing negative PEP and increasing positive PEP.

Before considering strategies to help reduce negative PEP, there is the question of whether negative PEP needs to be targeted directly in order to show improvements. One of the key results of this dissertation pertained to the cascade of anxious thinking and affect, and how this might contribute to cognitive biases that can have compounding effects and maintain each other over time (Hirsch et al., 2006). This suggests that individuals might engage in less negative PEP as other maintaining factors like attentional and interpretation biases decrease. For example, if a person pays less attention to the negative aspects of social situations or interprets them differently, they may feel less of a need to ruminate after the event, reducing negative PEP. Future research should assess specifically whether targeting factors other than PEP are likely to have positive impacts on PEP reduction. However, even if this is the case, we do not know whether working on PEP directly might have incremental effects (Price & Anderson, 2011). It is therefore worth considering current treatment recommendations and how this dissertation might inform interventions that would work to reduce negative PEP.

Reducing Negative PEP

Clinicians have already offered several different strategies that can be used to reduce negative PEP and also AP. In their outline of CBT for SAD, Leahy and colleagues (2012) described interventions to help target PEP and AP, including distraction, engaging in other more useful activities, thought records, and Socratic dialogue (e.g., exploring the link between PEP and mood), the overarching goal being to highlight discrepancies between catastrophic and actual outcomes. McEvoy and colleagues (2009) also noted behavioural experiments as a potential helpful intervention for AP and PEP. For applications with adolescents, the interested reader can also see Leigh and Clark (2016).

In addition, more recent third-wave CBT interventions (e.g., mindfulness, self-compassion) have shown promise in reducing negative PEP. For instance, in a study by Blackie and Kocovski (2018a), high socially anxious students gave a speech and completed a brief exercise consisting of prompts to elicit mindfulness (i.e., taking a balanced perspective and considering all aspects of their speech, including positive and negative aspects), common humanity (i.e., normalizing that many people become anxious about speeches), and self-kindness (i.e., writing a paragraph to themselves as if they were supporting a friend who completed a speech). Results showed that, compared to prompts to ruminate or write about the speech, self-compassion was related to less PEP the day after the speech, as well as increased willingness to engage in social situations in the future (Blackie & Kocovski, 2018a). Similarly, brief mindfulness training may provide relief from PEP. Indeed, using mindfulness skills repeatedly over two weeks after completing a social interaction task helped individuals high in social anxiety engage in less PEP (Lewis et al., 2021). Studying the impacts of these third-wave inspired interventions on PEP will likely enhance our understanding of SAD and inspire new adaptations in its treatment.

An additional clinical consideration stemming from this dissertation pertains to when PEP might be most salient for clients. The repeated assessment of PEP highlighted how negative thoughts about a speech were at their highest the day after a stressful social task, decreasing thereafter. This temporal pattern highlights a potential key window of opportunity for intervening to reduce PEP using the above suggested interventions. In clinical practice, this may involve describing this pattern during psychoeducation on PEP (e.g., PEP will go down; it won't stay high forever). Clients could also aim to complete a thought record the day after a very stressful social event. Behavioural experiments (e.g., tracking PEP across time to observe what happens) could also be used to test beliefs about PEP or ability to cope with the emotions induced by PEP.

Moreover, addressing PEP in the context of group therapy may be beneficial because between-session negative PEP can hinder progress in group CBT for people with SAD (Price & Anderson, 2011). Participants with other anxiety disorders (i.e., SAD, obsessive-compulsive disorder, panic disorder, generalized anxiety disorder) have also reported PEP following sessions of group CBT (Laposa et al., 2014). However, it is unknown whether between-session PEP might also have impacts on progress in group CBT for other anxiety disorders. As such, future areas of research may include examining this possibility and seeing whether interventions targeting between-session PEP could yield positive results on therapy progress or group interpersonal processes. For example, clinicians could provide the opportunity to help restructure these thoughts as they come up (e.g., asking clients to do a thought record about therapy the day after the therapy session).

Increasing Positive PEP

This dissertation further highlights that positive PEP may be protective and have beneficial effects (e.g., lower social anxiety symptoms, a more positive and emotionally intense memory experience of pleasant interactions, a less negative memory experience of stressful

interactions). Though correlational in nature, these findings provide preliminary support for the usefulness of assessing and promoting positive PEP in social anxiety. We know from cognitive-behavioural models that reducing negative PEP can help reduce social threat (Wong & Rapee, 2016). Could promoting positive PEP also serve to reduce social threat, or even contribute in some ways to reward responsibility and social wellbeing? This is a possibility that is worth exploring in future clinical research.

Interventions that may foster positive PEP could include those focused on promoting positive imagery (e.g., McEvoy et al., 2018) and increased cognitive flexibility like cognitive restructuring and behavioural experiments. An example of a behavioural experiment could be comparing what happens to anxiety and appraisals of an social situation if someone focuses on the negative aspects of an event versus the positive aspects of an event. This experiment would provide the opportunity to highlight how it impacts anxiety and challenge unhelpful beliefs about PEP. Additionally, an in-session exercise could consist of intentionally asking people during session check-ins to bring to mind positive social events from the past week, which may promote engagement in positive PEP and response to social rewards. These interventions have the potential to promote a more balanced view of past social situations to help break the vicious cycle of social anxiety.

Methodological Implications

A strength of this dissertation is that each study used different measurements to examine PEP. Study 1 used longitudinal ecological momentary assessment of PEP paired with standardized social tasks, while Study 2 relied on retrospective cross-sectional report of PEP and an idiosyncratic social task. Each study attempted to balance controlling for confounding factors and biases, feasibility, respondent effort, and personal relevance of anxiety-inducing stimuli.

The use of standardized speeches in Study 1 helped ensure that participants had similar experiences on which to ruminate, which may have come at the cost of personal relevance for some. The repeated daily assessments helped reduce retrospective bias in PEP reports but came at increased demand of participants and possibly influenced the process we were examining. The longitudinal nature of the study also lent itself better for establishing temporal relationships.

For Study 2, participants recalled a recent social interaction they perceived as being stressful or pleasant, increasing personal relevance but adding between subject variability. Retrospective reports of PEP may also have been biased in unmeasurable ways (e.g., under or over reported), while the cross-sectional assessment increased feasibility and decreased demand on participants. No research design is perfect. By utilizing complementary methods across studies, this dissertation helped fill the gaps in our understanding of the at times tricky to assess process that is PEP.

There is also opportunity for meaningful discussion on the role of measurement strategies on results and their interpretation. Indeed, Study 1 measured PEP and AP six times over the course of two days. I analyzed these data in two ways to answer different research questions: momentary levels to examine changes and relationships over time (i.e., alert 1, alert 2…alert 6) and average levels (i.e., mean of alerts 1-3, mean of alerts 4-6) to assess overall relationships with speech-specific factors. Ecological momentary assessment provides many advantages, including limiting recall bias and enabling the examination of behaviour and symptom changes over time and in different contexts (Shiffman et al., 2008).

However, I posit that moment-by-moment reports in Study 1 may have been affected by random confounding factors (e.g., if a participant was in a class at the time of the alert, their self-report for that alert may have been impacted in unpredictable ways). By also looking at average levels of PEP and AP throughout day, the resulting scores may have been more robust to the

influence of random confounding factors and habituation compared to the individual moment-by-moment levels. Examining aggregate data, however, likely resulted in a loss of information and richness brought by the ecological momentary assessment. The decision to use both average and momentary levels of PEP and AP may have contributed to the inconsistent findings within Study 1 regarding the link between PEP about the first speech and AP about the second speech (i.e., finding a positive association between Day 2 PEP and Day 3 AP in the serial mediation, but failing to find an association between momentary PEP and subsequent AP in the hierarchical linear models). Additional research on the analytical uses of EMA data is needed to support this hypothesis.

This discrepancy highlights the importance of considering measurement strategies within this dissertation. Taken together, results indicated that the relationship between PEP and AP is complex and further nuanced by level of measurement (e.g., momentary versus averaged). Researchers should think carefully about their research questions and which measurement level would be best suited to answer them, keeping in mind the strengths and limitations of each approach. For example, researchers interested in assessing the effects of covariates on momentary levels or temporal patterns may be better assessing momentary levels. In contrast, taking average measurements might be more suited for instances when that same level of detail is not necessary to answer the question at hand. Pre-registration may help promote reflection on the types of analyses that will answer the research questions and prevent post-hoc changes to the analytic strategies (Simmons et al., 2021).

