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Memory Bias for Anxiety Prior to Academic Achievement Situations: Influences of Time, Mood, Personality and Post-Event-Processing

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Abstract

The current thesis examines memory bias for state anxiety prior to academic achievement situations like writing an exam and giving a speech. The thesis relies on the reconstruction principle, which assumes that memories for past emotions are reconstructed rather than stored permanently and accurately. This makes them prone to memory bias, which is affected by several influencing factors. A major aim is to include four important influencing factors simultaneously. Early research on *mood* and emotional autobiographical memory found evidence for the existence of a propositional associative network (Bower, 1981; Collins & Loftus, 1975), leading to mood congruent recall. But empirical findings gave also strong evidence for the existence of mood incongruent recall for one's own emotions, which was for example linked to mood regulation via mood repair (e.g. Clark & Isen, 1982), which seems to be associated to the *personality traits* extraversion and neuroticism (Lischetzke & Eid, 2006; Ng & Diener, 2009). Moreover, neuroticism and trait anxiety are related to rumination, which is seen as *negative post-event-processing* (e.g. Wells & Clark, 1997). Overall, the *elapsed time* since the emotional event happened should have an impact on recall of emotions. Following the affect infusion model by Robinson and Clore (2002a), the influence of personality on memory bias should increase over time. Therefore, three longitudinal studies were realized, using naturally occurring as well as laboratory settings. The used paradigm was equivalent in all studies. Subjects were asked about their actual state anxiety prior to an academic achievement situation. Directly after the situation, current mood and recall of former anxiety were assessed. The same procedure was repeated a few weeks later. Personality traits and post-event-processing were also assessed. The results suggest a need to have a differentiated view on predicting memory bias. Study 1 (N = 131) as well as study 3 (N = 53) found evidence for mood incongruent memory in the sense of mood repair and downward regulation as a function of personality. Rumination was found to cause stable overestimation of pre-event anxiety in study 2 (N = 141) as well as in study 3. Although the relevance of the influencing factors changed over time, an increasing relevance of personality could not consistently be observed. The tremendously different effects of the laboratory study 2 indicated that such settings are not appropriate to study current issues. Theoretical and psychotherapeutically relevant conclusions are drawn and several limitations are discussed.

Zusammenfassung

Die vorliegende Arbeit untersucht Gedächtnisverzerrungen für Zustandsangst vor einer Universitätsprüfung und vor einem Vortrag als akademische Leistungssituationen. Die Arbeit stützt sich auf das Rekonstruktionsprinzip, wonach Erinnerungen für Gefühle rekonstruiert und nicht permanent und akkurat gespeichert und abgerufen werden, was diese wiederum anfällig für Verzerrungen macht. Ein Hauptziel der Arbeit ist die simultane Untersuchung von vier wichtigen Einflussfaktoren auf diese Gedächtnisverzerrungen. Frühe Forschung über den Zusammenhang von aktueller Stimmung und emotionalem autobiographischen Gedächtnis fand starke Hinweise für die Existenz eines propositionalen assoziativen Netzwerks (Bower 1981; Collins & Loftus, 1975), was zu einem stimmungskongruenten *Recall* emotionaler Inhalte führt. Andererseits zeigen empirische Befunde auch die Existenz eines stimmungsinkongruenten *Recalls* (z. B. Clark & Isen, 1982), welche beispielsweise mit Stimmungsregulation durch *mood repair* verknüpft wurde. *Mood repair* wiederum scheint unter anderem von den Persönlichkeitseigenschaften Extraversion und Neurotizismus abzuhängen (z. B. Ng & Diener, 2009). Darüber hinaus hängen Neurotizismus und soziale Ängstlichkeit mit Rumination, einer Form des negativen *Post-Event-Processings* zusammen (z. B. Wells & Clark, 1997). Weiterhin prognostiziert das Affect-Infusion-Modell nach Robinson und Clore (2002a; 2002b), dass mit zunehmender Zeitspanne seit dem Ereignis der Einfluss der Persönlichkeitseigenschaften auf die Gedächtnisverzerrung zunehmen sollte. Zur Untersuchung dieser Mechanismen wurden drei Längsschnittsstudien unter naturalistischen und Laborbedingungen realisiert. In allen drei Studien wurden die Probanden gebeten, ihre aktuelle Zustandsangst vor der Leistungssituation einzuschätzen. Nach der Situation wurden ihre aktuelle Stimmung sowie ihre retrospektive Einschätzung ihrer Angst vor dem Ereignis erfasst. Diese Messung wurde wenige Wochen später wiederholt. Auch Persönlichkeitsmerkmale und Rumination wurden erhoben. Die Ergebnisse legen nahe, dass die valide Vorhersage von Gedächtnisverzerrungen im vorliegenden Kontext differenziert erfolgen sollte. In Studie 1 ($N = 131$) und Studie 3 ($N = 53$) fanden sich Hinweise für stimmungsinkongruente Gedächtnisverzerrungen im Sinne von *mood repair* und Abwärtsregulierung der Stimmung in Abhängigkeit der Persönlichkeit. Rumination führte in den Studien 2 ($N = 141$) und 3 konsistent zu einer retrospektiven Überschätzung der Angst vor der Rede. Obwohl sich die Bedeutung der Einflussfaktoren im Laufe der Zeit verändert, konnte ein zunehmender Einfluss der Persönlichkeit nicht konsistent nachgewiesen werden. Die enorm abweichenden Effekte der zweiten Studie (Laborstudie) lassen eine valide Anwendbarkeit von Laborsettings für die vor-

liegende Fragestellung kritisch in Frage stellen. Theoretische und psychotherapeutisch relevante Schlussfolgerungen werden gezogen und Limitationen diskutiert.

You, the psychologist says, looking over the room, may believe that memory is but a video recording that is documenting the days of our lives as they happen and storing them in the brain's archives. This is a common assumption and an intuitive metaphor, not lacking in elegance: the brain is a library in which the tales of our times are bound and housed; a beautiful metaphor, but, alas, erroneous and misleading. Memory is not a storage place but a story we tell ourselves in retrospect. As such, it is made of storytelling materials: embroidery and forgery, perplexity and urgency, revelation and darkness. He steps forward with practiced theatricality.

Noam Shpancer, The Good Psychologist

1 Theoretical Background

There is an uncountable amount of potential emotional situations in our lives. These situations give the opportunity to generate autobiographical memories, which are fulfilling a number of functions. Of course, there is the remembering itself. There are feelings of pleasure we all like to remember and relive. But there are also negative feelings which we want to avoid not only in the past but also in the future. Negative experiences in the past may tell us to change our behavior in the future. That's what we all learned more or less in our individual development. But these autobiographic memories have some other functions, too. For example, they seem to be linked to issues, goals or people that we care about (Reisberg & Heuer, 2004). These memories could therefore tell us how we are influencing our perceptions of the world, which may have an impact on our behavior and information processing. Conway and Tacchi (1996) suggested that one of the general functions of autobiographical knowledge is to *ground* the self. But how do we remember our past reactions? Early theorists relied on *copy theories*, having the idea that memories are copies of original situations, fading over time (see Brewer, 1986, for an overview). Later the *reconstructive theories* pursued the idea that the personal memory is not copied but reconstructed, an idea we follow until today. Of course, when somebody is reconstructing memories, contortions could occur. From a personality psychology perspective, here could be a "chance" for personality traits to operate. But there are several other influencing factors which should be systematically reviewed and empirically examined in the current thesis, to get a better understanding of functioning and functions of autobiographical memory for emotional reactions in academic achievement situations. If somebody would ask me, which emotion would be most likely to occur in such situations, my answer would definitely be "anxiety". But how will one remember this anxiety in the future? That's what the current thesis wants to outline and examine in the following sections.

Before having a closer look at these aspects it is crucial to give an overview of the theoretical basics of the considered topics. The following sections will provide an introduction to the most important keywords and –concepts of the present paper. First I would like to introduce traits and states. Second I would like to give some information about substantial concepts concerning emotions. Third I would like to define basic aspects of memory, before introducing an integrating conceptual framework for this paper.

1.1 Emotional States

When thinking about emotional events, we should examine the meaning of emotions itself. Defining the construct "emotion" led to controversial debates in psychological research (e.g. Otto, Euler & Mandl, 2000). As a consequence, there are several definitions which are focusing various aspects of emotional processing. An impressing overview was given by Kleinginna and Kleinginna (1981). Their much-noticed article lists more than 100 definitions from different perspectives. They tried to integrate all these definitions, leading to the following statement (Kleinginna & Kleinginna, 1981, p. 355):

> Emotion is a complex set of interactions among subjective and objective factors, mediated by neural/hormonal systems, which can (a) give rise to affective experiences such as feelings of arousal, pleasure/displeasure;(b) generate cognitive processes such as emotionally relevant perceptual effects, appraisals, labeling processes; (c) activate widespread physiological adjustments to the arousing conditions; and (d) lead to behavior that is often, but not always, expressive, goal-directed and adaptive.

Considering an actual perspective of the general psychology, the following working definition provides an overview in a nutshell. Following these considerations, emotions are "object-oriented, involuntarily triggered affective reactions associated with temporary changes in experience and behavior" (Rothermund & Eder, 2011, p. 166, author's translation). To sum up, the emotional reaction itself consists of four components: the affective, the cognitive, the physiological and the behavioral component.

1.1.1 Distinguish between Emotional State and Trait

Focusing on emotional states and traits, there is an idea indicating the presence of basically different sources of self-knowledge for trait and state judgments of emotion (Robinson & Kirkeby, 2005). Personality traits are represented in one's beliefs about the self, which are global in nature. Robinson and Clore (2002a) described emotional states as distinct feelings whereas traits could be seen as beliefs about feelings. Following a differential psychology perspective, traits could be seen as temporal stable features which are relatively independent of situational or status influences (for example neuroticism), whereas states are temporal unstable, situation- and status-dependent features, for example mood (Kelava & Schermelleh-Engel, 2008).

1.1.2 Distinguish between Emotions and Mood

So far, there was a focus on differentiation between state and trait. Concerning state, there is another crucial distinction to make. When thinking about affect, it becomes clear that the term *emotion* alone could not represent the whole spectrum of possible affective (state) conditions. Therefore, there are some more concepts which try to describe emotional states more selectively. *Figure 1* depicts the most important ones, indicating that one distinguishing characteristic between these concepts is the time course of each. Following Oatley and Jenkins (1996), (facial) expressions and autonomic changes last from 0.5 to 4 seconds. The corresponding self-reported *emotion* lasts between a few minutes and a few hours. This is called a typical emotional episode.

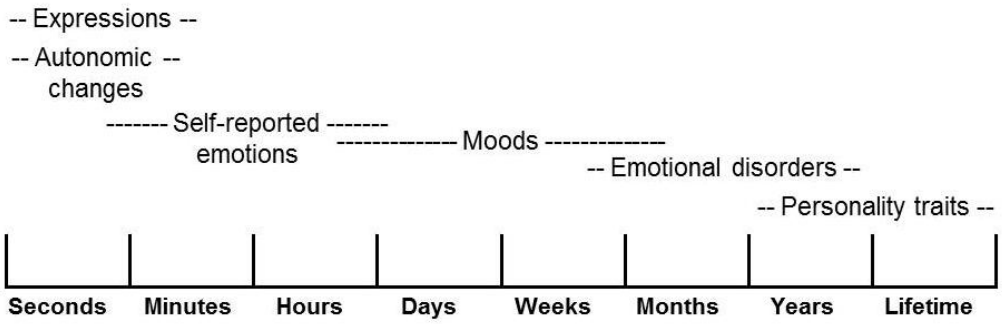

Figure 1. Potential affective phenomena in relation to possible time spans (according to Oatley & Jenkins, 1996).

Going further, there is the term *mood*, indicating an emotional state which lasts for hours, days or weeks. It could have a low intensity background and have no concrete start or stop. Beside the duration, there are some other differences between moods and emotions, as the lower intensity of moods and their diffuseness or globality, having no explicit antecedent (Frijda, 1993; Oatley & Jenkins, 1996). Davidson (1994, p. 52) argued that emotions bias action, whereas moods bias cognition using the following words: "[M]oods may always be present. Moods provide the affective background, the emotional color, to all what we do. Emotions can be viewed as phasic perturbations that are superimposed on this background activity." Moreover, Davidson (1994) mentions that moods and emotions dynamically interact in such a way that emotions could lead to specific moods and moods could alter the probability that particular emotions occur. Frijda (1993) considers affect as the major component of moods. This leads to two ways of experience of moods as states of unfocused

pleasant or unpleasant feelings or as states with lowered thresholds for the appraisal of the affective valence of events.

1.1.3 Anxiety: A Specific Emotion

There are plenty of human emotions, like basis or fundamental emotions like happiness, anger an sadness (e.g. Ekman & Cordaro, 2011; Izard, 2009, 2011; Levenson, 2011). The present paper will focus on anxiety as one of the most ubiquitous negative emotion (Sarason & Sarason, 1990). When talking about anxiety, one should start in defining trait anxiety and state anxiety, as the need to differentiation was explained above. *Trait anxiety* is defined as a stable interindividual difference concerning the tendency to appraise situations as threatening and react with increasing state anxiety (Laux et al., 2013). *State anxiety* is a consciously perceived emotional state, which is characterized by tension, nervousness, compulsion and worry together with increased activity of the autonomic nervous system (Spielberger, 1972). Trait and state anxiety are not independent from each other. The higher a person's trait anxiety, the more likely is the occurrence of state anxiety in different situations (Spielberger, 1972). The state anxiety reaction itself has four components (Janke, 1986): Perceptual emotional components (e.g. reported anxiety), cognitive components (e.g. thoughts about the situation), somatic components (e.g. arousal of the central nervous system) and behavioral components (e.g. mimic). The differentiation between state anxiety and trait anxiety is also important for the current work, which is focusing mainly on memory distortions concerning *state* anxiety. As explained below, there will also be a trait anxiety perspective in predicting state-anxiety related distortions in memory.

1.1.4 Social Anxiety

Anxiety as a ubiquitous negative emotion (Sarason & Sarason, 1990) is likely to occur in several situations, for example in academic achievement situations like writing an exam or giving a talk. As explained above, this could lead to situational specific state anxiety. Anxiety in a social situation could therefore be seen as response to a perceived threat (Rapee & Heimberg, 1997). A person's stable tendency to react with anxiety in such situations would be trait anxiety. Both phenomena could be named social anxiety focusing either state or trait anxiety (Zeidner & Matthews, 2011). Anxiety could be seen as a continuum, ranging from mild to moderate anxiety, subclinical anxiety and, highest in severity, anxiety disor-

ders (e.g. Vye, Scholljegerdes & Welch, 2007). Therefore, social anxiety could be seen as a subclinical form of social anxiety disorder (Abraham et al., 2013; Staugaard, 2010). Note that severe impairments, for example psychosocial problems (Wittchen, Fuetsch, Sonntag, Müller & Liebowitz, 2000) could also occur in subclinical forms of social anxiety disorder. Subclinical symptoms could also predict later development of clinical relevant social anxiety disorder (Davidson, Hughes, George & Blazer, 1994). Social anxiety disorder, formerly known as social phobia (see Heimberg et al., 2014, for a review), is a mental disorder which is characterized by an irrational fear of being negatively evaluated by others. The subject fears that he or she will show anxiety symptoms or act in an embarrassing or humiliating way (APA, 2013). In the literature, there is also the term *evaluation anxiety* (see Leitenberg, 1990), which is connected to the term fear of negative evaluation. Fear of negative evaluation is, as explained above, one core feature of social anxiety (Heimberg, Brozovich & Rapee, 2012). Evaluation anxiety is associated with social situations that have the potential for the individual to be evaluated (Levinson & Rodebaugh, 2015). Following the DSM-V (Diagnostic and Statistical Manual of Mental Disorders, fifth edition) this fear could occur in social or achievement situations (APA, 2013), whereas the ICD-10 (International Statistical Classification of Diseases and Related Health Problems) only focuses on social situations (Dilling, 2010). This is an important notice when looking at some specific situations, which could cause anxiety in social anxious individuals. Giving a speech could be seen as social situation, producing *public speaking anxiety*, which could be seen as a subtype of social phobia (see Blöte, Kint, Miers & Westenberg, 2009, for a review). Another common situation is writing an exam, potentially leading to state *test anxiety*. Writing an exam has to be seen as performance or achievement situation, which is only included in the DSM-V, but not in the ICD-10 criteria for social anxiety disorder, as explicated above. But there is another reason why test anxiety is a special case. As a common sense, test anxiety is seen as a type of social anxiety only if a person is especially afraid of potential humiliation or embarrassment (the negative evaluation by others). If the main fear applies to the failure of the exam, the test anxiety is seen as specific phobia. The current work focuses both, public speaking anxiety and test anxiety, as state anxiety for academic achievement situations.

