UNIVERSITY OF CALIFORNIA,
IRVINE

The Influence of Emotional Valence on Integral Memory Accuracy Using a Novel Emotion Induction Procedure

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Psychology and Social Behavior

by

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Dissertation Committee:
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2018

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Acknowledgements

I have had the fortune of being surrounded by kind, intelligent, and supportive people throughout my entire life. It is to these individuals that I owe any ounce of personal or professional success. Although there is not enough room here to acknowledge all of the people who contributed to my journey, I hope these next paragraphs will provide a glimpse into how truly grateful I am to each and every one of you.

I would first like to thank my wonderful committee members. Most people are lucky to have one good mentor throughout graduate school; I got three. Susan, Liz, and Linda: I could not imagine the last six years without any one of you. You have all been, and continue to be, role models for what I hope to become both personally and professionally. I am constantly amazed by your wisdom, strength, and ability to balance all aspects of life. Thank you for your continual selflessness, patience, and compassion.

PSB wouldn't have been the same without Allison, Claudia, Diane, Ellen, Mariah, Tiffany, and of course, Toni. Your warmth and support have meant the world to me. I am also extremely grateful to Beth Loftus and Mike Yassa for their insight on early versions of these dissertation studies.

My family has been the most constant source of unconditional love and support throughout my life. To Mom, Dad, Mike, Katie, and Violet: I wouldn't trade the family I have for any in the world. I've had the privilege to grow up knowing that I could always rely on you to be there for me when I needed you. Much of my interest in emotion and memory--the focus of this dissertation-- is driven by my desire to always hold on to the memories we've created together throughout the years. Thanks to you all for the love you've shown me.

To Sue, Phil, Ryan, and Kait Wojcik: You are some of the most incredible people I've ever met. You've always welcomed me with open arms and compassion. Your genuine care for your loved ones and joy for life is a constant inspiration to me. Thank you for always treating me like one of the family.

My experience at UCI wouldn't be complete without the friends I've made along the way. You are the reason UCI has become home. Thank you for sharing this awesome experience with me. I would not be the person I am today without each and every one of you. To Becca, Marie, Amanda, Lauren, and Kevin: Thank you for six years of constant laughter and knowing I'll always have a friend by my side. Through intramural sports, trips to Napa and Vegas, shared loves of cheese, Netflix binges, suffering through pet allergies just to hang out, yoga classes, and countless other adventures, you five have become some of my closest friends. To my lab mates: Kate, Joanna, Mayan, Christie, Melody, Dmitry, and Lilian: You've made research life such a fun and fulfilling experience. All of you are extraordinary researchers and equally extraordinary friends. Thank you for your abundantly insightful feedback, the constant support, and the fantastic experiences throughout the years. To my cohort, Anna, Becca, DJ, Eric, Kate, Kevin, Liz, Melissa, Raquel, and Valentina: You've been my inspiration from day 1.

I also owe a great deal to the huge team of Research Assistants who made these studies possible. Cailah, Cesar, Christina, Colleen, Erick, Gao, Hannah, Jasmine, Jasveen, Johanna, Lauren, Mary, Megan, Missy, Monika, Paula, Phoebe, Susan, and Xueping: Thank you for dedication to our research. I wouldn't have anything to write about here if it weren't for you. I've loved working with you all and learning from you every step of the way.

Finally, I couldn't have gotten this far without Sean Wojcik- the best person I know. I cannot even begin to imagine who I would be if we hadn't met six years ago. You are my constant, never-failing positive mood induction. You are impossibly kind, brilliant, hilarious, thoughtful, insightful, fun-loving, inspirational, driven, reliable, charming (and handsome, too!). You've helped me to be the best researcher I can possibly be. Thank you for all your support over the last six years.

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I'd also like to thank the American Psychological Association. This dissertation research was funded through a Dissertation Research Grant through the APA and would not have been possible otherwise.

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Charles, S.T., Piazza, J.R., Mogle, J., **Urban, E.J.**, Sliwinsky, M.J., & Almeida, D.M. (2015). Age differences in emotional well-being vary by temporal recall. *J Gerontol B Psychol Sci Soc Sci, 71*, 798-807. doi:10.1093/geronb/gbv011

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ABSTRACT OF THE DISSERTATION

The Influence of Emotional Valence on Integral Memory Accuracy

Using a Novel Emotion Induction Procedure

By

Emily Johanna Urban

Doctor of Philosophy in Psychology and Social Behavior

University of California, Irvine, 2018

Professor Susan Charles, Chair

Emotional memories are useful for future decision-making. Despite their utility, memories for details about past emotional events, and memories for the emotions experienced during the event, are susceptible to bias over time. Whether emotion enhances or hinders memory depends on a number of factors, including the valence of the emotions experienced. The present dissertation implemented a novel emotion induction technique designed to test memory accuracy in a controlled yet ecologically valid situation: the positive Trier Social Stressor Task (TSST). Instead of giving a speech about their qualifications for a job in front of stern evaluators, participants in the positive condition discussed a highly enjoyable hobby for warm and supportive observers. A neutral TSST condition was also developed.

The new TSST conditions, which were compared to the original negative TSST, were validated in Study 1 and replicated in Study 2. Participants in the positive condition increased in positive emotion from baseline to post-speech, participants in the neutral condition remained in a stable affective state, and participants in the negative condition decreased in positive and increased in negative emotion. The intensity of emotions was similar in the emotional conditions.

Study 2 tested memory accuracy for the details of, and emotions experienced during, the speech task by giving participants a surprise memory test one week after their initial visit. The influence of memory bias on intentions for future behavior was also measured. Memory accuracy was similar across groups over a number of indices except one in which the negative group performed worse than the positive and negative conditions. The negative group overestimated negative and underestimated positive emotions experienced during the TSST when recalling them one week later. Regardless of condition, the more positive and the less negative participants recalled feeling during the TSST, the more willing they were to participate in a similar future study even after statistically adjusting for emotions experienced during the TSST. This dissertation contributes a new emotion induction technique that can be used in a variety of studies. The lack of group differences in memory for emotional detail and the importance of emotional memory for decision making is discussed.

Introduction

An experience may last as long as a few seconds, or even a few hours, but the memory of this experience has the potential to inform decision making throughout one's lifetime. People use information retained from an experience, such as the details of the environment and the emotions felt, to determine whether the experience (or elements of the experience) should be repeated or avoided in the future (Levine & Pizarro, 2004). Therefore, it is important for the memories of an experience to last over time, particularly for experiences that are most relevant for survival and the attainment of personal goals. Despite the need for long-lasting and accurate memories of the past, however, it is impossible to remember every detail from every experience given the overabundance of sensory information in the environment. Cognitive resources are limited, so only certain pieces of information from an experience can be retained and later recalled. Because of this selectivity, memory does not act simply as a repository for all the information gathered during an experience to later be recalled, whole and intact. Instead, certain details are omitted, and those still retained are susceptible to forgetting and alteration over time.

People are often more confident in the accuracy of their memories than evidence suggests they should be (e.g., Busey, Tunnicliff, Loftus, & Loftus, 2000; Talarico & Rubin, 2003). Memory researchers commonly observe that certain central aspects of an experience are often over-represented in memory compared to other, less essential aspects (e.g., Christianson & Loftus, 1991; Levine & Edelstein, 2009). Memories can also change over time, such that each new time an experience is recalled, some details are slightly altered and other details are completely forgotten (Levine, Lench, & Safer, 2009). Moreover, people have the ability to incorporate entirely new information into memories of the past, and sometimes even 'remember' events that have never occurred (Loftus, 2003a; Loftus & Pickrell, 1995).

Although the constructive nature of memory can in some cases be highly detrimental (Loftus, 2003b), flexibility of memory for past events can also be adaptive (Schacter, 1999). Over time, new experiences accumulate, goals transform, and what is important to be remembered changes. In this way, a flexible memory with the ability to incorporate new information related to currently relevant goals and desires can be extremely useful (Levine et al., 2009). Much of memory research has been dedicated to examining what determines whether information about the past is retained, adapted, exaggerated, or omitted over time. Many agree that one of these determinants is emotion, although findings conflict as to when emotion enhances and when it hinders memory.

A literature review of the influence of emotion on memory will first be outlined. Then, several characteristics that are thought to contribute to the relationship between emotion and memory will be discussed, such as the contrast between central and peripheral information, emotional valence, and the focus on integral compared to incidental memory. Throughout these sections several approaches to studying the influence of emotional valence on memory will be presented along with their respective advantages and disadvantages. The importance of balancing internal and external validity in studies of emotional valence and integral memory will be discussed and previous attempts of this balance will be outlined. Then, Study 1 will introduce a novel emotion induction technique that attempts to balance internal and external validity. Study 2 will go on to use the novel mood induction technique to study the effects of emotional valence on integral memory accuracy. Finally, the utility of the novel induction technique will be discussed along with the implications of the study results.

Emotion Influences Memory

Emotion guides attention towards features of the current environment that have the greatest relevance to well-being and survival, leading to enhanced consolidation and stronger representation of these features in memory (McGaugh & Cahill, 2003). Indeed, emotional events and stimuli are typically better remembered than non-emotional events and stimuli (Brown & Kulik, 1977; Cahill et al., 1996; Levine & Pizarro, 2004). Memories for emotional events are also often accompanied by subjective feelings of confidence in the accuracy of those memories. For example, flashbulb memories, or subjectively vivid memories of highly significant events in the past, are often cited as evidence for the accuracy of emotional memories (Brown & Kulik, 1977). Yet, although the general consensus in the field is that emotional experiences are more memorable than non-emotional ones, the accuracy of these memories has been questioned by many (Hirst et al., 2009; Levine, 1997; Loftus, 2003a; Loftus & Pickrell, 1995; J. M. Talarico & Rubin, 2003). One study demonstrated, for example, that memory for details about the attacks of 9/11 and of everyday neutral events decayed at a similar rate over time, implying that heightened confidence in the accuracy of emotional memories may actually be unfounded (J. M. Talarico & Rubin, 2003). In another study, participants reported remembering previously presented negative scenes more than neutral scenes, even though details associated with neutral scenes were better remembered than those associated with negative scenes (Rimmele, Davachi, Petrov, Dougal, & Phelps, 2011). Despite confidence in their accuracy, peoples' memories for emotional events appear just as susceptible to alteration and re-interpretation as memories for neutral events (Levine et al., 2009; Levine & Pizarro, 2004).

Central vs. Peripheral Detail

Researchers interested in the effects of emotion on memory often differentiate between the type of detail being remembered, examining both details *centrally* related to a past experience (e.g., the subject of the experience) and details *peripherally* related, or irrelevant to the experience (e.g., unrelated characteristics of the environment). A number of studies have demonstrated that emotion enhances memory for details central to the focus of the memory, albeit at the expense of memory for details peripheral to the focus (Easterbrook, 1959; Kensinger et al., 2007; Levine & Edelstein, 2009; Loftus, 1979). For example, one study tested memory accuracy for central vs. peripheral details of emotional and non-emotional pictures (Kensinger et al., 2007). One emotional picture described was of a threatening snake (the central detail) in a forest background (the peripheral detail). This study found that central details of emotional pictures (e.g., the snake) were better remembered than peripheral details of the same pictures (e.g., the forest). When looking at neutral pictures (e.g., a monkey in a forest), however, there were no differences in the number of central compared to peripheral details correctly remembered.

Emotional Valence, Arousal, and Memory

Many of the studies reviewed above tested the differing effects of emotional compared to neutral emotion on memory. An underlying assumption of this research is that emotional material and moods enhance memory because they elicit higher levels of arousal. Emotional events are often physiologically arousing in nature, leading to the release of neurochemicals that facilitate stimulation of brain areas important for the processing and storing of emotional material (McGaugh, 2004). Because they are more arousing than neutral material, positive and negative materials are often coupled together in studies of emotion and memory. However,

researchers have acknowledged the need to understand the influence of valence, in addition to arousal, on memory (Kensinger, 2009; Levine & Pizarro, 2004). Although it is widely acknowledged that emotional arousal enhances memory accuracy, the influence that emotional valence has on memory accuracy is still an open question.

Appraisal theories of emotion. According to appraisal theories of emotion, positive and negative emotion provide different cues for cognitive processing of the external world based on the status of current goals (Clore et al., 2001; Clore, Schwarz, & Conway, 1994; Levine & Edelstein, 2009). Positive emotion is usually experienced when things are going well: there is no immediate threat to survival, current goals and needs are being met, and whatever strategy one is using to navigate life in that moment is working. Thus, positive emotions signal a person to keep behaving in the same way as long as the environment stays constant. According to appraisal theories, then, positive emotion leads to a greater reliance on internalized strategies and heuristics, or top-down processing. Negative emotion, on the other hand, is usually experienced when things are going wrong. One's survival could be threatened (in one way or another), current goals are being blocked, and whatever strategy one is using to attain personal goals is not effective. In this way, negative emotions signal the need for a change in behavior. Because the behaviors that occurred naturally in this particular situation are not successful, it is necessary to rely less on the most accessible internal tendencies, and more on information that can be gleaned from the external environment.

Appraisal theory also predicts that the experience of an emotion indicates what aspects of the setting should be attended to and processed to successfully navigate an ever-changing environment. Positive emotion is thought to broaden one's attentional focus, leading to an enhanced focus on peripheral details of the surrounding environment (Fredrickson, 2001; Rowe,

Hirsh, & Anderson, 2006). Negative emotions, on the other hand, serve to narrow one's attentional focus towards whatever is causing the negative emotional response (i.e., central details), given that people who are feeling negative are more invested in changing their current circumstances. Because of the differing effects of broadening vs. narrowing attention, people experiencing positive emotions are thought to have a better memory for the peripheral details of the event and people experiencing negative emotions are thought to have better memory for the central details of the event.

Appraisal theories, valence, and type of memory detail. A handful of studies support appraisal theories of emotional memory. One study examining autobiographical memory for positive and negative events demonstrated that a greater proportion for central vs. peripheral details were recalled about negative events compared to positive events (Berntsen, 2002). Another study examining central and peripheral memory for positive and negative pictures also found a greater enhancement in memory for central compared to peripheral details for negative pictures than for positive pictures (Waring & Kensinger, 2009). These findings imply that enhanced memory for central details of an emotional stimulus is stronger for stimuli associated with negative, rather than positive emotion.

Other studies have demonstrated that people who are experiencing negative emotion might be less likely to incorporate incorrect information into memory. For example, in one study participants were induced into either a positive or negative mood (Storbeck & Clore, 2005). Next, the researchers used the Deese-Roediger-McDermott paradigm (DRM; Deese, 1959; Roediger & Mcdermott, 1995) where participants were presented multiple wordlists, each containing words semantically related to the first word in the list. At the time of recall, participants freely recalled the words they remembered seeing. The numbers of correctly recalled

words, as well as the number of "lure" words (words that were related to the lists but were never actually presented) were summed. Compared to participants induced into positive or neutral moods, those induced into negative moods were less susceptible to endorsing that a never-presented lure word had been presented, implying greater accuracy in memory for the initial word lists presented. In another study, participants viewed two emotionally complex scenes, one positive and one negative. An hour later, they were induced into positive, negative, or neutral mood and then half of the participants received misinformation about the images they had seen earlier. When their memory was tested, participants in the negative mood condition were less likely to incorporate false information into their memory of the pictures compared to those in the positive and control groups (Forgas, Laham, & Vargas, 2005). Together, these studies provide support for the idea that negative emotion directs attention towards details (more specifically *central* details) of an experience, thus strengthening memory for those details.

Incidental vs. Integral Memory and Emotion

The influence of valence on memory for information has primarily been examined for central or peripheral information that is completely unrelated to whatever elicited the emotion in the first place (incidental memory). Emotions can also influence memory for whatever actually caused the emotional response (integral memory). For example, a person might get in an argument with a co-worker and then return to work and go about their day. Incidental memory researchers would ask "how does that person's emotional reaction to the argument influence what they remember about the work that was completed after the argument?" Integral memory researchers, on the other hand, ask "how does that person's emotional reaction to the argument influence what they remember about the details of the argument itself?"

Nearly all research that examines the differential influence of valence on memory accuracy relies on tests of incidental memory. For example, participants might first undergo either a positive, negative, or neutral mood induction. Then, participants are exposed to information that constitutes the material for a subsequent memory test, but that is unrelated to the content of the mood induction. Incidental studies can examine whether positive or negative mood states relay certain memory benefits or deficits. They do not, however, provide information about how positive compared to negative emotions relay memory benefits or deficits for the initial experience that caused the emotional reaction in the first place. Often, it is our memory for details that happened *during* an emotional experience that are most important, not the details of something unrelated that happened *after* an emotional experience.

The reason most research examines the effects of valence in the context of incidental memory is that designing an integral memory study that allows a test of memory for the exact same material, regardless of condition, is difficult. Situations that create feelings of positive emotion are often inherently different in nature from situations that create feelings of negative emotion. Thus, the content of the situation that produced the positive response is different from the content of the situation that produced the negative response, so testing memory for what happened in each situation requires a completely different set of memory questions. Therefore, simply comparing what is remembered during a positive event with what is remembered during a negative event only allows for descriptive information about what types of details are remembered. This approach does not ensure that any differences in memory accuracy between conditions are due to the effects of the emotions experienced and not the content of the experience or the difficulty of the questions themselves.

Studies of emotion and incidental memory. Given the difficulty of assessing integral memory accuracy for past emotional experiences, many researchers turn to laboratory studies to understand the influence of emotion on memory accuracy for stimuli that aren't necessarily related to the source of the initial emotional response. Studies employing this method typically take one of two approaches: assessing memory for emotional compared to non-emotional stimuli or assessing memory for some standardized stimuli following a mood induction.

In the first approach, researchers present a set of stimuli, such as word lists, pictures, or videos, and later ask participants to either freely recall the details of the stimuli or to indicate whether they recognize certain aspects of the stimuli. The assumption is that the inherent characteristics of the stimulus influence the way the overall stimulus is processed by the observer. Although memory for the number of details in positive compared to negative stimuli is somewhat integral in that participants are being tested on the source of the emotional response, these studies do not necessarily assess how the participants' mood state influences their memory. The sole focus is on the emotional characteristics of the stimuli, not the experience of the observer. Studies using this method find that emotional words, pictures, and video clips are typically better remembered than neutral ones (Cahill et al., 1996; E. a Kensinger & Corkin, 2003; Ochsner, 2000). In addition, a number of theorists believe emotional memory enhancements are greater for negative content than for positive content (Kensinger, 2009).

The second approach involves inducing participants into some mood (using any number of methods from showing pictures or videos, to recalling past events that made the person feel the target emotion, to listening to sad or happy music) and then exposing them to some stimulus. The stimulus could be any variety of things, including written or spoken wordlists, pictures, or stories. The participant is later asked to recall details about the stimuli they were exposed to

following the mood induction. One consistent pattern that is often found when using this approach has been termed mood congruency, or the preferential recall of information (positive or negative) that matches the current mood of the person recalling (Blaney, 1986). People who are induced into negative moods recall a greater proportion of negative information relative to positive information compared to those in positive or neutral moods (Matt, Vazquez, & Campbell, 1992). A similar effect has been found among people with various levels of depression, who are assumed to be experiencing more negative moods on average than people without depression (Gaddy & Ingram, 2014; Matt et al., 1992). This approach to studying the effects of valence on memory, however, typically measures the proportion of positive compared to negative information recalled, not necessarily the accuracy of what is recalled.

The approaches discussed in this section have the benefit of testing the effects of valence on memory in a controlled, internally valid setting. The emotional response can be manipulated by the researcher using very consistent methods and the stimuli can be held constant across conditions. Given the fact that the subject material of the memory tests are not related to whatever caused the subject's emotional state, however, these benefits come with the tradeoff of not being able to answer questions about integral memory for emotional events. Thus, the external validity of laboratory studies on emotional valence and memory is poor.

Autobiographical memory and emotion. Most integral memory and emotion studies rely on memory for past autobiographical experiences. Studies assessing memory for autobiographical experiences often ask participants to recall details about specific, highly publicized and emotional events (i.e., "flashbulb memories"; (Brown & Kulik, 1977) or use the Autobiographical Memory Task (AMT; Williams & Broadbent, 1986; Williams & Dritschel, 1988) to study more personally relevant autobiographical experiences. In the AMT, participants

are instructed to retrieve a specific personal memory related to a cue word or phrase provided by the experimenter. Using this method allows for the examination of a number of features of autobiographical memory, such as the specificity of the memory (Williams et al., 2007) the proportion of positive compared to negative memories retrieved (Blaney, 1986), or other phenomenological characteristics of retrieved memories (Luchetti & Sutin, 2016). Autobiographical memory studies are highly externally valid in that they offer insight into how emotional experiences are remembered in every-day life.

Research from autobiographical memory studies demonstrates that positive memories tend to be more readily retrieved than negative memories (Walker, Skowronski, & Thompson, 2003). This is in part because people tend to have more pleasant experiences than negative experiences, but research has also found that pleasant autobiographical memories tend to fade more gradually than unpleasant memories (Walker, Skowronski, Gibbons, Vogl, & Thompson, 2003; Walker, Skowronski, & Thompson, 2003). Positive autobiographical memories either have a greater proportion of peripheral details or a balance between peripheral and central details (Berntsen, 2002; Talarico, Berntsen, & Rubin, 2009). Negative memories, on the other hand, are often accompanied by a greater proportion of central compared to peripheral details (Berntsen, 2002; Christianson & Loftus, 1990). Furthermore, the strength or intensity of the emotions reported to have been experienced during negative past events is positively related to the number of central details recalled, but not related to the number of peripheral details recalled (Berntsen, 2002; Christianson & Loftus, 1990).

Research using the autobiographical memory approach offers useful insights into the influence of emotional valence on memory; however, one difficulty of this method is the inability to assess memory *accuracy*. Unless a prospective approach is used, researchers cannot

assess how accurate the memories of the emotional events might later be. One way to address this issue, however, is to examine the consistency of the memories over time. For example, one flashbulb memory study employed a longitudinal approach by asking participants to recall details of their memory for first hearing about the September 11 terrorist attacks the day after they happened and again between 1 and 32 weeks later (J. M. Talarico & Rubin, 2003). The researchers were not able to document how participants actually heard about 9/11, but by assessing memories for 9/11 at multiple time points, they were able to assess the consistency in remembered details between measurements. They found that the consistency of these memories declined over time, implying that the memories were not as accurate as participants believed them to be. This provides evidence that although autobiographical memory studies are highly useful to study the phenomenological characteristics of memory, they are not able to infer accuracy regarding the details of the memory itself. Furthermore, memories being recalled by participants using autobiographical methods can vary in any number of features, such as the intensity and type of emotions experienced at the time, the setting of the original experience, or the peripheral details of the environment. Because of this, comparing the qualities of positive and negative memories is confounded by the fact that they are based on different types of experiences. Therefore, studies on autobiographical memory may be high in external validity, but when it comes to assessing memory accuracy, internal validity is lacking.

Balancing internal and external validity to study valence and memory accuracy. A handful of emotional valence and memory studies have attempted to address the difficulties associated with the incidental nature of lab-based memory studies and the retrospective and unfalsifiable nature of autobiographical memory studies. For example, one study utilized the power of appraisals in eliciting a positive and negative response to the exact same event. The

researchers surveyed a group of people following the highly emotional final playoff baseball game between the Boston Red Sox and New York Yankees in 2004 and again 23-27 weeks later (Kensinger & Schacter, 2006). The same exact event produced a positive response (among Red Sox fans), a negative response (among Yankees fans), and neutral responses (among those who didn't support either team). Although the positive response group and negative response group reported the same number of details during the first survey, the negative response group recalled these details more consistently than the positive response group at the time of the second survey. The consistency of responses across time can be thought of as an indicator of memory accuracy. Despite this, the accuracy of information initially recalled was not assessed, thus true accuracy as a function of how positively or negatively participants viewed the game could not be quantified.

Another set of studies have examined memory for pictures that are imbedded in varying emotional contexts. The same "target" pictures, or those that are subject to a later memory test, are seen across conditions, so the content of the memory test can be the same for all participants. The target pictures, however, are flanked by some emotional material intended to make the overall narrative of the sequence positive, neutral, or negative (and thus induce a neutral, negative, or positive response in participants). For example, some studies have examined the influence of emotion on memory accuracy when neutral pictures are accompanied by narratives that vary in valence (Cahill & McGaugh, 1995) and in some cases are also flanked by emotional pictures (Adolphs, Tranel, & Buchanan, 2005; Moore, Urban, & Martin, under review). The neutral pictures serve as the target material, but the accompanying narratives and pictures determine whether the overall context the target is presented in is neutral, positive, or negative in nature. Two of the studies did not include a positive condition, however, so could only speak to the enhancing effects of negative emotion over neutral states on memory (Adolphs et al., 2005;

Cahill & McGaugh, 1995). The one study that compared the accuracy of positive and negative contexts, however, found no difference in memory accuracy for content encoded in the neutral and negative contexts, but that memory accuracy was worst when the content was encoded in a positive context (Moore et al., under review). The rationale for this finding was that positive emotion broadened participants' attention away from details of the target stimuli, leading to detriments in memory for this information.