Another important analytical consideration was the decision to use a continuous measure of social anxiety in answering the question of whether the relationship between social anxiety and worsening performance appraisals could be explained by PEP. One of the first study's aims was to extend the work of Cody and Teachman (2011) who found that participants high in social

anxiety reported more PEP than those low in social anxiety, and more PEP was in turn related to worsening ratings of global aspects of performance. Their results provided a potential mechanism by which social anxiety influences performance appraisals over time. Study 1 did not replicate their findings. Though participants higher in social anxiety symptoms reported engaging in more PEP on average the day following Speech 1, average PEP was unrelated to a worsening in performance appraisals.

These different findings could be partially explained by methodological difference between the two studies. For example, Cody and Teachman used a different measure of PEP and timeframe (i.e., the Post-Event Processing Questionnaire three days after a speech; Rachman et al., 2000). Study 1's use of a continuous measure of social anxiety compared to Cody and Teachman's use of dichotomization could further help explain the discrepancy. A dichotomized, previously continuous variable in a regression analysis can have many unpredictable effects. For example, it can result in loss of information, statistical power, and effect size or, to the contrary, it can lead to spurious statistical significance and overestimation of effect size (MacCallum et al., 2002). Moreover, continuous variables can be dichotomized using various methods, including using a median split, a particular number of standard deviations from the mean, or an established clinical cut off. The choice of method can further impact results and contribute to comparability issues across studies (MacCallum et al., 2002). For example, the sample median, mean and standard deviation will vary study to study, producing different cut off values. Therefore, it is important to consider that potential impacts of dichotomizing continuous measures and to avoid doing so when possible.

Limitations and Future Directions

The results of this dissertation must be considered within the methodological limitations of the research designs. When considering the studies as a whole, the main limitation constitutes

the types of samples used. Participants were students or young adults from the University of Ottawa community or from across Canada. Extrapolation of results beyond the student, young adult, and Canadian populations should be made with caution. In addition, participants displayed a wide range of social anxiety symptoms. Results may have been different if the studies had examined PEP within a clinical or analogue sample for social anxiety disorder. Recruiting samples showing high social anxiety levels may help mitigate the floor effects seen in Study 1. It would also be of interest to study positive PEP and PEP following pleasant social interactions in more highly distressed individuals.

Moreover, data from both studies relied on participants' self-report answers to questionnaires. Though to the best of my knowledge, the only way to assess PEP, AP, and the phenomenological experience of memory is by self-report, it must nonetheless be noted that self-report is subject to various response biases (e.g., social desirability, acquiescence, random responding, faking; Miller et al., 2013). Care was taken to screen data for patterns indicative of these biases, particularly in Study 2 due to its online nature and the use of panel participants by including validity checks. However, participants' responses, as any form of data, included bias despite best efforts. Various other cognitive processes not measured in the current studies may have also impacted results, such as memory difficulties and biases. In particular, Study 2's results may have been affected by recall biases as participants tried to remember not only information about the social interaction but also how much they thought about it since it occurred.

Relatedly, both studies also included cross-sectional components. Study 2 was entirely cross-sectional, whereas Study 1 included some aspects measured at the same time. For example, peak anxiety and performance appraisals were both measured immediately after the speech. Conceptually, the serial order of peak anxiety during speech 1 – performance appraisal was chosen within the mediation model based on the reasoning that, although assessed after speech 1,

peak anxiety would have preceded the appraisal of performance. However, it is important to note that both anxiety and performance appraisals were assessed at the same time after speech 1. Therefore, it is possible that, had variables been entered differently, poorer performance appraisals may have predicted higher peak anxiety levels. As such, the observed effects are correlational ones and causality cannot be infirmed in either study. Carefully designed experimental study would be needed to disentangle the directions of effects and account for other confounding variables.

Furthermore, indicators of effect size were not available for the negative binomial regressions in Study 2, which instead relied on the arbitrary *p*-value cut-off of < .05 to determine notable effects. However, *p*-values have limitations and can lead to making unfounded conclusions (e.g., Wasserstein et al., 2019). Preregistration of analyses and hypotheses for both studies also contributed to research transparency and thoughtful research design.

Lastly, collection of data for Study 1 occurred before the onset of the COVID-19 pandemic, while data collection for Study 2 occurred during the second wave of the pandemic. The *zeitgeist* that is the COVID-19 pandemic may have impacted Study 2 results in unknown ways. I attempted to capture how social interactions may have changed with the inclusion of virtual social interactions in the study. Descriptive statistics (see Table 2 in Chapter 4, page 90) indicated that approximately 70% of the interactions recalled by participants were in person and approximately 27% were remote via videoconferencing or audioconferencing/telephone. It cannot be determined whether these percentages would have been different if data had been collected pre-pandemic. However, even if most social interactions were face to face, they may have taken on new meaning with the restrictions people have been living through, potentially becoming more important, more stressful, or more limited, and impacting mental health along with various other factors (e.g., COVID-19 related stressors).

Indeed, the first Mental Health Research Canada's national survey of Canadians (data collected from April 22-28, 2020) found that the percentage of respondents reporting high to extremely high anxiety quadrupled from 5% to 20% since the start of the pandemic (Dozois, 2021), though pre-pandemic levels were measured retrospectively introducing bias. Loneliness also appeared to be high with approximately 8.4% of a Canadian adult sample collected in May and June 2020 reporting feeling lonely five or more days in the past week (Wickens et al., 2021), though this study also did not include comparisons with pre-pandemic data. Individuals with higher pre-pandemic levels of social anxiety reported greater COVID-19 anxiety, an increase in fear of negative evaluation since the start of the pandemic, and more loneliness (data collected in May 2020; Ho & Moscovitch, 2022). Interestingly, those with higher pre-pandemic social anxiety reported greater efforts to affiliate with others and, when they also experienced higher functional impairment pre-pandemic, a more positive emotional response to this affiliation. The COVID-19 pandemic has undoubtedly impacted Canadians and others around the world and, by proxy, will also affect research on social anxiety and mental health in general. The full extent of these ramifications will likely only come to light once the pandemic has come to pass.

Conclusion

The studies composing this dissertation provide a clearer picture of PEP in the context of social anxiety. Study 1 showed that PEP after a speech decreased over time in a non-clinical student sample, showing a similar time course to AP about an upcoming speech. It also underscored the cascading effects of anxiety on thoughts and feelings about the speeches. Study 2 illustrated how positive PEP could relate to social anxiety and memory in ways different from negative PEP. Recalled pleasant social interactions were also linked with more positive PEP and less negative PEP compared to stressful social interactions. The current studies' findings and

implications will undoubtedly inform further research on PEP and contribute to our understanding of the development and maintenance of anxiety in social situations.

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Appendices

Appendix A: Study 1 Consent Form

uOttawa

CONSENT FORM FOR RESEARCH PARTICIPATION[13]

Title: Speaking about controversial topics: What do you think?

Researchers:

Andrea R. Ashbaugh, Ph.D., C.Psych	Leanne Kane, B.A.	Amanda Dezenosky
Associate Professor	Ph.D. Student	Honours Thesis Student
School of Psychology	School of Psychology	School of Psychology
University of Ottawa	University of Ottawa	University of Ottawa
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Invitation to Participate: I am invited to participate in the abovementioned research study conducted by Principal Investigator Andrea R. Ashbaugh, Ph.D., Co-Principal Investigator Leanne Kane, B.A., and Honours Thesis Student Amanda Dezenosky, University of Ottawa. This research project is being conducted as part of Leanne Kane's Ph.D. thesis. The data will also be used for Amanda Dezenosky's honours thesis.

Purpose of the Study: The purpose of this study is to better understand how people perform during speeches on controversial topics and explore how this is related to their thoughts and feelings.

Participation: My participation will entail <u>two laboratory sessions</u> (in the INSPIRE Laboratory, located on the 5th floor of the Vanier building, University of Ottawa), as well as filling out <u>six short surveys sent to you by text messages in between these sessions</u>. Each laboratory session will last a maximum of 1 hour.

At the beginning of the <u>first session</u>, I will be asked to fill out a series of questionnaires related to anxiety and my mood, and to provide general information about myself such as age, self-identified gender, and family income. Afterwards, I will be asked to present a 5-minute speech which will be recorded and evaluated by experts on public speaking. I will also be asked

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[13] For both studies, French consent and debriefing forms were also provided to participants.

some further questions related to my performance. The experimenter will then explain to me the procedure for the smartphone alerts.