In a German sample of adolescents and young adults, the lifetime prevalence of clinical relevant social anxiety disorder were estimated to be 7.3 %, showing a rate of 4.9 % for men and a rate of 9.5 % for women. The 12-month prevalence was 3.2 % for men, 7.2 %

for women and 5.2 % in total (Wittchen, Stein & Kessler, 1999). In an US-sample, the life-time prevalence was estimated to be 12.1 %, with a 12-month prevalence of 6.8 %, respectively (Kessler, Chiu, Demler & Walters, 2005). Social anxiety disorder was found to be highly co-morbid with other mental disorders, especially other anxiety disorders and depressive disorders (Fehm, Pelissolo, Furmark & Wittchen, 2005; Magee, Eaton, Wittchen, McGonagle & Kessler, 1996; Schneier, Johnson, Hornig, Liebowitz & Weissman, 1992; Wittchen et al., 1999). The comorbidity with alcohol use disorders seems to be unclear (Schneier et al. 1992; Magee et al. 1996, Wittchen et al., 1999).

As anxiety per se, social anxiety appears at all stages of response and therefore leads to cognitive, emotional, physiological and behavioral consequences which could evoke severe psychological distress (Fehm et al., 2005; Nagata, Suzuki & Teo, 2015). At the following, I would like to examine important characteristics and correlates of social anxious reactions. Typical physiological symptoms of social anxiety are blushing, sweating and stammering (Amies, Gelder & Shaw, 1983; Beidel, Turner & Dancu, 1985; Solyom, Ledwidge & Solyom, 1986). But there are also other typical anxiety related symptoms (Reich, Noyes & Yates, 1988), which are coming along with increased autonomic arousal, for instance increased heart rate (Gonzalez-Bono et al., 2002) leading to perceived heart palpitations. The most common emotions in social anxiety disorders are anxiety and shame (Gilbert, 2000; Veale, 2003). At a behavioral level, there is avoidance behavior like leaving threatening situations. But even if subjects remain in the social situation, they may use safety (also called self-protective) behaviors (Clark, 2001; Wells et al., 1995). Therefore these behaviors are also called subtle avoidance (Rapee & Heimberg, 1997). This could for example be the avoidance of eye contact or the use of make up to conceal blushing. Such safety behaviors are associated with increased state anxiety during a social interaction (Plasencia, Alden & Taylor, 2011). Looking at the cognitive component of a social anxious reaction, there is evidence for negative evaluatory cognitions (Beidel et al., 1985; Leary, Kowalski & Campbell, 1988), increased self-attention (e.g. Woody & Rodriguez, 2000), attention bias towards negative cues in others (e.g. Amir, Weber, Beard, Bomyea & Taylor, 2008; Mogg, Philippot & Bradley, 2004), negative interpretation bias of social stimuli (e.g. Amir, Beard & Bower, 2005; Constans, Penn, Ihen & Hope, 1999; Stopa & Clark, 2000), maladaptive attributions for social behavior, like internal attribution of perceived failure in social interaction (Beidel et al., 1985; Henderson et al., 2014) and perceived inability to cope, related to the absence of coping thoughts (Glass, Merluzzi, Biever & Larsen,

1982). It is also important to mention cognitive reactions in anticipation to and after the situation, for example post-event-processing or rumination (see Brozovich & Heimberg, 2008, for a review).

There are several explanatory models for the development and maintenance of social phobia. In the following, I will give an overview of the most important cognitive models in a nutshell. One of the first cognitive theories was the model by Beck, Emery and Greenberg (1985), indicating that social anxious subjects view themselves as incompetent and insufficient expecting others to have a critical attitude towards them. More complex is the cognitive model by Clark and Wells (1995). They emphasize the role of automatical thoughts in social situations. These could include an expected negative evaluation, which lead to increased self-attention, attention bias towards negative cues in others and finally security behavior and anxiety-related symptoms. These aspects interact with each other. Moreover, information processing before (anticipation) and after the situation (e.g. rumination) are renowned to be influenced, too. The cognitive-behavioral model by Rapee and Heimberg (1997) proclaimed also distortions and biases in the processing of social and evaluative information, which could lead to heightened anxiety in social situations and are cause also the maintenance of social phobia.

At trait level, social anxiety is related to other personality constructs. As the literature shows, there is a strong relationship with neuroticism, which is seen as a nonspecific, underlying characteristic of social anxiety (see Stein & Gelernter, 2012, for a review). Neuroticism is a personality trait describing individual differences in negative emotional response, associated with low emotional stability (Ostendorf & Angleitner, 2004; Costa & McCrae, 1992). Following the five factor theory, it consists of several facets like anxiety, anger, depression, self-consciousness, impulsiveness and vulnerability (Costa & McCrae, 1992). Empirical findings indicate that high levels of social anxiety are corresponding with higher neuroticism (Bienvenu, Hettema, Neale, Prescott & Kendler, 2007; Bienvenu et al., 2004; Hettema, Neale, Myers, Prescott & Kendler, 2006; Schmidt & Riniolo, 1999; see also Lahey, 2009, for a review), which was also found for test anxiety (Hoferichter & Raufelder, 2013; Schmidt & Riniolo, 1999).

Another important personality trait is extraversion. Extraversion refers to quality and quantity of one's interpersonal interactions and is associated with positive emotions (Ostendorf & Angleitner, 2004). Following the five factor theory, it consists of facets like warmth,

gregariousness, assertiveness, activity and excitement seeking (Costa & McCrae, 1992). Lower extraversion seems to be associated with higher levels of social anxiety (Bienvenu et al., 2004; Bienvenu et al., 2007; Bienvenu & Stein, 2003) which was also found for test anxiety (Schmidt & Riniolo, 1999).

1.2 Memory

Following Matlin (2009, p. 21), memory is "the process of maintaining information over time". The process of generating memories consists of encoding, storage and retrieval of information (Pohl, 2007). Encoding is the process of converting new information into a construct which could be linked to a persistent cognitive structure (Myers, 2014), allowing the process of storage into the systems explained above. Retrieval means the process of recovering a target memory (Anderson, 2009). The following passages provide an overview about relevant concepts concerning the structure of memory in short.

1.2.1 Organization of Memory – Episodic and Sematic Memory

Concerning the organization of memory, it is common that we divide memory into long- and short-term plus sensory memory (Atkinson & Shiffrin, 1968). Short term memory is "a term applied to the retention of small amounts of material over periods of a few seconds" (Baddeley, 2009a), which is not relevant here. The sensory memory is a brief storage of sensory information which could be transferred to short term memory (Baddeley, 2009a). In contrast, long-term memory is "a system or systems assumed to underpin the capacity to store information over long periods of time" (Baddeley, 2009a).

Tulving (1972, 1983) made the distinction between episodic and semantic memory in human long-term memory (see *Figure 2*). Episodic memory contains consciously recollected previous experiences. It can be seen as relived past and contains concrete, temporal and spatial organized knowledge. A typical item could be a student's knowledge about the last maths exam. The semantic memory, in contrast, stores more general knowledge such as common knowledge, independent of the circumstances of knowledge acquisition. For example, this could be the student's general knowledge of his or her behavior in academic test situations.

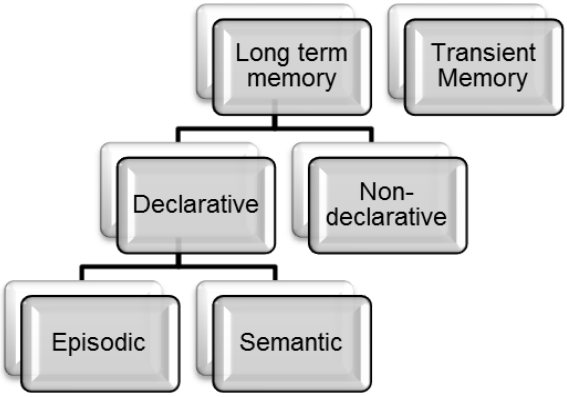

Figure 2. Conception of memory following Tulving (1972), showing the organization of declarative long-term-memory.

1.2.2 Autobiographical Memory

The autobiographical memory is a "memory across the lifespan for both specific events and self-related information" (Baddeley, 2009b). According to Rubin (1986), autobiographical memory is a source of information of our lives, helping us making judgements about our personalities and behavior. It could provide a sense of identity and continuity. Brewer (1986) named it as "memory for information related to the self". Different to Baddeleys (2009b) definition of autobiographical memory as depending on both episodic and semantic memory, there are some concepts proposed, with the idea, autobiographical memory could be a type of episodic memory only (Assink & Schroots, 2010). In the present work, I follow the approach that autobiographical memory relies on episodic and semantic memory both, which will be outlined during the following chapter.

To sum up, I gave an overview about basic concepts concerning emotion, especially anxiety and memory, which are crucial for the understanding of my work. In the next chapter I would like to present some underlying models, integrating emotion and memory.

1.2.3 Implicit vs. Explicit Autobiographical Memory

Theoretical and practical considerations formed the distinction between explicit and implicit memory systems (e.g. Jacoby, 1991; Tulving & Schacter, 1990). Explicit memory correlates with representations of both episodic and semantic memory, like specific experiences or facts. Concerning retrieval, episodic contents are attended by feelings of remembering, semantic contents by feelings of knowing (Levine, Lench & Safer, 2009). In con-

trast, implicit memory refers to information not accessible to conscious awareness but nevertheless influencing current emotional, cognitive and behavioral reactions. This pertains for example priming, habituation and conditioning. The current study refers to explicit memory, which has some implications for the following theoretical considerations.

1.3 The Self-Memory-System as a Frame Theory

There are some controversial debates concerning the question, if memories for past emotions are stored permanently and accurately or if they, consistent with other autobiographical information, were reconstructed (see Levine, Prohaska, Burgess, Rice & Laulhere, 2001, for a review). On the one hand, there are findings that memories of emotional significance of events are stored permanently, in contrast to memories for events themselves (LeDoux, Romanski & Xagoraris, 1989). Lang (1994) argued that intense emotions are easily recalled, resilient to extinction and effortlessly reactivated because of their strong connection to the subcortical motivational system. Zajonc (1980) thought of a separate memory store for affective responses, which is consistent with findings of emotional dissociation in trauma patients (Christianson, 1992; Daum, Flor, Brodbeck & Birbaumer, 1996; Tobias, Kihlstrom & Schacter, 1992; Witvliet, 1997).

On the other hand, there are theories and findings indicating that emotions are not stored directly in memory, but are reconstructed (see Levine, 1997, for a review). There are studies that identified uncovered inaccuracies when recalling past emotions. This issue will be discussed in detail below. The current study refers to a reconstruction standpoint. This is not in contradiction to the findings discussed just above. Moreover there is some important information missing, linking the statements concerning implicit and explicit autobiographical memory to the question if emotional memories are stored permanently or were reconstructed. There is substantial evidence that explicit emotional memories are more likely to be reconstructed, whereas researchers investigating implicit emotional memory report permanently and accurately retained memories (Levine et al., 2009). As the current study focuses explicit emotional memory, the basic frame theory should allow reconstructing processes.

An important integrating approach for understanding autobiographical memory which follows the reconstruction principle is the model provided by Conway and Pleydell-Pearce (2000), called *self-memory-system*. Note that the self-memory-system itself is also valid for

non-emotional information but represents the idea that the mechanisms explained below will also fit the special relationship between emotions and memory (see also 1.3.1). Following this model, memories are transitory dynamic mental constructions within a self-memory system. In short, this self-memory system (see *Figure 3*) contains an autobiographical knowledge base and current goals of the working self. There are control processes modulating the access to the knowledge base by successively shaping cues used to activate autobiographical memory knowledge structures. Therefore, it is possible to *reconstruct* specific memories. The interaction of the knowledge base to active goals is reciprocal and the knowledge base is also a base for the goals of the working self.

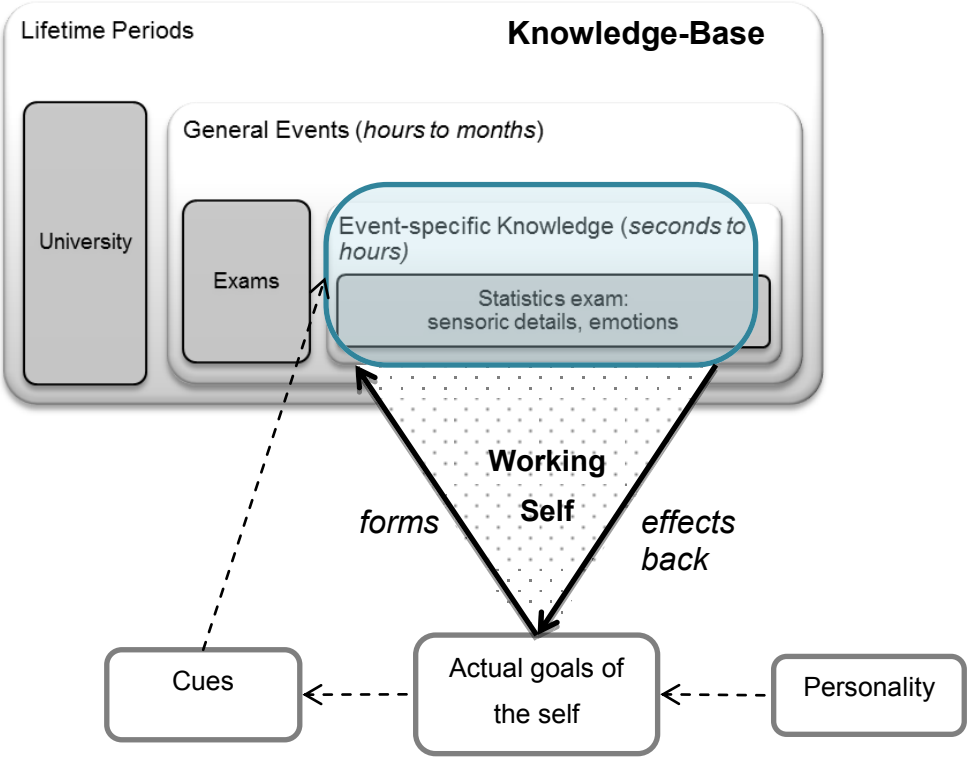

Figure 3. Schematic illustration of the self-memory-system (author's illustration based on the model by Conway & Pleydell-Pearce, 2000).

When having a closer look, there are three areas of autobiographical knowledge: lifetime periods, general events and event specific knowledge. To sum up, there are different levels of specificity concerning the organization of knowledge. Knowledge stored at the level of a lifetime period contains cues which could be able to index a set of general events meanwhile these general events could index event specific knowledge. A specific autobiographical memory could be seen as a stable pattern of activation over the indexes of the three

knowledge structures. The construction of these patterns is limited by the content of the other parts of the knowledge base and by central control processes that coordinate access to the knowledge base and modulate output from it.

Giving a link to Tulving's (1972) concept of episodic and semantic memory, lifetime periods and general events could be seen as semantic, whereas the event specific knowledge could be relate to episodic memory, although it does not correspond directly. In a later work, Conway (2005) structured lifetime periods and general events into a concept called *conceptual self*, whereas the specific events were called *episodic memories*.

Focusing the self, it is evident that there is a strong relation between the self and autobiographical memory. Following Robinson (1986), autobiographical memories are resourcing the self by sustain or change aspects of it. The self, especially the current goals of the self, works by control processes that modulate the construction of memories. The *working self* refers to the concept of the working memory, provided by Baddeley (1986). The working memory has the function to keep information in mind when performing complex tasks (Baddeley, 2009a). The core part of the memory is a set of control processes that coordinate and modulate other systems. The goals of the working self are forming a subset of working-memory control processes organized into interconnected goal hierarchies with the function to constrain cognition and behavior. The goal structure of the working self could be seen as constrained by its own history. Therefore, autobiographical knowledge is encoded through the goal structure of the working self. This leads to individual types of goal-related autobiographical knowledge that is retained in the knowledge base.

1.3.1 Linking the Self-Memory-System to other Theories Concerning Emotional Processing

As explained above, the self-memory-system is not exclusively developed to understand memory for emotions but for all autobiographical information. The authors describe the idea that the self-memory-system is also valid for emotional memories. Due to the integrative character of the model, there are a number of important other models related to emotional processing subsumed in this model, which are crucial to introduce shortly.

The model by Carver and Scheier (1990) focuses the *action-guidance system* which is nearly equivalent to the working-self goal structure indicated by Conway and Pleydell-

Pearce (2000). This system is monitored by a second system, the emotion system, which has the function to assess and regulate the rate at which the goal system reduces discrepancy. Positive emotions indicate an acceptable rate of discrepancy reduction, whereas negative emotions reflect an increasing failure to reduce discrepancies.

There is a comparable model, drawn by Oatley and Johnson-Laird (1987) and enhanced by Oatley (1992). Following this model, emotions are distinct forms of communication between different domains of the cognitive system. Therefore, goals and plans communicate with other processes and structures only by their output. Other parts of the cognitive system communicate with the goal only via its input, indicating a negative feedback loop. Every goal (and associated plan) is monitored by a mechanism which has to assess, if there is a change of probability to achieve an important goal. In case of a detection of such a change, the monitoring mechanism produces an alert signal to the cognitive system whose arousal increases as a consequence. These alert signals are thought to be emotions.

The model by Stein and colleagues (Levine, Stein & Liwag, 1999; Stein & Trabasso, 1992) understands emotions as signals for changes in working-self goals that have been achieved, blocked, or threatened. This would lead to appraisal and goal change. This is an essential condition for the development of a causal model of the emotional experience. In terms of the self-memory-system-model, this knowledge for specific experiences would be represented at the general event level at the knowledge base.