Based on the research presented here it seems that negative emotion generally enhances memory (Adolphs et al., 2005; Cahill & McGaugh, 1995; Kensinger & Schacter, 2006; Smith et al., 2004) and that positive emotion might even be detrimental to memory (Moore et al., under review). This is generally consistent with the research using incidental memory and emotion paradigms. Although the studies discussed in this section have made considerable advances in balancing the advantages and disadvantages of autobiographical memory studies and laboratory studies when looking at the effects of valence on memory accuracy, a trade-off between internal and external validity can still be seen in each of these studies. Either objective memory accuracy was not actually measured (Kensinger & Schacter, 2006), or the subject material of memory tests were not truly integral to the initial emotional response (as they were not the cause of the emotional response; Adolphs et al., 2005; Cahill & McGaugh, 1995; Moore et al., under review; Smith et al., 2004). More research in this area, therefore, is needed to better understand the differential influence of positive and negative emotion on integral memory accuracy while providing a stronger balance between external and internal validity.

Dissertation Study Aims

The aims of the present dissertation are twofold. In Study 1, the aim is to create a laboratory situation that is externally valid in nature (similar to autobiographical memory

studies) but is also internally valid in that it allows for controlled positive, negative, and neutral emotion inductions and a test of memory for the same content (similar to laboratory emotion and memory studies). In Study 2, the aim is to use this novel laboratory situation to test the influence of valence on integral memory accuracy for central and peripheral details related to the cause of the emotional response. Study 2 will attempt to generalize findings from studies on emotional valence and incidental memory accuracy to integral memory accuracy. In the next section, I will introduce the Trier Social Stressor Task (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) and discuss why it is a good candidate for the first aim.

Study 1 Introduction

Designing a Study of Integral Effects of Valence on Memory

To provide a strong test of how valence influences integral memory in an ecologically valid setting it is necessary to create a task that is as similar as possible across conditions and yet still reliably induces a positive, negative, or neutral response in participants. Ideally the task would produce strong emotional responses that simulate life-like emotional experiences. Furthermore, to ensure a true test of valence, the emotional responses would also be similar in intensity across positive and negative conditions so that the potential influence of arousal can eliminated. The TSST, a commonly used laboratory-based psychosocial stressor is an ideal candidate in that it is controlled in nature and has the potential to be varied on emotional valence. The TSST requires participants to give an impromptu speech in front of two to three stern evaluators, who are study confederates and are instructed to interject during the participant's speech (e.g., "you are spending too much time on this aspect, please move on.") and not to display any supportive behaviors (e.g., nodding or smiling). The TSST reliably induces self-conscious negative emotions as a result of social evaluation (Dickerson & Kemeny, 2004;

Dickerson, Mycek, & Zaldivar, 2008). The TSST is traditionally used to study the biopsychosocial stress response and serves as a potent and life-like negative mood induction. Positive and neutral versions following the same structure as the classic TSST would serve the purposes of the current research: creating three conditions similar in structure but differing in the emotion induced.

Attempts to Make a Positive TSST

Two lab groups to my knowledge have published attempts to create more positive versions of the TSST. Taylor and colleagues (2010) assessed whether having a supportive audience during the speech task influences biological and psychological responses to stress. They used the classic negative TSST and compared it to a TSST with a supportive audience and a control condition where there was no audience (Taylor et al., 2010). All participants gave a speech on why they would be good candidates for a popular campus job. In the supportive condition, evaluators were instructed to demonstrate non-verbal signs of interest and support, such as leaning forward, exchanging positive glances, and smiling. Although the supportive condition was rated as significantly more supportive by participants compared to the non-supportive condition, there were no differences in positive or negative affect change from baseline to post-speech between conditions. Furthermore, participants in the supportive condition had a higher peak cortisol level, greater increases in systolic and diastolic blood pressure, and a marginally greater change in heart rate ($p<.052$), than the control condition. There were no group differences in peak cortisol level ($p=.099$), increases in heart rate, or increases in blood pressure between participants in the supportive condition and the non-supportive condition. These results demonstrate that this version of a positive TSST did not successfully induce

participants to feel more positive, feel less negative, or demonstrate less of a physiological stress response.

Another lab group has also implemented a more positive TSST in their research, which is called the "friendly" Trier (f-TSST; Wiemers, Schoofs, & Wolf, 2013). These researchers have used the f-TSST in a series of studies (Herten et al., 2016; Wiemers, Sauvage, Schoofs, Hamacher-Dang, & Wolf, 2013; Wiemers, Sauvage, & Wolf, 2013; Wiemers, Schoofs, et al., 2013; Wiemers & Wolf, 2015), three of which have used the procedure to test memory accuracy. In these studies, participants in the negative TSST condition gave a speech about their qualifications for a fictitious job in front of reserved evaluators. Participants in the f-TSST condition were told to talk freely about their career aspirations[1] in front of friendly evaluators who helped avoid awkward pauses by asking follow-up questions.

Despite these alterations to the classic TSST paradigm, positive affect increased in only two of the 5 studies among the f-TSST group (Herten et al., 2016; Wiemers & Wolf, 2015). In those two studies, however, there were no significant group differences in positive affect following the speech task, so even though positive affect increased in the f-TSST group participants in that condition were not experiencing more positive emotions compared to other conditions. In addition, negative affect in the f-TSST condition only decreased in one study (Herten et al., 2016), and actually increased in another (Wiemers, Sauvage, & Wolf, 2013). Although the f-TSST didn't necessarily diminish the experience of negative affect, there were still group differences in negative affect between the f-TSST and classic TSST in all four studies

[1] In one study participants were able to choose a topic from a list related to the subjects of a job interview (Herten et al., 2016).

that used the classic TSST[2] (Herten et al., 2016; Wiemers, Sauvage, Schoofs, et al., 2013; Wiemers, Sauvage, & Wolf, 2013; Wiemers, Schoofs, et al., 2013).

In contrast to the study conducted by Taylor and colleagues (2010), all of the other studies mentioned found no increase in cortisol, an indicator of HPA axis functioning, among participants in the f-TSST condition (Herten et al., 2016; Wiemers, Sauvage, Schoofs, et al., 2013; Wiemers, Sauvage, & Wolf, 2013; Wiemers, Schoofs, et al., 2013; Wiemers & Wolf, 2015). They did, however, find an increase in salivary alpha-amylase (sAA), an indicator of sympathetic adrenomedullary system (SAM) reactivity among the f-TSST group. These increases in sAA were not significantly different than the increases observed among the classic negative TSST condition (Herten et al., 2016; Wiemers, Sauvage, Schoofs, et al., 2013; Wiemers, Sauvage, & Wolf, 2013; Wiemers, Schoofs, et al., 2013).

Taking the results of the above studies together, previous versions of a positive TSST procedure were not effective at inducing participants to feel positive emotions (at least at a higher level than those in the negative TSST), and did not reliably decrease negative emotions. Past versions of a positive TSST typically did not activate the HPA-axis (with the exception of Taylor et al., 2010), as measured through cortisol, but did increase levels of sAA, blood-pressure, and heart rate to the same extent as the negative TSST.

One reason past attempts at creating a positive version of the TSST have been unsuccessful could be due to the topic of the speech. In all of the studies above, the positive condition was still required to give a speech about something related to their career aspirations or their qualifications for a job. Participants were still required to talk about their future careers, which can be quite stressful even in the presence of a supportive, friendly audience. Another

[2] One of the five studies reported here did not include the classic negative TSST condition but instead used another control condition with which the f-TSST had no differences in post-speech negative affect (Wiemers & Wolf, 2015).

reason the positive condition might have been unsuccessful is that the speech preparation period and speech task themselves lasted between 13 and 15 minutes. Perhaps participants initially felt a boost in positive emotion, but over time these responses diminished. Furthermore, no matter the topic, running out of content during at 10 minute speech could be fairly uncomfortable. Finally, previous studies have included small sample sizes, which might have made the effects of a f-TSST difficult to detect. Most of the aforementioned studies included 24 to 43 participants in the f-TSST condition (Herten et al., 2016; Wiemers, Sauvage, Schoofs, et al., 2013; Wiemers, Sauvage, & Wolf, 2013; Wiemers, Schoofs, et al., 2013; Wiemers & Wolf, 2015). The largest group size for the positive version of the TSST was approximately 61 participants. Thus, a positive version of the TSST might be more successful if the topic of the speech was more enjoyable, the length of the speech was somewhat shorter, and if a larger group of participants was recruited.

Study 1 Method

Research Design and Hypotheses

The overall aim of Study 1 was to create a life-like laboratory situation that could be reliably varied by emotional valence and still allow for memory tests of consistent stimuli. Thus, for Study 1 I adapted previous versions of the original TSST and attempts at the friendly TSST to make two new TSST conditions: One that reliably induces positive affect and reduces negative affect in participants (positive TSST) and one that reliably induces neutral affect in participants (neutral TSST). These two new conditions were compared to the original TSST that reliably induces negative affect and reductions in positive affect among participants. Participants were assigned one of three conditions: 1) the original, negative TSST, 2) the new neutral TSST, or 3) the new positive TSST. Participants in each condition reported the extent to which they felt 12

positive and 14 negative emotions at baseline and again after finishing the TSST task. Items were averaged within valence at baseline and post-TSST to assess change in overall positive and negative emotion.

My hypotheses regarding within-group change (hypotheses 1a-1c) and between-group differences (hypotheses 2a-2b) in positive and negative emotion are outlined below:

Hypothesis 1a: The positive TSST condition will increase the experience of positive emotions and decrease the experience of negative emotions.

Hypothesis 1b: The neutral TSST condition will maintain levels of baseline negative and positive emotions.

Hypothesis 1c: The negative TSST condition will increase the experience of negative emotions and decrease the experience of positive emotions.

Hypothesis 2a: After the respective TSST has been completed and adjusting for baseline levels of positive emotion, the positive TSST group will report experiencing the most positive emotion, the neutral TSST group an intermediate amount of positive emotion, and the negative TSST group the least positive emotion.

Hypothesis 2b: After the respective TSST has been completed and adjusting for baseline levels of negative emotion, the negative TSST group will report experiencing the most negative emotion, the neutral TSST group an intermediate amount of negative emotion, and the positive TSST group the least negative emotion.

Power Analysis

Two power analyses were performed using the power package in RStudio (RStudio Team, 2016) to determine the target sample size for detecting the effect of TSST condition on positive and negative mood change. To estimate the expected effect size of the TSST

manipulation, effect sizes from previous studies utilizing the TSST and a version of the friendly TSST were gathered. Only studies which measured and reported changes in positive and negative emotion from baseline to post-TSST were included. Four studies reported statistics on negative emotion change from baseline to post TSST (Herten et al., 2016; Wiemers, Sauvage, Schoofs, et al., 2013; Wiemers, Sauvage, & Wolf, 2013; Wiemers, Schoofs, et al., 2013), and all but one of these reported on positive emotion change (Wiemers, Sauvage, & Wolf, 2013).

In each of the four studies a repeated measures ANOVA was run (separately for positive and negative affect) to assess changes in emotion by condition. In all four studies, the original TSST group increased in NA and the f-TSST group either decreased or did not change in NA. The r effect sizes for these analyses ranged from .37 to .46, with the weighted effect size equaling .43. To detect this size effect with a power level of .80 and a significance of p=.05, 15.2 participants were needed in each group.

In the three studies examining changes in positive affect, there were no significant differences between groups. This demonstrates that previous versions of the f-TSST have only successfully lowered NA compared to the original TSST and did not successfully increase PA. With no reference effect size based on previous literature for which to conduct a power analysis, I predicted the differences between groups on changes in PA for the new TSST to be slightly smaller than changes in NA (i.e., a medium effect size around r of .30). For three groups (original TSST, neutral TSST, and f-TSST), 33.49 participants were required for each group to detect an effect of medium size at a significance level of p = .05 with power of .80. Thus, Study 1 aimed to recruit a total of 99 participants, 33 in each condition.

Participants

A total of 105 eligible undergraduate students were recruited from the University's human subjects lab pool to participate in Study 1. Subjects who enrolled in the study received class credit for their participation. Participants ranged in age from 18 to 33 years old (M = 20.76, SD = 2.48) and 77% identified as being female. Participants were 49.5% Asian/Pacific Islander, 29.5% Hispanic, 9.5% Caucasian, 2.9% African American, 6.7% Biracial/Multiracial, and 1.9% other ethnicity. More than two thirds (70.5%) of the sample was born in the United States.

Procedure

Participants arrived to a laboratory in the University's psychology department and were greeted by a trained research assistant (RA). The RA explained the nature of the study and obtained informed consent. Next, participants completed a screening questionnaire on a lab computer to determine eligibility for the study. Participants were eligible for the study if they were at least 18 years of age, had a strong command of the English language, and were not currently taking mood-altering medications, such as anti-depressants. Participants who took mood-altering medications were excluded because the medications could interfere with the participant's response to the TSST mood induction procedure. Those who reported taking mood-altering medication in the screening questionnaire were told they were not eligible for the study, were dismissed from the study, and were awarded one half research credit for their time.

Following the consent and eligibility screening questionnaire, participants completed a questionnaire intended to measure their baseline emotions on the computer. Two new RAs then administered the TSST mood induction procedure. Afterwards, participants were instructed to take one final set of questionnaires, which asked participants to report the emotions they experienced during the TSST, other appraisals regarding the task, and whether they had

completed a similar task in the past. Finally, the original RA returned to the participant's room to debrief the participant, thank them for their participation, and dismiss them from the study. The entire session was designed to be completed within 30 minutes.

TSST Mood Induction Procedure

TSST mood induction condition was randomly assigned based on participant number. When the participant first arrived they were assigned to be in the original negative TSST, the positive TSST, or the neutral TSST. Differences between each condition are described below. For each of the three conditions, two RAs who had not previously interacted with the participant during the study conducted the TSST. Research using only two TSST evaluators has been found to successfully elicit a stress response in the classic TSST (e.g., Dickerson et al., 2008) and it was assumed that two researchers would also be sufficient to elicit positive emotion in the positive TSST condition.

In each condition, TSST evaluators entered the participant room, gave the participants instructions for the next part of the study, and answered any questions the participant had regarding the task. The evaluators then left the room for two minutes while the participant prepared for the speech task. All participants were given a pen and a pad of paper to help prepare for the task. After the two minute preparation period was completed, the evaluators re-entered the room and instructed the participant to begin their speech. The speech task, which lasted five minutes, was video recorded. After five minutes the evaluators ended the speech task, instructed the participant to complete a set of questionnaires on the computer, and left the room.

Negative TSST. The negative TSST condition was designed to be similar to the classic TSST speech task. The TSST sometimes includes a mental math task in addition to a speech task, however, for the purposes of the current research only a speech task was included.

In the negative TSST condition, the evaluators, who were wearing white lab coats, informed the participant that they were to imagine they are interviewing for a demanding new job related to their career aspirations (specific wording of the instructions for each condition can be found in Appendix A). Participants were told that the purpose of the exercise was to gather information for school officials on how prepared UCI students were for the job market and that the evaluators had been trained to analyze the participant's performance. Furthermore, participants were told that the video recording of their speech would be evaluated by a separate panel for style, eloquence, and overall quality. After these instructions, participants had two minutes to prepare for the speech using a pen and notepad, but were not allowed to use their notes during the speech.

During the speech, the trained evaluators were instructed to maintain a stern expression and take notes on a clipboard. The evaluators were told to refrain from nodding, smiling, or giving any words of encouragement to the participant. Their posture was stiff and reserved. Furthermore, evaluators took turns making scripted interjections at regular intervals (approximately every 45 seconds), with comments such as "*You are spending too much time on this aspect.*" A full list of interjections that were used is presented in Appendix A. After five minutes the evaluators abruptly ended the speech, provided no feedback to the participant regarding the speech, and left the room.

Positive TSST. The positive TSST condition was designed to be as similar to the negative condition as possible but to increase positive emotion and decrease negative emotion. A "friendly" version of the TSST has been implemented by previous research groups and so the current study aimed to include characteristics of previous friendly TSST studies. Previous research using a positive TSST condition has decreased negative emotion, but has not

successfully increased positive emotion. The goal for the present research was to not only decrease negative emotion in the positive TSST condition, but to also increase positive emotion.

Evaluators of the positive TSST condition did not wear lab coats and also introduced themselves warmly upon meeting the participant. The evaluators informed the participant that they were to imagine they were being interviewed by two new UCI students who were interested in starting a new hobby. The participant was instructed to give a description of one of their favorite hobbies or activities and why they enjoy it so much. They were told that the purpose of this exercise was to gather information for incoming UCI students on what current students are passionate about doing. Participants were told that they were not going to be evaluated in any way and that the video recording was just meant to help the researchers confirm notes after the session. After the instructions were given, participants had two minutes to prepare for the speech using a pen and notepad, which they were allowed to use during the speech.

During the speech in the positive condition, evaluators were told to try to mirror the affect of the participant but to also display compassionate and understanding facial expressions. Evaluators maintained comfortable eye contact and gave verbal and non-verbal signals of engagement (e.g., nodding, laughing at appropriate moments, smiling genuinely, saying "uh-huh"). Their posture was attentive and relaxed. Evaluators were instructed to avoid awkward pauses if possible and took turns making scripted comments or questions (approximately every 45 seconds). Comments were meant to express interest (e.g., "*Wow, that's really cool.*") and questions were meant to help avoid awkward pauses (e.g., "*How did you get started with this hobby?*") Evaluators were given a list of acceptable comments and questions to use (see Appendix A). Importantly, all comments that were made were as general in nature as possible so that the same question could be applicable to all participants within the positive condition. For

example, instead of saying "*What equipment do you need for scuba diving?*" the evaluator would ask "*How did you get started with scuba diving?*" The idea was that not all hobbies would require equipment, but asking how the participant got started with that hobby would always be applicable. After five minutes, the evaluators indicated that the speech period was finished and that they thought the participant gave a lot of good information regarding their hobby.

Neutral TSST. The neutral TSST aimed to provide a control condition to which the negative and positive conditions could be compared. Evaluators in this condition did not wear lab coats and maintained a professional demeanor. They informed the participant that they were to imagine they were giving a speech to high school students who are interested in attending UCI about the details of their daily routine during a typical weekday from the time they wake up. Participants were told the purpose of this exercise was to gather information for local high school students on what the daily routine of a UCI student is like. Similar to the positive condition, participants in the neutral condition were told that they were not going to be evaluated and that the video recording was just meant to help the researchers confirm notes after the session. After the instructions, participants had two minutes to prepare for the speech using a pen and notepad, which they were allowed to use during the speech.

Evaluators of the neutral condition were told to be kind, but to refrain from laughing or smiling genuinely. They were allowed to nod, smile socially (i.e., without crinkling the corners of their eyes) and take notes to show engagement. Evaluators in this condition were instructed not to make any comments or question unless an awkward pause occurred. In the case that pauses occurred in the participant's speech, evaluators took turns probing for more details simply for the sake of avoiding awkward silences (e.g., "*What do you do next*?", "*Can you tell me about this in a little bit more detail?*"). A full list of scripted comments and questions that were used is

available in Appendix A. After five minutes, the evaluators ended the speech and thanked the participant for their participation in the study.

Measures

Demographics. At the end of the study session, participants provided information on their age, gender, racial/ethnic group, birthplace, years lived in the United States, and their highest level of education.

Baseline and post-TSST positive and negative emotion. Just after completing the eligibility questionnaire, participants rated how accurately 26 emotion items described how they were feeling at the current moment on a scale of 1 '*Not at all Accurate*' to 5 '*Extremely Accurate*'. The scale was comprised of emotion items chosen from the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) and the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), as well as researcher-generated items. This scale was created to measure a similar number of low compared to high arousal positive and negative emotions and to more keenly measure feelings related to anger and irritability. A full list of items and their sources is presented in Appendix B. Positive and negative emotion items were averaged separately for each participant to allow for tests of change in emotional valence by condition. Immediately after completing the TSST, participants again rated how accurately the same 26 emotion items described how they were feeling at the current moment on the same scale used to measure baseline emotion.

Post-TSST overall valence and arousal. Participants were also asked to rate how positive and negative the task made them feel overall on two separate scales from 1 '*Not at all/Neutral*' to 7 '*Very Positive*' and 1 '*Not at all/Neutral*' to 7 '*Very Negative*'. If participants indicated feeling at least some positive emotion on the previous measure (i.e., a 2 or higher), they

were asked to indicate how activating or arousing the positive emotions were that they felt during the speech task overall. Participants rated their positive arousal on a scale of 1 '*Not at all/I felt calm*' to 7 '*Very much/I felt excited*'. After rating their experienced arousal, participants were prompted to describe what aspects of the task made them feel positive. Similarly, participants rated their negative arousal if they indicated experiencing at least some negative emotion in the previous measures. They indicated how activating or arousing the negative emotions were that they felt during the speech task overall on a scale of 1 '*Not at all/I felt bored*' to 7 '*Very much/I felt tense*'. Participants were then asked to describe what aspects of the task made them feel negative.

Performance appraisal questionnaire. After reporting post-TSST emotions, participants were given an adapted version of the Performance Attribution Questionnaire (Appendix C; as used in Dickerson, Gable, Irwin, Aziz, & Kemeny, 2009). The questionnaire assessed a variety of appraisals related to the TSST experience.

Task difficulty and effort. Perceived difficulty of the TSST task was measured using one item rated from 1 '*Not very difficult*' to 7 '*Very difficult*'. Participants reported how much effort they expended on the task using one item rated from 1 '*Didn't try hard*' to 7 '*Tried hard*'. Participants also reported how much they gave up/quit trying and how much they wanted to give up/quit trying during the task on two items using a scale of 1 '*Not at all*' to 7 '*Very much*'.

Evaluation by others. Participants were asked to rate whether they felt their performance was being evaluated by others during the task and whether they felt their performance could be evaluated by others at a later time in two items on a scale of 1 '*Not at all*' to 7 '*Very much*'. They were also asked to indicate how they thought those around them would have rated their performance overall from 1 '*Very poor*' to 7 '*Excellent*' and how effective they thought they

were in meeting the goal of the researcher from 1 '*Not at all effective*' to 7 '*Very effective*'. Four items also assessed the extent to which participants felt liked, disliked, accepted, or rejected during the task on a scale of 1 '*Not at all*' to 7 '*Very much*'.

Self-evaluation. Appraisals of their own performance were measured by asking participants how threatening, challenging, and stressful the task was (three items rated on a scale of 1 '*Not at all*' to 7 '*Very much*' and how confident, in control, and how well they thought they performed overall (three items measured on a 7 point scale where higher scores indicated more confidence, more control, and better performance). They also were asked to describe what their main goal was during the TSST task in an open ended question and rated how effective they were in meeting their own goals for the task (one item rated on a scale of 1 '*Not at all*' to 7 '*Very much*').

Impressions of evaluators. Participants also provided evaluations of the evaluators who conducted the TSST session. They were asked to indicate how friendly they thought the researchers were on a sliding scale from 0 'Extremely unfriendly' to 100 'Extremely friendly'. Furthermore, participants rated how much of each of 10 emotion items (calm, confident, happy, interested, angry, anxious, bored, irritable, passive, and sad) they thought the evaluators were feeling on a scale from 1 'Not at all' to 5 'Extremely'. The positive and negative emotion items were averaged separately for each participant.

Previous TSST experience. At the end of the session, participants were asked whether they ever participated in a study in which they were required to give a speech in front of evaluators on a 5 point scale from '*Definitely not*' to '*Definitely yes*'. Based on their responses, participants were coded as either having participated in a TSST study previously (those who responded '*Probably yes*' or '*Definitely yes*') or not having participated in a previous TSST

study (those who responded '*Definitely not*', '*Probably not*', or '*Unsure*'). Those who had previously participated in a TSST study were asked to indicate how the task in the other study made them feel on a 7-point scale from '*Very negative*' to '*Very positive*'. They also compared the current TSST to the previous speech task on difficulty and how negative and positive it made them feel. Each of these three items was rated on a 5 point scale, where higher ratings indicated participants thought of the current task as more difficult, negative, or more positive than the one they had completed previously. Finally, participants were asked to describe the similarities and differences between the current study's TSST task to the speech task they had completed in the previous study.