Over the next two days, I will receive smartphone alerts with a link to a few questions about my thoughts and feelings and I will need to complete the questions within 60 minutes of receiving the alert. I will be able to specify a 9-hour period on both days during which I am open to receiving the alerts.

The second laboratory session will take place on the fourth day, where I will be asked to fill out a questionnaire related to my thoughts and feelings, and give a second speech that will also be recorded and evaluated by experts. I will then be asked some further questions related to my performance. I will be given feedback on both speeches after I give my second speech.

Benefits: This study examines performance during speeches and how it is related to thoughts and feelings. The primary benefit of your participation is that you have helped with the advancement of our knowledge of how these factors influence one another. Results will expand our knowledge of how thoughts and feelings can affect performance.

Risks: I can expect to experience some slight discomfort due to presenting the speeches. However, this should not be any more uncomfortable than giving a presentation in a classroom setting. I may also experience some discomfort from receiving feedback and critiques from the experts. My participation in this study will also entail that I volunteer personal information about my thoughts, feelings, and actions. It is possible that I may experience some mild emotional discomfort when answering questionnaires related to my thoughts, feelings, and actions. If I find that I am frequently feeling depressed or anxious, I may wish to contact my family physician or any of the resources listed below. Lastly, I understand that I may incur costs if I go over the text message and data limits I have with my cellphone provider and that I and *not* the researchers are responsible for the payment of those costs. I am free to withdraw from the study at any time.

Voluntary Participation: My participation is voluntary. I am free to withdraw from participation at any time without any negative consequences. If I refuse to participate in this study it will have no impact on my academic program. If I choose to withdraw from the study, all data collected to that point will be destroyed, unless I grant permission to use it. If I know in advance that I will not be able to complete the smartphone alerts and/or the second laboratory session, I should inform the experimenter right away.

Confidentiality and Anonymity: The information that I will share will remain strictly confidential and will be used solely for the purpose of this research. The only people who will have access to the research data are the primary investigator and her research team. Results will be published in pooled (aggregate) format and presented at professional conferences and in academic journals.

Conservation of Data: The data collected from the questionnaires will be kept in a secure manner. Specifically, it will be stored on Qualtrics servers located in Canada. Electronic data will be stored on the University of Ottawa server, located on the University of Ottawa campus. More

specifically, the data will be saved on a subfolder of the server which is only accessible by members of Dr. Ashbaugh's research team and University of Ottawa IT personnel who might need to manage the server. A regular backup of electronic data will be made onto a password-protected external hard drive, which will be kept in the locked data-analysis space of of Andrea R. Ashbaugh. Written data will be stored in a locked cabinet located in the data-analysis space of Andrea R. Ashbaugh. The video recordings of the task will be made on a SD card and transferred to the password-protected computer mentioned above, and deleted from the SD card. All identifying information (e.g., my signed consent form, my phone number, my video recordings) will be stored separately from anonymous data. Written data will be destroyed 7 years after the publication of results, and electronic data will be stored indefinitely. My phone number and my video recordings will be deleted after the publication of results.

Compensation:

If I am an ISPR student, I will be compensated with one course credit on Day 1 and one course credit on Day 4 of the study. To thank me for my contribution to the research project on Days 2 and 3 (the smartphone alerts), I will be given the option to enter my name in a draw to win one of four Amazon gift cards each valued at $50 for each series of questions I complete within 60 minutes of receiving the smartphone alert (e.g., if I respond to six of the six alerts within the 60-minute window, I will have six "tickets" in the draw). The draw is open to all research participants who enter their name in the draw, regardless of whether they decide to withdraw from further participating in the research project. Please see below for additional descriptions of the draw process.

If I am not an ISPR student, to thank me for my contribution to the research project on Days 1 and 4 (the laboratory visits), I will be given the option to enter my name in a draw to win one of four Amazon gift cards each valued at $50. If I choose to enter my name, I will have one "ticket" in the draw as compensation for Day 1 and one as compensation for Day 4. To thank me for my participation on Days 2 and 3 (the smartphone alerts), I will be given the option to enter my name in the same draw again for each series of questions I complete within 60 minutes of receiving the smartphone alert (e.g., if I respond to six of the six alerts within the 60-minute window, I will have six "tickets" in the draw). The draw is open to all research participants who enter their name in the draw, regardless of whether they decide to withdraw from further participating in the research project. Please see below for additional descriptions of the draw process.

Information regarding the draw (identical for ISPR students and non-ISPR participants):

Upon completion of the study, four names will be randomly selected amongst those who have entered and the individuals whose name is drawn will be informed by phone. To win the prize, the person must correctly answer a skill testing question. If the person cannot be reached within 14 days from the date of the draw, the prize will be awarded to the second name that is randomly selected and so on until the prize has been awarded. The odds of winning a prize will depend on the number of eligible entries received. The prize must be accepted as awarded or forfeited and cannot be redeemed for cash.

Your name and phone number that you provide when you enter the draw are collected for the purposes of contacting you if your name is selected in the draw. Your name and the contact information you have provided will be kept confidential and then destroyed once the prizes have been awarded.

We reserve the right to cancel the draw or cancel the awarding of the prize if the integrity of the draw or the research or the confidentiality of participants is compromised. The draw is governed by the applicable laws of Canada.

Funding sources: This research project is funded by a Frederick Banting and Charles Best Doctoral Award from the Canadian Institutes of Health Research awarded to the Co-Principal Investigator, Leanne Kane.

Contact: I may address my questions about the research to Andrea R. Ashbaugh (613) 562-5800 x4813, andrea.ashbaugh@uottawa.ca

If I have questions concerning my rights as a study participant, I may contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5.
Tel: (613) 562-5387
Email: ethics@uottawa.ca

Consent: By signing below I indicate that I have read and understand my participation in this study and my rights as a participant. There are two copies of the consent form, one of which is mine to keep.

_____
Participant's Name (First and Last)

_____
Signature

_____
Date

_____
Researcher's Name (First and Last)

_____
Signature

Resources for Social Anxiety (in Alphabetical Order):[14]

Canadian Mental Health Association (CMHA)

Location: 1355 Bank St, Suite 301, Ottawa, Ontario
Tel: 613.737.7791
Services: Mental health information and referral service, which offers information on mental health services, referrals to needed/wanted services, needs assessments, education , advocacy, and consultation to Ottawa residents. Services in French and English
Website: www.cmhaottawa.ca

Centre for Psychological Services and Research (CPSR)

136 Jean-Jacques Lussier (4031)
Tel: 613.562-5289
Services: Psychological treatment, adult assessment, child & family assessment, and career counselling.

Community Information Centre of Ottawa (CICO)

Tel: 613.241.4636 x 211or Toll Free 1.866.540.0565
Services: Provides information about a wide range of services in the Ottawa area, including information and referral through the 241-INFO line, fax and email. Information available in French and English.Website:
www.cominfo-ottawa.org

Eastern Ottawa Resource Centre (EORC)

Location: 2339 Ogilvie Road, Main level, Ottawa, Ontario
Tel: 613.741.6025 or 613.745.4818 x6137453665 (Crisis line)
Services: Various programs and services including resource and referral, community development and mental health support. Offered in English and French.
Website: www.eorc-gloucester.ca

Nepean, Rideau and Osgoode Community Resource Centre (NROCRC)

Location: 1642 Merivale Rd. Nepean, Ontario
Tel: 613.596.5626
Services: Non-profit organization serving Nepean, Rideau and Osgoode wards. Services include counselling, housing loss prevention and information and referrals to other services. Services in English only.
Website: www.nrocrc.org

Ottawa Academy of Psychology Referral Service

Tel: 613.235.2529

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[14] A resources sheet was provided to each participant at the end of the consent and debriefing forms.

Services: Service provided by the Ottawa Academy of Psychology to help individuals find a psychologist in Ottawa (Note that not all psychologists in Ottawa are members of the Ottawa Academy of Psychology)
Website: www.ottawa-psychologists.org

Student Academic Success Service (SASS)
100 Marie-Curie Private
(4th Floor, MCE)
Ottawa ON Canada
K1N, 1A2
Tel: 613-562-5200
Fax: 613-562-5964
Email: couns@uOttawa.ca

Self-Help Books related to Social Anxiety:

Antony, M.M., & Swinson, R. (2008). Shyness and Social Anxiety Workbook: Proven, Step-by-Step Techniques for Overcoming your Fear. New Harbinger Publications; 2nd Revised edition

Butler, G. (2008). Overcoming Social Anxiety and Shyness: A Self-Help Guide Using Cognitive Behavioral Techniques. Basic Books.