To sum up, these theories show that memories in which knowledge of goals are highlighted will also bring forward memories for emotional experience. The self-memory-system, basing on these well elaborated theories, includes these approaches to ensure to be also valid for remembering emotional contents.

1.3.2 Accuracy in Memory for Emotional Events

Baddeley (2009a) described memory laxly as “something we complain about”, indicating that irregularities concerning the function of memory are common. In chapters 1.3 and 1.3.1 I talked about a reconstruction process of memories. Reconstructing does not mean copying, which provides a target for contortions. Memories are often inaccurate due to the underlying *memory bias*, also called *recall bias*, which lead to distortions at the retrieval of target information. As the literature shows, this is also present for emotional information.

A common finding is an overestimation of the emotional intensity of an event (Barrett, 1997; Christianson & Safer, 1996; Fredrickson, 2000; Parkinson, Briner, Reynolds & Totterdell, 1995; Thomas & Diener, 1990; Wilson, Meyers & Gilbert, 2003). Similar results were also obtained in state social anxiety (e.g. Abbott & Rapee, 2004) and test anxiety (Devito & Kubis, 1983; Dewhurst & Marlborough, 2003; Keuler & Safer, 1998), which are on the focus of this paper. There are a few influencing factors, which could explain these findings.

The first factor is the elapsed time since the target event. Secondly, mood has the power to influence the recall bias in different ways, precisely *mood congruent* or *mood incongruent*. The third factor is post-event-appraisal. The last considered factor is the influence of personality.

1.3.2.1 The Accessibility Model - Or: The Time as Basic Variable

When talking about influencing factors concerning remembering emotional contents, there is an important model, the so called *accessibility model*, provided by Robinson and Clore (2002a; 2002b). This model takes into account a basic variable, which could extend the self-memory-system and give a prediction for distortions in memories. To simplify, this variable is time. Compliant with the accessibility model, self-reports of emotion will reflect other sources of non-experiential information, if data from special experience is inaccessible. These other sources include both memory for episodic details of an emotional event and semantic knowledge about one´s emotions in general. In detail, there are at least 4 types of knowledge influencing the report of emotions (see *Figure 4*). These types are increasing in generality.

First, there is the *experiential knowledge* which is used if people could access their feelings directly. This type of knowledge is argued to be limited to reports of current emotions. To give an example, people could be asked to tell their emotions directly when opening their birthday gifts or waiting for an oral examination to begin. The experiential knowledge is episodic in nature.

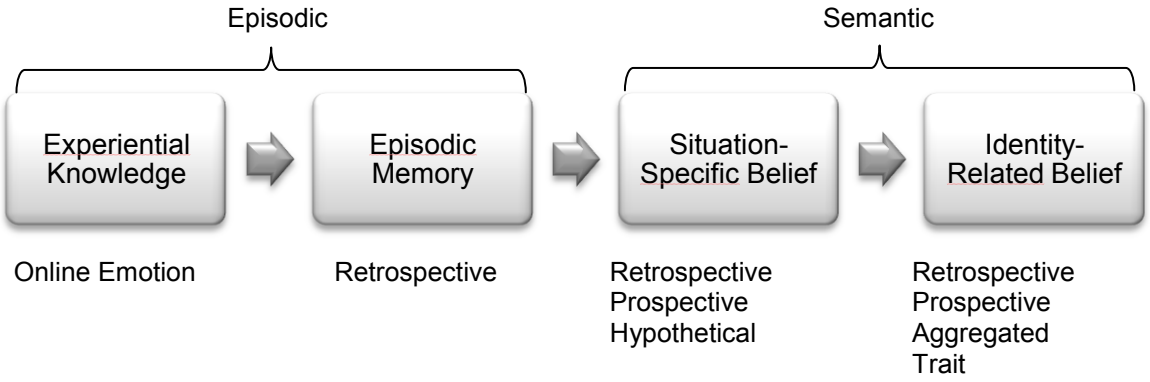

Figure 4. Sources of information in emotional self-report (according to Robinson and Clore, 2002a).

Second, there is the *episodic memory* for the retrieval of specific moments from the past. There is the assumption that people cannot re-experience past feelings but can reconstruct them by recalling relevant thoughts and event-specific details. For example, people could have a special idea of themselves in social performance situations, such as job interviews. The episodic memory is, as its name implies, episodic in nature.

Third, there is the *situation-specific belief*. People could generate a belief about the emotions that are likely to be elicited in a particular type of situation. As an example, many people believe that insults lead to anger, watching laughing babies is associated with happiness and funerals are painful. The situation-specific belief is semantic in nature.

The fourth type is the *identity-related belief*, which refers to people's access to beliefs about their emotions in general. This source of emotion knowledge includes the beliefs assessed by trait emotion scales (e.g., trait anxiety), as well as social stereotypes (e.g., gender stereotypes). One example is the belief that women are more anxious than men. The identity-related belief is, as the situation-specific belief, semantic in nature.

One elementary assumption of the accessibility model is that people switch from an episodic memory strategy to a semantic memory strategy, if the type of self-report aggravates episodic retrieval. When people were asked to report their online emotions, they could do this promptly. When ask to report feelings over a longer time periods, e.g. hours or weeks, it becomes more difficult. The accessibility model predicts that at a certain point people do not attempt to recall episodic memories, but use semantic emotion knowledge to reconstruct memories.

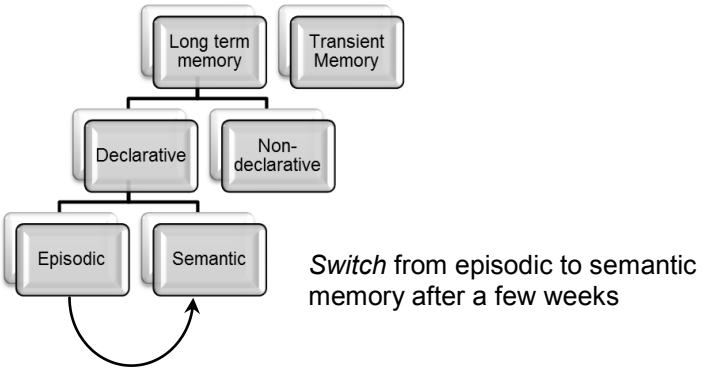

Figure 5. Amplification of Tulving's (1972) conception when integrating the assumption of the memory-switch suggested by Robinson and Clore (2002a).

Following their empirical testing about this hypothesis, Robinson and Clore (2002a) could collect support for this. At the level of "last few weeks", people seemed to switch from episodic to semantic memory, when ask to retrieve information (see *Figure 5*). Tulving (1985) reckons that affect plays a more important role in the episodic than in the semantic system.

1.3.2.2 Mood-Congruency vs. Mood-Incongruency

The process of retrieval could be biased through the accessibility of particular content in memory, which is varying with the subject's mental state at the time of retrieval (Shiffman, Stone & Hufford, 2008). Therefore, another important influencing factor is mood at time of retrieval (e.g. Parkinson et al., 1995). There are two main conceptions, the *mood congruent recall* and the *mood incongruent recall*. The mood congruent recall, also called assimilation effect, is characterized by a memory bias into the direction of the actual mood. If one is in a bad mood, he or she would overestimate the amount of his or her anxiety when remembering the situation shortly before the last dentist visit. This does also apply for remembering positive events in positive mood, vice versa. The concept mood incongruent recall, or contrast effect, describes that memories of emotional events were remembered opposite to the actual mood. To keep the example of the dentist visit: If one is in a bad mood, he or she could *under*estimate the anxiety before the last dentist visit.

Mood congruent recall seems to be a general phenomenon. To begin with there are findings indicating that the recall of prior emotions are biased into the direction of the actual mood (Bower, 1981; Parkinson et al., 1995), for example a negative memory bias in de-

pression (e.g. Ellis, Beevers & Wells, 2011). The same was observed for estimated prior pain intensity, which was congruent to subject's actual pain intensity (Eich, Reeves, Jaeger & Graff-Radford, 1985; Smith & Safer, 1993). The most important theoretical approach for mood congruent recall is the *associative network theory* by Bower (1981), relying on the *spreading-activation model of memory* (Collins & Loftus, 1975). This is said to be a memory system consisting of connected propositional nodes in a network, representing for example emotions, behaviors, beliefs or events. If one node is activated, strongly interconnected nodes will be activated, too. For example, there is a subset of nodes representing mood states, such as happiness or sadness. If a person is in a special mood state, the correspondent mood node is activated and, in turn, lead associated concepts getting activated, too. This causes a preferably processing of mood-associated contents, like mood congruent memories. When in a pleasant mood, people will better recall pleasant memories, when they are in bad mood, people will better remember unpleasant material. To sum up, following this model, mood is automatically priming those memories with which it is associated.

Another approach focuses self-schemata, which could be triggered by life events. If a schema is activated, information processing is congruent to the knowledge connected with that schema. This is for example predicted in the cognitive model of depression and anxiety by Beck and Clark (1988). For example, threatening situations activate threat-related schemata, leading to mood congruent (which is schema congruent) memory.

Another theory which has to be mentioned when talking about mood congruent recall is the *encoding specificity principle* (Jacoby & Craik, 1979; Tulving & Thomson, 1973), which implies that contextual information affects the retrieval of information from memory. The retrieved memory would be most accurate if conditions at encoding meet conditions at retrieval. The idea is that a retrieval cue will enhance the recall if it was encoded with the target information during the learning situation. There are findings for this principle of context-dependent memory for the importance of the context like being underwater or on land (Godden & Baddeley, 1975), the state like being sober or drunk (Goodwin, Powell, Bremer, Hoine & Stern, 1969) or being in an acute maniac episode (Weingartner, Miller & Murphy, 1977) and, most important for the current paper, for mood in the sense of mood congruent recall (Eich & Metcalfe, 1989). Mood congruent recall for test anxiety was for example found in the study by Safer, Levine and Drapalski (2002), but there are a few

studies that showed no evidence for mood congruent recall in anxiety (e.g. Foa, McNally & Murdock, 1989; Levy & Mineka, 1998).

Theoretical explanations for mood incongruent recall are mostly based on theories of emotion regulation (Forgas & Ciarrochi, 2002; Morris & Reilly, 1987). The used term "mood repair" indicates that subjects are using controlled mechanisms to counteract automatic associations produced by negative moods (Clark & Isen, 1982; Fiske & Taylor, 1984). For example, the retrieval of positive memories enables subjects to repair a bad mood state (Blaney, 1986; Clark & Isen, 1982; Josephson, Singer & Salovey, 1996; Singer & Salovey, 1988) which was also found for autobiographical memories (Brockmeyer, Kulessa, Hautzinger, Bents & Backenstrass, 2015; Forgas & Ciarrochi, 2002; Kovacs et al., 2015; Parrot & Sabini, 1990; Wisco & Nolen-Hoeksema, 2010).

Forgas (1995) proposed the *affect infusion model*, indicating that there is affect infusion (producing mood congruence) as well as affect control (producing mood incongruence). Using a motivated strategy, subjects are able to produce mood incongruent processing to protect important goals and motives. This strategy will be used, if an important, high relevant content is focused. A person is using pre-defined goal structures, which are less influenced by actual mood. In contrast, the heuristic strategy would use mostly the actual mood to get information about a specific content, leading to mood congruent memory. The model is therefore able to explain inconsistent findings concerning mood and memory. Mood repair therefore focuses the motivated strategy. There are no studies presenting mood repair in regard to recall bias for (state) social or test anxiety. However, there are findings indicating that mood repair via biasing autobiographical memory does not work in depressed mood (e.g. Hetherington & Moulds, 2014; Joormann, Siemer & Gotlib, 2007; Werner-Seidler & Moulds, 2012).

Mood repair is only one aspect of mood incongruent recall: in some cases, people tend to retrieve positive memories to repair an existing negative mood state. But there is also another possibility, which is shown by findings suggesting that people in good mood use an overestimation of initial, negative emotions to exaggerate their perceived success in coping with a threat. For example, this was shown for emotions during psychiatric treatment (Karney & Coombs, 2000), pre-psychotherapy distress (Safer & Keuler, 2002) or pre-blood-donation anxiety (Breckler, 1994). People may be motivated to exaggerate previous

unpleasant feelings to enhance their positive mood in the present (Conway & Ross, 1984; Karney & Coombs, 2000). For test anxiety, this was shown by Keuler and Safer (1998), who asked students to rate their anxiety the day before an exam and recall those ratings one month later. Half the participants had received their exam results and half had not. The informed group showed a stronger tendency to overestimate pre-exam anxiety at recall. As the informed group should no longer be anxious about the exam results, this result indicates a mood incongruent effect. Students with low anxiety tended to overestimate pre-exam anxiety to maximize feelings of pride and accomplishment to have coped with stressful events. Comparable results of mood-incongruence for test anxiety were found in the study by Dewhurst and Marlborough (2003), which will be mentioned more detailed below.

1.3.2.3 Post-Event-Appraisals

Also the *appraisal congruence approach* (Levine, 1997; Levine et al., 2001) has to be mentioned, although it doesn't focus on mood-congruency directly, but on appraisal congruency. Levine (1997) used the cognitive appraisal theory to provide a model to understand the reconstruction of emotional contents. A person's conscious or unconscious evaluation of the relationship between a stimulus and his or her well-being is called appraisal (Arnold, 1960). People experience emotions when evaluating contextual conditions as being relevant to their goals and values. Levine (1997) argued that emotional memories are reconstructed based on recall of the emotion-eliciting circumstances and their appraisals of those circumstances. So, the retrospective evaluation (appraisal) can influence the reconstruction process by subsequently modifying the reprocessing of contents. Thus, not the mood per se influences the direction of the memory bias, but the congruency of the appraisal. The more the appraisals change, the less stable are the memories for intensities of past feelings, getting biased into directions consistent with current appraisals (Levine et al., 2001). This is closely related to a phenomenon known as post-event processing in social anxiety. Here, there is a persistent processing after the event, for example rumination, which then also can modify the memories of the event (e.g. Wells & Clark, 1997). There are findings for a negative memory bias concerning negative feedback after a speech task in subjects engaging in negative post-event processing (Abbott & Rapee, 2004; Edwards, Rapee & Franklin, 2003; Perini, Abbott & Rapee; 2006).

So far, I discussed internal post-event-processing. But changes in appraisal could also be due to external processing, maybe because of new information provided after an event. Concerning test anxiety, in the study by Safer et al. (2002), students were asked to rate their pre-exam test anxiety. One week later, after receiving their results, they were asked to recall their pre-exam test anxiety. Students who learned they had done well on the exam underestimated, those who learned they had done poorly overestimated the pre-exam test anxiety. The authors integrated these results into appraisal theories, indicating that the post-event-knowledge (the result of the exam) had an impact on the estimation of the target anxiety. The authors concluded that it is useful to update emotional memories based on current experience, because this could make them more accurate and could guide goal-directed action by adapting future behavior. Interestingly, the study by Dewhurst and Marlborough (2003) produced contradictory results. In a comparable paradigm relative to Safer et al. (2002), students who learned they had done better than desired on the exam *over*estimated their pre-exam test anxiety, whereas students who learned they failed the exam *under*estimated the pre-exam test anxiety. The authors discussed theories of impression-management (Tedeschi & Riess, 1981), predicting that subjects are motivated to maximize social acceptance by dissociating themselves from negative outcomes and associating themselves with positive results. The tendency of underperforming students to underestimate the pre-exam anxiety could be seen as reducing its importance, which in return could produce a distance from negative outcomes. This could lead to self-enhancement which could in return support self-esteem (Augoustinos & Walker, 1995).

1.3.2.4 Personality and Trait Anxiety

Next to situational specific factors there is another, person specific factor which has to be taken into account. There are studies indicating that memories are depending on aspects of personality (McAdams, Diamond, de Aubin & Mansfield, 1997; Woike, 1995) and trait information (Klein, Cosmides, Tooby & Chance, 2002). Some personality styles are able to increase accessibility to specific sets of memories (e.g., Kihlstrom, 1981; McAdams et al., 1997; Strauman, 1996; Woike, 1995). There is a phenomenon called trait-congruency effect. This implies that humans handle incoming information congruent to their emotion-related personality traits. This was for example shown for attention (e.g. Derryberry & Reed, 1994) as for judgement and memory (Rusting, 1999). There are a few studies focusing on the accuracy of past anxiety in relationship with personality. For instance, people tend to underestimate their former anxiety and negative emotions when higher in extraver-

sion (Barrett, 1997; Rusting, 1999) and higher in the personality trait of negative mood repair (Smith & Petty, 1995; Rusting & DeHart, 2000; McFarland & Buehler, 1997). In contrast, higher values of neuroticism (Barrett, 1997; Rusting, 1999) and social anxiety (Richards & Whittaker, 1990) lead to an overestimation of previous anxiety and negative emotion. There are also some relevant findings for test anxiety. The study by Devito and Kubis (1983) showed an overall overestimation of recalled test anxiety two weeks after the exam, which was significantly positive related to trait anxiety. The higher the trait anxiety, the stronger was the exaggeration of prior test anxiety. The already discussed study by Saf-er et al. (2002, see 1.3.2.3) included also personality variables to predict memory distor-tion. They found no substantial personality influence on recalled test anxiety but identified a positive relationship between neuroticism and the recall of negative emotions. The higher a subject's neuroticism, the higher was the exaggeration of negative emotions. But there are also some studies failing in producing a memory bias for social anxiety (e.g. Rapee, McCallum, Melville, Ravenscroft & Rodney, 1994). It is discussed that memory biases for negative and social threatening information may only occur among socially-anxious indi-viduals under conditions of forthcoming social threat (Kimbrel, 2008; Kimbrel, Nelson-Gray & Mitchell, 2012).