Study 1 Results

All confidence intervals are reported at the 95% level. For all significant interactions, confidence intervals (in repeated measures GLMs) and planned contrast tests (in one way ANOVAs) were compared between groups to determine the nature of the significant effect. Levene's or Mauchly's tests of homogeneity of variances were used to detect any violations to assumptions of homogeneous variances. In the case of a violation to homogeneous variances, contrast statistics did not assume equal variances and used corrected degrees of freedom (Games-Howell for one-way and Greenhouse-Geisser for repeated measures).

Mood Induction Efficacy

Two repeated measures General Linear Models were conducted to test change in positive and negative emotion between baseline and just after the speech task. In each model time (baseline vs. post-speech) was entered as within subjects variables and condition (neutral, positive, or negative) was used as the between subjects variable. See Table 1 for means, standard

errors, and 95% confidence intervals by valence and condition and Figures 1 and 2 for graphical representations.

Table 1.

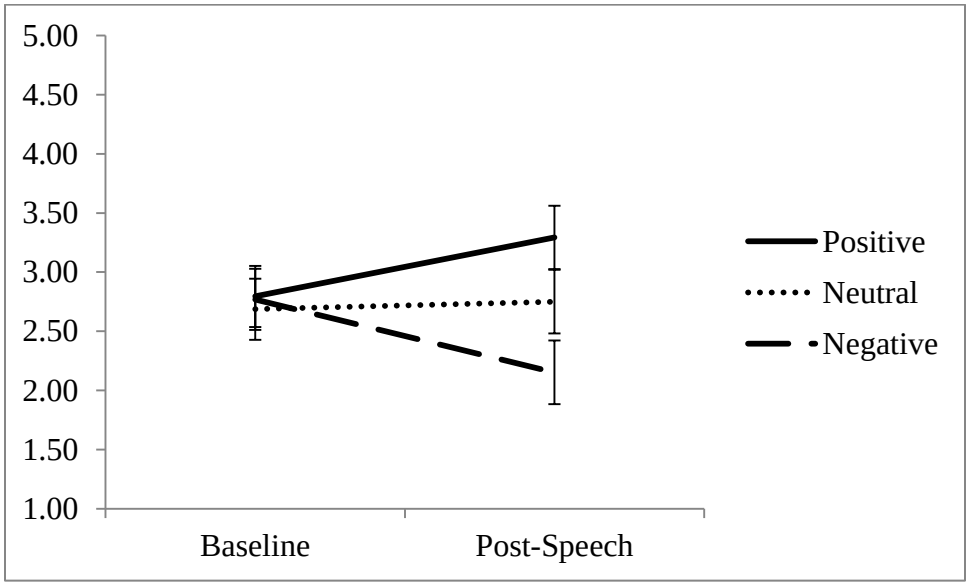
Study 1 Emotion Means, Standard Errors, and 95% CIs by Valence and Condition

	Baseline Positive Emotion		Post-Speech Positive Emotion	
Condition	*M* (*SE*)	95% CI	*M* (*SE*)	95% CI
Positive	2.80 (0.13)	2.54 - 3.05	3.29 (0.14)	3.02 - 3.56
Neutral	2.69 (0.13)	2.43 - 2.94	2.75 (0.14)	2.48 - 3.02
Negative	2.77 (0.13)	2.51 - 3.03	2.15 (0.14)	1.88 - 2.42
	Baseline Negative Emotion		Post-Speech Negative Emotion	
Condition	*M* (*SE*)	95% CI	*M* (*SE*)	95% CI
Positive	1.85 (0.11)	1.66 - 2.04	1.70 (0.11)	1.48 - 1.91
Neutral	1.98(0.11)	1.78 - 2.17	1.81 (0.11)	1.60 - 2.03
Negative	1.96 (0.11)	1.77 - 2.15	2.61 (0.11)	2.39 - 2.83

Note. SE = Standard Error; CI = Confidence Interval

For change in positive emotions between baseline and post-speech, there was a main effect of condition, $F(2, 102)=5.60$, $p=.005$, $\eta_p^2=.099$, but no significant main effect of time, $F(1, 102)=0.103$, $p=.749$, $\eta_p^2=.001$. These were qualified by a significant interaction between condition and time, $F(2, 102)=32.42$, $p<.001$, $\eta_p^2=.389$. The three groups did not differ in positive emotion at baseline. After the speech task, the positive group increased significantly, the negative group decreased significantly, and the neutral group did not change in levels of positive emotion. After the speech task the positive group reported significantly more positive emotion than the neutral condition, which in turn reported significantly more positive emotion than the negative condition.

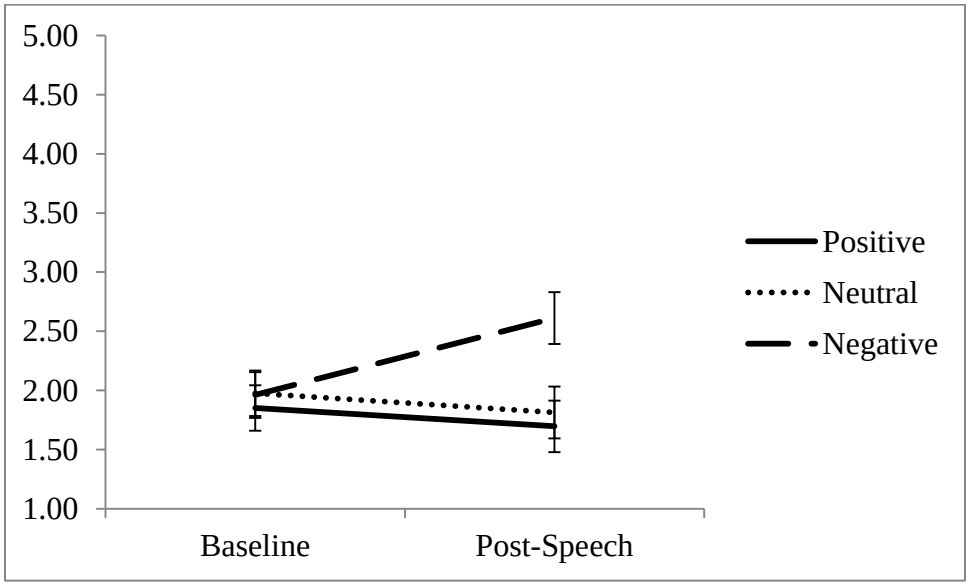
Figure 1.
Change in Positive Emotion by Condition (Study 1)



Note. Error bars represent 95% Confidence Intervals.

Regarding change in negative emotion over time, a main effect of condition, $F(2, 102)=8.12$, $p=.001$, $\eta_p^2=.137$, and a main effect of time, $F(1, 102)=4.85$, $p=.030$, $\eta_p^2=.045$, were qualified by an interaction between condition and time, $F(2, 102)=28.32$, $p<.001$, $\eta_p^2=.357$. See Table 1 for means, standard errors, and 95% confidence intervals that were used to determine the nature of the significant interaction. Although there were not differences in baseline negative emotion, after the speech task the negative condition reported significantly more negative emotion than the neutral and positive conditions, which did not differ significantly from one another. The negative condition increased significantly in negative emotion from baseline to post-speech; the neutral and positive conditions did not show significant change in negative emotion.

Figure 2.
Change in Negative Emotion by Condition (Study 1)



Note. Error bars represent 95% Confidence Intervals.

Speech Task Overall Valence and Arousal.

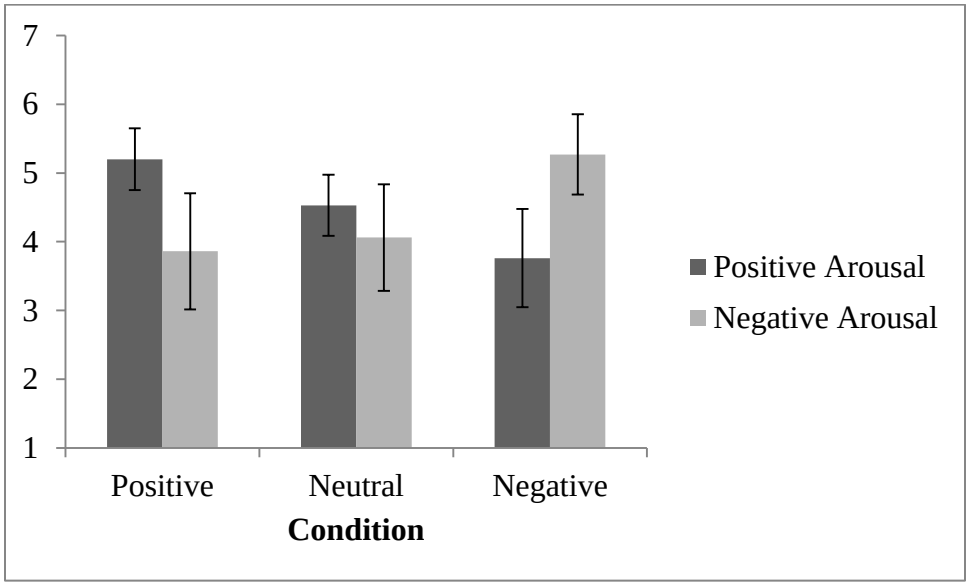
Two one-way ANOVAs were used to look at the single-item assessments of how positive or negative participants thought the speech task was overall. Participants in the positive condition reported the speech task to be significantly more positive overall than the neutral group followed by the negative group $F(2, 102)=46.90$, $p<.001$, all contrasts t's>3.63, *ps*<.002. For ratings of overall negativity by condition, $F(2, 102)=46.58$, $p<.001$, participants in the negative condition found the speech significantly more negative overall than the other two groups, *t*'s>48.55, *ps*<.001. The neutral group reported the speech task as being more negative than the positive group, $t(57.05)=2.26$, $p=.028$.

To compare how arousing participants found the different speech tasks, participants who reported feeling at least some positive or negative emotion because of the task (using the single-item assessments) were then prompted to answer how arousing they found those feelings. A total of 82 participants found the speech task at least a little positive in nature (35 in the positive

condition, 30 in the neutral condition, and 17 in the negative condition) and 65 participants found the task at least a little negative (14 in the positive condition, 18 in the neutral condition, and 33 in the negative condition).

To rule out the possibility that the differences in the TSST groups are predominantly based on valence and arousal, it is important to compare the level of arousal of the intended valence: positive feelings for the positive condition and negative feelings for the negative condition (i.e., the respective arousal). If the positive feelings in the positive condition are equally as arousing as the negative feelings in the negative condition then any differences in dependent variables could be attributed to valence only and not arousal. However, if one group experienced more arousing emotions (of the valence of the intended induction) this task would not provide a strong test of the effects of valence on a dependent variable, as valence would be confounded with arousal. To test this, an independent samples t-test was conducted comparing the respective arousal between the positive and negative conditions. There was not a significant difference in respective arousal, $t(61.46) = -0.20$, $p = .842$, demonstrating that the positive feelings among participants in the positive condition were equally as arousing as the negative feelings experienced by those in the negative condition (see Figure 3).

Figure 3.
Positive & Negative Arousal of Speech Task by Condition (Study 1)



Note. Error bars represent 95% Confidence Intervals.

TSST Appraisals.

A series of one-way ANOVAs were conducted to compare appraisals of the speech task by condition.

Task difficulty and effort. Participants in the negative condition found the task significantly more difficult than those in the positive, $t(67.91)= 5.38$, $p<.001$, or neutral groups, $t(51.79)= 8.70$, $p<.001$; overall $F(2, 102)=35.85$, $p=.000$. The task was rated as more difficult in the positive condition compared to the neutral condition, $t(52.91)= 2.15$, $p=.036$. There was a marginal difference between conditions in how much effort they reported putting into the task, $F(2, 102)=2.80$, $p=.066$, but no planned contrasts were significant, ts <1.58, ps>.117.

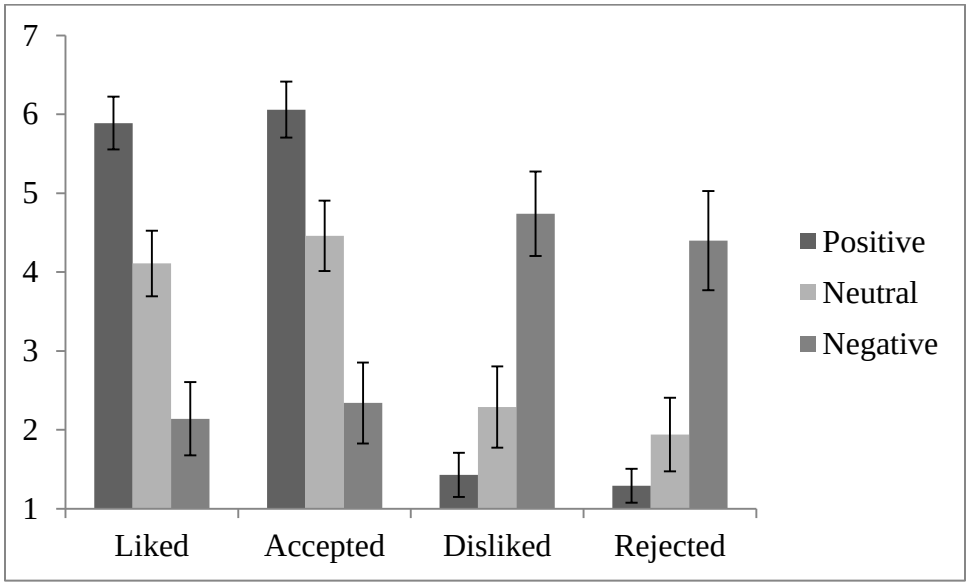
Evaluation by others. Regarding whether participants thought their performance during the speech was being evaluated, the omnibus test revealed marginal differences between groups, $F(2, 102)=2.93$, $p=.058$, where the negative group believed their speech was being evaluated more so than the neutral group, $t(102)= 2.42$, $p=.017$, but the positive group did not differ from

the negative or neutral group in this domain, *ts* < 1.32, *ps* > .18. There were no group differences on whether the participants thought their speech performance would be evaluated at a later time, $F(2, 102)=2.16$, $p=.121$.

There were significant differences between groups on how they thought observers would have rated their overall performance, $F(2, 102)=17.89$, $p<.001$, and how effective they thought they were at meeting the goal of the researcher, $F(2, 102)=3.92$, $p=.023$. Participants in the negative condition believed their performance would have been rated significantly worse than participants in both the positive, $t(66.32)= 4.92$, $p<.001$, and neutral conditions, $t(54.49)= 4.83$, $p<.001$. Similarly, participants in the negative condition believed they were significantly less effective at meeting the goals of the researcher compared to both the positive, $t(62.89)= 2.34$, $p=.022$, and neutral conditions, $t(59.63)= 2.22$, $p=.030$. The positive and neutral group did not significantly vary from one another on how they thought their performance would be evaluated or in how effective they thought they were at meeting the goals of the researcher.

Four one-way ANOVAs revealed significant group differences in reports of feeling liked, accepted, disliked, and rejected, *Fs*>50.78, *ps*<.001. All contrasts were significant, *ts*>2.62, *ps*<.012 (see Figure 4), where participants in the positive group felt significantly more liked and accepted, and significantly less disliked and rejected, than the neutral and negative groups. The neutral group felt significantly more liked and accepted, and significantly less disliked and rejected than the negative group.

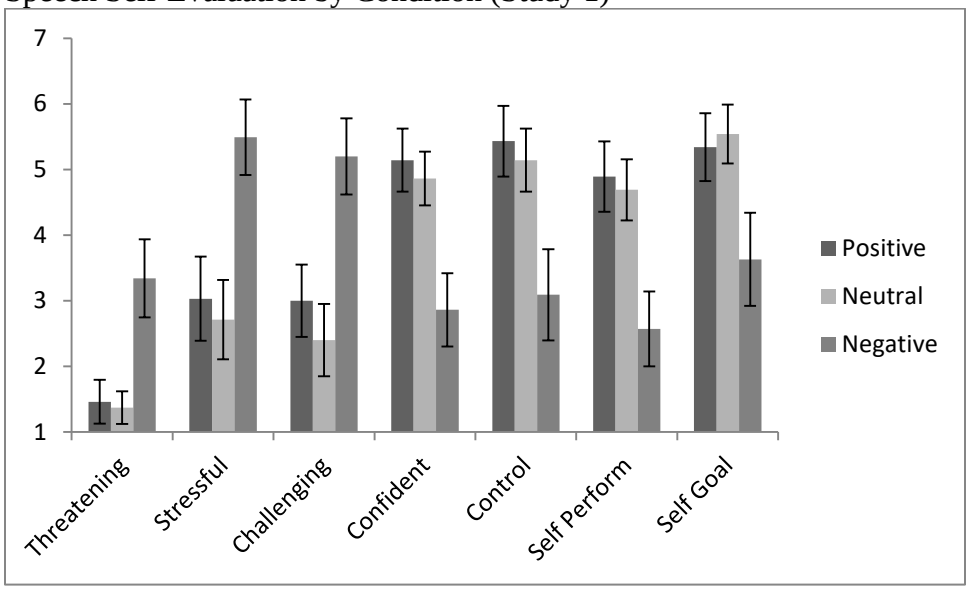
Figure 4.
Feeling Liked & Accepted by Condition (Study 1)



Note. Error bars represent 95% confidence intervals.

Self-evaluation. Participants rated how threatening, stressful and challenging they thought the speech task was. They also rated how confident, in control, and how they thought they performed overall. Participants also were asked to describe what their main goal was during the task (open-ended) and then rated how effective they thought they were in meeting their goal. All omnibus tests were significant, *Fs*> 14.18, *ps*<.001. Planned contrasts revealed no differences between the positive and neutral groups for any variables. The negative condition was significantly different from the positive and neutral groups on all variables, *ts*>3.98, *ps*<.001, where the negative group rated the task as more threatening, stressful, and challenging, felt less confident and in control, and rated themselves as performing worse and being less effective in meeting their goals for the task (See Figure 5).

Figure 5.
Speech Self-Evaluation by Condition (Study 1)



Note. Error bars represent 95% confidence intervals.

Impressions of evaluators. Participants were also asked to indicate their impressions of the speech evaluators on friendliness as well as what positive and negative emotions they thought the evaluators were feeling. All three omnibus tests were significant, *Fs*> 38.05, *ps*<.001, and all contrasts were significant as well, *ts*>2.27, *ps*<.001. Participants in the positive condition rated the evaluators as significantly more friendly, followed by participants in the neutral and negative conditions. A similar pattern was found for how much positive emotion participants thought the evaluators were experiencing (positive > neutral > negative). The opposite pattern was found for negative emotions participants thought evaluators were experiencing (negative > neutral > positive).

Previous TSST Experience

A total of 14 participants (3 in the neutral condition, 4 in positive, and 7 in negative) reported either probably or definitely having participated in a previous TSST study. All analyses were re-run excluding these people, assuming that prior experience with a Trier might diminish

the effect of a subsequent Trier. However, nearly all results remained the same (both in direction and significance) when excluding these individuals.

Three differences emerged in the analyses on TSST appraisals. First, after excluding individuals who had previously completed the trier, the omnibus test regarding whether participants thought their performance during the speech task was being evaluated became significant, $F(2, 88)=4.40$, $p=.015$. The negative group remained the highest on this measure, but the positive and negative groups became marginally different, $t(88)=1.93$, $p=.057$. The neutral and positive conditions were similar. Second, ratings of whether participants thought they were effective at meeting the goals of the researcher were no longer significantly different between the negative and neutral conditions, $t(45.45)=1.88$, $p=.067$. Lastly, the significant difference between the neutral and negative condition regarding how much positive emotion they thought the evaluator experienced became only marginally significant, $t(88)=5.39$, $p=.085$.

Study 1 Discussion

In summary, Study 1 successfully demonstrated the effectiveness of two new TSST conditions: one neutral and one positive in nature. Results provided support for Hypotheses 1a-1c in that the positive TSST increased positive emotion in the participants (although contrary to what was predicted, negative emotion did not change); the neutral group did not change in positive or negative emotions; and the negative group increased in negative and decreased in positive emotions. Hypothesis 2a was also supported in that the three groups differed significantly in positive emotions experienced as a result of the TSST. Hypothesis 2b was only partially supported, however, in that the negative group was significantly higher in negative emotion than the other two groups, but the positive and neutral groups did not significantly vary from one another. One possible explanation for the lack of difference in negative emotion

between the positive and neutral groups is the presence of a floor effect. Participants in both groups started with low levels of negative emotions. The speech task did not alter negative emotion for either group, but it would have been difficult to lower the already low levels any more for the positive group. If participants in future studies begin in a more negative mood, I would expect those in the positive condition would decrease their negative emotions experienced from baseline to post-speech.

The one-item assessments of how positive and negative the groups found the speech task also provided support for Hypotheses 1a-2b. The task was rated most negative by the negative group (and least negative by the positive group) and most positive by the positive group (and least positive by the negative group). Importantly, participants did not differ in reported levels of arousal such that the positive feelings among those in the positive condition were reported as being equally as arousing as the negative feelings among those in the negative condition. Thus, the manipulation was successful in isolating an effect of valence, not arousal.

The groups differed in the expected direction as far as appraisals regarding the speech task, their own performance, and the evaluators of the speech task. Participants in the negative condition felt the task was more difficult, threatening, stressful, and challenging, felt more disliked and rejected, found the evaluators less friendly, and thought they performed worse compared to participants in the neutral and positive conditions. On the other hand, participants in the positive condition felt most liked and accepted, least disliked and rejected, and found the evaluators as the most friendly compared to the negative and neutral condition. These results demonstrate the effectiveness in not only inducing the intended emotional responses among participants, but also in influencing cognitive appraisals of the experience. It should be noted, however, that the positive and neutral conditions did not differ on a number of variables,

including how much they thought they were being evaluated, how well they thought they performed, in how threatening, stressful, challenging they found the task, or in how confident and in control they felt. Although an ideal manipulation would have created group differences in how confident and in control they felt as well as how well participants felt they performed (all factors I aimed to increase in the positive condition), it is less surprising not to find differences among the other variables. Neither the positive or neutral tasks were meant to be threatening, stressful, or challenging. Furthermore, participants in both the positive and neutral conditions were told that they were not being evaluated.

Finally, the direction and significance of the main results remained largely the same even after excluding participants who had engaged in a similar Trier task in the past. Because there were no changes in the nature of the results after excluding these participants, it is likely that the three TSST conditions are effective even for those who have done a similar task in the past. In sum, the positive and neutral TSST conditions tested in Study 1 were efficacious. This was the first study to implement a version of a positive TSST that successfully increased positive emotion among participants to the extent that there were group differences in post-speech positive affect between all three conditions.

Study 2 Introduction

Given the effectiveness of the three Trier conditions from Study 1, Study 2 aims to use these mood inductions to test the influence of valence on memory accuracy. Memory for past emotional experiences informs our future decisions. Given this, it is important to understand under what conditions memory for past emotional experiences is accurate, when it is biased, and what influences these biases. Study 2 assesses memory accuracy for details of the TSST experience and memory for the emotions experienced during the speech task.

The f-TSST and Memory Accuracy

Two[3] of the studies that attempted the f-TSST also tested memory accuracy as a function of being in the f-TSST or classic negative TSST conditions (Wiemers, Sauvage, Schoofs, et al., 2013; Wiemers, Sauvage, & Wolf, 2013). Although these previous studies were unable to elicit group differences in positive emotion, their results are useful in informing hypotheses for the present studies. In both of the previous f-TSST and memory studies, a number of objects (e.g., pencil, water bottle, stopwatch) were present during the speech session that served as content for a memory test one day later. TSST evaluators interacted with some of the objects (e.g., sharpened the pencil) but did not interact with other objects in the room. Objects that the evaluators used were considered central objects, as they were associated with the evaluators (who were the source of stress). Objects that were not used were considered peripheral objects. The memory test included a recognition task where participants rated how sure they were they had seen the exact object pictured on the computer screen. All critical objects were pictured (both central and peripheral) as well as a number of distractor objects that weren't originally in the speech room. One of the studies also asked participants to identify the faces of the TSST evaluators in a set of pictures which included 3 distractors (Wiemers, Sauvage, Schoofs, et al., 2013).

In both studies, the participants in the negative TSST condition had better memory for central objects compared to those in the f-TSST condition, but there was no difference in recognition of peripheral objects between groups. Participants in the negative TSST group also had better memory accuracy for the evaluators' faces than participants in the f-TSST group. These results support the notion that negative emotion relays greater memory benefits than those

[3] A third study did measure memory accuracy between the f-TSST and a control condition other than the classic negative TSST (Wiemers & Wolf, 2015). This study attempted to understand the influence of cortisol, not emotional valence, on memory accuracy, and thus will not be discussed here.

afforded by positive emotions for information that is centrally related to the source of the emotional response. Results from these studies should be interpreted with caution, however, given that the groups only differed in levels of negative emotion (but not necessarily positive) and also had differences in cortisol reactivity. Because participants in the negative conditions had a pronounced increase in cortisol not observed among participants in the f-TSST conditions, memory differences could possibly be due to effects of arousal, and not valence.