Hope, D.A., Heimberg, R.G., Juster, H.A., & Turk, C.L. (2010). Managing Social Anxiety Workbook. A Cognitive-Behavioral Approach. Oxford University Press; 2nd Revised edition

Appendix B: Study 1 Debriefing Form

uOttawa

DEBRIEFING FORM FOR RESEARCH PARTICIPATION

Thank you for participating in our research! Please read the following information and answer the last questions below to submit your data.

TITLE: Speaking about controversial topics: What do you think?

INVESTIGATORS AND INSTITUTION:
The study you just participated in is being conducted at University of Ottawa by Andrea R. Ashbaugh, Ph.D, Leanne Kane, B.A., and Amanda Dezenosky, as part of Leanne Kane's Ph.D. thesis and Amanda Dezenosky's honours thesis.

STUDY PURPOSE AND IMPLICATIONS:
You were told that the purpose of this study was to better understand how people perform during speeches on controversial topics and explore how this is related to their thoughts and feelings. More specifically, we were interested in seeing how performance and anxiety ratings during the speeches would be related to how much you thought about the speeches outside of the lab. Research shows that people typically think the most about the negative aspects of a stressful situation the day after it occurs, and that how much they think about it depends on how anxious they were and how well they think they did (e.g., Cody & Teachman, 2011; Dannahy & Stopa, 2007; Perini et al., 2006; Rowa et al., 2014). However, it is still unknow how thinking about past social events relates to how people think about future similar social situation; this is why you completed two similar speeches. Lastly, we were interested in how thinking about a stressful social situation could affect how people remember that situation. We hypothesize that greater negative thinking about the first speech will be associated with more anxiety, worst performance ratings, and more negative thinking about the second speech. We also hypothesize that thinking about the negative aspects of the speech will change the memory for the speech (e.g., by making it more vivid, less coherent, more negative). Since the study is still ongoing, we request that you do not talk about the specific hypothesis of this study with other people.

<u>USE OF DECEPTION:</u>
We used some deception as part of this study. We informed you that we were recording your speeches and that experts on public speaking would be evaluating your speech to compare it to other participants. However, there are no experts that will be evaluating you as part of the current study. As such, the evaluation sheet you were shown by the experimenter was just an example evaluation sheet and will not be used to evaluate you. We used this deception in order to increase your anxiety about the speeches to try and promote thinking about the speeches in between both laboratory sessions. The camera footage from your speeches will be kept as a record of your

performance, should we need to check information about your speeches (like how long they were) and assess your performance at a later date.

There are two copies of this form, and one will be for you to keep for your records. If you have any comments, questions, or if you would like information on the results of this study, please contact the principal investigator, Dr. Andrea Ashbaugh at (613) 562-5800 ext. 4813.

If you have experience any distress as a result of participation in the study you can speak to the researcher conducting today's study, or contact the Cognitions and Anxiety Studies Laboratory at (613) 562-5800 ext. 4456. If you would like to obtain personal support or help for social anxiety, a list of potential resources in the Ottawa area is included at the bottom of this handout.

If you have any questions concerning your rights as a research participant please contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5
Tel: (613) 562-5387, Email: ethics@uottawa.ca

Now that I have been fully informed to the nature of the study and the study protocol I consent for my data to be used:

_____
Participant's Name (First and Last)

_____
Signature

_____
Date

_____
Researcher's Name (First and Last)

_____
Signature

Appendix C: Study 1 ISPR Recruitment Text

Project title: Speaking about controversial topics: What do you think?

Short description: Participation will include giving two short speeches on controversial topics. You will also need to have a smart phone with Internet access and SMS compatibility since we are also interested in your thoughts and feelings outside of the lab.

Full description: The aim of this study is to see how students perform during speeches on controversial topics and explore how this is related to their thoughts and feelings. Participation will involve two laboratory sessions lasting 45 and 30 minutes, respectively. During these sessions, participants will be asked to give two short speeches and fill out questionnaires. They will also receive six alerts on their smartphone over the course of two days with short questions about their thoughts and feelings (5 minutes per alert). Please note that for this study, participants should understand English well and own a smartphone with Internet access and SMS compatibility. Participants will be compensated with two course credits, one for each laboratory session. For each completion of the questions via smartphone, participants will be entered in a draw for one of four $50 Amazon gift cards. Participation will be on a first come/first serve basis. Principal Investigator: Andrea R. Ashbaugh, Ph.D., andrea.ashbaugh@uottawa.ca; Co-Principal Investigator: Leanne Kane, B.A., [email address].

Appendix D: Study 1 Facebook and Printed Advertisement

Speaking about controversial topics: What do you think?

PARTICIPANTS NEEDED FOR RESEARCH IN PSYCHOLOGY

Researchers at the University of Ottawa are looking for volunteers to take part in a study of public speaking on controversial topics.

Your participation would involve two laboratory sessions lasting 45 and 30 minutes, respectively. During these sessions, you would be asked to **give two short speeches and fill out questionnaires**. You would also receive six alerts on your smartphone over the course of two days prompting you to answer some **short questions about your thoughts and feelings**. These alerts would each take up only five minutes of your time.

For each part of the study completed you will be entered in a draw for **one of four $50 Amazon gift cards** (that is, up to 8 opportunities to have your name in the draw!!!). Participation will be on a first come/first serve basis.

For more information about this study, or to volunteer for this study, please contact the Co-Principal Investigator, Leanne Kane, at **[email address]**

This study is being conducted by the Cognition and Anxiety Studies Laboratory under the supervision of Dr. Andrea R. Ashbaugh.
It has been reviewed by, and received ethics approval through the University of Ottawa Research Ethics Board.

Appendix E: Study 1 Ecological Momentary Assessment Items

Please indicate how ***sad*** you are feeling right now from 0 "Not at all sad" to 10 "The most sad I have ever felt"

0 1 2 3 4 5 6 7 8 9 10

Please indicate how ***anxious*** you are feeling right now from 0 "Not at all anxious" to 10 "The most anxious I have ever felt"

0 1 2 3 4 5 6 7 8 9 10

Please indicate how ***happy*** you are feeling right now from 0 "Not at all happy" to 10 "The most happy I have ever felt"

0 1 2 3 4 5 6 7 8 9 10

Please read the following questions relating to <u>the speech you gave at the first laboratory visit</u> and rate how much you agree with each question.

Currently, I worry I could have left a bad impression during the speech.

Do not agree Completely agree
1 2 3 4 5 6 7

Currently, I am not particularly thinking about the speech.

Do not agree Completely agree
1 2 3 4 5 6 7

Currently, I think about how I could have done things differently during the speech.

Do not agree Completely agree
1 2 3 4 5 6 7

Currently, I think about how I left a good impression during the speech.

Do not agree Completely agree
1 2 3 4 5 6 7

Currently, I find it difficult to forget about the speech.

Do not agree						Completely agree
1	2	3	4	5	6	7

Currently, I think about all the things I did right during the speech.

Do not agree						Completely agree
1	2	3	4	5	6	7

Please read the following questions relating to <u>the speech you will be giving</u> at the next laboratory visit and rate how much you agree with each question.

Currently, I worry about the speech I will be giving.

Do not agree						Completely agree
1	2	3	4	5	6	7

Currently, I am not particularly thinking about the speech I will be giving.

Do not agree						Completely agree
1	2	3	4	5	6	7

Currently, I think about all the mistakes I am likely to make during the speech.

Do not agree						Completely agree
1	2	3	4	5	6	7

Currently, I think about the things I am likely to do well during the speech.

Do not agree						Completely agree
1	2	3	4	5	6	7

Currently, I find it difficult not to think about the speech I will be giving.

Do not agree						Completely agree
1	2	3	4	5	6	7

Currently, I think about how I can only do my best during the speech I will be giving.

Do not agree						Completely agree
1	2	3	4	5	6	7

Appendix F: Study 1 Coding Sheet Presented to Participants

ISPR number of the student being evaluated: _____

Speech 1 ☐

Speech 2 ☐

Please rate the student's performance during their speech on the following criteria, as compared to their fellow students.