1.3.3 Integration and Aim of the Current Study

There were controversial debates about the question if memories for past emotions are stored permanently and accurately or if they are were reconstructed (Levine et al., 2001). The self-memory-system (Conway & Pleydell-Pearce, 2000) proposes the reconstruction principle. Memories are transitory dynamic mental constructions within a self-memory system, which were reconstructed by control processes modulating the access to an autobi-ographical knowledge base via current goals of the working self. If this reconstruction is assumed, biases concerning the retrieval of emotional memories are able to occur. There is much evidence for the existence of a memory bias for emotional self-report, especially in explicit memory (Levine et al., 2009). Memory distortions of self-reported anxiety could be influenced by several factors. The current work focuses on the elapsed time since the target event, mood congruent or mood incongruent recall, post-event-processing and the influence of personality. When having a closer look, it is obvious that these influencing factors are not independent from each other. Therefore, I would like to propose a theoreti-cally and empirically based integration of these concepts.

Early research on mood and emotional autobiographical memory found evidence for the existence of a propositional associative network (Bower, 1981; Collins & Loftus, 1975), leading to mood congruent recall. But empirical findings gave also strong evidence for the existence of mood incongruent recall for one's own emotions, showing that mood-congruence is not exclusively occurring. Theoretical explanations for this phenomenon are the existence of mood regulation via mood repair (e.g. Clark & Isen, 1982) and the idea to maximize feelings of pride and accomplishment after coping with a stressful event (e.g. Keuler & Safer, 1998). As explained, the affect infusion model (Forgas, 1995) proposed different strategies to induce mood, such as affect infusion to produce mood congruence or affect control, which produces mood incongruence. This was extended by the dual-process mood-management-model by Forgas (2000), which proclaims an affective homeostasis which is achieved through temporal changes in information processing strategies. Therefore, after automatically driven affect infusion, subjects should tend to mood congruent recall, whereas, to achieve homeostasis, motivated strategies, like mood repair via mood incongruent recall should be used. This is in accordance to Sedikides (1994) findings, suggesting a *first congruent, then incongruent* memory-approach. There is another approach which has to be taken into account, which is the asymmetric effect of mood-congruence (see Holland & Kensinger, 2010, for a review). There are findings suggesting a more stable mood congruent effect for positive than for negative emotions (Isen, 1985; Rusting, 1998).

Mood repair seems also to be related to the personality traits extraversion and neuroticism. Extraversion is associated with positive affect, whereas neuroticism is associated with negative affect (Costa & McCrae, 1980; Watson & Clark, 1984). High extraversion is therefore linked to maintenance of positive emotions (Lischetzke & Eid, 2006; Ng & Diener, 2009) and functional emotional coping styles like positive thinking (McCrae & Costa, 1986). Interestingly, the mood repair effect itself seems not to be strongly linked to extraversion (Kokkonen & Pulkkinen, 2001; Lischetzke & Eid, 2006; Larsen & Prizmic, 2004), whereas neuroticism is linked to a decreased tendency of mood repair (Ng & Diener, 2009). On a theoretical level, this could be due to a special characteristic in neuroticism. Negative mood states, which are hedonically unpleasant, could be beneficial for individuals high in neuroticism (Tamir, 2005; Tamir & Robinson, 2004). These findings are in accordance with those by Kämpfe and Mitte (2009), who found that neuroticism is positively related to a desire for unactivated unpleasant affects and negatively related to a desire for activated pleasant affect.

Another strong relationship seems to exist between personality and tendencies for reappraisal and post-event-processing. As explained, people vary in their engaging in (positive) reappraisal and (negative) post-event-processing, like rumination. Trait anxiety is related to (negative) post-event-processing (e.g. Abbott & Rapee, 2004) and rumination (e.g. Wells & Clark, 1997). This relationship seems also be valid for neuroticism as well (Augustine, Hemenover, Larsen & Shulman, 2010; Hankin, Fraley & Abela, 2005; Hervas & Vazquez, 2011; Roberts, Gilboa & Gotlib, 1998).

Personality itself could be linked to the self-memory-system (Conway & Pleydell-Pearce, 2000), because personality variables could have an impact on actual goals of the self (see *Figure 3*). Overall, the elapsed time since the emotional event has to be taken in account. According to Robinson and Clore (2002a), there is a memory switch from an episodic memory strategy to a semantic memory strategy, indicating the use of semantic emotion knowledge to reconstruct memories. Therefore, the influence of personality on memory bias should increase over time.

The current paper focuses on recall-accuracy of state anxiety ratings prior to academic achievement situations, which are writing an exam and giving a speech, using naturally occurring as well as laboratory settings. As explained above, there are a few studies examining emotional recall bias for exam and speech situations, leading to inconsistent findings. For example, mood congruent recall for test anxiety was found in the study by Safer et al. (2002). For general trait anxiety, there is also some evidence for the presence of a mood congruent memory bias for autobiographical material (Burke & Mathews, 1992; Richards & Whittaker, 1990). On the other hand, further studies showed no evidence for mood congruent recall in anxiety (e.g. Foa et al., 1989; Levy & Mineka, 1998, Mogg & Mathews, 1990; Wenze, Gunthert & German, 2012). In contrast, Keuler and Safer (1998), as well as Dewhurst and Marlborough (2003) found mood incongruent recall with an overestimation of prior test anxiety in order to self-enhancement. The role of post-event-knowledge in test anxiety remains unclear as well. Safer et al. (2002) showed an appraisal congruent recall. Students who learned they had done well on the exam underestimated, those who learned they had done poorly overestimated the pre-exam test anxiety. The results by Dewhurst and Marlborough (2003) were contradictory. Students who learned they had done better than desired on the exam overestimated their pre-exam test anxiety, whereas students who learned they failed the exam underestimated the pre-exam test anxiety, which is linked to impression management theories. Negative post-event processing due to negative feedback

was found to predict negative memory bias after a speech task (Abbott & Rapee, 2004; Edwards et al., 2003; Perini et al., 2006). Personality influences on recall of social and test anxiety showed trait-consistent-effects for anxiety (Devito & Kubis, 1983; Krans, de Bree & Bryant, 2014; see also Morgan, 2010, for a review), neuroticism (Safer et al., 2002) and extraversion (Barrett, 1997; Rusting, 1999), but it remains unclear, how they are linked to mood states.

1.4 Hypotheses

The current paper will integrate these approaches into three longitudinal studies. A special aim is to investigate the influence of the explained factors simultaneously, studying differential conditions of mood incongruent memory as a function of personality and time. Moreover, technological progress allows assessing emotions and physiology in ecological, event-contingent on-line settings. The rationale will be equivalent in all studies. Subjects will be asked about their actual state anxiety prior to an academic achievement situation, whereas achievement-related anxiety seems to be the most reported emotion in undergraduates (Pekrun, 1992). Even cognitive and physiologic assessments will be obtained. Directly after the situation, there mood will be assessed. Then they were asked to recall their former anxiety. The same procedure will be repeated a few weeks later. Personality traits and post-event-processing will also be assessed. *Figure 6* provides an overview about the main hypotheses of the current work. Specific hypotheses of each single study will be explained in the corresponding section.

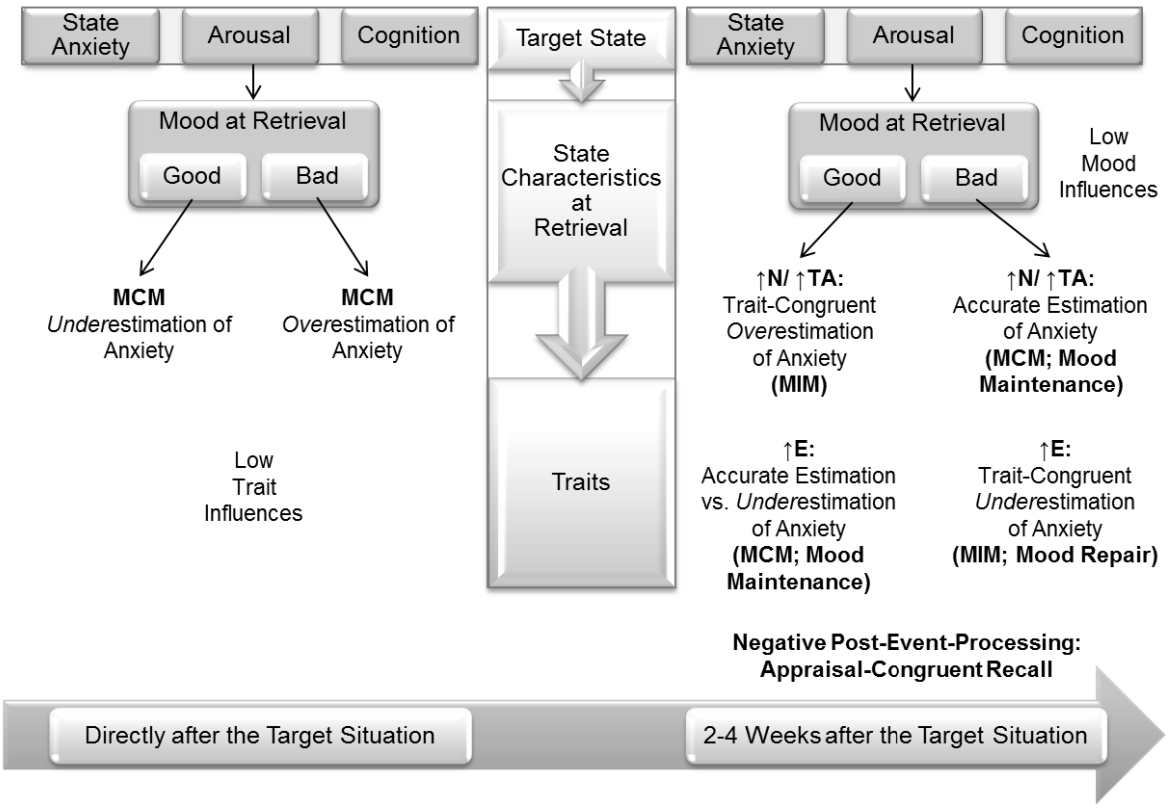

Figure 6. Overview about the main hypotheses of the current work.
Note. MCM: Mood Congruent Memory; MIM: Mood Incongruent Memory; N: Neuroticism; TA: Trait Anxiety; E: Extraversion

The superordinate hypotheses are as follows:

Hypothesis 1: An overall overestimation of the reported anxiety directly before the event is predicted.
At all levels of recall, there will be an overall overestimation of the reported anxiety prior to the academic achievement situation (Barrett, 1997; Christianson & Safer, 1996; Fredrickson, 2000; Parkinson et al., 1995; Thomas & Diener, 1990; Wilson et al., 2003).

Hypothesis 2: Mood congruent recall will appear directly after the event.
Directly after the target event, mood congruent recall will appear, indicating a decreasing overestimation the better the assessed mood is (Forgas, 1995; 2000; Forgas & Cariocci, 2002; Sedikides, 1994; Singer & Salovey, 1988).

Hypothesis 3: Mood incongruent recall will appear at follow-up occasion of measurement.
With increasing time after the target event, mood incongruent recall will be observed (Forgas, 1995; 2000; Forgas & Cariocci, 2002; Sedikides, 1994; Singer & Salovey, 1988).

Hypothesis 4: Trait congruent recall will become more important over time.
The influence of trait variables neuroticism, social anxiety and extraversion on memory distortion will be increasing over time (Robinson & Clore, 2002a; 2002b).

Hypothesis 5: Neuroticism should be linked to negative mood maintenance and mood incongruent recall in positive mood.
The effects of mood on cognitive processes depend on individual differences in emotion-related personality traits (Rusting, 1999). Neuroticism is predicted to be linked to mood congruent recall in negative mood (mood maintenance; Ng & Diener, 2009; Rusting & DeHart, 2000) and hypothesized with mood incongruent recall in positive mood, due to findings indicating a positive relationship between neuroticism and negative affect (Kämpfe & Mitte, 2009; Tamir, 2005; Tamir & Robinson, 2004). Concerning mood maintenance it is hypothesized that this will be via accurate recall. It should be investigated, if social anxiety is related to comparable phenomena.

Hypothesis 6: Extraversion should be linked to positive mood maintenance and negative mood repair.

Moreover, the link between extraversion and emotion regulation via mood maintenance and mood repair is addressed. Extraversion is predicted to be linked to mood congruent recall in positive mood (mood maintenance; Lischetzke & Eid, 2006; Ng & Diener, 2009), with a weaker influence in negative mood (mood repair; Kokkonen & Pulkkinen, 2001; Lischetzke & Eid, 2006). It should be investigated, if mood maintenance in positive mood is linked to accurate or underestimated recall.

Hypothesis 7: Appraisal congruent memory should be observable.

Following the appraisal congruence approach (Levine, 1997; Levine et al., 2001), appraisals after the event are congruently related to the memory outcome. Therefore, the effect of ruminative post-event-processing should lead to an overestimation memory bias for those subjects, who engage highly ruminative (Abbott & Rapee, 2004; Edwards et al., 2003; Perini et al., 2006). Increasing rumination should therefore produce increasing memory bias.

2 Study 1

The first study investigated the memory bias for self-reported anxiety prior to an exam at university, so in a natural setting. Therefore, three occasions of state measurement were realized: the evening before the exam, directly after the exam and after receiving the exam results. The specific hypotheses were as follows.

2.1 Hypotheses

I. An overall overestimation of the reported anxiety at the evening before the exam is predicted.

At all levels of recall, there will be an overall overestimation of the reported anxiety at the evening before the exam (Barrett, 1997; Christianson & Safer, 1996; Fredrickson, 2000; Parkinson et al., 1995; Thomas & Diener, 1990; Wilson et al., 2003).

II. There should be trait-consistent relationships between neuroticism and extraversion with state levels of anxiety.

Anxiety levels at the evening before the exam will be positively related with neuroticism (Bienvenu et al., 2007; Bienvenu et al., 2004; Hettema et al., 2006; Hoferichter & Raufelder, 2013; Schmidt & Riniolo, 1999) and negatively related with extraversion (Bienvenu et al., 2004; Bienvenu et al., 2007; Bienvenu & Stein, 2003; Schmidt & Riniolo, 1999).

III. Mood congruent recall will appear directly after the exam.

Directly after the exam, mood congruent recall will appear, indicating a decreasing overestimation the better the assessed mood is (Forgas, 1995; 2000; Forgas & Cariocci, 2002; Sedikides, 1994; Singer & Salovey, 1988).

IV. Mood incongruent recall will appear at follow-up occasion of measurement.

At the third occasion of state measurement, mood incongruent recall will be observed (Forgas, 1995; 2000; Forgas & Cariocci, 2002; Sedikides, 1994; Singer & Salovey, 1988).

V. Trait congruent recall will appear at all occasions of measurement.

The personality variables neuroticism and extraversion will be linked to personality congruent recall, indicating an increasing overestimation of the pre-exam anxiety with increas-

ing neuroticism and a decreasing overestimation of the pre-exam anxiety with increasing extraversion (Barrett, 1997; Rusting, 1999).

VI. Trait congruent recall will become more important over time.

The influence of personality variables neuroticism and extraversion on memory distortion will be increasing over time (Robinson & Clore, 2002a; 2002b).

VII. Neuroticism should be linked to negative mood maintenance and mood incongruent recall in positive mood.

Neuroticism is predicted to be linked to mood congruent recall in negative mood (mood maintenance; Ng & Diener, 2009; Rusting & DeHart, 2000) and hypothesized with mood incongruent recall in positive mood, due to findings indicating a positive relationship between neuroticism and negative affect (Kämpfe & Mitte, 2009; Tamir, 2005; Tamir & Robinson, 2004).

VIII. Extraversion should be linked to positive mood maintenance and negative mood repair.

Extraversion is predicted to be linked to mood congruent recall in positive mood (mood maintenance; Lischetzke & Eid, 2006; Ng & Diener, 2009), with a weaker influence in negative mood (mood repair; Kokkonen & Pulkkinen, 2001; Lischetzke & Eid, 2006).

IX. The influence of the received mark should be examined exploratory.

The received mark may work as post-event-knowledge, leading to different appraisals concerning the exam. Exploratory, the influence of the memory distortion should be investigated under inclusion of the received mark as covariate.

2.2 Method

2.2.1 Participants

Participants were recruited at the University of Kassel, Germany, using flyers and short presentations of the study in several lectures. Students ($N = 131$) taking part in seven different exams participated the study, which were personality psychology ($N = 17$), statistics for students in psychology ($N = 38$), psychological diagnostics for teacher trainees ($N = 11$), economics ($N = 33$), architecture ($N = 5$), sociology ($N = 12$) and German philology ($N = 15$). The students were on an average at the third semester ($M = 2.86$, $SD = 1.87$, range: 1-9). The study included 38 men and 93 women. The mean age was 23.85 ($SD = 4.29$) years.