Furthermore, the distinction between central and peripheral information in the context of memory has been debated and some may argue that the definition of a central object as one that is used during an experience as overly inclusive. Some researchers define central information as being spatially integral to the emotional event, others define it as information that is conceptually related to the theme of the overall event (Levine & Edelstein, 2009). Still others define central features as being details that are relevant to the pursuit of a person's goals (Levine & Pizarro, 2004). The information tested in memory by Wiemers and colleagues does not necessarily fit with these various definitions of central compared to peripheral details.

Memory for Positive and Negative Emotion

In addition to assessing memory accuracy for details about past emotional situations, a number of studies have also measured how accurately people can remember the intensity and frequency of the emotions experienced in the past (see Levine et al., 2009 for a review). Our emotional response to what happens during an event is what informs us of whether it was ultimately good or bad in the context of the goals we were pursuing at the time. Like memory accuracy for the details of past events, however, memory for the emotions that we experienced is not indelible (Levine et al., 2009). In general people are able to accurately remember what emotions they have experienced in the past, but are less accurate when estimating the intensity of

those felt emotions. People tend to overestimate when recalling the intensity of previously experienced emotions (Levine et al., 2009; Miron-Shatz, Stone, & Kahneman, 2009; Thomas & Diener, 1990). Furthermore, negative emotions tend to be overestimated in memory to a greater extent than positive emotions (Miron-Shatz et al., 2009; Thomas & Diener, 1990). The reason negative emotions are overestimated to a greater extent is thought to be due to the greater survival implications negative events have compared to positive. It is safer to overestimate how negative something was in the past so as to be sure to avoid it in the future (Miron-Shatz et al., 2009; Rozin & Royzman, 2001).

The gap between how intensely an emotion was experienced and how intensely it was recalled varies not only as a function of valence, but also by different individual difference characteristics. For example, one daily diary study found that people across the sample overestimated how negative they felt during the week when recalling their emotions at the end of the week (Urban, Charles, Levine, & Almeida, under review). However, people with a history of depression overestimated their negative emotions to an even greater extent, which may contribute to difficulty recovering from depressive symptoms and vulnerability for experiencing recurring depressive episodes. Other studies have found that overestimations of emotion vary by age (Mill, Realo, & Allik, 2016), personality traits (Barrett, 1997), and repressive coping style (Cutler, Larsen, & Bunce, 1996), but not as a function of anxiety (Wenze, Gunthert, & German, 2012).

Understanding how emotions are, or are not, biased in memory is important for understanding the decisions people make in the future. Research has shown how people *remember* feeling in past situations is a stronger predictor of what they intend to do in the future than how they reported feeling in the moment (e.g., Safer, Levine, & Drapalski, 2002; Wirtz,

Kruger, Scollon, & Diener, 2003). Therefore, studying the ways in which memories of emotion may be biased by a variety of factors, such as the characteristics of the individual or the overall emotional tone of the experience, would help inform how people use memory to make important decisions about the future.

Study 2 Method

Research Design and Hypotheses

The aim of Study 2 was to examine how the valence of an experience influences integral memory accuracy regarding details related to the cause of the emotional experience. Memory accuracy was tested by examining memory for central and peripheral episodic details of the TSST experience and memory for the felt emotions during the TSST as a function of valence. Participants underwent one of three conditions using the same methodology that was validated in Study 1. In Study 2 blood pressure was also measured during a baseline period, the speech task, and recovery so that changes in physiological arousal could be compared between groups. In addition to participating in a version of the TSST, participants in Study 2 also took part in a second study session approximately 1 week later where they were given a surprise memory test on details regarding the TSST experience. Participants also reported how willing they would be to participate in a similar future study. My hypotheses regarding memory for central and peripheral details (hypotheses 3a-3b), memory for positive and negative emotions (hypotheses 4a-4b), and willingness to repeat a similar future study are detailed below:

Hypothesis 3a: Details central to the TSST experience will be best remembered among the emotional conditions compared to the neutral condition, with the negative condition having the best memory accuracy for central TSST details.

Hypothesis 3b: Details peripheral to the TSST experience will be best remembered among the emotional conditions compared to the neutral condition, with the positive condition having the best memory accuracy for peripheral TSST details.

Hypothesis 4a: Participants in all three conditions will tend to slightly overestimate the positive emotions they experienced during the TSST experience.

Hypothesis 4b: Participants in all three conditions will tend to overestimate the negative emotions they experienced during the TSST experience. This overestimation will be to a greater extent than the overestimation of positive emotion.

Hypothesis 5a: Participants in the positive condition will be more willing to participate in a similar future study than those in the neutral and negative conditions; those in the negative condition will be the least likely.

Hypothesis 5b: Willingness to participate in a similar future study will be influenced by the positive and negative emotions remembered from the TSST (the less positive and more negative the participant remembered feeling, the less willing to participate in a similar future study) and this will hold even when adjusting for emotions actually reported just after the TSST.

Power Analysis

A small to medium effect of emotion induction on memory accuracy was expected. A power analysis was conducted using the power package in Rstudio (RStudio Team, 2016) to determine the sample size necessary to detect a small to medium effect at a level of power of .80. For an effect size of r = .20 and an alpha level .05, the program recommended recruiting a total of 234 participants for three groups. Therefore my goal was to collect full data from 78 participants in each condition.

Given that the neutral and positive condition did not differ in negative emotion after the TSST in Study 1, I ran preliminary analyses after the first 85 participants had been collected (28 in the positive condition, 29 in the neutral condition, and 28 in the negative condition) to assess the initial effectiveness of the mood induction. Because the positive and neutral conditions did not differ in either negative or positive emotion following the speech-task, I ceased data collection in the neutral condition.

Participants

A total of 199 participants were recruited for Study 2 through the University's human subjects pool. Individuals who had participated in Study 1 were not able to sign up for Study 2. Participants were awarded class credit for participation and those who attended both research sessions were also entered into a raffle to win one of 35 Amazon gift cards in the amount of $20 each. The raffle was included to reduce attrition rates between study sessions. Of participants who enrolled, one withdrew due to feeling uncomfortable with being video recorded. Data from another participant was discarded due to a failure to follow directions during the speech-task. Thus, 197[4] comprised the final sample of participants who completed the first session (82 in the positive condition, 29 in the neutral condition, and 86 in the negative condition). Of that number, 179 returned to complete the study in the second session approximately one week later. Data from three participants was discarded due to inattention or not complying to researcher

[4] Six participants are missing data for blood pressure ratings due to machine or researcher error, thus blood pressure analyses include only 191 participants (80 in positive, 27 in neutral, 84 in negative). Due to a researcher error, one participant in the negative condition was missing responses to baseline questionnaires including baseline positive and negative emotion. Thus, the *n* for the negative condition is one smaller for any analyses including measures taken during the baseline questionnaire section.

instructions. Therefore, a total of 176[5] participants have data for the second session (75 from the positive condition, 28 from the neutral condition, and 73 from the negative condition).

More than three quarters (82.2%) of the sample identified as being female. Participants were 52.8% Asian/Pacific Islander, 24.9% Hispanic, 10.7% Caucasian, 1.5% African American, 7.1% Biracial/Multiracial, 2% other ethnicities, and 1% declined to answer. More than three quarters (80.2%) of the sample reported being native English speakers. At the time of the pre-screen questionnaire, a total of 97.5% of participants indicated being 25 and younger, and 92.4% indicated being 21 and younger. The median age range for participants was 18-21. Thus, this sample is representative of a typical college-aged sample.

Procedures

Participants signed up for two study sessions at the same time and were instructed to schedule their sessions between 5 and 9 days apart. The actual range of time between sessions was 4.65 days to 9.79 days (*M*=6.79, *SD*=1.40). On the day of their first session, participants were welcomed into the lab by a trained RA who gave a brief introduction to the study and obtained informed consent. Participants next took a brief screening questionnaire on the computer to assess eligibility for the study. Eligibility criteria were the same as in Study 1 and those who did not meet these criteria were thanked for their time, dismissed, and awarded partial credit.

Intake, baseline, and resting BP. Those who were eligible then had their weight, height, and the circumference of their non-dominant arm measured. Afterwards, the participant completed a number of study questionnaires, including a measure of baseline positive and negative emotion and several other questionnaires assessing depression, trait positivity,

[5] 2 early participants only completed part of the session 2 questionnaires due to a researcher error. Therefore, analyses regarding memory accuracy for TSST details include 2 fewer people than other session 2 analyses.

rumination, trait anxiety, anxiety sensitivity, social anhedonia, social avoidance, emotion regulation, and personality. The measures of individual differences do not apply to the aims of the dissertation and thus are not discussed further in this document. After completing the baseline measures participants underwent a 5-minute resting period during which the RA took 6 blood pressure measurements, each 1 minute apart (starting at the beginning of the resting period). Once the resting period was completed, the RA ushered the participant into a second study room, attached a blood pressure cuff that could be operated from the first room, and explained that the participant would be working with two other researchers for the next part of the study.

Mood induction, recovery, and session 1 dismissal. After the first RA left the room, two TSST RAs entered and administered the TSST mood induction procedure, as described in Study 1. During the speech, the participant's blood pressure was measured 5 times, one minute apart (starting 30 seconds after the speech had commenced). Once the speech task was complete, the TSST RAs left the room and the first RA ushered the participant back into the original study room. The participant then completed a brief questionnaire assessing post-TSST emotion. After this questionnaire was completed, the RA began measuring blood pressure during a 5-minute period while the participant continued taking questionnaires on the computer regarding their TSST experience. Six blood pressure measurements were taken every minute, starting after the participant completed the post-TSST emotion questionnaire.

The blood pressure measurements during the recovery period did not start until after the participant reported the emotions experienced during the speech task to reduce the amount of time between the actual speech task and reports of experienced emotions. Because the blood pressure cuff takes some time to attach, affixing it immediately would have increased the amount

of time between the speech task and emotion measurement, making the post-TSST emotion measurement less of a real-time measure.

Once the recovery period and questionnaires were completed, the RA thanked the participant for their time, reminded them of their second appointment, and dismissed them. The first study session was designed to be completed in one hour.

Follow-up session. Approximately one week after the first session, participants attended a 30-minute follow-up session in a completely novel laboratory room. The participant was welcomed by an RA who did not administer their TSST task (and in most cases had not interacted with the participant at all during the first session). Once arriving in the laboratory, the participant was asked to remember the emotions they felt during the TSST and were given a surprise memory test about the contextual details of the TSST from the previous session. They were also asked to identify the researchers who administered the TSST and questions about how much they ruminated about the speech task since its completion. Task-specific rumination was not applicable to the aims of the dissertation and thus is not discussed further.

After the memory test was over, the RA informed the participant that the lab was considering running a similar TSST study again in the future, but instead of getting credit, students would be paid cash for their participation. The participant was asked if they would be willing to give feedback regarding the study they completed so that the lab could plan how much future participants should be compensated for different tasks of the future study. We did not actually intend to run a second study, but used the hypothetical second study to measure how the participant's emotional experience during the TSST and their memory of this experience impacted their intentions for engaging in similar experience in the future. The participant was given a hard copy feedback questionnaire (see Appendix D) which contained questions regarding

the participant's willingness to participate in a similar future study, how much future participants should be paid, and whether the participant wanted to add their name to a list of people interested in participating in the new study.

Once the feedback questionnaire was completed, the RA debriefed the participant regarding the true purpose of the study. The participant was told that no participants were actually being evaluated regardless of the condition they were placed into and that we were intentionally trying to make participants in one of the conditions feel stressed. The participant was then asked if they had any questions about the study and were dismissed. Participants who failed to show up to the second session of the study were emailed the same debriefing statement.

One-month follow-up email. Participants who indicated they wanted to add their name to a list of potential participants for the hypothetical new study were emailed one month after their second session. The email directed the participant to a one-question survey asking the participant to indicate whether they'd like to be contacted about scheduling an appointment to participate in the new study. If participants indicated "no" they were told they would not be contacted about the study again. If participants indicated "yes" they were informed that the new study was not actually occurring and this was part of the study they had originally completed. They were given the lead researcher's email address to contact if they had any questions or concerns.

Session 1 Measures

Similar to Study 1, participants completed measures of Baseline and post-TSST positive and negative emotion, Post-TSST overall valence and arousal, Performance Appraisal Questionnaire, and Previous TSST experience. See above for descriptions of these measures. Due to a survey error, participants in Study 2 were not asked to estimate how much the Trier

researchers were feeling any positive or negative emotions. In addition to those measures, participants completed several other questionnaires, described in the section below.

Demographics. Demographic information for eligible Study 2 participants, including age, gender, race/ethnicity, and education, was pulled from the University's human subjects pool repository. These data were gathered when participants signed up to use the system using a pre-screening questionnaire and are available to researchers once participants sign up for the study. Participants completed the pre-screen anywhere between 3.5 years before the commencement of the current study to immediately before signing up to participate. Age was measured by asking participants to indicate their age within a set of age ranges (17 and under, 18-21, 22-25, 26-30, and 31-40). Because of these age ranges and the variable time lapse between when the pre-screen was completed and when the current study was completed, exact age could not be computed.

Blood pressure. Participants were affixed with a blood pressure cuff at three separate times during the study: during a 5 minute baseline period, the 5 minute speech-task, and the 5 minute recovery period. Six measurements using a GE CARESCAPE V100-1 blood pressure machine were taken every 60 seconds during the baseline and recovery periods with the first measurement taken at 00 seconds and the last measurement taken at 5 minutes. A total of five measurements were taken every 60 seconds during the speech-task portion, where the first measurement was taken at 30 seconds and the last was taken at 4 minutes and 30 seconds. Each measurement produced a reading of systolic blood pressure (SDP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and pulse.

For each measurement segment the average of each of the four indicators were taken, such that there was one mean SDP, DBP, MAP, and pulse for each participant at three time points (baseline, during the speech-task, and during recovery).

Session 2 Measures

Recalled positive and negative emotion. During the second session of the study, participants were asked to recall the positive and negative emotions they experienced during the TSST. This scale was comprised of the same 12 positive and 14 negative emotions assessed at baseline and just after the TSST on the same scale. Average recalled positive and negative emotion was calculated. Participants also recalled how positive and negative overall they remembered feeling during the session as well as how activating or arousing they remember those emotions to have been.

Recalled central and peripheral details. Participants were given a surprise memory test regarding the contextual details of the TSST. The memory test was divided into two parts: first a series of yes/no questions followed by a series of multiple choice questions which required participants to recall objects or experiences in more detail than the yes/no questions. These forced-choice questions required participants to recall details of the room in which they gave their speech and details about study procedures or the task itself (see items in Appendix E).

Yes/no memory questions. Participants first completed a recognition memory task containing a series of yes/no questions[6]. Approximately half of the questions measured features that were central, or thematically related to the speech task and the other questions measured features that were peripheral, or thematically unrelated to the speech task. The correct answer to half of all questions was "*yes*" and these were equally distributed between central and peripheral questions. Example questions included "*Did you have a specific amount of time to give your speech?*" (central) and "*Was there a shelf along the wall of the speech room?*" (peripheral). Each

[6] Four central yes/no questions were added for the final wave of data collection given the original central questions were answered correctly at an extremely high rate. The original central yes/no questions might have been too easy, making it difficult to detect group differences in accuracy. The four new questions were intended to be somewhat more difficult (regardless of condition). Therefore, for 56 participants, there were 16 central yes/no questions and 12 peripheral yes/no questions.

correct answer was given one point and the total score was computed by adding up the total number of correct answers. Scores were computed separately for central and peripheral questions. The correct answer to two of the yes/no central questions depended upon condition (e.g., "*Did the researcher say that they were evaluating your speech performance for quality?*").

Detailed memory questions. Next participants completed a series of more detailed questions regarding the speech task experience[7]. Each question required participants to identify a specific detail about the speech task from the first session and were given three choice options. These questions were again designed to either measure a central or peripheral detail. For example, participants were asked "*How much time did you have to give your speech?*" (central) and chose from 4, 5, or 6 minutes. Another sample question included "*What was on the shelf that was along the wall of the speech room?*" (peripheral) and chose from a laptop, a textbook, or a stapler. Correct responses to each question were given one point and the total number of correct answers were summed for central and peripheral questions separately. The correct answer to three of the central detail questions depended upon the participant's condition because they asked about condition-specific details of the task.

Computing memory accuracy scores. For each participant an overall accuracy score was computed by taking the total number of correct responses and dividing them by the total number of responses participants gave. This percentage score takes into account any skipped questions and allows for comparison between all participants regardless of the number of questions they were presented. In addition to an overall accuracy score, an accuracy score for each question type (central overall, central yes/no, central detail, peripheral overall, peripheral yes/no, peripheral detail) was computed. Therefore, each participant has a total of 7 accuracy scores

[7] As with the central yes/no questions, three central detail questions were added for the final wave of data collection. For the final participants, there were 9 central detail questions and 6 peripheral detail questions.

(overall, overall central, overall peripheral, central yes/no, central detail, peripheral yes/no, peripheral detail).

Memory confidence. After each forced-choice memory question participants were asked to indicate how confident they were that their answer to the previous question was correct on a scale from 1 (*not at all confident*) to 5 (*very confident*). Confidence judgements were modeled after those used by Van Damme & Seynaeve, (2013).

For the multiple choice questions, participants also indicated whether they vividly remembered the answer they provided, whether it just felt familiar, or if they were just guessing the correct answer. These questions were designed to exclude participants who reported just guessing and to measure whether the phenomenological experience of remembering was different as a function of emotional condition. These questions were modeled after Nemeth & Belli, (2006).

TSST researcher identification. Participants were also asked to identify the researchers who listened to the speech task. They were instructed specifically to identify the researchers who were in the room with them while they gave their speech, not the researcher who greeted them at the beginning of the first session. Participants were shown a series of pictures of all the study RAs one at a time and were asked to indicate "*yes*" if that person had listened to the participant's speech and "*no*" if they had not. Pictures of RAs who were responsible for running the second study session were not included in the identification test.

Given changes in personnel during the course of the study there were three separate sets of RA pictures that were shown to participants. Two sets contained a total of 10 pictures and one set contained a total of 12 pictures. In seven cases, a second TSST researcher was unavailable for a session at the last minute, so those participants only interacted with one TSST researcher. For

all other cases participants interacted with two researchers whose picture were contained in the picture set.

For each participant the total number of identifications was summed (potential scores included 0, 1, or 2) and then divided by the number of RAs who listened to their speech (either 1 or 2). Furthermore, the total number of misidentifications were summed (potential scores included 0 to 10 for two sets of pictures and 1 to 12 for one set of pictures) and divided by the number of pictures in each set (either 10 or 12) minus the number of RAs who listened to the participant's speech task (either 1 or 2). From these calculations each participant received an index of percentage of correct identifications and percentage of misidentifications.

Willingness for similar future experiences. Before participants were debriefed and dismissed from the study, they were given a feedback questionnaire used to assess their willingness to repeat the study again and asking how much money future participants of a similar study should be paid. Five total questions were asked on this feedback questionnaire. The first two questions asked participants to report how willing they would be to do <u>just</u> the speech task in a future study and how much participants should be paid <u>just</u> for completing the speech task in the future study. The second and third questions asked participants how willing they would be to participate in the <u>whole</u> study (inclusive of the speech task) and how much future participants should be paid for completing the <u>whole</u> study. Willingness was measured on a scale of 1 (*not at all willing*) to 7 (*extremely willing*) and compensation was measured on a scale of $0 to $60 listed in $5 increments. The questions about compensation were meant to capture the amount the participants thought would be needed to make participating in the study worthwhile. Thus, a greater suggested compensation indicated a greater expectation that the future study would be stressful, anxiety-provoking, and strenuous.

On the back page of the feedback questionnaire[8], the final question mentioned that the future study will likely compensate participants $15 for their participation and asked the participant whether they would like to sign-up to participate in the new study by checking "yes" to being contacted by email.

Study 2 Results

Mood Induction Efficacy

As in Study 1, two RM GLMs were conducted to test change in positive and negative emotion by condition (see Table 2 and Figures 6 and 7). For positive emotion, there was a marginally significant main effect of condition, $F(2, 193)=2.08$, $p=.128$, $\eta_p^2=.021$, but no main effect of time, $F(1, 193)=1.06$, $p=.305$, $\eta_p^2=.005$. However, there was a significant interaction between condition and time, $F(2, 193)=28.94$, $p<.001$, $\eta_p^2=.231$. The neutral condition had significantly higher baseline positive emotion than the positive condition but not the negative condition. The positive and negative groups did not differ significantly in levels of baseline positive emotion. For the neutral group, the mean level of positive emotion decreased slightly, but not significantly, after the speech-task. Following the speech task, positive emotion for the positive group increased significantly and decreased significantly in the negative group. Positive emotion was significantly higher after the speech task in the positive condition compared to the negative condition. After the speech task the neutral group did not differ significantly from the positive group in positive emotion, but had significantly higher positive emotion than the negative group.

[8] The first 30 participants were asked this question orally by the RA. Nearly all participants indicated that they would like to be contacted in the future. Only three participants (one from each condition) indicated that they would not like to be contacted for the future study. To resolve this issue, the question was added to the hard-copy feedback form to reduce the social pressure of agreeing to be contacted in the future. Therefore, analyses regarding willingness to be contacted will only be performed using data from participants who read the question on the feedback form.

Table 2.

Study 2 Emotion Means, Standard Errors, and 95% CIs by Valence and Condition

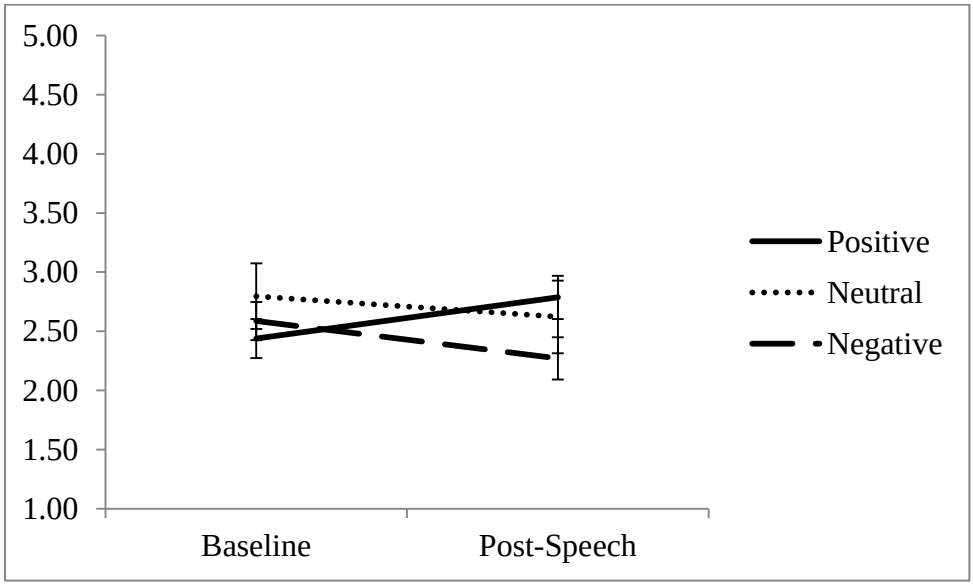
	Baseline Positive Emotion		Post-Speech Positive Emotion	
Condition	*M* (*SE*)	95% CI	*M* (*SE*)	95% CI
Positive	2.44 (0.08)	2.27 - 2.60	2.79 (0.09)	2.60 - 2.97
Neutral	2.80 (0.14)	2.52 - 3.07	2.62 (0.16)	2.32 - 2.93
Negative	2.59 (0.08)	2.43 - 2.75	2.27 (0.09)	2.09 - 2.45

	Baseline Negative Emotion		Post-Speech Negative Emotion	
Condition	*M* (*SE*)	95% CI	*M* (*SE*)	95% CI
Positive	2.11 (0.08)	1.96 - 2.26	1.75 (0.08)	1.59 - 1.91
Neutral	1.99 (0.13)	1.74 - 2.24	1.79 (0.14)	1.52 - 2.06
Negative	2.11 (0.08)	1.97 - 2.26	2.35 (0.08)	2.19 - 2.51

Note. SE = Standard Error; CI = Confidence Interval

Figure 6.