	Worse than average	Slightly worse than average	Average	Slightly better than average	Better than average
1) Eye contact	0	1	2	3	4
2) Long pauses	0	1	2	3	4
3) Voice quivering	0	1	2	3	4
4) Overall quality as a public speaker	0	1	2	3	4
5) Sophistication of vocabulary	0	1	2	3	4
6) Appropriate use of smiles	0	1	2	3	4
7) General quality of speech	0	1	2	3	4
8) General impression	0	1	2	3	4
9) Understandability	0	1	2	3	4
10) Ability to convince their audience	0	1	2	3	4
11) Fidgeting	0	1	2	3	4
12) Boringness	0	1	2	3	4

Appendix G: Study 2 Consent Form – ISPR Participants

uOttawa

CONSENT FORM FOR RESEARCH PARTICIPATION

Title:
Tell me about it! An online study on emotions in social situations

Researchers:

Andrea R. Ashbaugh, Ph.D., C.Psych
Associate Professor
School of Psychology
University of Ottawa
[mailing address]
andrea.ashbaugh@uottawa.ca
(613) 562-5800 x.4813

Leanne Kane, B.A.
Ph.D. Student
School of Psychology
University of Ottawa
[mailing address]
[email address]

Invitation to Participate: I am invited to participate in the abovementioned research study conducted by Principal Investigator Andrea R. Ashbaugh, Ph.D., and Co-Principal Investigator Leanne Kane, B.A, University of Ottawa. This research project is being conducted as part of Leanne Kane's Ph.D thesis.

Purpose of the Study: The purpose of this study is to better understand emotions in social situations.

Participation: My participation will consist of completing an online study available only in English. To be eligible to participate, I must be a) aged 18 to 25 years old and b) fluent in English. I will be asked to remember a social interaction I have had in the last week and answering a series of questionnaires related to how I think, feel, and act. Some questions will concern mental health. I will also be asked to provide general information about myself such as age, self-identified gender, and family income. This study will take about 30 minutes to complete.

Risks: My participation in this study will entail that I volunteer personal information about my thoughts, feelings, and actions. It is possible that I may experience some mild emotional discomfort when answering questionnaires related to my thoughts, feelings, and actions. If this is the case, I am encouraged to seek help in my area. I am also encouraged to consult the following websites for more information on mental health:

- http://www.cpa.ca/psychologyfactsheets/
- https://mdsc.ca/
- https://cmha.ca/document-category/mental-health

If I need immediate support, I can find the contact information of local crisis centres in Canada here: https://thelifelinecanada.ca/help/crisis-centres/

Benefits: By participating in this study, I may develop a somewhat increased awareness of my own thoughts, feelings, and actions. Additionally, this experience may contribute to my understanding of psychological research. Finally, my participation will contribute to an advanced understanding of how people think and feel.

Anonymity: I understand that the information I will share will remain strictly confidential and the information will be used strictly for research purposes. The only people who will have access to the research data are research team of Andrea Ashbaugh at the University of Ottawa. Anonymity is guaranteed because I am not being asked to provide my name or any other identifying information. Rather my data will be identified by a unique code that cannot be linked back to me. Qualtrics, the online survey platform, will also be managed to protect my anonymity. Results will be published in pooled (aggregate) format and presented at professional conferences and in academic journals. Completely anonymized quotes may also be presented when appropriate. Anonymized datasets containing only key study variables may also be made available online on a scientific research platform to promote transparency in research. In order to minimize the risk of security breaches and to help ensure my confidentiality, I am encouraged to use standard safety measures such as signing out of my account, closing my browser and locking my screen or device when I have completed the study.

Conservation of data: The data collected from the questionnaires will kept in a secure manner. Specifically, it will be stored on Qualtrics servers located in Canada. Electronic data will be stored on the University of Ottawa server, located on the University of Ottawa campus. More specifically, the data will be saved on a subfolder of the server which is only accessible by members of Dr. Ashbaugh's research team and University of Ottawa IT personnel who might need to manage the server. A regular backup of electronic data will be made onto a password-protected external hard drive. Data may be stored on password protected laptops; only completely anonymized information will be stored in this manner. Anonymized datasets with key study variables may also be placed on a scientific research platform, such as the Open Science Framework, to promote transparency in research. My anonymous data will be stored in these manners indefinitely.

Voluntary Participation and Compensation: In return for my participation in this study, I will be compensated with one (1) course credits through ISPR. I am under no obligation to participate and if I choose to participate, I can withdraw from the study at any time. At the end of each page, there is an option to withdraw from the survey and be redirected to the debriefing form. I understand that I will not be compensated if I leave the study without completing the debriefing form. On the debriefing form, I will be given the opportunity to withdraw my data from the study or submit it. I will still receive my compensation if I choose to withdraw my data after having

completed the survey. However, if I complete the study and submit my data, it will not be possible to withdraw my data at a later date, because the researchers do not have access to the names of participants in the study. I understand that I will not be compensated if I exit the survey's web browser without completing the study.

Funding sources: This research project is funded by a Frederick Banting and Charles Best Doctoral Award from the Canadian Institutes of Health Research awarded to the Co-Principal Investigator, Leanne Kane.

Contacts:
If I have any questions about the study, I may contact the main researcher:
Andrea Ashbaugh
Tel.: (613) 562-5800 x.4813
E-mail: andrea.ashbaugh@uottawa.ca

If I have any questions regarding my rights as a study participant, I may contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5
Tel.: (613) 562-5387
E-mail: ethics@uottawa.ca

Consent:
Participants should print a copy of the consent form to keep for their personal records by using the printing function of their browser (**File > Print**).

By clicking on the button below the list of statements below, I confirm that I am meeting the inclusion criteria and agree to participate in the above-mentioned study.

- I have read the above consent form;
- I agree to participate in the study;
- I understand that I may freely stop participating at any time by selecting the Withdraw option at the bottom of any page, without loss of compensation;
- I am 18-25 years old; and
- I am proficient in English.

I consent to participate in this study by clicking "Yes" here:

- Yes
- No

Appendix H: Study 2 Consent Form – Qualtrics Panel Participants

uOttawa

CONSENT FORM FOR RESEARCH PARTICIPATION

Title:
Tell me about it! An online study on emotions in social situations

Researchers:

Andrea R. Ashbaugh, Ph.D., C.Psych
Associate Professor
School of Psychology
University of Ottawa
[mailing address]
andrea.ashbaugh@uottawa.ca
(613) 562-5800 x.4813

Leanne Kane, B.A.
Ph.D. Student
School of Psychology
University of Ottawa
[mailing address]
[email address]

Invitation to Participate: I am invited to participate in the abovementioned research study conducted by Principal Investigator Andrea R. Ashbaugh, Ph.D., and Co-Principal Investigator Leanne Kane, B.A, University of Ottawa. This research project is being conducted as part of Leanne Kane's Ph.D thesis.

Purpose of the Study: The purpose of this study is to better understand emotions in social situations.

Participation: My participation will consist of completing an online study available only in English. To be eligible to participate, I must be a) aged 18 to 25 years old, b) currently living in Canada, and c) fluent in English. I will be asked to remember a social interaction I have had in the last week and answering a series of questionnaires related to how I think, feel, and act. Some questions will concern mental health. I will also be asked to provide general information about myself such as age, self-identified gender, and family income. This study will take about 30 minutes to complete.

Risks: My participation in this study will entail that I volunteer personal information about my thoughts, feelings, and actions. It is possible that I may experience some mild emotional discomfort when answering questionnaires related to my thoughts, feelings, and actions.
If this is the case, I am encouraged to seek help in my area. I am also encouraged to consult the following websites for more information on mental health:

- http://www.cpa.ca/psychologyfactsheets/
- https://mdsc.ca/
- https://cmha.ca/document-category/mental-health

If you need immediate support, I can find the contact information of local crisis centres in Canada here: https://thelifelinecanada.ca/help/crisis-centres/

Benefits: By participating in this study, I may develop a somewhat increased awareness of my own thoughts, feelings, and actions. Additionally, this experience may contribute to my understanding of psychological research. Finally, my participation will contribute to an advanced understanding of how people think and feel.

Anonymity: I understand that the information I will share will remain strictly confidential and the information will be used strictly for research purposes. The only people who will have access to the research data are research team of Andrea Ashbaugh at the University of Ottawa. Anonymity is guaranteed because I am not being asked to provide my name or any other identifying information. Rather my data will be identified by a unique code that cannot be linked back to me. Qualtrics, the online survey platform, will also be managed to protect my anonymity. Results will be published in pooled (aggregate) format and presented at professional conferences and in academic journals. Completely anonymized quotes may also be presented when appropriate. Anonymized datasets containing only key study variables in an aggregate format may also be made available online on a scientific research platform to promote transparency in research. In order to minimize the risk of security breaches and to help ensure your confidentiality, I am encouraged to use standard safety measures such as signing out of my account, closing my browser and locking my screen or device when I have completed the study.