2.2.2 Measures

MDBF. Actual mood was assessed using the good-bad subscale of the Multidimensional Mood Questionnaire MDBF (Steyer et al., 1997). The MDBF is an instrument for the assessment of the actual mental state consisting of three bipolar dimensions, which are good vs. bad mood, vigilance vs. tiredness and tranquility vs. agitation. For the good-bad subscale, higher values are indicating values in the direction of good mood. There are existing two short forms A and B, whereby the short form A was used in this study. There are four items forming each scale, introduced with: "*Right now I feel…*". Subjects were asked to rate the four items at a five-point Likert-type scale ranging from "1" (*definitely not*) to "5" (*extremely*). Chronbach's alpha for the short forms ranged between $\alpha = .73$ und $\alpha = .89$ (Steyer et al., 1997). Sum scores were computed to include this scale into further analyses.

STADI-S. Actual Anxiety was assessed by the state-anxiety scale of the German State-Trait-Anxiety-Depression Inventory (Laux et al., 2013). The STADI is a self-assessment inventory to measure anxiety and depression at both, state and trait levels. I used the state assessment to identify the actual anxiety prior to the exam. The state part consists of four scales including five items each. Anxiety is assessed via the subscales nervousness (affective component) and worry (cognitive component). Subjects were asked to rate these items at a four-point Likert-type scale ranging from "1" (*not at all*) to "4" (*very much*). An example item is: "*I am worried*". Chronbach's alpha for state anxiety is indicated to be $\alpha = .90$. This scale was also modified to assess remembered anxiety prior to the exam. Sum scores were computed to include this scale into further analyses.

NEO-FFI. Neuroticism and Extraversion were measured by the corresponding scales of the German version of the NEO five-factor inventory (NEO-FFI; Borkenau & Ostendorf, 2008). The whole questionnaire consists of 60 items, with 12 items measuring each of the Big Five personality dimensions. Subjects were asked to indicate the degree to which they agreed or disagreed with each of the statements using a 5-point Likert-type scale, ranging from "1" (*strongly disagree*) to "5" (*strongly agree*). An example item for neuroticism is: „*Sometimes I feel completely worthless*", for extraversion it could be: „*I am a cheerful, high-spirited person*". Chronbach's alpha is reported to be $\alpha = .87$ for neuroticism and $\alpha = .81$ for extraversion, the five-year-retest reliability for neuroticism is reported to be $r_{tt} = .78$ and $r_{tt} = .82$ for extraversion, respectively (Borkenau & Ostendorf, 2008). I included sum scores for the two scales neuroticism and extraversion to conduct further analyses.

2.2.3 Procedure

Data was collected at four points of measurement. About two weeks before the final exam, immediately before the exam, directly after the exam and just next to receiving the results of the exam, which was, averaged across all courses, approximately 18 days after the exam. The participants were recruited at the University of Kassel and their e-mail addresses were recorded. All candidates took written examinations which lasted 1 to 2 hours. Participants received mails with individualized hyperlinks to the relevant assessment, which they had to follow. The data was collected using the German online-survey platform *soscisurvey.de*. Participating students received credit or took part in a lottery drawing (where for example a tablet PC or vouchers for a restaurant could be won). The schematic process of the study is shown at *Figure 7*.

Two weeks before the final exam, participants had to give a declaration of consent to participate the study. They were told that the main content of the study is test anxiety, but not informed about the investigation of memory biases. Then they had to complete the neuroticism and extraversion subscale of the NEO-FFI (Borkenau & Ostendorf, 2008). It took about five minutes to complete them. There were $N = 210$ participants who took part in the survey.

TRAIT ASSESSMENT	
✓ Socioeconomical Information ✓ Assessment of Neuroticism and Extraversion (NEO-FFI)	Two weeks before the final exam
STATE 1	
✓ Assessment of State Anxiety (STADI)	The evening before the final exam
STATE 2	
✓ Actual Mood (MDBF) ✓ Retrospective State Anxiety (STADI)	Directly after the exam
STATE 3	
✓ Actual Mood (MDBF) ✓ Retrospective State Anxiety (STADI) ✓ Received Mark	After receiving the results

Figure 7. Schematic process of the study (simplified).
Note. NEO-FFI, NEO five-factor inventory; STADI, State-Trait-Anxiety-Depression Inventory; MDBF, Multidimensional Mood Questionnaire.

At the evening before the final exam, participants were asked to think about the exam the next day by answering some questions concerning the exam (e.g. preparation time). Then they had to report their current anxiety by completing the state-anxiety scale of the German State-Trait-Anxiety-Depression Inventory (Laux et al., 2013). This took about five minutes. There were $N = 185$ participants who also completed this survey. In the following, this is named the first occasion of measurement, because there was the first state assessment.

Directly after the exam, participants were asked, if they really took part in the exam. If not, they were excluded ($N = 17$). Then they had to complete the Multidimensional Mood Questionnaire (Steyer et al., 1997). Then they were asked to report their remembered anxiety regarding the evening before. Therefore I used a modified version of the State-Trait-Anxiety-Depression Inventory which focused on the past. After that, participants answered some questions about the exam (e.g. difficulty). Concerning the analyses, this is called the second (state) occasion of measurement.

The fourth time of measurement was just after the publication of the results. First, participants were asked if they already knew their grade. If not, they were invited to ask for their result and complete the survey immediately after that. Otherwise they were excluded. Then the procedure was as before: They completed the Multidimensional Mood Questionnaire (Steyer et al., 1997) and the modified version of the State-Trait-Anxiety-Depression Inventory to assess their remembered anxiety. After that, they were asked whether their received result was better, worse or just as expected. In the following, this is called the third (state) occasion of measurement. The assessments are displayed in detail in A.1- A.13.

Due to the longitudinal design of my study, there was also some drop-out. At the beginning there were $N = 210$ participants. There was an overall drop-out of 80 participants (38.10 %). This needs to take a closer look. First, there was a drop-out of $N = 25$ between the trait measure and the first state measure. I excluded all people who actually did not write the exam, which were another 17 participants. Moreover, participants had to fit the time intervals provided for each point of measurement. Further, I had to expect some compliance problems concerning the demands of the study, e.g. checking e-mails the evening before the exam. Due to these requirements, another 37 participants quit the study.

To test the relevance of the differences concerning person characteristics between participants and drop-out, independent-samples t-tests were conducted. The difference in age scores for participants ($M = 23.86$, $SD = 4.30$) and drop-out ($M = 25.69$, $SD = 5.26$) was significant ($t(206) = 2.73$, $p = .007$). The difference in the actual semester for participants ($M = 2.92$, $SD = 1.83$) and drop-out ($M = 4.06$, $SD = 2.40$) was also significant ($t(206) = 3.88$, $p = .007$). Also the difference in neuroticism for participants ($M = 32.96$, $SD = 9.04$) and drop-out ($M = 36.93$, $SD = 8.83$) was significant ($t(208) = 3.11$, $p = .002$). No significant differences in the means for gender and extraversion were obtained. These results suggest that people, who drop out the study, were significant older, studied in a higher semester and reported higher levels of neuroticism. This has to be taken into account when interpreting the results.

2.2.4 Statistical Analyses

Preliminary statistical analyses like descriptive analyses were conducted using IBM SPSS Statistics 21 (IBM, 2012). A one-way repeated measures ANOVA for the differences between actual and retrospective reported anxiety at the second and third occasion of measurement was used to test hypothesis *I*, whereas bivariate correlations were used to test hy-

pothesis *II*. Further analyses including structural equation modeling were conducted using MPlus7 (Muthén & Muthén, 1998-2012). By using these analyses, hypotheses *III-IX* were tested. I used the MLR, a maximum-likelihood estimation method with robust standard errors, to estimate parameters. The MLR has also the advantage that it is robust for non-normal distributed data (Muthén & Muthén, 1998-2012). The interaction effect of mood and personality on recall bias was examined using the latent moderated structural equations (LMS) approach (Klein & Moosbrugger, 2000). Note that standard model fit indices are not available for LMS (e.g. Dimitruk, Schermelleh-Engel, Kelava & Moosbrugger, 2007; Schermelleh-Engel, Kerwer & Klein, 2014). Instead of this, I first had a look at the model fit indices for the unrestricted model without interaction terms. Second I applied the log-likelihood difference test to check, whether there was an improvement concerning the fit of the restricted LMS-model relative to the unrestricted model (Muthén, 2014).

The items of the used measures were grouped into item parcels by computing their averages. For example, the four items of the MDBF were grouped into two parcels consisting of two items each. According to Little, Rhemtulla, Gibson and Schoemann (2013), item parceling is an adequate strategy to reduce the number of estimated parameters. The most relevant aim is to reduce the number of parameters in accordance with the sample size to get sufficient model statistics. Of course, there are some arguments against parceling for example concerning the dimensionality of a construct or the distortion of norms through the construction of parcels (see Little, Cunningham, Shahar & Widaman, 2002, for a detailed overview). Little et al. (2002) argued that the decision to compute parcels is justified when the study focuses the nature of a set of constructs instead of a set of items, which is given for the current study. According to the recommendations given by Little et al. (2002), I checked the item-total-correlations for each scale and made theoretical considerations concerning the content of the items. Afterwards I divided the items into two parcels per scale. I dealt with missing data by using the full-information maximum-likelihood (FIML) procedure in MPlus for estimating missing values in the analyses.

2.3 Results

2.3.1 Preliminary Analysis

The actual time lag between the first and the second occasion of measurement was $M = 18.97$ days ($SD = 11.09$ days). At *Table 1*, means, standard deviations and Cronbach's alpha for each scale are shown. The reliability was appropriate for each scale. A one-way

repeated measures ANOVA was conducted to compare the actual and retrospective anxiety levels. There were significant differences between the reported anxiety levels ($F(2,230) = 8.73$, $p = .000$). Post hoc tests for the differences between the paired anxiety ratings were applied using the Bonferroni correction. There was a significant difference between the retrospective reported anxiety directly after the exam in comparison to the actual reported anxiety ($M_{Diff} = -1.00$, $SE = .33$, $p = .009$) and also between the retrospective reported anxiety after three weeks in comparison to the actual reported anxiety ($M_{Diff} = -1.29$, $SE = .35$, $p = .001$). The difference between the two retrospective anxiety ratings was not significant ($M_{Diff} = -0.29$, $SE = .30$, $p = .988$). Thus, the overall retrospective anxiety rating showed an overestimation of the recalled anxiety.

Table 1

Means, Standard Deviations and Cronbach's alpha for Each Scale

Scale	*M*	*SD*	α
STADI Actual	24.15	7.70	.94
STADI Retrospective (2)	25.30	7.61	.94
STADI Retrospective (3)	25.33	8.40	.95
MDBF Actual (2)	13.89	4.78	.94
MDBF Actual (3)	15.70	4.21	.91
NEO Neuroticism	32.88	9.06	.90
NEO Extraversion	40.05	6.52	.80

Note. STADI, State-Trait-Anxiety-Depression Inventory; MDBF, Multidimensional Mood Questionnaire; NEO, NEO five-factor inventory; (2) second occasion of measurement; (3) third occasion of measurement.

Table 2 shows bivariate correlations between all scales. State anxiety prior to the exam was correlated, as expected, significantly with the retrospective reports of the former anxiety. Correlations between mood and the corresponding retrospective anxiety-reports were significant and negative indicating better mood could led to lower retrospective anxiety-ratings or vice versa overall. Correlations between neuroticism and mood were negative, indicating that higher levels of trait neuroticism correspond with lower levels of mood. The relationship between neuroticism and anxiety was positive and significant, which was also expected. Extraversion showed overall weak correlations with the other variables, apart from the negative correlation with neuroticism and the small positive correlation with

mood at the second occasion of measurement. There was also applied a Kolmogorov-Smirnov test for normal distribution, including the seven variables shown at *Table 1*. Results suggested normal distribution for all variables apart from mood at second and third occasion of measurement (see A.14). Due to the robustness of the MLR estimator, as explained above, it is acceptable to conduct the further analysis without some transformations.

Table 2
Bivariate Correlations for All Scales

Scale	1	2	3	4	5	6	7
1. STADI Actual	-	.90***	.90***	-.37***	-.22*	.35***	-.06
2. STADI Retro (2)		-	.92***	-.33***	-.20*	.45***	-.07
3. STADI Retro (3)			-	-.29**	-.15	.44***	-.03
4. MDBF Actual (2)				-	.31**	-.23**	.24**
5. MDBF Actual (3)					-	-.35***	.17
6. NEO N						-	-.46**
7. NEO E							-

Note. NEO N, Neuroticism; NEO E, Extraversion; *$p < .05$; **$p < .01$; ***$p < .001$.

Concerning the received mark, 10.34 % received a mark as expected, 20.69 % received a mark worse as expected and 68.97 % received a mark better than expected. Five one-way between subjects ANOVAs were conducted to compare anxiety levels, mood and personality for the mark worse than expected, as expected and better than expected conditions. There was a significant effect of received mark on the actual mood at the third occasion of measurement [$F(2, 113) = 7.30$, $p = .001$, $\eta^2_{partial} = .11$]. As *Table 3* shows, there were no significant effects for neuroticism, extraversion, anxiety prior to the exam and retrospective anxiety at the third occasion of measurement.

Table 3
One-Way Analysis of Variance of Anxiety Levels, Mood and Personality by Received Mark

Scale	*F*	*df*	*p*	$\eta^2_{partial}$
STADI Actual	1.94	2,113	.149	.03
STADI Retrospective (3)	1.64	2,113	.198	.03
MDBF Actual (3)	7.30	2,113	.001	.11
NEO Neuroticism	0.79	2,113	.455	.01
NEO Extraversion	1.82	2,113	.166	.03

Note. *F,* F-value; *df,* degrees of freedom; $\eta^2_{partial}$, partial Eta square.

For post-hoc analyses, the Games-Howell post hoc test was chosen, because the Levene's test indicated unequal variances for the effect of mood on received mark ($F = 5.69$, $p = .004$). The Games-Howell post hoc test indicates that the condition worse mark than expected differs significantly from the condition received mark as well as expected ($M_{Diff} = -4.13$, $SE = 1.02$, $p = .001$) and received mark better than expected ($M_{Diff} = -3.35$, $SE = 1.05$, $p = .008$). However, the as expected and better as expected conditions did not significantly differ from each other ($M_{Diff} = 0.77$, $SE = 0.60$, $p = .414$). Taken together, these results suggest that the nature of the received mark has an effect on the mood at the corresponding occasion of measurement. Participants receiving a mark worse than expected showed significantly lower mood scores, indicating worse mood than those with marks as expected or better than expected (see *Figure 8*).

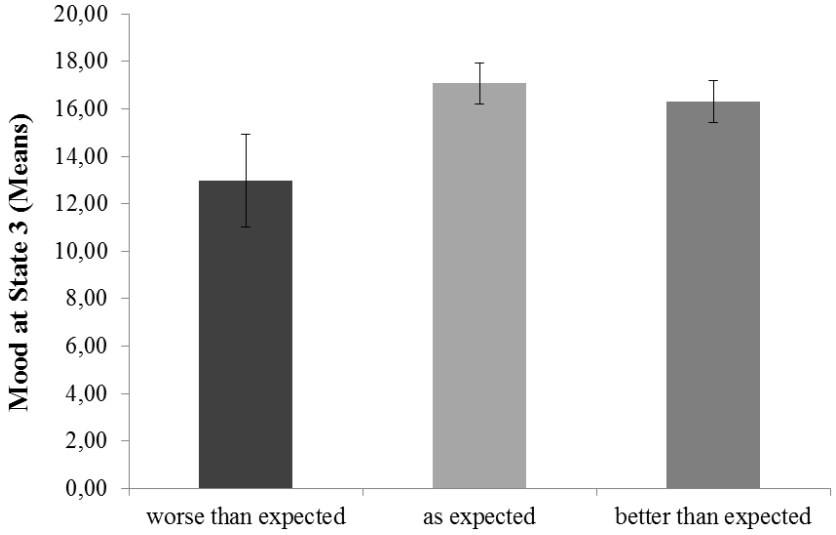

Figure 8. Means of mood at state 3, shown for different conditions of the received mark.
Note. Error bars denote the 95 % confidence intervals around the means.

2.3.2 Baseline Latent Change Model

I created latent variables for anxiety prior to the exam, retrospective anxiety directly after the exam and retrospective anxiety at the follow-up time of measurement. Each latent variable is represented by two parcel indicators. I also specified a latent method factor to control for method-specific influences due to parceling the data. Then I specified a baseline latent change model with two latent change variables to examine the changes in recalled anxiety compared to actual anxiety prior to the exam. This baseline latent change model

showed good fit indices ($\chi 2(9, 131) = 12.31$, $p = .196$; RMSEA (root mean square error of approximation) = .053, CFI (comparative-fit index) = .997, SRMR (standardized root mean square residual) = .032). At the baseline model, the mean of the first latent change variable was $M = 0.12$ ($SE = .03$, $p = .000$). For the second latent change variable it was $M = 0.50$ ($SE = .04$, $p = .000$).