Change in Positive Emotion by Condition (Study 2)

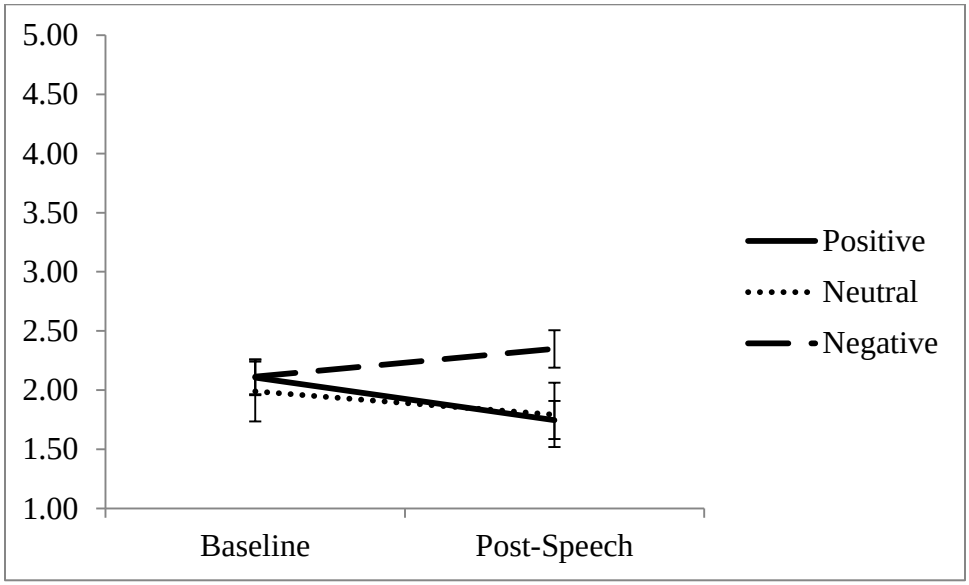


Note. Error bars represent 95% confidence intervals.

Regarding negative emotion change, a main effects of condition, $F(2, 193)=5.56$, $p=.004$, $\eta_p^2=.054$, and time, $F(1, 193)=5.17$, $p=.024$, $\eta_p^2=.026$, was further qualified by a significant interaction between condition and time, $F(2, 193)=22.29$, $p<.001$, $\eta_p^2=.188$. Groups did not differ significantly in baseline negative emotion. The neutral group did not show a significant change in negative emotion over time. The positive group decreased significantly and the negative group increased significantly as a result of the speech task. Following the speech task, the negative

group had significantly higher negative emotion than both the neutral and positive groups, which did not differ from one another.

Figure 7.
Change in Negative Emotion by Condition (Study 2)



Note. Error bars represent 95% confidence intervals.

Taking results from Study 1 and Study 2 together, the effects of the mood inductions were largely consistent across both studies. The neutral group showed no change in positive or negative emotion over time in either study. Furthermore, the negative group reliably increased in negative emotion and decreased in positive emotion as a result of the speech task. Participants in the positive condition reliably increased in positive emotion in both studies and decreased in levels of negative emotion in Study 2 (though showed no change in Study 1).

When comparing the conditions on positive and negative emotion reported after the speech task by condition, the positive group consistently reported the most positive emotion and the negative group reported the most negative emotion. The neutral emotion induction was less successful, however, in that it did not reliably differ from the positive condition in measures of positive or negative emotion after the speech-task. The neutral and positive conditions reported

similar patterns of negative emotion in both studies; in only Study 1 did the neutral and positive conditions differ in levels of positive emotion.

The lack of positive emotion differences between these two groups in Study 2 are likely driven by the fact that the neutral group had significantly higher baseline levels of positive emotion than the positive and negative groups. If the groups had started with similar baselines, the results would have been similar to Study 1. Therefore, although the neutral condition was not entirely successful in this set of studies, including a neutral condition in future research could still prove useful as a control condition to which the positive and negative groups can be compared.

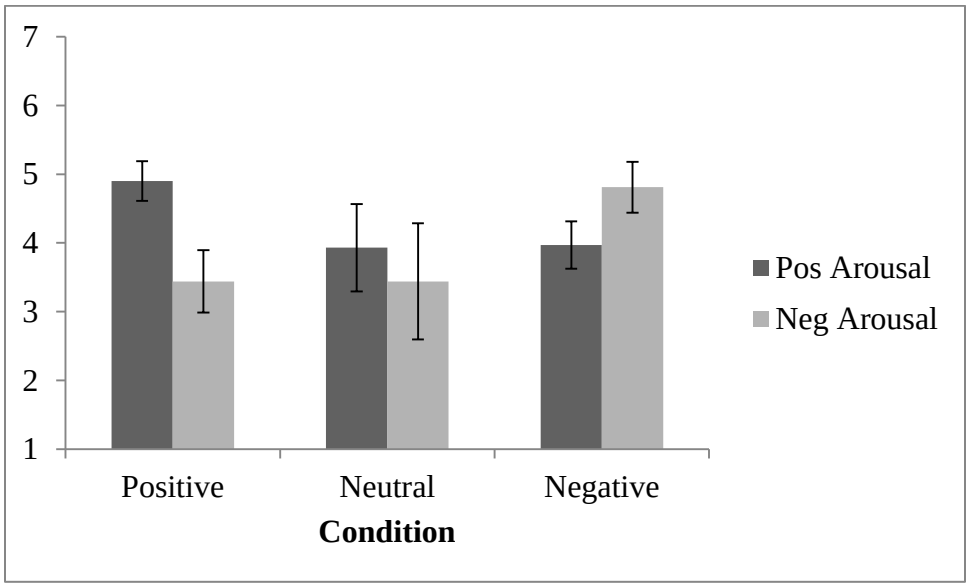
Speech Task Overall Valence and Arousal

Regarding how positive overall participants found the speech task as a function of condition, a significant one-way ANOVA, $F(2, 194)=40.54$, $p<.001$, and planned contrast tests revealed that participants in the positive condition found the task most positive followed by those in the neutral condition and then the negative condition, all $ts>2.36$, $ps<.020$. A second one-way ANOVA, $F(2, 194)=70.07$, $p<.001$, revealed that participants in the negative condition found the task as more negative overall than participants in both the neutral and positive groups, $ts>7.99$, $ps<.001$, but the neutral and positive groups did not differ in how negative they found the speech task, $t(44.80)=0.62$, $p=.541$.

A total of 170 participants rated the speech task as being at least a little positive (81 in the positive condition, 27 in the neutral condition, and 62 in the negative condition). One hundred thirty five participants rated the speech task as at least a little negative (39 in the positive condition, 16 in the neutral condition, and 80 in the negative condition). An independent samples t-test revealed that participants in the positive condition found the positive emotions

they experienced to be equally as arousing as the negative emotions experienced by those in the negative condition, $t(150.10)=0.37$, $p=.709$, see Figure 8.

Figure 8.
Positive & Negative Arousal of Speech Task by Condition (Study 2)



Note. Error bars represent 95% confidence intervals.

TSST Appraisals

Task difficulty and effort. A significant one-way ANOVA and planned contrasts revealed that as in Study 1, participants in the negative condition found the speech task to be significantly more difficult than those in the positive and neutral conditions, $ts>6.78$, $ps<.001$, overall omnibus $F(2, 194)=58.35$, $p<.001$. In contrast to Study 1, the positive group did not perceive the task to be more difficult than the neutral group, $t(194)=-0.59$, $p=.559$. The one-way ANOVA regarding the amount of effort put in by participants was not significant, $F(2, 194)=0.27$, $p=.764$, showing that groups did not vary how much effort they expended during the speech task.

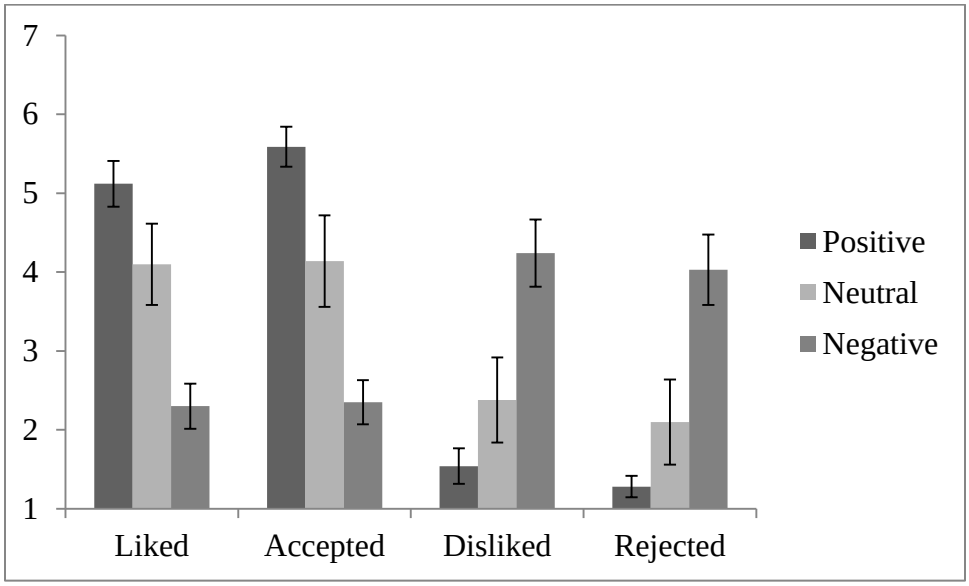
Evaluation by others. As expected (although in contrast to Study 1), there were significant differences in whether the participants thought their speech was being evaluated

during the task, $F(2, 194)=16.99$, $p<.001$. All three contrasts were significant, $ts>3.06$, $ps<.003$, such that the negative group felt like they were being evaluated the most and the neutral group felt they were being evaluated the least. There were marginal group differences regarding whether the participants thought their speech would be evaluated at a later time, $F(2, 194)=2.76$, $p=.066$, where the neutral condition thought evaluations at a later time were less likely compared to the positive and negative condition, $ts>2.07$, $ps<.040$.

Participants in the negative condition thought their performance would be rated significantly worse by observers than the neutral and positive conditions, $ts>5.99$, $ps<.001$, omnibus $F(2, 194)=60.43$, $p<.001$. In addition, participants in the positive condition thought they would be rated significantly better than the neutral condition, $t(55.38)=2.71$, $p=.009$. As in study 1, there were group differences in how effective participants believed they were at meeting the goals of the researcher, $F(2, 193)=31.26$, $p<.001$, where the negative group thought they were significantly less effective than the neutral and positive groups, $ts>4.98$, $ps<.001$, which were not significantly different from one another, $t(48.32)=0.92$, $p=.362$.

As in Study 1, the three groups differed significantly on how much they felt liked, accepted, disliked, and rejected, $Fs>63.51$, $ps<.001$. All contrasts were significant, demonstrating that the positive group felt the most liked and accepted, followed by the neutral group; the negative group felt the most disliked and rejected, $ts> 2.93$, $ps<.006$, (see Figure 9).

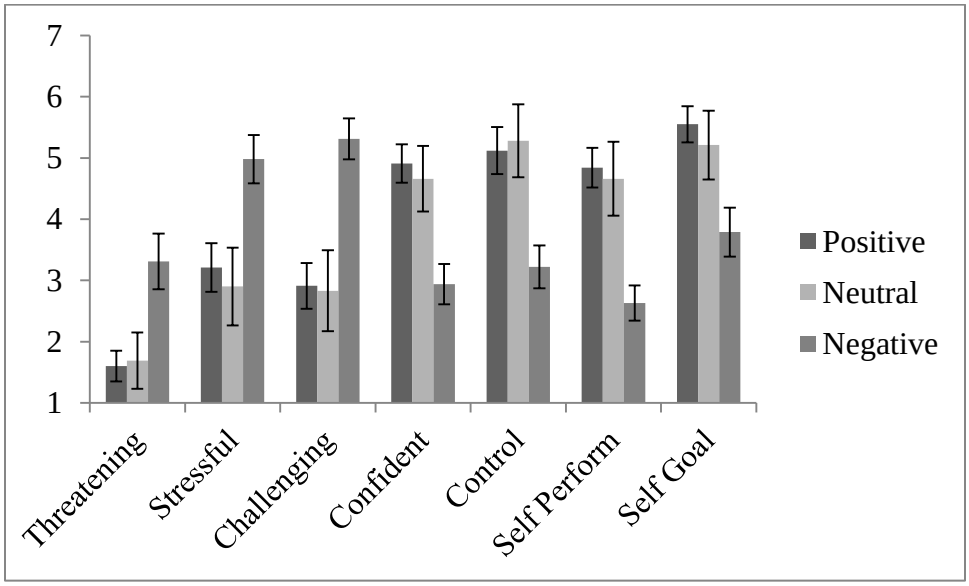
Figure 9.
Feeling Liked & Accepted by Condition (Study 2)



Note. Error bars represent 95% confidence intervals.

Self-evaluation. Results regarding group differences in self-evaluation variables after the speech-task replicated those from Study 1 and indicated that the experimental manipulation had its intended effects on self-evaluation (See Figure 10), *Fs*>25.50, *ps*<.001. Compared to the positive and neutral groups, the negative group rated the task as being more threatening, stressful, and challenging, felt less confident and in control, and thought they performed worse and were less effective in meeting their goals, *ts*>4.15, *ps*<.001. As in Study 1, there were no differences on any of these variables between the positive and neutral groups, *ts*<1.10, *ps*>.279.

Figure 10.
Speech Self-Evaluation by Condition (Study 2)



Note. Error bars represent 95% confidence intervals.

Impressions of evaluators. As in Study 1, participants differed significantly in how friendly they found the Trier evaluators to be, $F(2, 193)=246.80$, $p<.001$. All three contrasts were significant, $ts>6.94$, $ps<.001$, showing that the positive group found the evaluators to be most friendly, followed by the neutral and finally the negative groups.

Blood Pressure by Condition

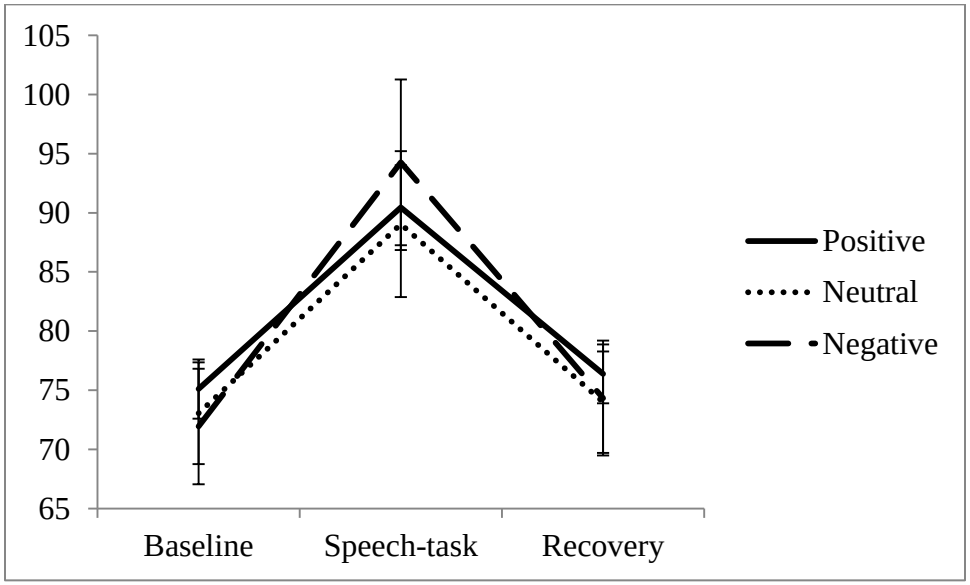
To test whether conditions differed in respect to physiological arousal during the speech task, four RM GLMs were conducted comparing the effects of time (baseline, speech-task, and recovery) and condition on averaged measures of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and pulse.

For all four measures, there were main effects of time, $Fs > 276.55$, $ps<.001$, showing that SBP, DBP, MAP, and pulse all increased between the baseline and speech-task periods, then declined again during recovery. For SBP, DBP, and MAP there were no main effect of condition

or interaction between condition and time *Fs* < 1.97, *ps* > .11, showing that there were no group differences in the rate at which SBP, DBP, or MAP changed over time.

For pulse, there was again no significant main effect of condition, $F(2, 188)=0.27$, $p=.761$, $\eta_p^2=.003$, however, there was a significant interaction between condition and time, $F(2.53, 237.93)=6.04$, $p=.001$, $\eta_p^2=.060$, see Figure 11 and Table 3. At baseline, the positive condition had significantly higher average pulse than the negative condition; the neutral condition did not differ from either the positive or negative condition at baseline. In looking at change from baseline to during the speech-task, the negative condition had greater increases in average pulse than both the positive and neutral condition. The negative group had a higher average pulse during the speech-task than the neutral group (significantly so) and the positive group (marginally significant). Furthermore, the negative condition had greater decreases in average pulse between the speech-task and recovery compared to the positive and neutral groups. Groups did not differ significantly in the average pulse recorded during the recovery period.

Figure 11.
Average Pulse by Condition Over Time



Note. Error bars represent 95% confidence intervals.

Table 3.

Average Pulse Means, SEs, and 95% CIs by Condition Over Time

	Baseline Average Pulse		Speech-Task Average Pulse		Recovery Average Pulse	
Condition	*M* (*SE*)	95% CI	*M* (*SE*)	95% CI	*M* (*SE*)	95% CI
Positive	75.10 (1.27)	72.60 - 77.60	90.44 (1.27)	86.86 - 94.03	76.37 (1.26)	73.88 - 78.86
Neutral	73.06 (2.18)	68.76 - 77.37	89.04 (3.13)	82.87 - 95.21	74.00 (2.17)	69.71 - 78.29
Negative	71.94 (1.24)	69.50 - 74.38	94.27 (1.77)	90.77 - 97.77	74.33 (1.23)	71.90 - 76.77

Note. *SE* = Standard Error; CI = Confidence Interval

Previous TSST Experience

A total of 30 participants in Study 2 reported either probably or definitely participating in a Trier-like speech task for a past study (6 in the neutral condition, 10 in the positive condition, and 14 in the negative condition). Analyses regarding the mood induction efficacy, speech task appraisals, and blood pressure measurements were re-run excluding these 30 individuals. Nearly all results remained the same when excluding individuals who had participated in a TSST previously. The few differences are outlined below.

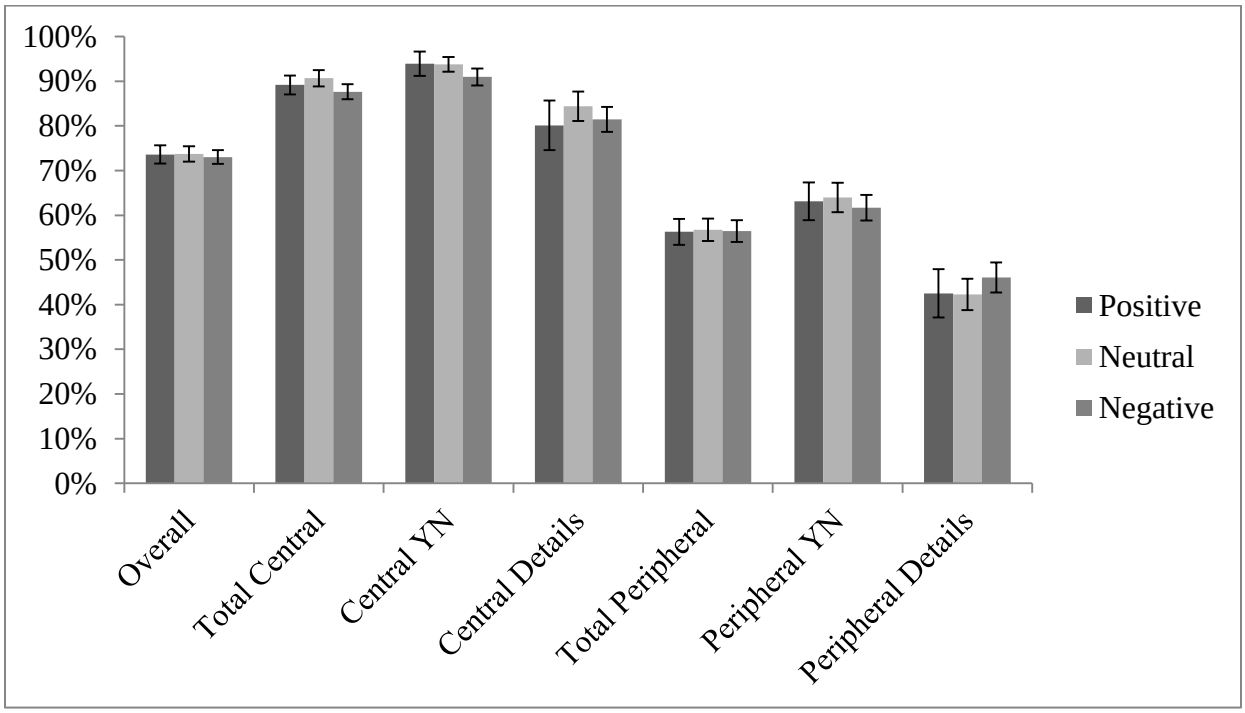
The main effect of time when looking at change in negative emotion by condition was no longer significant, $F(1, 163) = 2.30$, $p=.137$, $\eta_p^2=.014$. However, this did not change the nature of the significant interaction between time and condition. Second, the significant difference between groups on whether they thought they would be evaluated on the speech task at a later time became non-significant, $F(2, 164) = 1.27$, $p=.282$, $\eta_p^2=.014$. Participants in the neutral condition were no longer less likely to believe they could be evaluated at a future time compared to participants in the positive and negative conditions.

For changes in pulse over time by condition, the significance and direction of the time by condition interaction remained unchanged. The only difference lay in the significance of group differences in average speech-task pulse. Whereas the analysis that included all participants revealed that the negative group was significantly or marginally higher in speech-Task average pulse compared to the neutral group and positive groups (respectively), after excluding those who had completed a Trier speech task in the past the negative group was now only marginally higher than the neutral group and was now significantly higher than the positive group. This does not influence the finding that the negative group increases from baseline to the speech-task and decreases from the speech-task to recovery at a greater magnitude than the other two groups.

Memory Accuracy

Memory Accuracy for TSST details. A series of 7 one-way ANOVAs were conducted testing each memory accuracy score (overall, overall central, overall peripheral, central yes/no, central detail, peripheral yes/no, peripheral detail) as a function of condition (see Figure 12). Only the central yes/no accuracy measure was detected as having significant group differences, $F(2, 171)=3.14$, $p=.046$. Planned contrasts revealed that there was no significant difference between the positive and neutral group in accuracy, $t(171)=.10$, $p=.925$, but that the negative group had significantly worse accuracy than the positive group, $t(171)=-2.37$, $p=.019$, and marginally worse accuracy than the neutral group, $t(171)=-1.66$, $p=.098$. The remaining 6 omnibus ANOVAs were non-significant, $Fs< 1.93$, $ps>.148$.

Figure 12.
Memory Accuracy by Condition and Question Type



Note. Error bars represent 95% confidence intervals.

Because few differences between groups appeared in the overall accuracy scores, each yes/no and multiple choice memory question was examined to assess the overall rate of correct

responses. The central yes/no questions had a high rate of correct responses, with 90% or more of participants getting the correct answer for 12 of the 16. The central detail questions were more challenging, but 90% or more of the participants got the correct answer for 4 of the 9. None of the peripheral yes/no or detail questions received 90% or higher correct responses. Therefore, it seems that there was a ceiling effect of these questions, particularly for those central in nature.

A series of chi-square tests were conducted for each memory accuracy question to test whether there were group differences in the percentage of participants who responded with the correct answer. Of all 43 questions (including those added for the final wave of data collection), only 7 were revealed to have moderate ($p<.10$) or significant ($p<.05$) group differences. See Table 4 for a breakdown of the correct responses by condition and chi-square statistics.