Conservation of data: The data collected from the questionnaires will kept in a secure manner. Specifically, it will be stored on Qualtrics servers located in Canada. Electronic data will be stored on the University of Ottawa server, located on the University of Ottawa campus. More specifically, the data will be saved on a subfolder of the server which is only accessible by members of Dr. Ashbaugh's research team and University of Ottawa IT personnel who might need to manage the server. A regular backup of electronic data will be made onto a password-protected external hard drive. Data may be stored on password protected laptops; only completely anonymized information will be stored in this manner. Anonymized datasets with key study variables may also be placed on a scientific research platform, such as the Open Science Framework, to promote transparency in research. Only members of Dr. Ashbaugh's research team will have access to the rooms. My anonymous data will be stored in these manners indefinitely.

Voluntary Participation and Compensation: In return for my participation in this study, I will be compensated the amount I agreed upon before I entered into the survey. I am under no obligation to participate and if I choose to participate, I can withdraw from the study at any time. At the end of each page, there is an option to withdraw from the survey and be redirected to the debriefing form. I understand that I will not be compensated if I leave the study without completing the debriefing form. On the debriefing form, I will be given the opportunity to

withdraw my data from the study or submit it. I will still receive my compensation if I choose to withdraw my data after having completed the survey. However, if I complete the study and submit my data, it will not be possible to withdraw my data at a later date, because the researchers do not have access to the names of participants in the study. I understand that I will not be compensated if I exit the survey's web browser without completing the study.

Funding sources: This research project is funded by a Frederick Banting and Charles Best Doctoral Award from the Canadian Institutes of Health Research awarded to the Principal Investigator, Leanne Kane.

Contacts:
If I have any questions about the study, I may contact the main researcher:
Andrea Ashbaugh
Tel.: (613) 562-5800 x.4813
E-mail: andrea.ashbaugh@uottawa.ca

If I have any questions regarding my rights as a study participant, I may contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5
Tel.: (613) 562-5387
E-mail: ethics@uottawa.ca

Consent:
Participants should print a copy of the consent form to keep for their personal records by using the printing function of their browser (**File > Print**).

By clicking on the button below the list of statements below, I confirm that I am meeting the inclusion criteria and agree to participate in the above-mentioned study.

- I have read the above consent form;
- I agree to participate in the study;
- I understand that I may freely stop participating at any time by selecting the Withdraw option at the bottom of any page, without loss of compensation;
- I am currently living in Canada;
- I am 18-25 years old; and
- I am proficient in English.

I consent to participate in this study by clicking "Yes" here:

- o Yes
- o No

Appendix I: Study 2 Debriefing Form

uOttawa

DEBRIEFING FORM FOR RESEARCH PARTICIPATION

Thank you for participating in our research! Please read the following information and answer the last questions below to submit your data.

Title: Tell me about it! An online study on emotions in social situations

INVESTIGATORS AND INSTITUTION:
The study you just participated in is being conducted at University of Ottawa by Andrea R. Ashbaugh, Ph.D, and Leanne Kane, B.A.

STUDY PURPOSE AND IMPLICATIONS:
You were told that the purpose of this study was to better understand emotions in social situations. Research has found that, following a stressful social situation, people with social anxiety tend to review the embarrassing and distressing events that occurred during the interaction. This tendency is called negative post-event processing (PEP; Clark & Wells, 1995). For this study, we were interested in studying whether people also sometimes review the good things that occur during interactions (positive PEP). You were asked to complete questionnaires on mental health and a questionnaire assessing both positive and negative PEP while thinking of a recent social interaction you had during the past week. In fact, we asked about half of participants to think of a stressful social interaction and the other half, a pleasant social interaction. You were randomly assigned to one of these two conditions. You were not made aware of the existence of the other condition to protect the integrity of the research questions and avoid biasing your responses in any way.

Overall, we expect that participants who recalled a stressful social interaction will report having thought more about negative aspects of the interaction, and less about the positive aspects, compared to participants who recalled a pleasant interaction. We also think that participants' tendencies to think about negative and positive aspects of the interaction will impact how they remember the event, which is why you completed a questionnaire on your memory of the interaction and wrote a description of it. We hope that this study will be an important step towards better understanding emotions in social situations.

Because this is an ongoing study, and some of the information you have learned could bias other people's responses if they knew it at the beginning of the study, we ask you not to discuss the full content of the study to anyone. Thank you!

Thank you again for your participation. If you are interested in finding out more about the study and its findings or have any concerns or questions about the research itself please contact Andrea Ashbaugh, the Principal Investigator at (613) 562-5800 x.4813.

For Further Reading, if interested:

Clark, D. M., & Wells, A. (1995). A cognitive model of social phobia. In R. G. Heimberg, M. R. Liebowitz, D. A. Hope, & F. R. Schneier (Eds.), *Social phobia: Diagnosis, assessment, and treatment* (pp. 69–93). New York, NY: The Guilford Press.

Edwards, S. L., Rapee, R. M., & Franklin, J. (2003). Postevent rumination and recall bias for a social performance event in high and low socially anxious individuals. *Cognitive Therapy and Research*, *27*(6), 603–617. https://doi.org/10.1023/A:1026395526858

Sluis, R. A., Boschen, M. J., Neumann, D. L., & Murphy, K. (2017). Repetitive negative thinking in social anxiety disorder 2: Post-event processing. *Psycopathology Review*, *a4*(3), pr.045616. https://doi.org/10.5127/pr.045616

In the course of completing the questionnaires, you may have noticed some emotional discomfort, or become aware of difficulties you are experiencing with anxiety and/or depression. If this is the case, we encourage you to seek help in your area. We also encourage you to consult the following websites for more information on mental health:

- http://www.cpa.ca/psychologyfactsheets/
- https://mdsc.ca/
- https://cmha.ca/document-category/mental-health

If you need immediate support, you will find the contact information of local crisis centres in Canada here: https://thelifelinecanada.ca/help/crisis-centres/

If you are interested in seeking self-help resources, the Association of Behavioral and Cognitive Therapies maintains a searchable database of recommended books for a series of concerns, which can be found online: http://www.abct.org/SHBooks/

If you have any questions related to this study, please contact the researcher:
Andrea Ashbaugh
Tel.: (613) 562-5800 x.4813
E-mail: andrea.ashbaugh@uottawa.ca

If you have any questions concerning your rights as a research participant please contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5.
Tel: (613) 562-5387
Email: ethics@uottawa.ca

If you would like to print this page for your records and for future reference, you may do so by using the printing function of your browser (**File > Print**).

Please confirm that you are the only person who answered questions on this survey prior to submitting your data:

- ○ I attest that I am the sole completer of this survey.

Once again, thank you for participating in our research!

- o I would like to SUBMIT my data
- o I would like to WITHDRAW from the study (my data will be deleted)

Appendix J: Study 2 ISPR Recruitment Text

Study Name: Tell me about it! An online study on emotions in social situations

Description:
The aim of this online study is to better understand emotions in social situations. Participants will be asked to remember a social interaction they have had in the past week and to answer some questions relating to their emotions, thoughts, and behaviors. Participants will also complete a set of questionnaires on a variety of subjects, including some questions on mental health. Please note that for this study, participants should be fluent in English and aged 18-25. This study will take approximately 30 minutes to complete, and participants will be compensated with 1 course credit. Participants are selected on a first come/first served basis. Principal Investigators: Andrea R. Ashbaugh, Ph.D., andrea.ashbaugh@uottawa.ca, and Leanne Kane, B.A., [email address].

Appendix K: Study 2 Qualtrics Panels Recruitment Text

Tell me about it! An online study on emotions in social situations

Looking for individuals 18-25 to participate in a study on emotions in social situations!

Description

We are looking for interested individuals to complete a study on emotions in social situations. The survey should take no more than 30 minutes to complete and you will be compensated through Qualtrics. You will be asked to remember a social interaction you have had in the last week and to answer a series of questionnaires related to how you think, feel, and act. Some questions will concern mental health. You will also be asked to provide general information about yourself such as age, self-identified gender, and family income. You will not be asked to report any identifying information (like name or email address). All data will remain completely anonymous and confidential. Participants are selected on a first come/first served basis.