2.3.3 Linear Structural Models for Neuroticism and Extraversion

The next steps aimed to specify latent variables that could predict the latent change variables. Therefore I computed two different models, including trait neuroticism by two parcels and trait extraversion by two parcels, respectively. Moreover I included two latent mood variables, each for the second and third occasion of measurement and by two parcels, respectively. The latent change variables were regressed on neuroticism and mood (as well as on extraversion and mood). The used predicting variables were z-standardized.

Figure 9 shows the linear structural model for neuroticism and mood without interaction terms. It includes standardized factor loadings for indicator variables, standardized covariances between latent variables and standardized regression coefficients for linear relationships between latent variables. This model shows good fit to the data ($\chi 2(46, 131) = 58.30$, $p = .105$, RMSEA = .045, CFI = .991, SRMR = .052). Neuroticism predicted the latent change in recalled anxiety for both occasions of measurement. Mood was a significant predictor for the last occasion of measurement only.

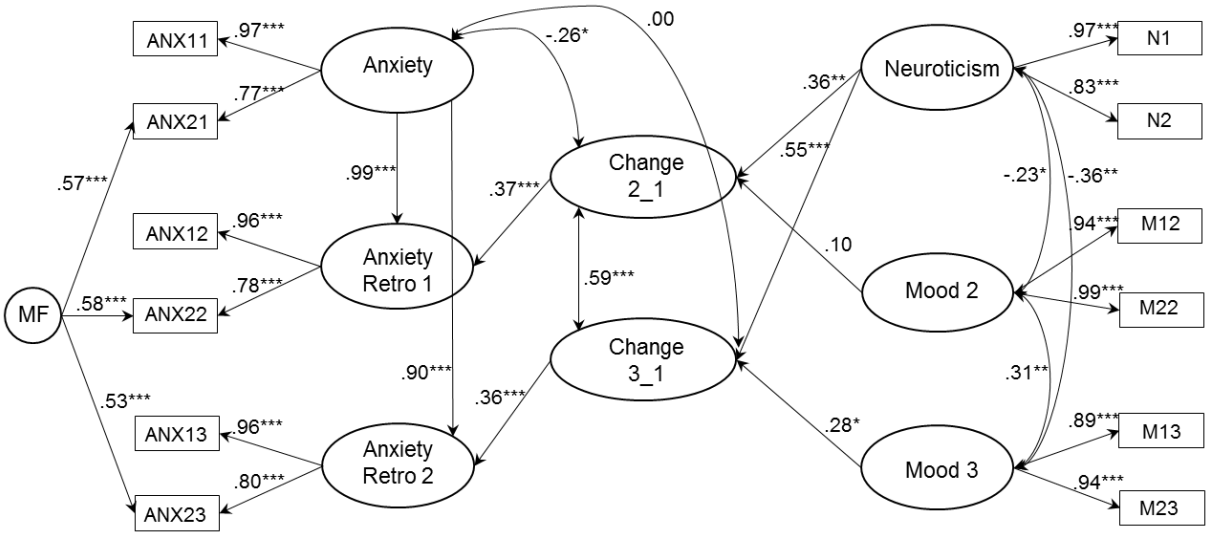

Figure 9. Linear structural model for neuroticism.
Note. All factor loadings and regression coefficients are standardized; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; MF: Method Factor.

Figure 10 shows the linear structural model for extraversion and mood without interaction terms. It includes also standardized factor loadings for indicator variables, standardized covariances between latent variables and standardized regression coefficients for linear relationships between latent variables. This model shows good fit to the data (χ2(46, 131) = 62.41, p = .054, RMSEA = .052, CFI = .988, SRMR = .043). Extraversion and mood were no significant predictors for the latent change in recalled anxiety for both occasions of measurement.

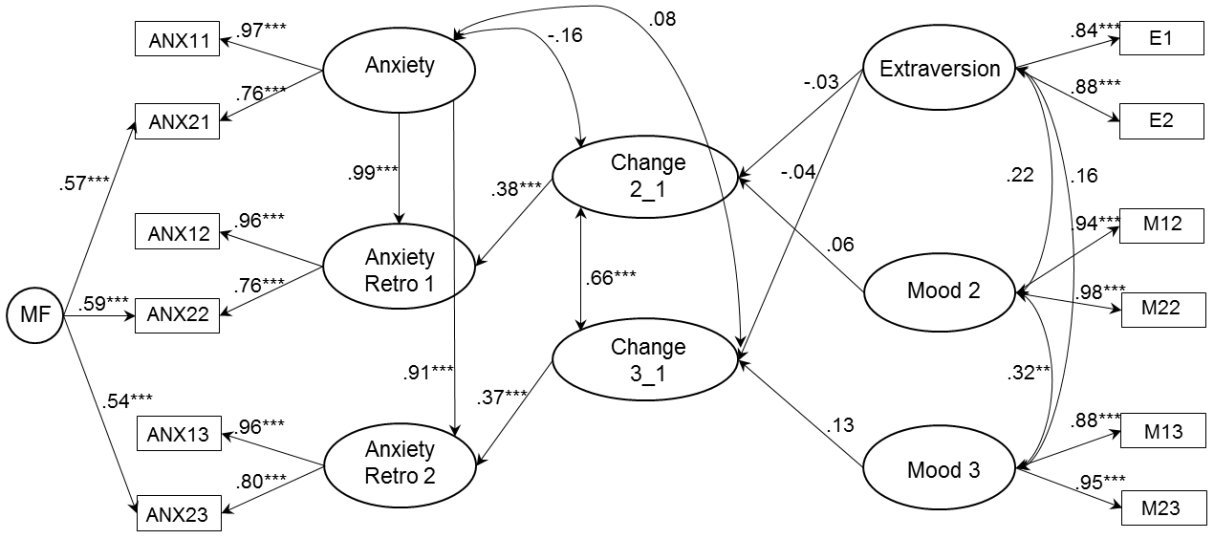

Figure 10. Linear structural model for extraversion.
Note. All factor loadings and regression coefficients are standardized; $^{**}p < .01$; $^{***}p < .001$; MF: Method Factor.

2.3.4 Moderator Models for Neuroticism

To examine the interaction effect of personality and mood on the latent change in reported anxiety, I used the LMS approach. The used predicting variables were z-standardized.

For the structural model, the *Equation 1* would be

$$\eta = \alpha + \beta_1\xi_1 + \beta_2\xi_2 + \gamma\xi_1\xi_2 + \varepsilon \quad (1)$$

whereas η is the latent change variable, ξ_1 is the latent mood variable, ξ_2 is the latent personality (neuroticism or extraversion) variable, α is the intercept, β_i are the slope regression parameters, γ is the regression parameter for the interaction between the latent variables

mood and personality and ε refers to the error. To prevent confusion, I will report regression coefficients in Latin letters, due to the convention to report standardized coefficients in Greek letters. Note that there are no standardized regression coefficients provided for LMS models in MPlus. Therefore I will report only unstandardized coefficients for the following analyses.

Due to the lack of standard model fit indices I used the log-likelihood difference test to check the model fit (Muthén & Muthén, 2005). The moderator model for neuroticism fit the data better than the linear model without an interaction term ($\chi 2(2, 131) = 26.33$, $p \leq .001$). Therefore it is useful to include the interaction term when analyzing the data. *Figure 11* shows the schematic path model of the LMS model. The interaction between neuroticism and actual mood at the time of retrospective assessment of the anxiety prior to the exam was a significant predictor for the bias in remembered anxiety only for the third occasion of measurement.

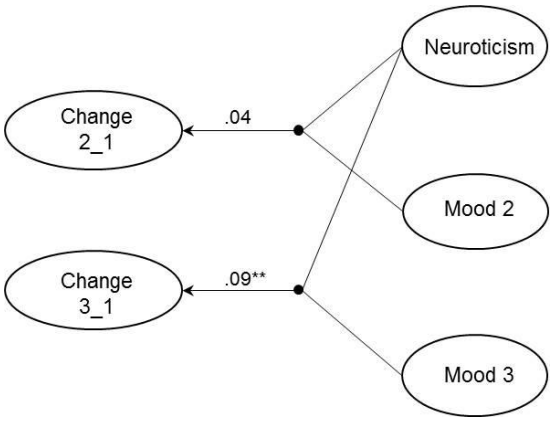

Figure 11. Schematic moderator model for mood and neuroticism predicting the memory distortion.
Note. Regression coefficients are unstandardized; $^{**}p < .01$.

Table 4 portrays the regression coefficients for the linear and the LMS model. As explained above, I only present unstandardized regression coefficients to compare the linear model with the LMS model. The intercepts for the memory distortion for the second state ($b_0 = .13$, $SE = .03$, $p = .000$) as well as for the third state ($b_0 = .16$, $SE = .04$, $p = .000$) were significant different from zero. For the significant regression parameters for neuroticism, confidence intervals were assessed, which were $CI_{95\%}$ [.44, .181] directly after the exam and $CI_{95\%}$ [.108, .281] after receiving the results, respectively. According to Paternoster, Brame, Mazerolle and Piquero (1998), a z-test was used to examine the statistical

relevance of the difference between the two parameter estimators, indicating that the difference is not statistically significant ($z = 1.59$, $p = .057$).

Table 4

Unstandardized Regression Coefficients for the Linear and the LMS Model for Neuroticism

	Difference between Actual and Retrospective Reported Anxiety					
	Change 2_1			Change 3_1		
Models and Predictors	*b*	*SE*	*p*	*b*	*SE*	*p*
Linear Model						
MDBF Actual	.03	.03	.395	.09	.04	.039
NEO Neuroticism	.10	.03	.002	.17	.04	.000
LMS Model						
MDBF Actual	.03	.03	.365	.08	.04	.045
NEO Neuroticism	.11	.04	.001	.20	.04	.000
MDBF x Neuroticism	.04	.03	.125	.09	.03	.005

Note. "MDBF actual" means the assessed mood at the second (Change 2_1) and at the third (Change 3_1) occasion of measurement, respectively; *b*, regression coefficient.

Neuroticism was a stable predictor for the disparity between retrospective and actual reported anxiety, which remained significant for all tested models. This is not the case for mood. Mood does not predict the gap in actual and retrospective reported anxiety at the second occasion of measurement, which was directly after the exam. In fact, mood becomes a significant predictor only at the third occasion of measurement. This applies for the linear model as well as for the LMS model. As noticed before, the interaction between mood and neuroticism becomes only significant at the third occasion of measurement.

All regression plots were created using the tool provided by Dawson (2015). The regression plot depicted at *Figure 12* elucidated the linear influence of the self-assessed neuroticism on the accuracy of remembered anxiety assessed directly after the exam. The greater the neuroticism, the greater was the overestimation of the retrospective assessed anxiety. At *Figure 13* the regression plot for the assessment after receiving the results of the exam is shown. People describing themselves as low in trait neuroticism showed accurate retrospective evaluation of their anxiety prior to the exam at low levels of mood as well as at high levels of mood. For people describing themselves as high in neuroticism there is a

different picture given. The better the mood the bigger appears the overestimation of the retrospective assessed anxiety.

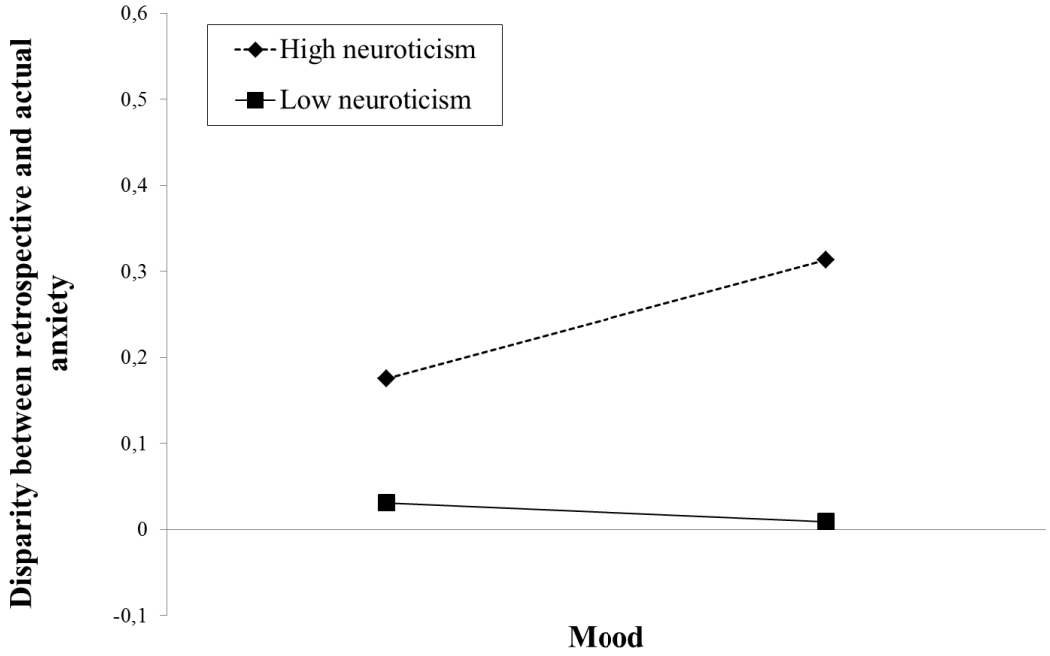

Figure 12. Regression plot for the interaction between mood and neuroticism predicting the latent change variable which indicates the disparity between retrospective and actual reported anxiety (Change 2_1).
Note. Mood is ranging from very bad mood on the left to very good mood on the right; only neuroticism is a significant predictor for this model.

Simple slopes for the association between mood and memory distortion were tested using the tool by DeCoster & Iselin (2005). The simple slopes could be described using *Equation 2*.

$$\eta = \alpha + \beta_1\xi_1 + (\beta_2 + \gamma\xi_1)\xi_2 + \varepsilon \quad (2)$$

The term in parentheses indicates the moderator function which could be tested to significance for several levels of the moderator. Simple slopes were tested for very low (-2 SD below the mean), low (-1 SD below the mean), moderate (mean), high (+1 SD above the mean) and very high (+2 SD above the mean) levels of neuroticism. In detail, simple slopes for moderate neuroticism ($b = .08$, $t(127) = 2.07$, $p = .040$), high neuroticism ($b = .16$, $t(127) = 3.12$, $p = .002$) and very high neuroticism ($b = .25$, $t(127) = 3.22$, $p = .002$) indicated a significant positive relationship between mood and memory distortion. In contrast, simple slopes for low neuroticism ($b = -.01$, $t(127) = 0.09$, $p = .931$) and

very low neuroticism (b = -.10, $t(127)$ = 1.42, p = .203) were not significant different from zero.

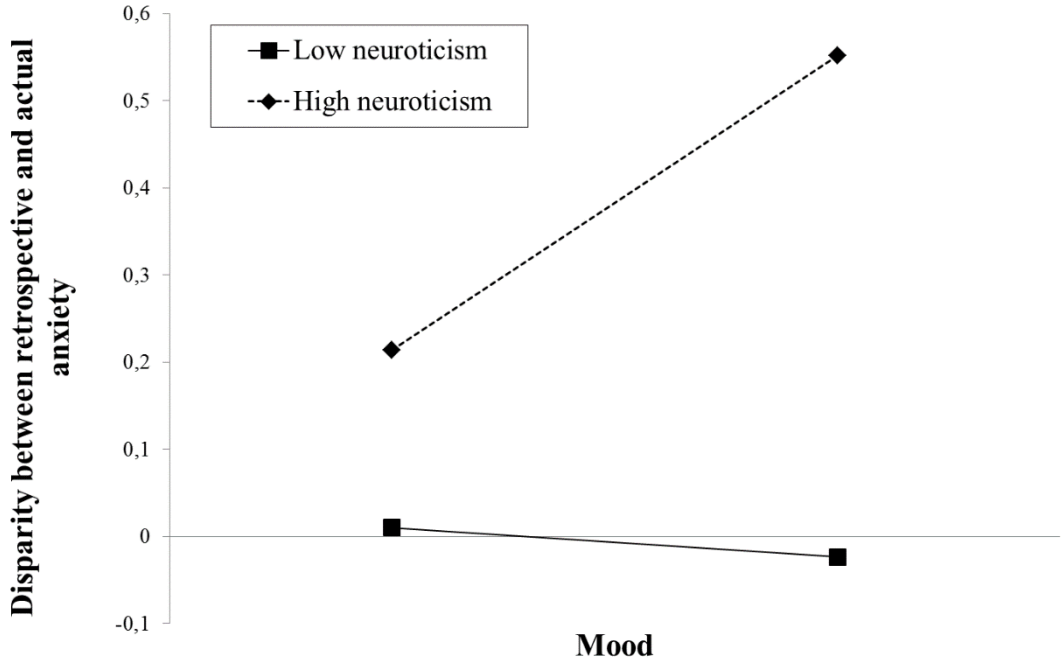

Figure 13. Regression plot for the interaction between mood and neuroticism predicting the latent change variable which indicates the disparity between retrospective and actual reported anxiety (Change 3_1).