Table 4.
Memory Accuracy by Question Type and Condition

		Percentage Correct				
Central Yes/No	Total N	Overall	Positive	Neutral	Negative	χ^2 statistic
Were you standing during your speech?	174	99.43	98.65	100.00	100.00	χ^2 (2) = 1.36, p = .507
Did you get to take notes while preparing for your speech?	174	98.28	98.65	96.43	98.61	χ^2 (2) = .672, p = .714
Were the researchers in the speech room while you prepared for your speech?	174	98.28	98.65	100.00	97.22	χ^2 (2) = 1.02, p = .599
Did you have a specific amount of time to give your speech?	174	97.70	98.65	96.43	97.22	χ^2 (2) =.57 , p = .752
Did the researchers let you know when you had 1 minute left in your speech?	173	97.11	98.65	92.86	97.18	χ^2 (2) = 2.43, p = .297
After ending the speech, did the researchers ask you how well you thought you did during your speech?	174	95.40	93.24	92.86	98.61	χ^2 (2) = 2.89, p = .236
Did the researchers ask you to repeat part of your speech for clarity?	56	94.64	100.00	--	90.00	**χ^2 (1) = 2.75, p = .097**[c]
Did the researchers move a microphone to the desk in front of you after the speech preparation period was over?	174	93.10	94.59	92.86	91.67	χ^2 (2) = .49, p = .783
Was your speech recorded using a video camera?	171	92.98	93.15	85.71	95.71	χ^2 (2) = 3.07, p = .215[d]
Did the researchers tell you that you would be able to use your notes during the speech?	56	92.86	88.46	--	96.67	χ^2 (1) = 1.41, p = .234
Did the researchers remind you how long you must continue to talk during the speech right before they told you to begin?	56	92.86	92.31	--	93.33	χ^2 (1) = .02, p = .882
Did the researchers time you while you gave your speech?	174	90.80	90.54	85.71	93.06	χ^2 (2) = 1.31, p = .519
Did the researchers tell you to look into the video camera during your speech?	174	87.93	95.95	100.00	75.00	**χ^2 (2) = 19.67, p = .000**
Were you instructed to talk about a particular topic during your speech?	174	86.21	87.84	92.86	81.94	χ^2 (2) = 2.31, p = .316
Did the researchers instruct you to imagine they were not research assistants, but were taking on a different role during your speech?	174	78.16	78.38	89.29	73.61	χ^2 (2) = 2.91, p = .234
Did the researchers say that they were evaluating your speech performance for quality?	56	75.00	88.46	--	63.33	**χ^2 (1) = 4.69, p = .030**
Central Details MPC	Total N	Overall	Positive	Neutral	Negative	χ^2 statistic
What topic were you instructed to talk about during your speech?	174	98.85	98.65	100.00	98.61	χ^2 (2) = .39, p = .823
How much time did you have to give your speech?	174	95.98	97.30	100.00	93.06	χ^2 (2) = 3.10, p = .212
From your perspective, where in the speech room was the video camera located?	174	95.40	94.59	96.43	95.83	χ^2 (2) = .21, p = .901
Who were you supposed to imagine the people who listened to your speech were?	174	93.10	87.84	96.43	97.22	**χ^2 (2) = 5.58, p = .061**[a]
How much time did you have to prepare for your speech?	56	80.36	84.62	--	76.67	χ^2 (1) = .56, p = .455

What did the researchers say the reason was for video recording your speech?	56	75.00	57.69	--	90.00	**χ^2 (1) = 7.75, p = .005**
What did the researchers say once the speech task was over?	56	66.07	61.54	--	70.00	χ^2 (1) = .45, p = .505
What color stopwatch did the researchers use to time your speech?	174	57.47	58.11	67.86	52.78	χ^2 (2) = 1.90, p= .387
What color notepad did you take notes on while preparing for your speech?	171	51.46	54.79	44.44	50.70	χ^2 (2) = .87, p= .646[d]

Peripheral Yes/No	Total N	Overall	Positive	Neutral	Negative	χ^2 statistic
Was there a ceiling fan in the speech room?	174	89.08	89.19	92.86	87.50	χ^2 (2) = .60, p = .742
Was there a printer on the desk in the speech room?	174	86.78	89.19	85.71	84.72	χ^2 (2) = .67, p = .716
Was there carpet in the speech room?	174	80.46	82.43	71.43	81.94	χ^2 (2) = 1.74, p = .420
Was there a clock in the speech room?	173	75.72	78.38	75.00	73.24	χ^2 (2) = .53, p = .767
Was there a shelf along the wall of the speech room?	173	74.57	72.97	82.14	73.24	χ^2 (2) = 1.01, p = .603
Was there a poster on the wall of the speech room?	173	72.83	71.23	75.00	73.61	χ^2 (2) = .183, p = .913
Was there a lamp in the corner of the speech room?	174	71.84	72.97	82.14	66.67	χ^2 (2) = 2.47, p = .291
Did the researchers who listened to your speech sit behind a table?	173	60.69	66.22	39.29	63.38	**χ^2 (2) = 6.54, p = .038**
Was there a table next to the doorway in the speech room?	174	42.53	39.19	57.14	40.28	χ^2 (2) = 2.93, p = .231
Did the video camera beep when it started recording your speech?	174	39.08	41.89	39.29	36.11	χ^2 (2) = .51, p = .774
Was there a whiteboard in the speech room?	174	33.91	29.73	35.71	37.50	χ^2 (2) = 1.03, p = .597
Was there a key in the cabinet's keyhole at the back of the speech room?	174	24.71	24.32	32.14	22.22	χ^2 (2) = 1.08, p = .584

Peripheral Details MPC	Total N	Overall	Positive	Neutral	Negative	χ^2 statistic
What was written on the whiteboard in the speech room?	173	76.30	73.97	71.43	80.56	χ^2 (2) = 1.31, p = .520
How many times did the video camera beep when it started recording your speech?	173	72.25	65.75	67.86	80.56	χ^2 (2) = 4.28, p = .117[b, c]
What pattern of carpet was in the speech room?	174	71.84	72.97	67.86	72.22	χ^2 (2) = .272, p = .873
What color keychain was on the key that was in the cabinet's keyhole at the back of the speech room?	174	22.41	28.38	17.86	18.06	χ^2 (2) = 2.64, p = .268
What was on the shelf that was along the wall of the room of the speech room?	174	12.07	8.11	14.29	15.28	χ^2 (2) = 1.92, p = .382
What shape was the table that was next to the doorway in the speech room?	174	9.20	6.76	14.29	9.72	χ^2 (2) = 1.42, p = .492

Note. Some percentages missing due to questions being added after data collection for the Neutral condition had been completed. Significant and marginal omnibus tests are bolded.

[a]An additional chi-square was computed to measure for group differences between the Positive and Negative conditions, **χ^2(1) = 4.61, p = .032**.

[b]An additional chi-square was computed to measure for group differences between the Positive and Negative conditions, **χ^2(1) = 4.04, p = .068**.

[c] Question became non-significantly different between groups when only high confidence responses were included.

[d] Question became marginally significant (p<.07) when only high confidence responses were included.

Taking a closer look at the 7 questions with significant or moderately significant group differences, we can see that for all three of the central yes/no questions the negative condition had the *lowest* percentage of correct responses. For the central multiple choice questions, however, the negative condition had the *highest* percentage of correct responses (although for one of these questions this percentage did not differ from the percentage of participants in the neutral condition who got the question correct). For the peripheral yes/no question, the emotional groups (positive and negative) had a higher percentage of correct responses compared to the neutral group. Finally, for the peripheral multiple choice question, the negative group had a marginally higher percentage of correct responses than the other two conditions.

Two new accuracy scores were computed to test whether the question type (either yes/no or multiple choice) influenced memory accuracy as a function of condition. Items were collapsed across central/peripheral indicators, and two one-way ANOVAs were run with total yes/no question accuracy and total multiple choice question accuracy as the dependent variables. There were no significant group differences found, $Fs<1.29$, $ps>.27$.

Influence of high confidence on memory accuracy for TSST details. To reduce the amount of variance due to guessing, the 7 one-way ANOVAs were re-run only including items where participants reported high confidence in their responses (i.e., responding with at least a 3 on the scale of 1 "*not at all confident*" to 5 "*very confident*"). Results were similar to when responses of all confidence levels were included, where group differences existed only for central yes/no questions, $F(2, 171)=3.77$, $p=.025$. The negative group still had significantly worse accuracy compared to the positive group, $t(171)=-2.68$, $p=.008$, but now had non-significantly lower accuracy (as opposed to marginally significant) than the neutral group,

t(171)=-1.56, *p*=.121. There were still no differences between the neutral and positive group, *t*(171)=0.43, *p*=.664. The remaining omnibus tests remained non-significant, *Fs* < 2.30, *ps*>.103.

Again, a series of chi-square tests were run to examine differences in percentage of correct responses by group. Five of the same 7 questions remained significantly different between conditions, but two became non-significant. An additional 2 questions became significant (see Table 4). Of the questions that were significantly different by groups when only high confidence responses were included, only one was peripheral in nature (and was a yes/no question) and the emotional groups (positive and negative) outperformed the neutral group, $\chi^2(2) = 6.85$, *p*=.033. The remaining six were central in nature, 3 of which were yes/no questions. Of the central yes/no questions, either the negative group had the highest accuracy (in 2 of the 3 cases) or the emotional groups had the highest accuracy (in the 3rd case), *ps*<.066. For the central multiple choice questions, the direction of the effect was mixed, where the negative condition had the worst accuracy in one question, the best accuracy in a second, and for the third the positive and negative groups both performed better than the neutral group.

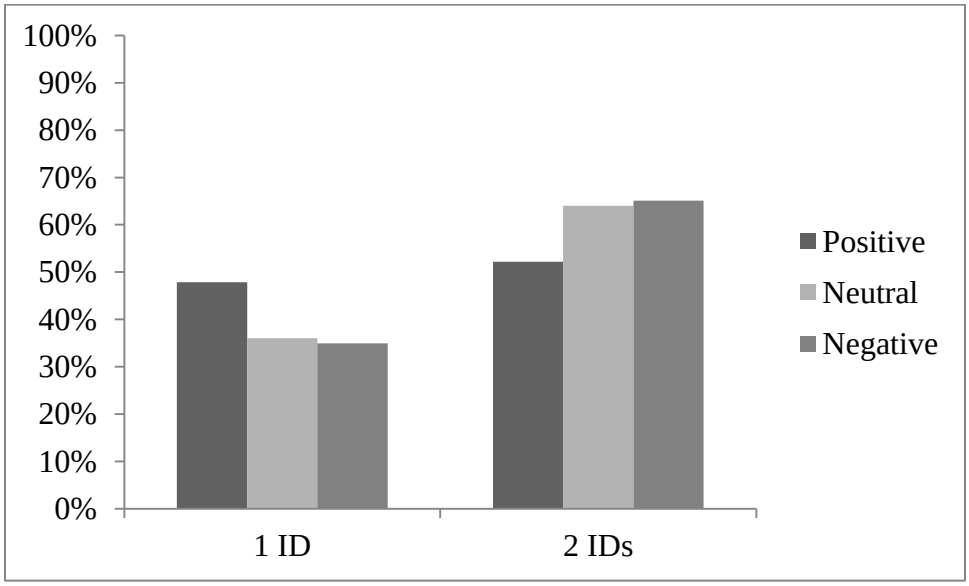
As before, two final one-way ANOVAs were conducted to examine whether there were group differences in overall accuracy as a function of question type (yes/no vs. multiple choice). In contrast to when all responses were included regardless of confidence level, results showed that the groups differed in accuracy on yes/no questions, F(2, 171)=4.02, p=.020, but not multiple choice questions, F(2, 171)=0.06, p=.941. When only high confidence responses were included, the negative group had significantly lower memory accuracy compared to the positive group, t(171)=-2.76, p=.006, and marginally lower memory accuracy compared to the neutral group, t(171)=-1.65, p=.101, on yes/no questions.

Influence of post-speech emotion on memory accuracy for TSST details. To examine whether the emotions participants felt following the speech were related to memory accuracy regardless of condition, a correlation between each accuracy score variable (both for all confidence responses and just high confidence responses) and post-speech positive and negative emotion was conducted. Only significant relationships will be mentioned here. When the whole sample was combined and only high confidence responses were examined, the more negative a person felt after the TSST the worse they performed on peripheral questions in general, r= -.15, p=.044, and on peripheral yes/no questions more specifically, r= -.18, p=.017. When running the same correlations for each condition separately, a few significant relationships emerged. For the neutral condition, the more negative a participant felt after the TSST, the worse they performed on peripheral questions in general, but only when all responses were included regardless of confidence, r= -.48, p=.011. For participants in the positive condition, the more positive they reported feeling after the TSST the less accurate they were overall on high confidence responses only, r= -.24, p=.040, particularly for multiple choice questions, r= -.24, p=.039. For participants in the negative condition for high confidence responses only, the more positive they reported feeling after the TSST, the worse they performed on central yes/no questions, r= -.27, p=.022.

The same set of correlations was conducted with the one-item appraisals of how positive and how negative participants found the TSST to be overall. Over the entire sample, the more negative participants thought the task was, the less accurate they were on overall accuracy for high confidence responses, r= -.18, p=.018, particularly for high confidence yes/no questions, r= -.16, p=.036. For participants in the negative condition, the more negative they found the TSST to be, the better they performed on central yes/no questions (but only when all levels of confidence responses were included), r= .25, p=.036.

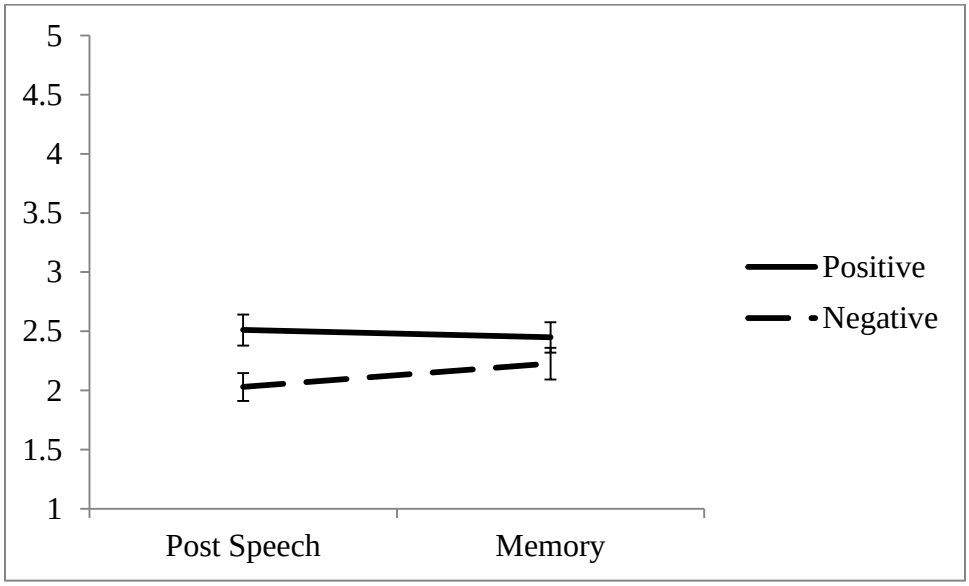
Identification of TSST researchers. Another indicator of memory accuracy is how well participants were able to recognize the people who listened to their speech during the first session. Both the percentage of correct identifications (identifying an evaluator who was actually present) and the percentage of incorrect identifications (identifying an evaluator who was not present) were examined. Participants were excluded from these analyses if they knew at least one of the TSST evaluators (n=4) or if there was only one TSST evaluator due to scheduling issues (n=7). Only six participants were unable to identify either of the TSST evaluators (two participants in each condition), so analyses regarding correct identifications were only conducted with participants who recognized at least one of the evaluators. Only four participants incorrectly identified both evaluators (two participants in the neutral condition, one in the positive condition, and one in the negative condition), so analyses regarding incorrect identifications excluded these individuals. A Kruskal-Wallis test revealed there were no significant differences between groups in the percentage of participants who only identified 1 evaluator compared to those who identified 2, $\chi^2(2)=2.54$, p=.282 (see Figure 13). A second test revealed that there were no significant difference between groups in the proportion of participants who incorrectly identified an evaluator who did not listen to the participant's speech, $\chi^2(2)=1.32$, p=.517.

Figure 13.
Number of Correct Evaluator Identifications by Percentage of Condition



Memory Accuracy for TSST Emotions. Correlational analyses revealed that participants were generally quite accurate when recalling the emotions they experienced as a result of the TSST. Recalled positive emotion was strongly correlated with experienced positive emotion, $r(174)=.81$, $p<.001$, and recalled negative emotion was strongly correlated with experienced negative emotion, $r(174)=.82$, $p<.001$. The lack of a perfect correlation, however, indicates that some memory bias for previously experienced emotions was present. A RM GLM was performed to assess the degree to which positive and negative emotions were biased in memory and whether this bias was larger for negative emotions that positive emotions (see Figure 14). Significant main effects of time and valence were qualified by a significant interaction between time and valence, $F(1, 175)=24.25$, $p<.001$, $\eta_p^2=.122$. Positive emotion was slightly underestimated in memory compared to post-speech, but this difference was not significant. Negative emotion, on the other hand, was significantly overestimated in memory compared to post-speech reports.

Figure 14.
Accuracy in Memory for Emotion by Valence



Note. Error bars represent 95% confidence intervals.

Next, two separate RM GLMs were conducted to assess memory accuracy for positive and negative emotions reported during the speech task as a function of condition (see Table 5 for means, standard errors, and 95% confidence intervals). For positive emotion, there were main effects of condition and time which were qualified by a significant interaction between condition and time, $F(2, 173)=6.13$, $p=.003$, $\eta_p^2=.066$ (see Figure 15). These effects remained significant when including baseline positive emotion as a covariate. In addition to the negative condition having significantly lower post-speech positive emotion compared to the other two groups, the negative condition was also the only group to significantly underestimate the positive emotion experienced during the TSST. Participants in the neutral and positive groups demonstrated no significant memory bias when recalling positive emotions.

Table 5.

Study 2 Post-Speech and Recalled Emotion by Valence and Condition

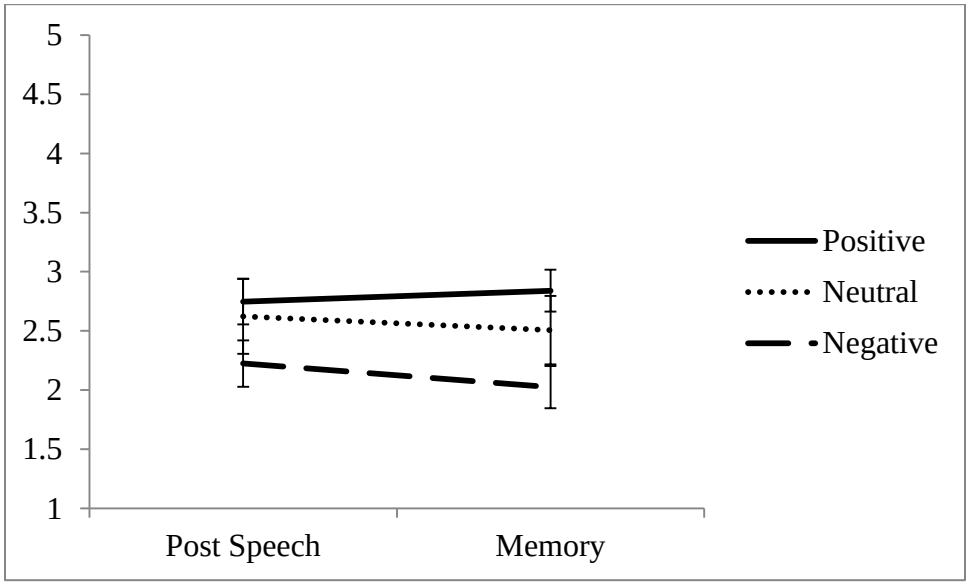
	Post-Speech Positive Emotion		Recalled Positive Emotion	
Condition	*M* (*SE*)	95% CI	*M* (*SE*)	95% CI
Full Sample	2.51 (0.07)	2.38 - 2.64	2.45 (0.07)	2.32 - 2.58
Positive	2.75 (0.10)	2.55 - 2.94	2.84 (0.09)	2.66 - 3.02
Neutral	2.62 (0.16)	2.31 - 2.94	2.51 (0.15)	2.22 - 2.80
Negative	2.22 (0.10)	2.03 - 2.42	2.02 (0.09)	1.85 - 2.20

	Post-Speech Negative Emotion		Recalled Negative Emotion	
Condition	*M* (*SE*)	95% CI	*M* (*SE*)	95% CI
Full Sample	2.03 (0.06)	1.91 - 2.15	2.23 (0.07)	2.09 - 2.36
Positive	1.79 (0.09)	1.62 - 1.96	1.86 (0.09)	1.68 - 2.05
Neutral	1.78 (0.14)	1.50 - 2.06	1.89 (0.15)	1.59 - 2.18
Negative	2.37 (0.09)	2.20 - 2.54	2.73 (0.09)	2.54 - 2.91

Note. SE = Standard Error; CI = Confidence Interval.

Figure 15.

Accuracy in Memory for Positive Emotion by Condition

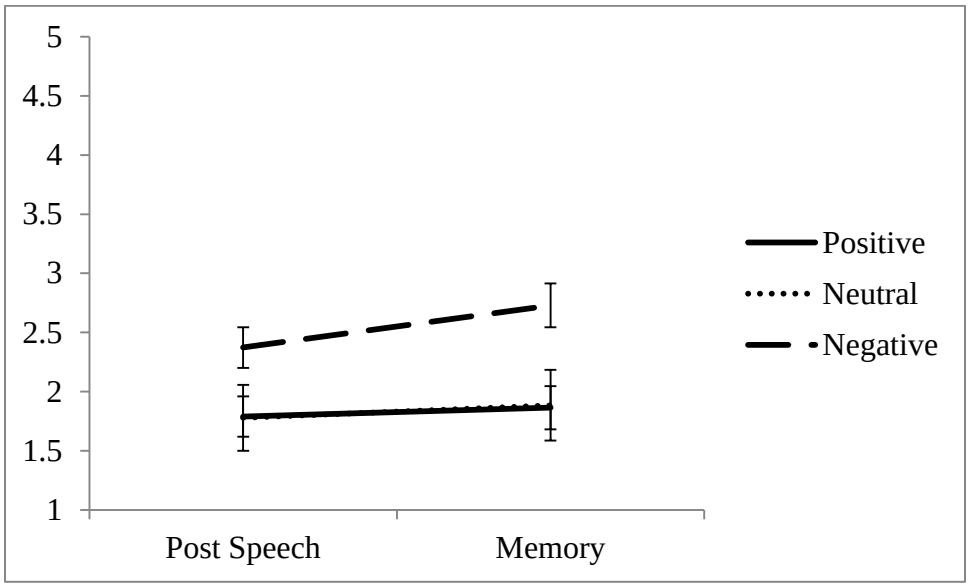


Note. Error bars represent 95% confidence intervals.

For negative emotion, there were significant effects of condition and time that were qualified by an interaction between condition and time, $F(2, 173)=6.24$, $p=.002$, $\eta_p^2=.067$ (see Figure 16). Adding in baseline negative emotion as a covariate did not change the significance or nature of these effects. The negative condition reported significantly higher negative emotion post-speech compared to the neutral and positive condition. Furthermore, the negative condition

significantly overestimated their experience of negative emotion during the TSST but the other two conditions showed no memory bias when recalling negative emotions.

Figure 16.
Accuracy in Memory for Negative Emotion by Condition



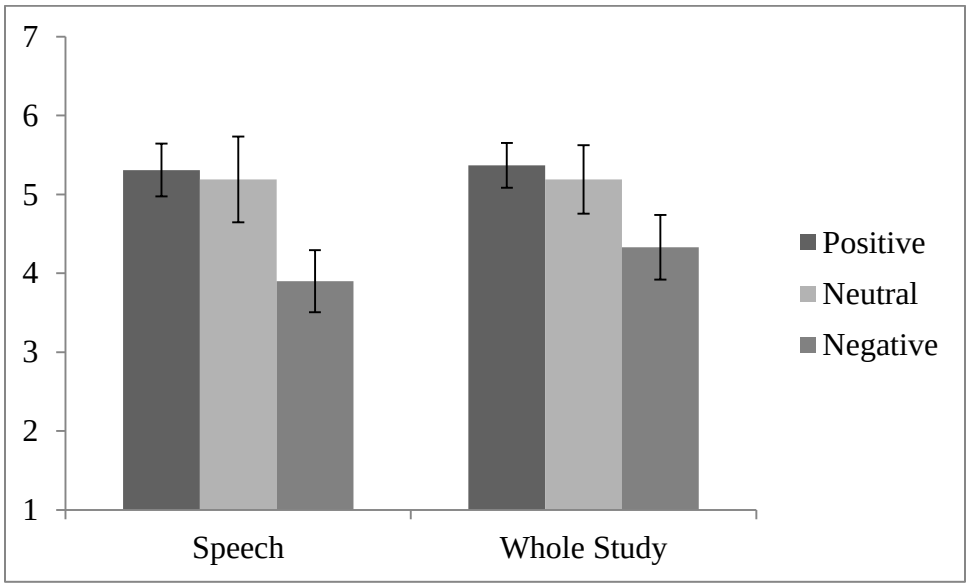
Note. Error bars represent 95% confidence intervals.