Eligibility

- Currently living in Canada;
- Aged 18 through 25
- Fluent in English

More information will be provided in the study consent form. To complete the study, click the next button at the bottom of the screen. Thank you for your interest in our research!

Appendix L: Study 2 Social Interaction Prompt

We will now ask you to remember a social interaction you had in the past week that you felt was *stressful* / *pleasant*. If you had many *stressful* / *pleasant* social interactions in the past week, please think of the interaction that *caused you the most distress* / *made you feel the best*. Please note that the social interaction you keep in mind could be an interaction that occurred in person, over the phone, over videoconferencing, or through any other platform. **Please answer the <u>rest of the survey</u> keeping in mind that specific *stressful* /*pleasant* social interaction.**

1. In the past week, **when** did this social interaction occur? Choose the option that best describes when the social interaction took place. For example, if the interaction occurred yesterday, choose "1 day ago (yesterday)."
    - 0 days ago (today)
    - 1 day ago (yesterday)
    - 2 days ago
    - 3 days ago
    - 4 days ago
    - 5 days ago
    - 6 days ago
    - 7 days ago

2. Where did you have this social interaction? This question refers to your **physical location** at the time of the interaction. For example, if you were having a conversation over videoconferencing at home, choose "At home."
    - At home
    - At work
    - At school
    - At the store
    - Other (please specify): _____

3. How did you have this social interaction? This question refers to **how/over which platform** the interaction occurred. For example, if you were having a conversation over videoconferencing at home, choose "Over videoconferencing."
    - In person
    - Over videoconferencing
    - Over the phone/audioconferencing (no video)
    - Other (please specify): _____

4. **With whom** did you have this social interaction? This question refers to the person(s) with whom you were interacting at the time. Please select all that apply.
    - A romantic partner
    - A family member (other than my partner)
    - A friend
    - A co-worker
    - A stranger
    - A figure of authority (e.g., a boss, a superior); Please specify: _____

- Other (please specify): _____

Please move the sliders below to indicate how strongly you felt the following three emotions during the social interaction, where 0 = No Emotion and 100 = Very Intense Emotion. For example, if you felt moderately anxious, move the slider next to "Anxious" to somewhere in the middle. Please do the same for all three emotions below.

During the social interaction, I felt...

No Emotion — Very Intense Emotion

0 10 20 30 40 50 60 70 80 90 100

Anxious

Content

Joyful

Appendix M: Study 2 Event Description Prompt

Please read the below instructions carefully.

We will now ask you to describe the same *stressful /pleasant* interaction you have been referring to in as much detail as possible for at least 2 minutes. There is a timer at the bottom of the page that will let you know how much time has passed. A button will appear on the bottom-right when you can advance to the next section. Although you will be able to advance after 90 seconds, we encourage you to write as much detail as you can.

Please do not include any information that could enable someone to identify you or other people (e.g., names, date of births, addresses, unique locations or occupations).

Go to the next page to complete this task.

[Page break]

Please use this space to describe the *stressful /pleasant* social interaction you have been referring to in as much detail as possible, while respecting the confidentiality of everyone involved:

Appendix N: Study 2 Final Attention Check Items

Lastly, it is vital to our study that we only include responses from people that devoted their full attention to this study. Otherwise, effort and time from both researchers and other participants could be wasted. You will receive your compensation for this study no matter what. However, please tell us how much effort you put worth towards this study.

I put _____ effort towards this study.

- Almost no
- Very little
- Some
- Quite a lot
- A lot of

Also, often there are several distractions present during studies (other people, TV, music, etc.). Please indicate how much attention you paid to this study. Again, you will receive your compensation no matter what. We appreciate your honesty!

I gave this study _____ attention.

- Almost no
- Very little of my
- Some of my
- Most of my
- My full

In your honest opinion, should we use your data in our analyses in this study?

- Yes
- No

Appendix O: Sociodemographic Questionnaire

Please read and answer the following questions as honestly and accurately as possible.

1. Age: _____

2. The sex you were assigned at birth:
   - Male
   - Female
   - Intersex
   - Other, please specify… _____
   - I prefer not to answer

3. The gender you identify with:
   - Man
   - Woman
   - Transman
   - Transwoman
   - Gender fluid / gender queer
   - Non-binary / agender
   - You don't have an option that applies to me. I identify as (please specify)… _____

4. Which ethnic or racial background(s) describes you most (check all that apply)?
   - Caucasian/White
   - African-Canadian/Black
   - Hispanic
   - Asian
   - Native Canadian
   - European
   - Pacific Islander
   - Middle Eastern
   - Indian
   - Other: _____
   - I prefer not to answer

5. Marital Status (select one):
   - Single
   - Committed relationship
   - Common Law or Living together
   - Engaged
   - Married
   - Divorced
   - Widowed
   - Other, please specify… _____
   - I prefer not to answer

6. Number of children: _____

7. Household annual income before taxes:
    - Less than 20,000$ CAD
    - 20,000-39,999$ CAD
    - 40,000-59,999$ CAD
    - 60,000-79,999$ CAD
    - 80,000$ + CAD
    - I prefer not to answer

8. What is your university student status?
    - Part-time student (less than 12 credits per semester)
    - Full-time student (12 credits or more per semester)
    - I prefer not to answer

9. What is your occupational status?
    - Part-time employed (25 hours of paid work or less per week)
    - Full-time employed (more than 25 hours of paid work per week)
    - Not currently employed
    - I prefer not to answer

10. Have you *ever* been diagnosed with any of the following mental disorders by a physician or mental health care professional? (check all that apply)
    - Neurodevelopmental disorder (e.g, intellectual disability, autism spectrum disorder, ADHD)
    - Schizophrenia spectrum or other psychotic disorder
    - Bipolar disorder
    - Depressive disorder (e.g., major depressive disorder, dysthymia)
    - Anxiety disorder (e.g., phobia, social anxiety, panic disorder)
    - Obsessive-compulsive disorder
    - Trauma- or stressor-related disorder (e.g, posttraumatic stress disorder)
    - Dissociative disorder (e.g., dissociative identity disorder, depersonalization/derealization disorder)
    - Eating or feeding disorder (e.g., bulimia, anorexia)
    - Sleep-wake disorder (e.g., insomnia disorder, narcolepsy)
    - Paraphilic disorder (e.g., pedophilic disorder, exhibitionistic disorder)
    - Sexual dysfuntion (e.g, erectile disorder)
    - Gender dysphoria (i.e., gender identity disorder)
    - Disruptive, impulse-control or conduct disorders
    - Substance-related or addictive disorders
    - Neurocogntive disorder (e.g., Alzheimer's)
    - Personality disorder (e.g., borderline personality disorder, antisocial personality disorder)
    - Other, please specify: _____
    - Not applicable. I have never been diagnosed with a mental disorder.

If you have been diagnosed with an *anxiety disorder*…

What was your diagnosis: _____

When did you receive this diagnosis: _____

Have you received treatment for this diagnosis?

- Yes
- No

If you have been diagnosed with a mental disorder (other than an anxiety disorder)…

Were you ever prescribed with medication to treat the disorder(s)?

- Yes, in the past. Please specify the medication: _____
- Yes, currently. Please specify the medication: _____
- Never
- I prefer not to answer

11. What is your first language?
    - English
    - French
    - Other, please specify: _____

12. How fluent do you consider yourself to be in English?
    - I am a native speaker or am totally fluent (100%)
    - I understand almost everything (>90%)
    - I understand a lot (>80%)
    - I understand about 70-80%
    - I understand about 50-70%
    - I understand less than 50%

Sociodemographic questions added or modified for Study 2:

- Do you currently live in Canada?
    - Yes
    - No, I currently live in this country (please specify country): _____
    - I prefer not to answer
- What is your university student status?
    - I am not a student
    - Part-time student (less than 12 credits per semester)
    - Full-time student (12 credits or more per semester)
    - I prefer not to answer

Appendix P: Depression Anxiety Stress Scales – 21

DASS-21

Please read each statement and indicate a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any one statement.

	0 Did not apply to me at all	1 Applied to me to some degree, or some of the time	2 Applied to me a considerable degree, or a good part of the time	3 Applied to me very much, or most of the time
1) I found it hard to wind down.				
2) I was aware of dryness of my mouth.				
3) I couldn't seem to experience any positive feeling at all.				
4) I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion).				
5) I found it difficult to work up the initiative to do things.				
6) I tended to over-react to situations.				
7) I experienced trembling (e.g., in the hands).				
8) I felt that I was using a lot of nervous energy.				
9) I was worried about situations in which I might panic and make a fool of myself.				
10) I felt that I had nothing to look forward to.				
11) I found myself getting agitated.				
12) I found it difficult to relax.				
13) I felt down-hearted and blue.				