The plot of the simple slopes for the interaction between mood and neuroticism is displayed at *Figure 14*. To get a better idea of the data concerning the hypothesis including mood as moderating variable, the same procedure was applied to the model, with interchanged predictor and moderator, indicating the relationship between neuroticism and memory distortion moderated by mood. The results are shown at A.15 and A.16. The simple slopes showed a significant positive relationship with the memory distortion, except the simple slope for very low levels of mood. The better the mood, the bigger is the relationship between neuroticism and (increasing) memory distortion.

As a next step I had to take account of the influence of the received mark. I included the evaluation of the received mark – better, worse or as expected – as a manifest covariate. The results held up for the gap in actual and retrospective reported anxiety assessed directly after the exam, as expected. For the assessment next to receiving the marks, mood was no longer a significant predictor when controlling for the mark (see A.17). The influence of neuroticism and the interaction effect held when controlling for the mark. The mark itself was no significant predictor for the memory bias (b = .04, SE = .03, p = .249, for the se-

cond and $b = .01$, $SE = .01$, $p = .760$ for the third occasion of measurement). The model was additionally computed controlling for sex. Sex itself became a significant covariate directly after the exam, indicating that women showed higher levels of memory distortion then man. The relationships between mood, personality and their interaction with memory bias kept stable after including sex.

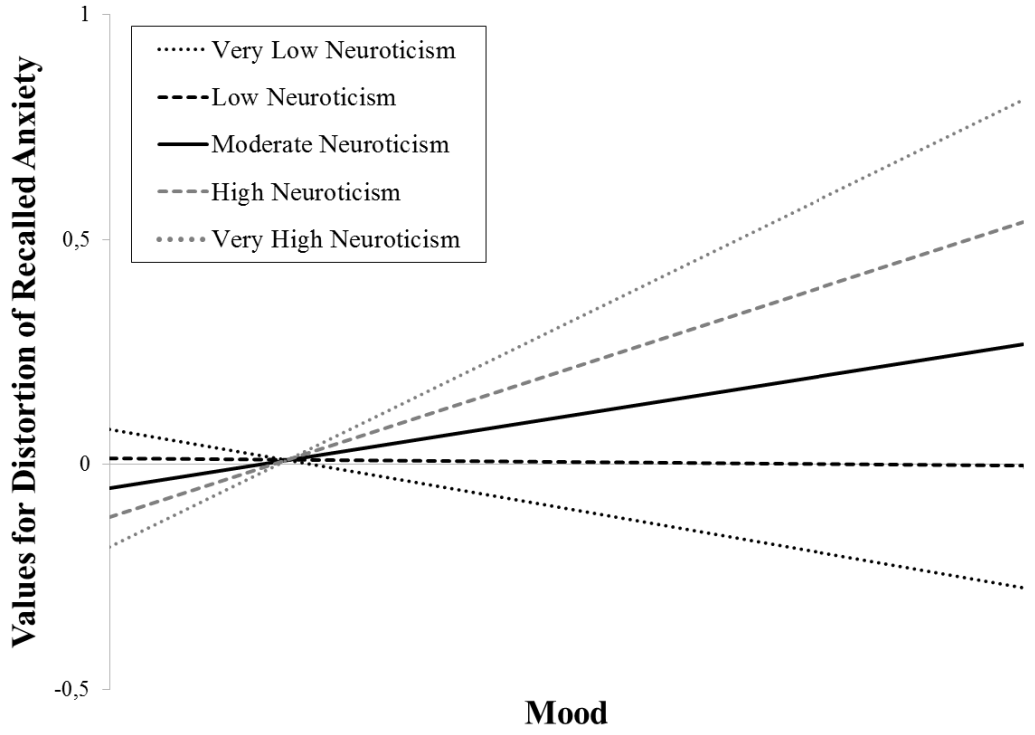

Figure 14. Plot of the simple slopes for the interaction between mood and neuroticism at the third occasion of measurement.
Note. Very low: - 2 SD below the mean, low: -1 SD below the mean, moderate: mean, high: +1 SD above the mean, very high: +2 SD above the mean.

2.3.5 Moderator Models for Extraversion

The same procedure was used to examine the model for extraversion. The moderator model for extraversion fit the data better than the linear model without an interaction term ($\chi 2(2, 131) = 204.64$, $p \leq .001$). Therefore the interaction term was included. *Figure 15* shows the schematic path model of the LMS model. The intercepts for the memory distortion at the second state ($b_0 = .13$, $SE = .03$, $p = .000$) as well as at the third state ($b_0 = .19$, $SE = .04$, $p = .000$) were significant. The interaction between extraversion and actual mood

at the time of retrospective assessment of the anxiety prior to the exam was a significant predictor for the bias in remembered anxiety only for the third occasion of measurement.

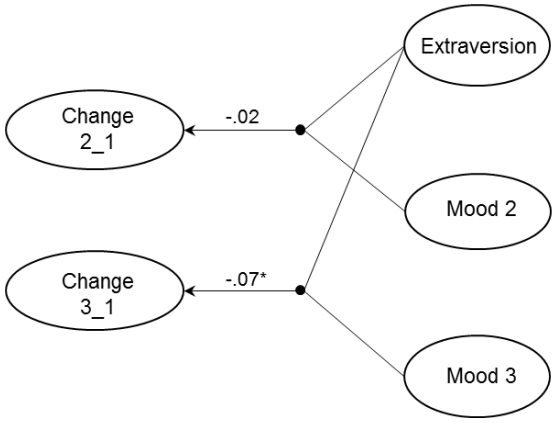

Figure 15. Schematic moderator model for mood and extraversion predicting the memory distortion.
Note. Regression coefficients are unstandardized; *p < .05.

Table 5 portrays the regression coefficients for the linear and the LMS model. Neither extraversion nor mood could predict the disparity between retrospective and actual reported anxiety directly after the exam and at the third occasion of measurement. This applies for the linear model as well as for the LMS model. The interaction between mood and extraversion was only significant at the third occasion of measurement.

Table 5

Unstandardized Regression Coefficients for the Linear and the LMS Model for Extraversion

	Difference between Actual and Retrospective Reported Anxiety					
	Change 2_1			Change 3_1		
Models and Predictors	*b*	*SE*	*p*	*b*	*SE*	*p*
Linear Model						
MDBF Actual	.02	.03	.549	.04	.03	.278
NEO Extraversion	-.01	.04	.834	-.01	.06	.804
LMS Model						
MDBF Actual	.02	.03	.513	.04	.04	.242
NEO Extraversion	-.02	.05	.655	-.05	.05	.317
MDBF x Extraversion	-.02	.04	.681	-.07	.03	.024

Note. "MDBF actual" means the assessed mood at the second (Change 2_1) and at the third (Change 3_1) occasion of measurement, respectively, *b*, regression coefficient.

Figure 16 displays the regression plot for the assessment after receiving the results of the exam. People describing themselves as low in trait extraversion showed an overestimation of the prior anxiety only when they are in good mood. The better the mood the bigger appears the overestimation of the retrospective assessed anxiety for those people. This seems not to be the case for people high in extraversion.

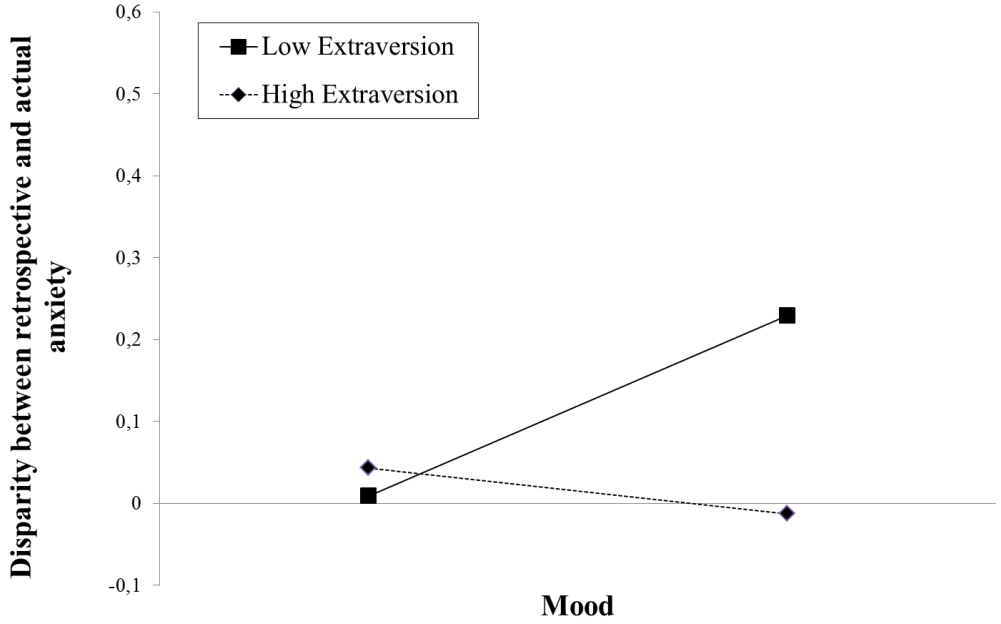

Figure 16. Regression plot for the interaction between mood and extraversion predicting the latent change variable which indicates the disparity between retrospective and actual reported anxiety (Change 3_1).
Note. Only the interaction "mood x extraversion" is a significant predictor for this model.

To have a closer look, simple slopes were also tested for this model, with the corresponding five levels of extraversion as for the model with neuroticism above. The simple slopes were only significant different from zero for very low extraversion ($b = .16$, $t(127) = 2.59$, $p = .010$) and low extraversion ($b = .10$, $t(127) = 2.37$, $p = .019$), indicating a significant positive relationship between mood and memory distortion. The remaining simple slopes for moderate extraversion ($b = .04$, $t(127) = 1.17$, $p = .245$), high extraversion ($b = -.02$, $t(127) = 0.45$, $p = .654$) and very high extraversion ($b = -.08$, $t(127) = 1.23$, $p = .222$) were not significant different from zero. The plot of the simple slopes for the interaction between mood and extraversion is displayed at *Figure 17*. These results indicate that subjects with at least moderate levels of extraversion showed no memory distortion, independent of the mood after receiving their results. Subjects low and very low in extraversion reported a bigger overestimation of the anxiety, the better their mood was. The vice versa test for mood as moderator provides no further information and can be found at A.18 and 0.

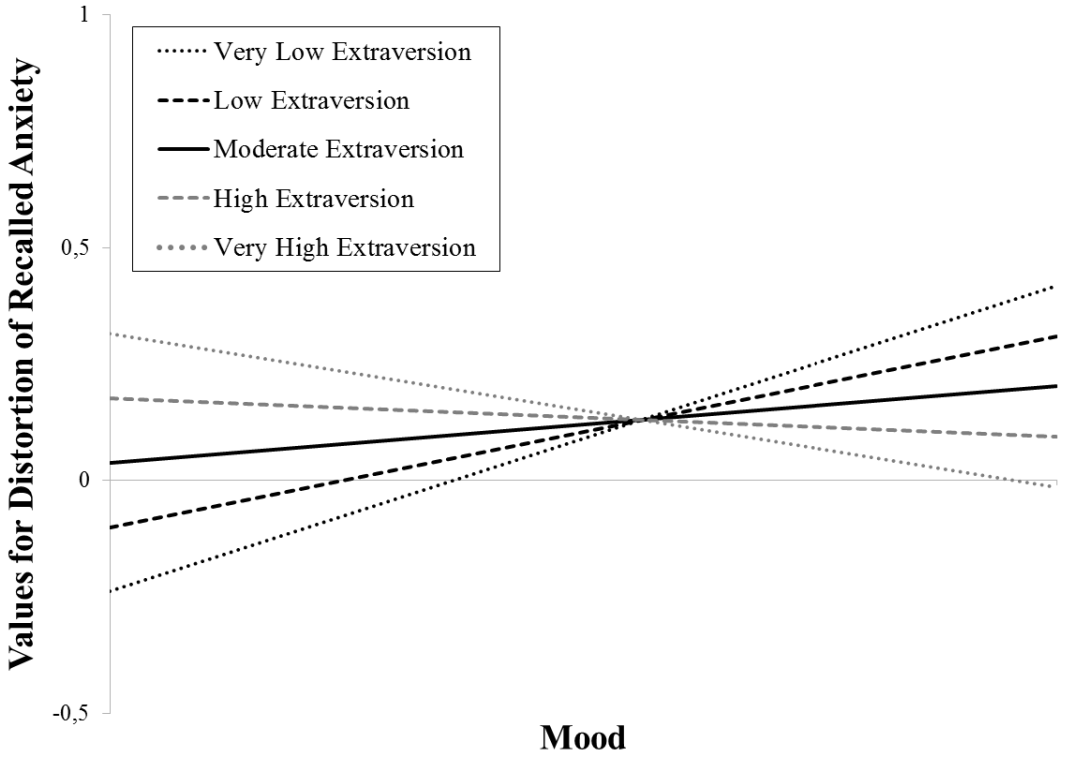

Figure 17. Plot of the simple slopes for the interaction between mood and extraversion.
Note. Very low: - 2 SD below the mean, low: -1 SD below the mean, moderate: mean, high: +1 SD above the mean, very high: +2 SD above the mean

When including the received mark – better, worse or as expected – as a manifest covariate, the results for the assessment directly after the exam held. There was no statistical significant influence of mood or extraversion. For the assessment next to receiving the marks, the interaction term was comparable to the model without the manifest covariate. Interestingly, the influence of extraversion became significant, with higher extraversion leading to an increasing overestimation of prior anxiety (see A.20). As well as for neuroticism, the mark itself was no significant predictor for the memory bias (b = .02, SE = .06, p = .526, for the second and b = .01, SE = .05, p = .841 for the third occasion of measurement). Moreover, the models were additionally computed controlling for sex. Sex itself became a significant covariate directly after the exam, indicating that women showed higher levels of memory distortion then men. The relationships between mood, personality and their interaction with memory bias remain unchanged.

2.4 Discussion

The first study aimed to examine the memory bias for self-reported anxiety prior to a university exam at the end of a semester. Therefore, three state measurements were realized: A state assessment at the evening before the exam, a state assessment right after the exam and a follow-up assessment after receiving the results. To begin with, I would like to sum up and discuss the results by linking them to the formulated hypotheses above.

2.4.1 Discussion of Hypotheses

Hypothesis I: An overall overestimation of the reported anxiety directly before the talk is predicted.

The overall overestimation of the reported anxiety at the evening before the exam could be found at manifest and latent analyses levels. Students overestimated their state test anxiety significantly, directly after the exam and after receiving the marks, which is in accordance to prior findings (Barrett, 1997; Christianson & Safer, 1996; Fredrickson, 2000; Parkinson et al., 1995; Thomas & Diener, 1990; Wilson et al., 2003).

Hypothesis II: There should be trait-consistent relationships between neuroticism and extraversion with state levels of anxiety.

The anxiety level at the evening before the exam was positively related with neuroticism, as predicted (Bienvenu et al., 2007; Bienvenu et al., 2004; Hettema et al., 2006; Hoferichter & Raufelder, 2013; Schmidt & Riniolo, 1999). The predicted negative relation with extraversion could not be shown; there was no significant relationship between the anxiety level and extraversion, which is contrary to previous findings (Bienvenu et al., 2004; Bienvenu et al., 2007; Bienvenu & Stein, 2003; Schmidt & Riniolo, 1999). In contrast, a study by Jylha and Isometsa (2006) found extraversion and anxiety symptoms to be uncorrelated when controlling for gender, age and education. Age and education is relatively comparable over the current sample, which could imply an explanation for this finding.

Hypothesis III: Mood congruent recall will appear directly after the exam.

There was no significant influence of mood at any model concerning the assessment directly after the exam. Against the hypotheses (Forgas, 1995; 2000; Forgas & Cariocci, 2002; Sedikides, 1994; Singer & Salovey, 1988), no mood congruent recall could be observed directly after the exam. Hence, there was a mood-independent recall directly after the exam. Therefore, the assumption that the recall of prior emotions is biased into the direction of the actual mood (Bower, 1981; Parkinson et al., 1995) could not to be underlined.

Hypothesis IV: Mood incongruent recall will appear at follow-up occasion of measurement.

The influence of mood changed over time. At the third occasion of state measurement, the influence of mood became significant for the model including neuroticism. The better the mood, the bigger was the overestimation of the recalled anxiety, indicating mood incongruent recall, as predicted (Forgas, 1995; 2000; Forgas & Cariocci, 2002; Sedikides, 1994; Singer & Salovey, 1988). For the model including extraversion, such an effect could not be reported.

Hypothesis V: Trait congruent recall will appear at all occasions of measurement.

At all occasions of measurement, neuroticism was positively linked to an increasing overestimation of the former anxiety, as expected (Barrett, 1997; Rusting, 1999). For extraversion, no significant influence could be observed. There was a minus-sign in front of the regression parameters for extraversion, but the coefficient was not significantly different from zero. So, personality congruent recall could only be observed for neuroticism. One possible explanation for this phenomenon could be that neuroticism is linked stronger to anxiety (Paulus, Vanwoerden, Norton & Sharp, 2016; see also Kotov, Gamez, Schmidt & Watson, 2010, for a review) and negative affect (e.g. Komulainen et al., 2014; Rusting & Larsen, 1997; Watson, Clark & Tellegen, 1988) than extraversion. Therefore, mechanisms of personality itself could be stronger for neuroticism than for extraversion.