Willingness for Similar Future Experience

The participant's willingness to participate in another study similar to the one they were currently enrolled in was examined as a function of condition. Four significant one-way ANOVAs, $Fs > 3.71$, $ps < .026$, revealed that participants in the negative condition were significantly less willing to participate in a similar future study compared to the positive and neutral groups (for just the speech portion and for the whole 2-part study) and recommended significantly more compensation for future participants compared to participants in the positive group (again for both the speech portion and the overall study), $ts > 2.89$, $ps < .005$. Recommended compensation did not differ between the neutral and negative groups, $ts < 1.02$, $ps > .313$. Willingness and recommended compensation did not differ between the neutral and

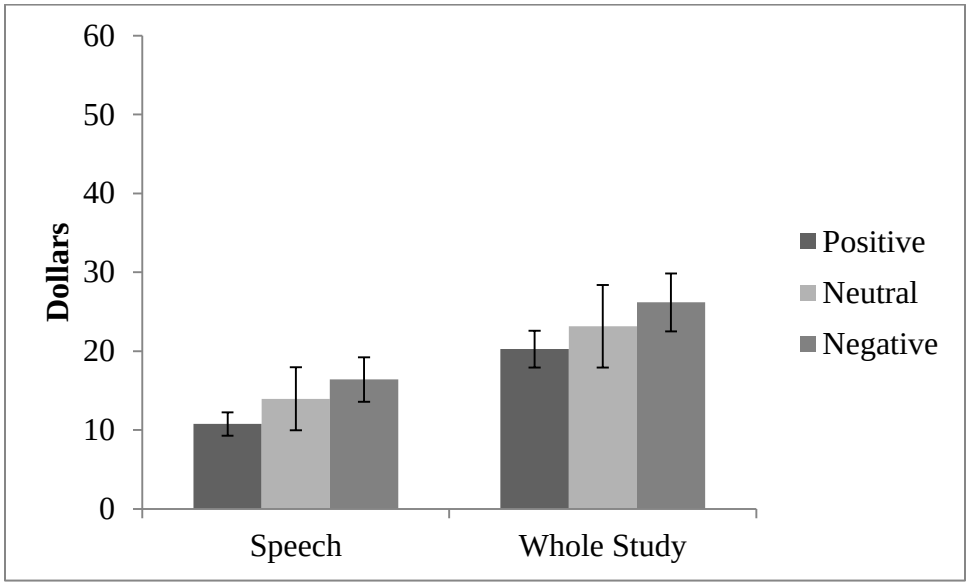
positive groups, *ts*< 1.54, *ps*>.134. See Figures 17 and 18 for graphical representations of these relationships.

Figure 17.
Willingness to Repeat Study Tasks by Condition



Note. Error bars represent 95% confidence intervals.

Figure 18.
Recommended Compensation for Future Participants by Condition



Note. Error bars represent 95% confidence intervals.

A chi-square test revealed significant group differences in whether participants wanted to be contacted for the supposed future study, $\chi^2(2)=14.90$, $p=.001$. The negative group was less likely than the positive and neutral groups to indicate that they wanted to be contacted for the future study (see Figure 19). A month later, when participants who indicated they would like to be contacted about a future study were emailed to ask about setting up an appointment, there were marginal group differences in whether they again agreed, $\chi^2(2)=4.84$, $p=.089$. The positive group was the most likely to agree to setting up an appointment compared to the neutral and negative groups (see Figure 20).

Figure 19.
Desire to be Contacted about Future Study by Condition

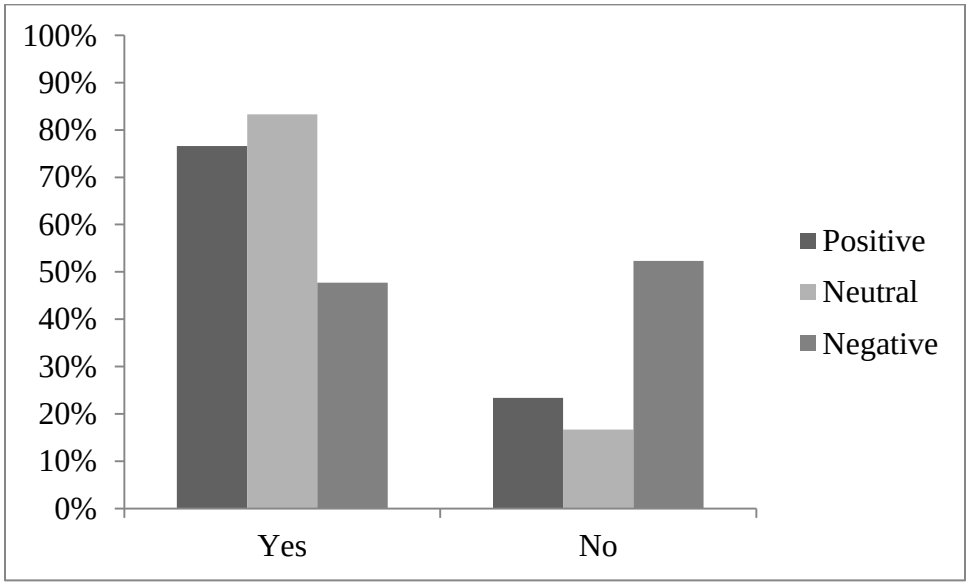
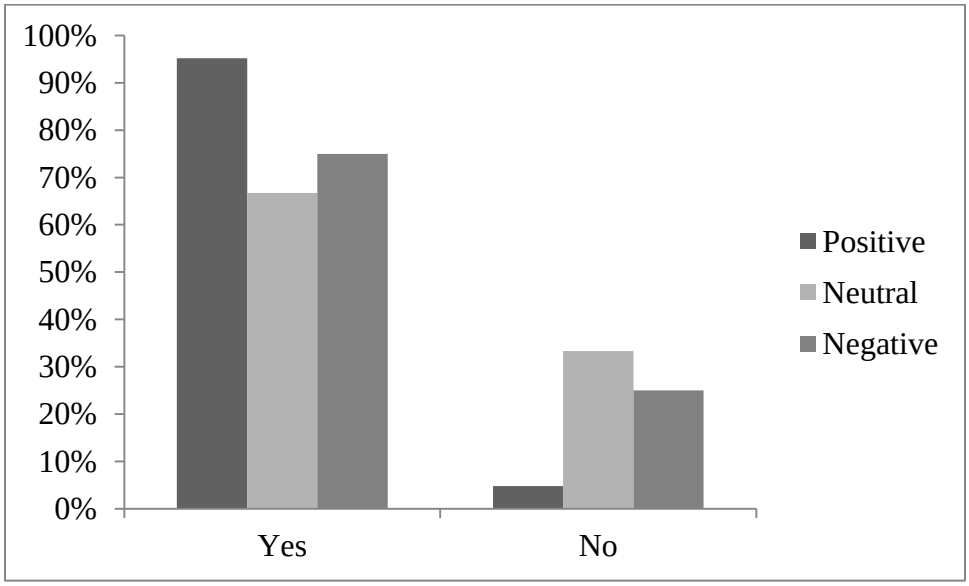


Figure 20.
Desire to Make New Appointment 1 Month Later by Condition



Remembered emotion's influence on similar future experience willingness. To examine the direct influence of experienced positive and negative emotion on willingness to complete a similar study in the future, correlations between the willingness variables, payment variables, and post-speech positive and negative emotion were conducted. The more positive a person felt after the speech task, the more willing they were to participate in another speech task, $r(172)=.49$, $p<.001$, and another similar study, $r(172)=.33$, $p<.001$. The more negative a participant felt after the speech task the less willing they were to participate in another speech task, $r(172)= -.39$, $p<.001$, or another similar study, $r(172)= -.36$, $p<.001$, and the more they recommended future participants be paid for the whole study, $r(172)=.15$, $p=.06$. There was no relationship between the post-speech positive emotions and amount of compensation recommended for a future speech task or overall study, r's< .15, ps>.06, or for the post-speech negative emotion and recommended compensation for just a future speech task, $r(172)=.12$, $p=.108$.

Similar results were found when looking at the correlations between the willingness and compensation variables along with remembered positive and negative emotion. To better understand the unique contribution of memory bias in influencing willingness to undergo a similar experience in the future, a series of stepwise regressions were computed. Each willingness or compensation variable was regressed first on recalled positive (or negative) emotion. Then post-speech positive (or negative) emotion was entered in the second step.

Recalled positive emotion was a significant predictor of each variable even after adjusting for positive emotion reported just after the speech task. The more positively participants recalled their emotions, the more willing they were to participate in another study, another speech task, and the less compensation they recommended for future participants (see Tables 6 and 7). Recalled negative emotion was a significant predictor of willingness to participate in another study and another speech task above and beyond negative emotion initially experienced, but was not a predictor of recommended compensation. The more negative participants recalled feeling, the less willing they were to participate in a similar future speech task or study.

Table 6.

Stepwise Regression of Willingness to Repeat Study Tasks on Recalled and Post-speech Positive and Negative Emotion

	Speech Willingness				Whole Study Willingness			
Positive Emotion	Model 1		Model 2		Model 1		Model 2	
	B (*SE*)	*t*	*B* (*SE*)	*t*	*B* (*SE*)	*t*	*B* (*SE*)	*t*
Constant	2.34 (0.34)	6.91***	2.09 (0.35)	6.00***	3.32 (0.33)	10.14***	3.23 (0.34)	9.41***
Recalled PA	0.97 (0.13)	7.42***	0.54 (0.22)	2.46*	0.65 (0.13)	5.12***	0.48 (0.22)	2.21*
Post-speech PA			0.51 (0.22)	2.37*			0.20 (0.21)	0.95
F	55.06***		31.08***		26.23***		13.56***	
R^2	.241		.265		.132		.136	
ΔF			5.63*				0.91	
ΔR^2			.024				.005	
Negative Emotion	Model 1		Model 2		Model 1		Model 2	
	B (*SE*)	*t*	*B* (*SE*)	*t*	*B* (*SE*)	*t*	*B* (*SE*)	*t*
Constant	6.98 (0.29)	24.51***	6.83 (0.30)	22.74***	6.49 (0.28)	23.13***	6.52 (0.30)	21.89***
Recalled NA	-1.02 (0.12)	-8.63***	-1.28 (0.21)	-6.24***	-0.71 (0.12)	-6.07***	-0.66 (0.20)	-3.25*
Post-speech NA			0.36 (0.23)	1.53			-0.07 (0.23)	-0.30
F	74.44***		38.68***		36.89***		18.39***	
R^2	.301		.310		.176		.176	
ΔF			2.34				0.09	
ΔR^2			.009				.000	

Note. All Model 1 *F* degrees of freedom: (1, 173); All Model 1 *t* degrees of freedom: (174); All Model 12 *F* degrees of freedom: (2, 172); All Model 2 *t* degrees of freedom: (173); *B*=Unstandardized coefficient; *SE*= Standard Error.

*p<.05. **p<.01. ***p<.001.

Table 7.

Stepwise Regression of Recommended Compensation on Recalled and Post-speech Positive and Negative Emotion

	Speech Payment				Whole Study Payment			
Positive Emotion	Model 1		Model 2		Model 1		Model 2	
	B (*SE*)	*t*	*B* (*SE*)	*t*	*B* (*SE*)	*t*	*B* (*SE*)	*t*
Constant	16.21 (2.29)	7.09***	14.40 (2.35)	6.12***	27.13 (3.06)	8.85***	25.12 (3.17)	7.92***
Recalled PA	-1.06 (0.88)	-1.20	-4.21 (1.49)	-2.84**	-1.61 (1.18)	-1.37	-5.13 (2.00)	-2.56*
Post-speech PA			3.80 (1.45)	2.62*			4.23 (1.96)	2.16*
F	1.44		4.17*		1.87		3.29*	
R^2	.008		.046		.011		.037	
ΔF			6.84*				4.66*	
ΔR^2			.038				.026	
Negative Emotion	Model 1		Model 2		Model 1		Model 2	
	B (*SE*)	*t*	*B* (*SE*)	*t*	*B* (*SE*)	*t*	*B* (*SE*)	*t*
Constant	10.60 (2.00)	5.30***	10.26 (2.12)	4.83***	18.68 (2.68)	6.97***	17.95 (2.84)	6.32***
Recalled NA	1.35 (0.83)	1.62	0.77 (1.45)	0.53	2.02 (1.12)	1.81	0.78 (1.94)	0.41
Post-speech NA			0.81 (1.65)	0.49			1.73 (2.20)	0.79
F	2.64		1.43		3.28		1.94	
R^2	.015		.016		.019		.022	
ΔF			0.24				0.62	
ΔR^2			.001				.004	

Note. All Model 1 *F* degrees of freedom: (1, 173); All Model 1 *t* degrees of freedom: (174); All Model 12 *F* degrees of freedom: (2, 172); All Model 2 *t* degrees of freedom: (173); *B*=Unstandardized coefficient; *SE*= Standard Error.

*p<.05. **p<.01. ***p<.001.

Four logistic regressions were computed where agreement to be contacted about a similar study during the second session and 1 month later were regressed on post-speech and recalled positive and negative emotion. The more post-speech positive emotion, and the less post-speech negative emotion, a participant reported, the more likely they were to agree to be contacted at a later date (see Table 8). Additionally, the less negative emotion that a participant recalled, the more likely they were to agree to be contacted later above and beyond the negative emotion they experienced in the first place. Recalled positive emotion was not related to how likely a participant was to agree to being contacted above and beyond experienced positive emotion. Neither experienced or recalled positive or negative emotion was related to likelihood of agreeing to schedule an appointment for the new study 1 month later, χ^2s<0.74, *p*s>.50.

Table 8.

Logistic Regression of Desire for Future Contact on Recalled and Post-Speech Positive and Negative Emotion

Positive Emotion	Model 1			Model 2		
	B (*SE*)	Wald	Exp (*B*)	*B* (*SE*)	Wald	Exp (*B*)
Constant	1.86 (0.60)	9.58**	6.40	2.19 (0.63)	11.87**	8.89
Recalled PA	-1.04 (0.25)	16.78***	0.36	-0.46 (0.40)	1.37	0.63
Post-speech PA				-0.70 (.38)	3.28	0.50
χ^2(df)		20.35(1)***			23.74(2)***	
R^2		.128			.148	
Negative Emotion	Model 1			Model 2		
	B (*SE*)	Wald	Exp (*B*)	*B* (*SE*)	Wald	Exp (*B*)
Constant	-2.69 (0.53)	26.06***	0.07	-2.47 (0.54)	21.11***	0.09
Recalled NA	0.92 (0.21)	18.71***	2.50	1.41 (0.38)	13.52***	4.09
Post-speech NA				-0.66 (0.41)	2.52	0.52
χ^2(df)		21.89 (1)***			24.55 (2)***	
R^2		.137			.153	

Study 2 Discussion

Replicating the Positive TSST

Study 2 was successful in replicating the positive TSST condition introduced in Study 1 in that it increased positive emotion. The positive TSST in Study 2 also was even able to decrease the amount of negative emotions participants were feeling. The effects of the neutral TSST were also similar to Study 1 in that there was no change in positive or negative emotion in

neutral TSST participants. Because participants in the neutral condition started with higher baseline levels of positive emotion compared to the positive condition, however, these two groups did not differ in post-speech positive emotions as they did in Study 1. The negative condition remained effective in decreasing positive emotion and increasing negative emotion among participants. Therefore, Study 2 strengthened support for the newly adapted positive TSST condition and provided some support for the efficacy of the neutral TSST condition.

Physiological Arousal

Participants in Study 2 also underwent measures of blood pressure during a baseline period, the speech period, and a recovery period. Results demonstrated that the three conditions did not differ in the pattern of change over time in systolic blood pressure, diastolic blood pressure, or mean arterial pressure. The increase in pulse between baseline and the speech task, and its decrease between the speech task and recovery, was largest for the negative condition, however. These results illustrate that each of these conditions led to similar levels of physiological arousal in general, but that the negative condition may have been slightly more physiologically arousing. The fact that groups did not differ greatly in physiological arousal and not at all in subjective arousal demonstrates that the two new TSST conditions are effective in isolating valence effects rather than arousal. Despite this, future research using these adaptations of the TSST should also examine changes in cortisol and salivary alpha-amylase levels, as previous research has shown that friendly versions of the TSST do not increase cortisol (Herten et al., 2016; Wiemers, Sauvage, Schoofs, et al., 2013; Wiemers, Sauvage, & Wolf, 2013; Wiemers, Schoofs, et al., 2013; Wiemers & Wolf, 2015) but do increase salivary alpha-amylase to a similar extent as the negative TSST (Herten et al., 2016; Wiemers, Sauvage, Schoofs, et al., 2013; Wiemers, Sauvage, & Wolf, 2013; Wiemers, Schoofs, et al., 2013).

Memory Accuracy

Remembering the details. Results from this study did not support Hypotheses 3a and 3b regarding group differences in memory for central and peripheral TSST details. The neutral condition was hypothesized to have the worst memory accuracy of the three groups for both central and peripheral information. When looking at accuracy in identifying the evaluators who listened to the speech, no group differences emerged. When looking at the average memory score by question type, the only significant result revealed that the neutral condition actually did not differ from the positive condition and in fact had *better* memory accuracy than the negative condition when central yes/no questions were examined. When looking at individual items, this trend continued where the neutral condition often did not differ from the positive condition, but occasionally an effect of emotion was found where the positive and negative groups did indeed outperform the neutral group. A number of possible explanations for this pattern of results are outlined in the general discussion.

The positive condition was expected to have the best memory for peripheral details of the TSST and the negative condition was expected to have the best memory for central details of the TSST. In looking at the average memory accuracy scores, these expectations were not supported. In fact, the negative group even had worse memory accuracy than the other two groups on some of the central questions, a finding that was the opposite of what was expected. However, the lack of consistent findings related to the memory accuracy scores when broken down into central, peripheral, yes/no, and multiple choice prevents any firm conclusions from being made.

When looking at the effects of emotion on memory accuracy, not necessarily as a function of condition assignment, the more negative participants felt the worse they performed on peripheral memory questions. Furthermore, the more negatively participants viewed the

TSST, regardless of condition, the less accurate they were overall. These findings, although only holding for high confidence responses, provide some weak evidence that negative emotion can be detrimental for memory accuracy.

Remembering emotions. The strong correlation between remembered and experienced emotion demonstrated that participants were, in general, very good at estimating previously experienced emotions. There was some overestimation in memory for negative emotions but no significant differences in memory for positive emotions. Therefore, Hypothesis 4a was not supported given that positive emotions were accurately recalled, but Hypothesis 4b was supported in that negative emotions were overestimated in memory. When looking at how memory accuracy was influenced by condition assignment, the only group that demonstrated memory bias was the negative TSST group. Participants in the negative condition tended to underestimate the positive emotions they felt and overestimate the negative emotions they felt when recalling their TSST experience.

Emotion and Memory Informing Future Behavior

Unsurprisingly, participants in the negative condition were less willing to participate in a similar experiment in the future compared to participants in the neutral and positive conditions and were also less likely to agree to be contacted for the future experiment. Participants in the positive and neutral conditions were similarly willing to participate in a future experiment, and were similarly likely to agree to be contacted for such a study. However, one month after indicating their initial interest in the future experiment, participants in the positive condition were marginally more likely to set up an appointment for the new experiment compared to those in the neutral and negative conditions. Thus, although the positive and neutral groups did not differ on most of the measures indicating willingness to participate in a similar future study,

Hypothesis 5a was largely supported in that the negative condition was least likely to express interest in participating in the future study.

Regardless of condition, the more positive a participant remembered feeling during the TSST, the more willing they indicated they would be to participate in another similar speech task or study and the less money they thought future participants needed to be compensated for the study. These results remained even after the post-speech positive emotions were entered into the model, indicating that the more positive a person's memory of the TSST experience, regardless of how positive the experience actually was, the more willing they would be to do something similar in the future. The more negative a participant remembered feeling after the TSST, the less willing they were to participate in another speech task or overall study and the less likely they were to agree to being contacted for a future study even after adjusting for the emotions they actually reported feeling after the TSST. Therefore, Hypothesis 5b was supported in that willingness to participate in a similar future study was uniquely influenced by memory for positive and negative emotions above and beyond the emotions actually experienced.

General Discussion

The present dissertation designed an effective and externally valid mood induction that can be used to examine the effects of valence on integral memory. Over two studies, the efficacy of two new adaptations to the classic Trier Social Stressor Task was demonstrated. A new positive TSST condition increases positive emotion and can also decrease negative emotion in participants. The new neutral TSST condition successfully keeps participants in a stable affective state. These two new conditions have the potential to serve as adequate comparison groups to the classic, negative TSST. All three TSST conditions presented here undergo similar tasks for a similar amount of time but effectively induce positive, neutral, or negative mood. Furthermore,

all three conditions are similarly arousing as assessed using blood pressure measurements (with the exception of pulse being slightly elevated among in the negative group). Finally, the emotions experienced in the positive and negative conditions are equally emotionally arousing, allowing for a true test of valence effects independent of arousal.

Using the new TSST conditions, the second dissertation study examined differences in integral memory accuracy as a function of emotional valence. Given the high rate of correct responses to questions regarding details of the TSST, however, very few group differences were discovered. When looking at combined memory accuracy scores (which averaged the number of correct responses to individual questions according to whether it was central or peripheral in nature or if it was a yes/no or multiple choice question) groups only differed in accuracy for centrally related yes/no memory items. Contrary to what was hypothesized, the negative group showed the worst performance for these types of questions and the positive and neutral conditions showed the best. In looking at individual items, only a handful proved to be useful in distinguishing between experimental conditions on accuracy. The direction of these results were mixed, however, where the emotional conditions did perform better on certain questions compared to the neutral group for some items, but in other cases the negative group had the worst memory accuracy compared to the positive and neutral groups, which did not differ.

Despite the lack of differences between conditions on memory for details of the TSST, there were differences in how well the emotions experienced during the TSST were remembered. Participants in the negative condition tended to overestimate their negative emotions and underestimate their positive emotions experienced during the speech task, but the positive and neutral groups had fairly accurate recollections. Participants in the positive and neutral conditions were most willing to participate in a similar study experience in the future and even

agreed to being contacted for a future study at a higher rate compared to the negative group. The more positive and the less negative a person remembered their initial emotional response to the TSST to be, the more willing they were to participate in similar study tasks in the future, even after adjusting for the emotions actually experienced during the TSST. These findings demonstrate the utility of measuring remembered emotion when attempting to predict future behavior in addition to measuring the emotions as they were experienced in the moment.

The Utility of a Positive TSST

One of the largest contributions of the present research is the development of a successful positive TSST condition. A variety of control conditions for the TSST have been used in the past, but none have successfully been able to create a positive control. The TSST is one of the most potent and widely used laboratory stressors. It has helped numerous researchers understand how people function under controlled, yet stressful situations. The new positive TSST could be used to help researchers understand how people function in controlled, yet uplifting situations, such as decision making contexts, social interaction studies, or studies on motivation.

In the context of memory research, the positive TSST shows great promise. It offers the controlled environment of laboratory studies along with the richness of autobiographical memory studies. The combination of a controlled setting along with a life-like and complex interpersonal situation allows for the study of integral memory accuracy for emotional events. Despite these advantages, however, assessment of integral memory accuracy remains difficult. Researchers who decide to use the positive TSST in the future are advised to use care when developing, testing, and selecting material to be used in a memory test.

Mixed Findings Regarding Valence and Memory

Analyses regarding memory for TSST details as a function of emotional valence yielded a series of mostly null results. Given the lack of significant findings and the mixed direction of exploratory follow-up analyses, it is difficult to make any firm conclusion about the role valence has in integral memory accuracy based on the present research. Other than the fact that the memory items were simply too easy, there are a number of considerations that might help explain the pattern or results, or lack thereof.

The not-so-neutral condition. First, any memory accuracy differences found among participants in the neutral condition should be interpreted with caution. Although the neutral manipulation had the intended effect of keeping participants in a stable affective state, participants in this condition reported experiencing similar levels of positive and negative emotions as those in the positive condition after the speech task. This was due to participants in the negative condition beginning with higher baseline levels of positive emotion and somewhat lower baseline levels of negative emotion compared to the positive group. Furthermore, physiological arousal as measured by change in blood pressure did not differ significantly between the neutral and positive groups. Thus, the neutral condition proved to be an unreliable control condition in comparison to the positive condition. Because memory accuracy was expected to differ between these groups as a result of the differences in emotion experienced after the TSST manipulation, but the positive and neutral groups did not differ in emotional experience following the TSST, it is unsurprising that these two groups did not differ greatly when it came to memory accuracy. Had all groups begun the study with similar levels of positive emotion, the positive and neutral groups would likely have differed in post-speech positive

emotion, in which case more firm conclusions regarding the influence of positive emotion on memory accuracy could be drawn.