14) I was intolerant of anything that kept me from getting on with what I was doing.				
15) I felt I was close to panic.				
16) I was unable to become enthusiastic about anything.				
17) I felt I wasn't worth much as a person.				
18) I felt that I was rather touchy.				
19) I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat).				
20) I felt scared without any good reason.				
21) I felt that life was meaningless.				

Appendix Q: Modified Perception of Speech Performance

MPSP

We would like you to rate yourself during the speech for which you were evaluated. For each feature, please circle the appropriate number to indicate how you think you performed.

	Not at all	Slightly	Moderately	Much	Very much
1) Kept eye contact	0	1	2	3	4
2) Had long pauses	0	1	2	3	4
3) Voice quivered	0	1	2	3	4
4) Was a good public speaker	0	1	2	3	4
5) Used sophisticated vocabulary	0	1	2	3	4
6) Smiled appropriately	0	1	2	3	4
7) Generally spoke well	0	1	2	3	4
8) Made a bad impression	0	1	2	3	4
9) Was understandable	0	1	2	3	4
10) Was not convincing	0	1	2	3	4
11) Fidgeted excessively	0	1	2	3	4
12) Bored audience	0	1	2	3	4

Appendix R: Post-Event Processing Inventory – Trait Version

PEPI-T

Please rate the extent to which you agree or disagree with the following statements by selecting the numbers that correspond with your answer choices. **Please rate each statement with regard to how you generally think following social situations.**

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1. After social events, I think about the mistakes I made during the situation.					
2. After social situations, I replay the event over in my mind.					
3. I focus on the negative aspects of social events after they occur.					
4. After social encounters, I think about how poorly the situation went.					
5. After social events, I think about other similar past situations.					
6. I find it difficult to forget about social events after they are over.					
7. I experience recurring thoughts about social events long after they are over.					
8. After social situations, my thoughts about the event interfere with my ability to concentrate.					
9. After social situations, I experience distressing thoughts about the event.					
10. After social situations, I become overwhelmed by my thoughts.					
11. I experience intrusive thoughts about the social situation after the event has occurred.					
12. After social situations, I become preoccupied by my thoughts.					

Appendix S: Post-Event Processing Inventory – State Version

PEPI-S

Please rate the extent to which you agree or disagree with the following statements by selecting the numbers that correspond with your answer choices. **Please rate each statement with regard to the social interaction you just described.**

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1. I thought about the mistakes I made during the event.					
2. After the event, I kept replaying the situation over in my mind.					
3. I generally focused on the negative aspects of the event after it occurred.					
4. I thought about how poorly the situation went.					
5. After the event, I thought about other similar past situations.					
6. I found it difficult to forget about the event after it was over.					
7. I experienced recurring thoughts about the event long after it was over.					
8. My thoughts about the event interfered with my ability to concentrate.					
9. After the event was over, I experienced distressing thoughts about the situation.					
10. After the situation was over, I became overwhelmed by my thoughts.					
11. I experienced intrusive thoughts about the event.					
12. When thinking about the event, I became preoccupied by my thoughts.					

Appendix T: Social Phobia Inventory

SPIN

Please indicate how much the following problems have bothered you during the past week. Select only one answer for each problem, and be sure to answer all items.

	0 Not at all	1 A little bit	2 Somewhat	3 Very much	4 Extremely
1) I am afraid of people in authority					
2) I am bothered by blushing in front of people					
3) Parties and social events scare me					
4) I avoid talking to people I don't know					
5) Being criticized scares me a lot					
6) Fear of embarrassment causes me to avoid doing things or speaking to people					
7) Sweating in front of people causes me distress					
8) I avoid going to parties					
9) I avoid activities in which I am the centre of attention					
10) Talking to strangers scares me					
11) I avoid having to give speeches					
12) I would do anything to avoid being criticized					
13) Heart palpitations bother me when I am around people					
14) I am afraid of doing things when people might be watching					
15) Being embarrassed or looking stupid is among my worst fears					
16) I avoid speaking to anyone in authority					
17) Trembling or shaking in front of others is distressing to me					

Appendix U: Social Interaction Thoughts Questionnaire

SITQ

The following statements are thoughts you may have had about the social interaction you just described. Please read each statement and indicate how often you had that thought since you had the interaction.

Since the interaction, I had the thought:

	Never	Not often (1-2 times)	Sometimes (3-4 times)	Often (5-6 times)	Very often (more than 6 times)
1) The interaction went well					
2) I could have done much better					
3) I felt anxious during the interaction					
4) The other person looked interested in our conversation					
5) I said the wrongs things					
6) The other person seemed to like me					
7) I felt at ease during the interaction					
8) The other person looked bored					
9) My blushing/sweating/dry mouth/shaking must have been obvious					
10) I handled the interaction well					
11) The interaction went badly					
12) I made a fool of myself during the interaction					
13) The other person reacted positively to me					
14) I enjoy interacting with new people					
15) I always do badly in this type of situation					

16) I enjoyed getting to know the other person					
17) I must have looked stupid					
18) It all went smoothly					
19) I felt self-conscious					
20) I talked about interesting topics					
21) I made so many mistakes					
22) I felt confident					
23) I came across as self-assured					
24) I felt awkward					
25) I was at my best					
26) My heart was pounding so fast					
27) I didn’t make a good impression					
28) I did the best I could					

Appendix V: Speech-Related Memory Experiences Questionnaire

SR-MEQ

Please think about the speech you gave *10 minutes ago/three days ago*. Bring back to mind what happened, how you felt and how you reacted. Read the statements below and indicate how much you agree with each of them in relation to how you remember your speech.

	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
1) My memory for the speech is very vivid.					
2) My memory for the speech is very detailed.					
3) My memory for the speech is dim.					
4) The order of events in the memory is clear.					
5) This memory is of the speech that occurred *10 minutes ago/four days ago*, not a summary or merging of many similar or related events.					
6) This memory comes back to me in bits and pieces, not as a logical, coherent story.					
7) This memory is a blending of many similar, related events rather than a specific memory about the speech.					
8) This memory was easy for me to recall.					
9) It was difficult for me to think of this memory.					
10) I had to think for a while before I could recall the speech.					
11) As I remember the speech, I can hear it in					

my mind.					
12) My memory for the speech does not involve a lot of sensory information (sounds, smells, tastes, etc.).					
13) As I remember the speech, I have a difficult time recalling the particular physical reactions and sensations I had during the experience.					
14) In my memory, I see this experience through my own eyes.					
15) I view this memory as if I was an observer to the experience.					
16) As I remember the speech, I feel like an observer watching myself.					
17) My emotions are very intense concerning the speech.					
18) The memory of the speech evokes powerful emotions.					
19) This memory does not evoke strong emotions in me.					
20) The overall tone of the memory is positive.					
21) The overall tone of the memory is negative.					

Appendix W: Memory Experiences Questionnaire

MEQ

Please think again about the *stressful* / *pleasant* interaction we have been asking you to think about. Bring back to mind what happened, how you felt and how you reacted. Read the statements below and indicate how much you agree with each of them in relation to how you remember the interaction.

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1) My memory for this event is very vivid.					
2) My memory for this event is very detailed.					
3) My memory for this event is dim.					
4) The order of events in the memory is clear.					
5) This memory is of an event the occurred at a particular time and place, not a summary or merging of many similar or related events.					
6) This memory comes back to me in bits and pieces, not as a logical, coherent story.					
7) This memory is a blending of many similar, related events rather than a specific memory about a particular event.					
8) This memory was easy for me to recall.					
9) It was difficult for me to think of this memory.					
10) I had to think for a while before I could recall this event.					
11) As I remember the event, I can hear it in my mind.					
12) My memory for this event does not involve a lot of sensory information (sounds, smells, tastes, etc.).					
13) As I remember the event, I have a difficult time recalling the particular physical reactions and sensations I had during the experience.					

14) In my memory, I see this experience through my own eyes.					
15) I view this memory as if I was an observer to the experience.					
16) As I remember this event, I feel like an observer watching myself.					
17) Please select “2 Disagree” for this item.					
18) My emotions are very intense concerning this event.					
19) The memory of this event evokes powerful emotions.					
20) This memory does not evoke strong emotions in me.					
21) The overall tone of the memory is positive.					
22) The overall tone of the memory is negative.					