Operationalization of central and peripheral. Second, the inability to find memory accuracy differences based on what was centrally or peripherally related to the TSST might not be due to a lack of emotional influences, but an issue with how "central" and "peripheral" were operationalized. There are a variety of ways that central and peripheral details are operationalized (see Levine & Edelstein, 2009) and these operationalizations are often at odds with one another. What was considered central in this research was anything that would be related to the assumed goal of the participant: doing well on the speech task. Under this umbrella, questions about the participant's performance itself are likely the most centrally related to the experience. Questions related to the length of the speech, the demeanor of the evaluators, or the topic of the speech are also likely candidates for centrally related items. Other questions, like the color of the stopwatch used to time the speech, are decidedly less central in nature. Initially this question was considered central because the stopwatch is an indicator of the fact that the speech was being timed. Upon further consideration, however, whether the participant's speech was timed or not is more of a central detail than the color of the stopwatch, which has no bearing on how successful the speech becomes. The fact that some questions could be understood as peripheral *and* central serves to make the pattern of results more difficult to interpret. The question of how to operationalize "central" and "peripheral" is one that would benefit greatly from further theoretical scrutiny among researchers in the field.

Detriments of negative emotion? The one significant difference found between groups was that participants in the negative condition had the worst memory accuracy for central yes/no questions. If we assume the questions used to assess memory in this study were not overly easy,

were able to detect group differences, and reliably distinguished between what constitutes a "central" compared to "peripheral" detail, this finding could provide limited evidence that negative valence is detrimental to memory under these particular circumstances. More specifically this finding could mean that negative valence is detrimental to information centrally related to the cause of the initial emotional response. This notion is supported by the exploratory correlational analysis that showed the more negative participants appraised the TSST to be, the worse their overall accuracy on items they felt confident about.

Although emotion is thought to enhance memory in general, there exists evidence to the contrary in the literature. Emotion, particularly negative emotion, is thought to lead to memory narrowing, where central details are better remembered than peripheral details (Levine & Edelstein, 2009). However, as in the present study, this is not always the case. For example, in one study military personnel underwent two forms of interrogation as part of military survival school training (Morgan et al., 2004). Participants were interrogated two times, once in a low-stress interrogation and once in a high-stress interrogation. When later asked to identify their interrogators, participants were more accurate in identifying low-stress interrogators compared to interrogators in the high stress condition. This finding implies that the highly stressful, emotional condition was actually detrimental to memory accuracy. The explanation for this and other seemingly disparate findings is that emotional arousal is beneficial for memory to a certain extent; once arousal is extremely high it can actually impair memory (Levine & Edelstein, 2009). This explanation is not sufficient when applied to the present results, however, as the positive and negative conditions were shown to be equally arousing subjectively. However, there could be some other explanation as to why negative emotion would cause decreased accuracy. For example, perhaps because the negative TSST induces feelings of self-consciousness more so

than the positive or neutral TSST, participants tend to focus on their own internal state (and what is directly causing that state) to a greater extent. This could be an example of extreme memory narrowing, where only the very central aspects were enhanced in memory (e.g., exactly what the evaluator said during the speech that made the participant feel upset). Those aspects might not have been appropriately captured in the current set of memory accuracy questions.

The role of arousal. It is possible that differences in memory accuracy observed in the literature are only driven by emotional arousal and not valence. Perhaps the current study didn't detect many group differences in memory accuracy simply because each group demonstrated similar levels of physiological arousal and the positive and negative groups reported emotions that were similarly arousing subjectively. While this explanation is plausible, I do not believe it to be the case in this situation. Although arousal is an integral part of the emotion-memory relationship, valence is also important to consider (Kensinger, 2009). In addition to simply alerting us that something is happening in the immediate environment that we need to pay attention to (arousal), emotion gives us insight as to what that something means for our well-being (valence); at the very basic level emotion tells us whether our current situation is good or bad. Functionally, valence should prove an important dimension of emotion over and above the utility of arousal. Practically, however, the extent of the memory differences as a function of valence in this study was minimal. Instead of this being indicative of the role valence does or does not play in memory accuracy, it could point to the role of other overlooked characteristics not assessed in the current research.

The role of goal-relevance. One characteristic that could have played a role in the current findings is goal-relevance. Emotion has been found to enhance memory for goal-relevant information, or information that is potentially useful for current goals (Levine & Edelstein,

2009). The groups in the current study were assumed to have the same goal of successfully completing the speech task. Thus, information such as whether participants were allowed to use notes, whether they were being video recorded, or the reactions of the evaluators hold the same importance regardless of condition. Additionally, information such as what was sitting on the shelf in the room is equally unimportant for each condition. The fact that the information contained in the memory test was equally goal-relevant for all conditions, one might not expect memory accuracy differences between conditions. Therefore, future research could use one or more of these TSST conditions and manipulate the goal to be pursued by the participant. Memory accuracy could then be examined as a function of goal-relevance in addition to valence.

Importance of Emotional Memory for Informing Future Behavior

Remembering information from past emotional experiences is useful for learning what should and should not be avoided in the future. Perhaps the most important aspect of learning from past experiences is remembering our emotional responses to them. If we were to only remember the specific details of previous events but not how we felt about them, our memory would not prove to be a very useful guide for future behavior. The current studies add to a body of literature demonstrating that people are fairly good at recalling their emotional responses of the past (Levine et al., 2009). Despite general accuracy, these studies, like others, have also demonstrated that memory for emotion is not perfect. The flexibility in our memory for emotion allows for the ability to constantly incorporate new information as our situations change and our old goals are replaced with new ones.

Although the finding that memory for emotion is susceptible to bias is not new, the current research is one of few studies to have examined the behavioral consequences of this bias. Past research has shown that people's memories of how they felt during past experiences

informed their intentions for future behavior. For example, one study found that the extent to which students overestimated how anxious they felt before a midterm exam was related to how much they planned to study for the final (Safer et al., 2002). Another study found that participants' memory for the emotions they felt during a recent vacation was the strongest predictor of whether they would take the same vacation over again above and beyond the emotions they reported in the moment during the vacation (Wirtz et al., 2003). The current studies are consistent with past research in showing that remembered emotions matter as much, if not more so, than the actual emotions experienced when attempting to predict future behavior.

In the present research emotional memory bias was more prevalent for participants in the negative than the positive or neutral conditions. This finding supports the notion that negative emotions are overestimated in memory more so than positive emotions (although positive emotions were recalled with accuracy in the current study). Negative emotions signal threat to one's goals, well-being, or even one's safety. Thus, negative emotions hold stronger implications for survival that positive emotions (Miron-Shatz et al., 2009; Rozin & Royzman, 2001), and overestimating how negative something was in the past serves as an even stronger signal to avoid a similar situation in the future. Interestingly, for participants in the negative condition this bias extended to underestimating how positive they felt during the speech task.

The decision to be contacted again for a similar TSST study in the future was influenced by the negative emotions participants remembered experiencing, even after adjusting for the negative emotions they felt during the TSST. The more negative a participant remembered feeling, regardless of their condition, the less willing they were to do a similar study in the future and the less likely they were to agree to being contacted for such a study. Memories for positive emotions similarly influenced participants' willingness for a similar future experience, albeit in

the opposite direction. These findings provide evidence for the utility of using memory for past emotional experiences to inform intentions for future behavior.

Conclusion

Decades of research has been devoted to understanding when emotion aids and when it hinders memory. Despite the extensive work in this area, only more recently have the unique effects of valence, and not just arousal, been considered a potential moderator of memory accuracy. Most research on emotion and memory has relied upon either autobiographical memory methodology, which lacks experimental control, or laboratory studies, which lack external validity and the ability to look at the integral effects of emotion on memory. The present dissertation introduced a new laboratory mood induction technique meant to provide a positive and a neutral version of the Trier Social Stressor Task. Through the use of this new technique, memory accuracy for the details and emotions experienced in carefully matched positive, neutral, and negative conditions was examined. Very few memory differences were found with the exception that participants in the negative condition had worse memory of some of the details centrally related to the speech task experience. Participants in the negative condition also had the most biased memory of emotions experienced during the speech task and were the least willing to participate in a similar future study. In addition to contributing the first successful attempt at a positive TSST condition, this research provides a step in the direction of understanding how emotion influences integral memory of an experience and how this may differ as a function of whether the initial experience was positive or negative in nature. Furthermore, this research contributes further evidence that behavior is a result of how past events are remembered, not just how they were experienced.

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Appendix A

TSST Condition-Specific Speech Instructions and Interjections

Negative TSST Speech Instructions:

Evaluator 1: "During this part of the study you will be participating in a mock interview. You are to imagine you are interviewing for a demanding new job that is related to your career aspirations. You will prepare and then give a short 5-minute speech to your interviewers on why you are the strongest candidate for the position. Your argument should include aspects of your personality, how you relate to others, your professional capabilities, and your priorities and values. We recommend that you describe each of these characteristics in detail and provide appropriate examples. It is important that you speak for the entire five minutes."

Evaluator 2: "The purpose of this exercise is to gather information for school officials on how prepared UCI students are for the job market. We, your interviewers, have been trained to analyze your overall performance. Imagine that we are UCI administrative officials looking for the most qualified candidates. You will also be video recorded so that a separate panel can later evaluate your speech for style, eloquence, and the overall quality of your presentation. Do you have any questions? You now have 2 minutes to prepare your speech. You will be given paper and a pen to outline your talk but you will not be allowed to use these notes when giving your speech."

List of Interjections:

- Please keep your hands still. / Please refrain from hand gestures.
- Please do not fidget.
- You are being too superficial. / Please provide additional examples.
- You are spending too much time on this aspect. / Please move on to another strength.
- Please move on to (another) weakness.
- Please continue talking. / It is important that you continue talking for the entire 5 minutes.
- Please refrain from using "like" or "um". / Remember to refrain from using "like" or "um".
- Please maintain eye contact. / Remember to maintain eye contact.
- Speak clearly. / Speak louder.
- It is important that you stay focused on the task at hand.

Positive TSST Speech Instructions:

Evaluator 1: "We're going to be working with you during the next part of the study. During this part of the study you will be participating in a mock interview. You are to imagine that you are being interviewed by two new UCI students that are interested in starting a new hobby. You will prepare and then give a short 5-minute description to two UCI students about a hobby or activity that you greatly enjoy and are passionate about. Describe your hobby in detail and why you enjoy it so much. Try to imagine and describe how you feel while you're engaging in this hobby and how a new student might also enjoy the hobby. It is important that you speak for the entire five minutes."

Evaluator 2: “The purpose of this exercise is to gather information for incoming UCI students on what current students are passionate about doing. We, your interviewers, aren’t going to evaluate you or grade you in any way. Imagine that we are new UCI students and that we are only present to take notes about your favorite hobby or activity. You will also be video recorded so that we can confirm our notes after your session. Do you have any questions? You now have 2 minutes to prepare your description. You will be given paper and a pen to outline what you share, which you’ll be able to use while telling us about your favorite hobby.”

List of Interjections:

- How did you get started with _____?
- How long have you been doing _____?
- What do you think is the most interesting part of _____?
- Who do you usually do _____ with?
- What makes you like _____so much?
- How could someone interested in _____ get involved?
- What’s your favorite memory of _____?
- Oh, I didn’t know that!
- Sounds really fun/enjoyable/exciting/relaxing!
- Wow, that’s really cool.
- That’s interesting!
- Definitely! ~or~ Awesome! ~or~ Cool!

<u>Neutral TSST Speech Instructions:</u>
Evaluator 1: “During this part of the study you will be participating in a mock interview. You are to imagine that you are being interviewed by high school students that are interested in attending UCI. You will prepare and then give a short 5-minute description to two pretend high school students about the details of your daily routine. You will give a description outlining all the steps of your routine on a typical weekday starting from when you wake up. Your description should be as detailed as possible and should focus on every single part of your routine. For example, instead of saying “I wake up and go to class then have lunch” focus more on the details- what time do you wake up? What do you do after you get out of bed? How do you get ready for the day? It is important that you speak for the entire five minutes.”

Evaluator 2: “The purpose of this exercise is to gather information for local high school students on what the daily routine of a UCI student is like. We, your interviewers, aren’t going to evaluate you or grade you in any way. Imagine that we are high school students and that we are only present to take notes about what you do on a typical weekday. You will also be video recorded so that we can confirm our notes after your session. Do you have any questions? You now have 2 minutes to prepare your description. You will be given paper and a pen to outline your routine and you will be allowed to use these notes when giving your description.”

List of Interjections:

- Okay, please continue telling us about… [what you do during the day].
- What do you do in the… [morning, afternoon, evening]?
- What do you do next?

- How much time do you usually spend on that?
- Can you tell me about this in a little bit more detail?
- Keep going, we're just trying to get information for potential new UCI students.
- How similar do you think your routine is to the routines of other UCI students?
- Is this what you do on every day of the week?
- How do you think your routine could be better?
- How is this routine different from your routine on the weekend?

Appendix B

Modified POMS-PANAS Scale of State Emotion

This scale consists of a number of words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word. Indicate to what extent you feel this way right now, that is, at the present moment *OR* indicate the extent you have felt this way over the past week (circle the instructions you followed when taking this measure)

1	2	3	4	5
Very Slightly or Not at All	A Little	Moderately	Quite a Bit	Extremely

_____ 1. Active
_____ 2. Stressed
_____ 3. Unhappy
_____ 4. Bored
_____ 5. Attentive[a]
_____ 6. Excited[a]
_____ 7. Happy
_____ 8. Lonely[b]
_____ 9. Enthusiatic
_____ 10. Interested[a]
_____ 11. Anxious
_____ 12. Relaxed
_____ 13. Passive
_____ 14. Irritable[a]
_____ 15. Angry[b]
_____ 16. Embarrassed[b]
_____ 17. Cheerful
_____ 18. Proud[a]
_____ 19. Confident[b]
_____ 20. Nervous
_____ 21. Energized
_____ 22.Frustrated[b]
_____ 23. Sad
_____ 24. Overwhelmed
_____ 25. Calm
_____ 26. Tired

Note. Wording of instructions depended on the stage of the study. The baseline measure and post-TSST measure used wording regarding how the participant feels right now. The measure during the follow-up will instruct participants to recall emotions felt during the task.
[a]Item appears in the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988); [b]Item was added from other sources; Items without a superscript are from the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971)

Appendix C

Please indicate your impressions of the session of tasks you just completed.

1. Did you feel liked during the task?

1	2	3	4	5	6	7
Not at all			Somewhat			Very much

2. Did you feel accepted during the task?

1	2	3	4	5	6	7
Not at all			Somewhat			Very much

3. Did you feel disliked during the task?

1	2	3	4	5	6	7
Not at all			Somewhat			Very much

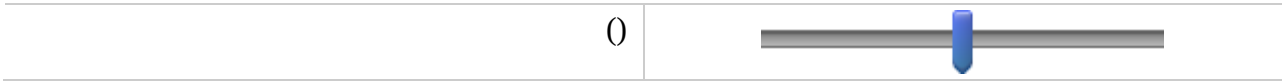
4. Did you feel rejected during the task?

1	2	3	4	5	6	7
Not at all			Somewhat			Very much

5. Think of the researchers who listened to you during the interview task. How friendly do you think these researchers were during the session?

Extremely Unfriendly Extremely Friendly

0 17 33 50 67 83 100



Please indicate your impressions of the interview task you just completed.

6. This session was:

1	2	3	4	5	6	7
Not very Difficult						Very difficult

7. During the session, I:

1	2	3	4	5	6	7
Tried hard						Didn't try hard

8. During the session, I felt:

1	2	3	4	5	6	7
Not at all Confident						Very confident

9. During the session, I felt:

1	2	3	4	5	6	7
Out of control						In control

10. Overall, I thought I performed:

1	2	3	4	5	6	7
Very poorly						Very well

11. Overall, I thought the tasks were THREATENING:

1	2	3	4	5	6	7
Not at all						Very much

12. Overall, I thought the tasks were CHALLENGING:

1	2	3	4	5	6	7
Not at all						Very much

13. Overall, I thought the tasks were STRESSFUL:

1	2	3	4	5	6	7
Not at all						Very much

14. I just "gave up" or quit trying:

1	2	3	4	5	6	7
Not at all						Very much

15. I wanted to give up or quit trying:

1	2	3	4	5	6	7
Not at all						

Please indicate your impressions of the interview task you just completed.

16. My performance on the speech was being evaluated by others during the task.

1	2	3	4	5	6	7
Not at all						Very much

17. My performance on the speech could be evaluated by others at a later time.

1	2	3	4	5	6	7
Not at all						Very much

18. How do you think those around you would have rated your performance overall?

1	2	3	4	5	6	7
Very poor			Average			Very excellent

19. What was the goal (as stated by the researcher) of this task? _____

20. How effective do you think you were in meeting the goal of the researcher?

1	2	3	4	5	6	7
Not at all effective						Very effective

21. What was YOUR main goal during the interview? (this doesn't have to be the same goal that the researcher stated during the instructions) _____

22. Did you achieve YOUR goal for this task?

1	2	3	4	5	6	7
Not at all						Very much

Appendix D

Participant Feedback Questionnaire

You have received this questionnaire because you have recently completed a study where you were required to give a speech and we would like to know your opinions about that task.

Recently, our lab has received grant money to conduct some similar studies. We want to run a new study with a speech task just like the one you completed last session, and pay our research subjects for participating. The study will last 90 minutes over two sessions, and will involve the same task you completed.

1) **How willing would you be to do JUST the speech task (like the one you did in this study) in a future study?**

Not at all willing			Neutral			Extremely willing
1	2	3	4	5	6	7

2) **How much do you think we should pay our subjects JUST for completing the speech task (and not for other study tasks)?**

$0	$5	$10	$15	$20	$25	$30	$35	$40	$45	$50	$55	$60

3) **How willing would you be to participate in a whole 2-session experiment similar to this one in the future (*including* the speech task and various questionnaires)?**

Not at all willing			Neutral			Extremely willing
1	2	3	4	5	6	7

4) **How much do you think we should pay our subjects for participating in a whole 2-session experiment similar to this one in the future (*including* the speech task and various questionnaires)? *<u>*This amount should NOT be less than the amount you indicated in question 2 above, since it INCLUDES the speech task AS WELL AS the other parts of the study session.*</u>***

$0	$5	$10	$15	$20	$25	$30	$35	$40	$45	$50	$55	$60

5) **At this time we are planning on paying participants $15 for taking part in the new study. We're going to be recruiting participants for the new study in a few weeks. The tasks would be very similar to what you did in the current study and it would take place over 2 sessions for a total of 90 minutes.**

Would you like to join the sign-up list to participate in the new study?

☐ Yes ☐ No

*If you check yes, you will be contacted via email (using your email address on SONA) with more information about the new study.

We greatly appreciate your feedback. Thank you for your participation and your opinions.

Appendix E

Peripheral and Central TSST Memory Questions

Yes/No Recognition Questions

This next set of questions will ask you to remember details about the speech task (and the time you had to prepare for the speech) from last session. Some questions will be about the task itself, some about the researchers who listened to your speech, and some will be about the room where you gave your speech (which we call "the speech room"). Some of the answers to the questions you might remember well, but some of them you might not remember very well at all. Please respond to each question by selecting the option that best matches your memory for the speech task and the speech task preparation from your last session.

For each question, you will also be asked **how confident you are that your response is correct** on a scale of 1 (Not at all confident) to 5 (Very confident).

Central Yes/No

1. Did the researchers instruct you to imagine they were not research assistants, but were taking on a different role during your speech? (Y* or N)
2. Were you instructed to talk about a particular topic during your speech? (Y* or N)
3. Did you get to take notes while preparing for your speech? (Y* or N)
4. Did you have a specific amount of time to give your speech? (Y* or N)
5. Did the researchers time you while you gave your speech? (Y* or N)
6. Was your speech recorded using a video camera? (Y* or N)
7. Did the researchers remind you how long you must continue to talk during the speech right before they told you to begin? (Y* or N)[a]
1. Were the researchers in the speech room while you prepared for your speech? (Y or N*)
2. Did the researchers move a microphone to the desk in front of you after the speech preparation period was over? (Y or N*)
3. Did the researchers tell you to look into the video camera during your speech? (Y or N*)
4. Were you standing during the speech? (Y or N*)
5. Did the researchers let you know when you had 1 minute left in your speech? (Y or N*)
6. After ending the speech, did the researchers ask you how well you thought you did during your speech? (Y or N*)
7. Did the researchers ask you to repeat part of your speech for clarity? (Y or N*)[a]
1. Did the researchers say that they were evaluating your speech performance for quality? (Y or N)[a, b]
2. Did the researchers tell you that you would be able to use your notes during the speech? (Y or N)[a, b]

Peripheral Yes/No

1. Was there a table next to the doorway in the speech room? (Y* or N)

2. Was there a shelf along the wall of the speech room? (Y* or N)
3. Did the video camera beep when it started recording your speech? (Y or N*)
4. Was there a key in the cabinet's keyhole at the back of the speech room? (Y* or N)
5. Was there a whiteboard in speech room? (Y* or N)
6. Was there carpet in the speech room? (Y* or N)
1. Did the researchers who listened to your speech sit behind a table? (Y or N*)
2. Was there a clock in the speech room? (Y or N*)
3. Was there a poster on the wall of the speech room? (Y or N*)
4. Was there a ceiling fan in the speech room? (Y or N*)
5. Was there a printer on the desk in the speech room? (Y or N*)
6. Was there a lamp in the corner of the speech room? (Y or N*)

After each question, participants are asked:

1. How confident are you that your answer to the above question is correct?
   - from 1 (Not at all confident) to 5 (Very confident)
   - This scale was modeled after Van Damme & Seynaeve, 2013

Multiple choice Recognition Questions [All questions where 'Yes' is the correct answer above will has a follow-up forced-choice MPC question below, even if the participant did not choose 'Yes' above.]

Central multiple choice questions

1. Who were you supposed to imagine the people who listened to your speech were? [b]
   a. High school students
   b. New UCI students
   c. UCI administrative officials
2. What topic were you instructed to talk about during your speech?[b]
   a. Your qualifications for a new job
   b. Your daily routine
   c. Your favorite hobby or activity
3. What color notepad did you take notes on while preparing for your speech?
   a. Blue
   b. Pink
   c. Green*
4. How much time did you have to give your speech?
   a. 4 minutes
   b. 5 minutes*
   c. 6 minutes
5. What color stopwatch did the researchers use to time your speech?
   a. Red*
   b. White

c. purple

6. From your perspective, where in the speech room was the video camera located?
    a. To the left of the researchers (your left)*
    b. Between the researchers
    c. To the right of the researchers (your right)
7. What did the researchers say the reason was for video recording your speech?[a, b]
    a. So a separate panel could watch it later
    b. In case they lost their notes
    c. To confirm their notes later
8. How much time did you have to prepare for your speech?[a]
    a. 2 minutes*
    b. 3 minutes
    c. 4 minutes
9. What did the researchers say once the speech task was over?[a]
    a. "You did a great job on this"
    b. "Your time is up"
    c. "The other researcher will be back with you shortly"*

<u>Peripheral multiple choice questions</u>

1. What shape was the table that was next to the doorway in the speech room?
    a. A rectangle
    b. A circle*
    c. A square
2. What was on the shelf that was along the wall of the speech room?
    a. A laptop*
    b. A textbook
    c. A stapler
3. How many times did the video camera beep when it started recording your speech?
    a. Once*
    b. Twice
    c. Three times
4. What color keychain was on the key that was in the cabinet's keyhole at the back of the speech room?
    a. Silver
    b. Black
    c. Yellow*
5. What was written on the whiteboard in the speech room?
    a. Your participant number
    b. It was blank*
    c. The name of the research lab
6. What pattern of carpet was in the speech room?

a. Zigzags
b. Circles
c. Speckled*

After each question, participants are asked

1) How confident are you that your answer to the above question is correct?
   - from 1 (Not at all confident) to 5 (Very confident)
     - This scale was modeled after Van Damme & Seynaeve, 2013
2) Regarding the option you selected above, do you vividly remember this, does it just feel familiar, or were you just guessing?
   a. Vividly remember
   b. Familiar
   c. Guessing
      - This scale was modeled after Nemeth & Bell (2006)

Notes. Items were pseudo-randomized in presentation order so that the correct response was not predictable but questions came in order of when they might have been noticed during the speech task. All Yes/No questions were asked at the same time (before the multiple choice items).
[a]Question was added for final wave of data collection (around N=60)
[b]Correct answer depends on condition.