Hypothesis VI: Trait congruent recall will become more important over time.

Neuroticism was, unlike extraversion, a stable significant predictor for the memory distortion at all points of assessment, whilst the regression coefficient for neuroticism increased over time, indicating an increasing influence of neuroticism. The difference test of the regression parameters over time showed only a tendential increase, which was not significant

different from zero. Extraversion showed no significant influence. Therefore, the hypothesis deducted by the model by Robinson and Clore (2002a; 2002b) and also produced by a recent study (Mill, Realo & Allik, 2016) could not be confirmed fully.

Hypothesis VII: Neuroticism should be linked to negative mood maintenance and mood incongruent recall in positive mood.

Interaction effects between neuroticism and mood on the memory bias were only found after receiving the results of the exam. Increasing neuroticism indicated an increasing overestimation of the pre-exam anxiety the better the mood was. This is in accord with findings indicating a positive relationship between neuroticism and negative affect (Kämpfe & Mitte, 2009; Tamir, 2005; Tamir & Robinson, 2004). Therefore, mood incongruent recall was observed for subjects who are in positive mood and reported high values of neuroticism. For those low in neuroticism, the recall remains accurate, this could be interpreted as actual mood maintenance (Ng & Diener, 2009; Rusting & DeHart, 2000). Vice versa, when they are in good mood, subjects overestimated their pre-exam anxiety as a function of neuroticism, indicating mood incongruent and personality congruent recall. This pattern was also present for moderate and low mood (but not for very low mood, where no influence of neuroticism was obtained). Interestingly, subjects which are in really bad mood showed a personality-independent accurate recall.

Hypothesis VIII: Extraversion should be linked to positive mood maintenance and negative mood repair.

The results for interaction effects between extraversion and mood are more difficult to interpret. Effects occurred only at the assessment after receiving the mark, not directly after the exam. Firstly, subjects with at least moderate levels of extraversion showed accurate recall of pre-exam anxiety, indicating personality congruent, mood independent recall. For people low and very low in extraversion, this was not the case. The pattern found here seems to be comparable to the pattern for subjects high in neuroticism: Subjects low and very low in extraversion reported a bigger overestimation of the former anxiety, the better their mood was. Lischetzke, Pfeifer, Crayen and Eid (2012) suggested that a hedonic mood regulation intention mediates the relation between state extraversion and pleasant–unpleasant mood, which should be comparable for trait extraversion. Therefore, extraverts should have an intention to improve their mood or actively maintain an already pleasant mood. Acting extraverted could be a way to experience more pleasant effect (Lischetzke et al., 2012). Earlier studies by Kokkonen and Pulkkinen (2001) and by Lischetzke and Eid

(2006) assumed that extraversion should have a stronger influence in positive mood maintenance than in negative mood regulation. One prediction was that subjects in positive mood will maintain their mood by more positive memories (via underestimation of prior anxiety or accurate recall) when high in extraversion. Interestingly, the predicted maintenance via underestimation could not be found in the data. There was no underestimation of prior anxiety, but a non-mood-specific, personality dependent accuracy in recall. One might argue that accurate recall in positive mood could also be linked to mood maintenance, which could be supported by the data. Mood repair via underestimation of recalled anxiety in negative mood could not be identified. The relationship between extraversion and positive affect could be shown in a large number of studies (e.g. Costa & McCrae, 1980; Lucas & Fujita; Rusting & Larsen, 1997, Smillie, DeYoung & Hall, 2015).

Hypothesis IX: The influence of the received mark should be examined exploratory.
The received mark was included as a covariate into the structural equation models. The mark itself was no significant predictor for the memory distortion in both models. For the neuroticism model, the influence of mood disappeared, whereas the influence of neuroticism and the interaction of mood and neuroticism remained as before. For the extraversion model, extraversion itself became a positive significant predictor for the memory bias, whereas the other parameters were stable. This is contradictory to the study by Safer et al. (2002), where the nature of the received mark leads to completely different patterns concerning the recall of the pre-exam test anxiety. For the current study, one explanation for this pattern could be the strong relationship between the received mark and the actual mood. The received mark had a significant influence on the mood at the third occasion of measurement, indicating worse mood for subjects receiving a worse mark than expected relative to the other conditions. This could be an explanation for a high amount of shared variance between mark and mood, leading to no substantial consequences for the personality x mood-interactions in the current study.

2.4.2 Conclusion

The presented results suggest that participants tend to overestimate their recalled anxiety prior to a university exam directly after and also a few weeks after the exam, giving also evidence for the validity of the reconstruction principle (Conway & Pleydell-Pearce, 2000) at mean levels. Moreover, the results suggest that this overestimation is influenced systematically by mood, personality and by the passed time since the exam.

A main conclusion is that network models of mood, like the associative network theory by Bower (1981), are not able to predict the results of such a complex real life design used in the current study, although they have still wide influence. Directly after the exam, there was a mood-independent recall, where only neuroticism could predict the bias in memory. After a few weeks, mood incongruent recall as a function of neuroticism was observed. No mood congruent effect could be observed in the current study. Concerning mood incongruent memory, the study gives evidence for the influence of personality traits, forming personality congruent effects. Neuroticism was the strongest predictor in this study, whereas extraversion had weaker influences, which might by due to a stronger link between neuroticism and anxiety (Paulus et al., 2016; see also Kotov et al., 2010, for a review) and negative affect (e.g. Komulainen et al., 2014; Rusting & Larsen, 1997; Watson et al., 1988), as compared to extraversion. Therefore, mechanisms of personality could be stronger for neuroticism than for extraversion. Although mood incongruent recall is often associated with mood repair processes via *under*estimation of prior anxiety in bad mood, it was not possible to identify such phenomena in the sample. Instead, the *over*estimation of anxiety during good mood for people high in neuroticism or low in extraversion appeared. This seems to be against hedonic and homeostatic principles, but earlier studies ruled out the link between negative mood states, which are hedonically unpleasant, but could be beneficial for individuals high in trait neuroticism (Kämpfe & Mitte, 2009; Tamir, 2005; Tamir & Robinson, 2004). As explained earlier, the dual-process mood-management-model by Forgas (2000) proclaims an affective homeostasis which is achieved through temporal changes in information processing strategies. Originally, the idea is that after natural occurring affect infusion, subjects should firstly tend to mood congruent recall. To achieve homeostasis, motivated strategies via mood incongruent recall should be used secondly, if necessary. If linking this to the actual data, people high in neuroticism and low in extraversion may use the mood incongruent memory strategy in good mood to reconstitute their desired mood, which is hypothesized to be congruent to their personality style. Moreover, extraversion is linked to subjective well-being (e.g. Cheng et al., 2016; Costa & McCrae, 1980; Steel, Schmidt & Shultz, 2008) and better health prospects (e.g. Pressman & Cohen, 2005). The results suggest that at least moderate levels of extraversion may have a protective influence against dysfunctional negative memory distortions, whereas participants low in extraversion showed comparable results to those high in neuroticism. A possible explanation for these findings could be that extraversion might protect against stressors (see Schneider & Jackson, 2014) which potentially could lead to negative memory distortions and, in turn, a

more negative affect. This is in accordance to a study by Bienvenu et al. (2007) who learned that low extraversion and high neuroticism are risk factors for social phobia. Moreover, the current study focuses only anxiety, which is evaluated as negative affect. It was not possible, to recall positive emotions for the participants. Positivity is seen as less negativity, which could also explain the results.

It seems that directly after the exam, a personality-driven strategy was used (instead of the proclaimed mood-congruency), whereas mood interactions occurred only a few weeks after the event. That is not exactly the prediction of the affect infusion model by Robinson and Clore (2002a) but a hint, that the elapsed time since the exam has an influence of the prediction of the memory bias. Interestingly, mood became more important after a few weeks but interacts with personality. Due to the proclaimed episodic-to-semantic shift, one could argue that the role of personality should become more important, which seems not to be the case in the current study. The effect of post-event knowledge suggests that, due to a large amount of shared variance with the mood resulting from receiving the mark, the meaning of the mark itself could be diminished.

2.4.3 Limitations

There are also some methodological factors, concerning the design and procedure of the study, which should be taken into account. Neuroticism and Extraversion were assessed using the NEO-Five Factor Inventory (Borkenau & Ostendorf, 2008). Thus, the aim is to measure a latent construct at the basis of a self-report measure, which might lead to problems concerning the construct validity (Cook & Campbell, 1979). Sensitizing effects or the Hawthorne-effect, where subjects built hypotheses about the aim of the study and therefore change their (response-) behavior, are possible to occur. Therefore, the trait measurement could be distorted. Furthermore, in this context, social desirability is of great importance. One aspect concerning this is that socially desirable characteristics are highlighted. This is problematic since personality traits are not value-free (Asendorpf & Neyer, 2012). It has been shown in some studies that subjects are able to forge the entire test and also relevant appearing ranges of key concerning the NEO-PI-R (NEO personality inventory revised) or the NEO-FFI (Krahé & Herrmann, 2003; Scandell & Wlazelek, 1996; Topping & O'Gorman, 1997; Winkelspecht, Lewis & Thomas, 2006). As a consequence, test validity could decrease (Topping & O'Gorman, 1997) and more variance unrelated to the addressed construct variance could be produced (Zickar & Robie, 1999). On the other hand,

the use of standardized self-report measures provides strong advantages, for example due to robust quality criteria like reliability, especially in comparison to so called “objective” personality measures (see Ortner et al., 2007). Such “objective” measures are subject of research but not competitive concerning reliability and economy yet. Therefore, the use of self-report measures could be seen as a standard procedure at the moment, but one have to mention potential limitations.

Another potential problem focuses the sample size in view of statistical analyses. The sample size was relatively small. Initially, this could lead to problems concerning the model estimation in structural equation modelling. There are several rules of thumb concerning the minimum sample size, for example 5 to 10 observations per parameter, (which were at least 230 participants for the current study) but one should not only rely on these rules (Muthén & Muthén, 2002). Recent studies conclude that the required sample size could also be less than the at least 5 observations per parameter (Sideridis, Simos, Papanicolaou & Fletcher, 2014; Wolf, Harrington, Clark & Miller, 2013). As one possible problem, standard errors of the parameters may be overestimated or underestimated depending on the situation. An overestimation of standard errors may lead to a missing of significant effects, whereas an underestimation would lead to exaggerated effects. The study by Sideridis et al. (2014) tried to examine minimum sample size requirements to validly support specific hypotheses regarding functional brain connectivity. As one criterion, they took model fit indices like the RMSEA into account, linking them to power analyses. In the current study, model fit indices for the baseline models suggest no violations of these considerations. Nevertheless, it should be noted, that potential power problems could underestimate the found effects.

Concerning sample size and characteristics, one should be also take a look at the external validity, which is limited due to a few influencing factors. Participants were all recruited at the University of Kassel, Germany and took part in in seven different exams, including liberal arts as well as science-oriented and economic disciplines. Nevertheless, this is a limitation concerning location and disciplines, which should be taken into account and could lead to difficulties regarding the generalizability of the findings. This is also present for possible self-selecting effects due to high drop-out rates. Although no significant differences in the means for gender and extraversion were obtained, people who drop out the study were significant older, studied in a higher semester and reported higher levels of neu-

roticism. Another possible source of influence on the results is due to the recruitment of the sample. The subjects participated voluntarily. A self-selection in the composition of the sample could not be excluded. In literature, a concept called "volunteer bias" (Rosenthal & Rosnow, 1969) could be found, which implies that volunteer participants differ from non-participating subjects, for example in their need for recognition. To scrutinize possible motives of the participants in retrospect seems difficult. Therefore, it could merely be noted that one should consider the possibility of distorting self-selection, possibly accompanied by socially desirable response tendencies.

Moreover, it was not possible to assess, whether the participants really participate the exam. It could not be ensured that there were no students concealing their non-participation, maybe due to other motives. Furthermore, due to the design of the study, the context of the state and trait measurements could not be controlled or even standardized, which lead to a variety of possible unknown state factors, for example if subjects are alone, at home or on the move. Concerning the already mentioned encoding specificity principle (Jacoby & Craik, 1979; Tulving & Thomson, 1973), such contextual influences could have relevant impact on recall performance (e.g. Godden & Baddeley, 1980; Grant et al., 1998).

Another aspect focuses the influence of the received mark. As for the participation of the study itself, it cannot be ruled out that subjects made biased statements concerning their received mark. The question, if the mark was better, worse or as expected could lead to a bias, because it assumes that subjects know, what they expected. Due to ethical problems, it was not possible to ask for their concrete mark or ask their professor. Another problem occurs because the mark was not evenly distributed across conditions, which lead – together with the small sample size – to problems concerning the statistical analyses. Moreover, it remains also unclear, if all participants really had informed themselves about their received mark. It is possible, that individuals acted against the instruction to inform about the mark before responding to the measurement. This could lead to an underestimation of the influence of the received mark.

Another influencing factor is linked with the time interval between the exam and the announcement of the received mark. Since the follow-up measurement was linked directly to the publication of the marks, there was some relevant variance in time. This could explain, why the time-dependent prediction, which was increasing significance of trait variables,

deducted from the accessibility model by Robinson and Clore (2002a; 2002b) could not be observed.

2.4.4 Summary

Study 1 aimed to investigate the memory bias for self-reported anxiety prior to a naturalistic exam at university. Therefore, the initial anxiety rating at the evening before the exam was compared to an assessment directly after the exam and a few weeks later, after receiving the results. Mood assessments were made simultaneously to the retrospective assessments and the personality variables neuroticism and extraversion were measured. The presented results suggest that participants tend to overestimate their recalled anxiety prior to a university exam directly after and also a few weeks after the exam. As a main conclusion, common network models predicting mood congruent recall are not able to explain the results of the current study. Moreover, mood incongruent recall was observed and found to be dependent on personality traits neuroticism and extraversion. Interestingly, the effects are mainly driven by effects of the *over*estimation of anxiety during *good* mood for people high in neuroticism or low in extraversion, which could be explained via homeostatic principles linked to individual benefit through affective states. In turn, people high and moderate in extraversion and also those low in neuroticism might be protected against the negative memory bias, which seems to be linked to health aspects. Concerning the elapsed time since the exam, the main prediction deducted by the accessibility model Robinson and Clore (2002a), which indicates an increasing meaning of semantic-related personality could not be approved. The effect of post-event knowledge suggests that, due to a large amount of shared variance with the mood resulting from receiving the mark, the meaning of the mark itself could be diminished. Several influencing factors are discussed. Taken together, the results indicates that the complex interaction of elapsed time since the event, the actual mood as well as personality traits have to be taken into account when predicting memory distortions in an academic achievement situation as a complex real life context. These influencing factors lead to different paths of memory bias, which have to be analyzed differentiated.

3 Study 2

The second study investigated the memory bias for self-reported anxiety prior to the unheralded task to hold a short speech in front of a camera and a student assistant. The study took place in a laboratory setting. Therefore, four occasions of state measurement were realized: A baseline measurement after doing relaxation training, a state assessment just before giving the speech, a state assessment right after giving the speech and a follow-up assessment after four weeks.

A special feature at study 2 is the inclusion of a physiological measurement system before and during the speech. As explained above, emotions are associated with modulated physiological arousal (Levenson, 2003; Thayer & Siegle, 2002), especially with regulation of the autonomic nervous system, which includes an excitatory sympathetic and an inhibitory parasympathetic nervous system. If a subject perceived physiological or psychological stress, the excitatory sympathetic nervous system increases activity to produce physiological arousal, which leads for example to increased heart rate. The parasympathetic system, in turn, will decrease inhibition, leading to vagal withdrawal (Appelhans & Luecken, 2006). The ability of the autonomic nervous system to adapt at specific requirements is connected with the function of immediate heart rate variability. This is in turn one requirement for emotion regulation (Gross, 1998). Heart rate variability (HRV) is therefore seen as a measure of the interaction between sympathetic and parasympathetic influences on heart rate that provides information about autonomic flexibility and represents the capacity for regulated emotional responding (Appelhans & Luecken, 2006).

Changes in heart rate variability are found to be associated with anxiety at state and trait levels. The pattern of sympathetic activation and parasympathetic decreased inhibition is associated with anxiety states (Friedman, 2007) and stress responses per se (Porges, 1992). For example, worry is associated with cardiac vagal decreases, indicated by lower HRV (Lyonfields, Borkovec & Thayer, 1995; Thayer, Friedman & Borkovec, 1996). At trait level, trait anxiety and social anxiety seem to be associated with reduced parasympathetic HRV at rest or overall HRV, indicating an underlying diminished autonomic flexibility (Fuller, 1992; Mezzacappa et al., 1997). The meta-analysis by Chalmers, Quintana, Abbott and Kemp (2014) found an association between anxiety disorders and reduced heart rate variability.

3.1 Hypotheses

The second study investigated the memory bias for self-reported anxiety prior to the unheralded task to hold a short speech in front of a camera and a student assistant in a laboratory setting. The fourth state measurement included a measure for rumination since the speech task. At trait levels, neuroticism, extraversion and social phobia were assessed. The hypotheses are as follows.

I. The successful induction of anxiety through the speech task should be proved through anxiety ratings and HRV levels (implementation control).

At state levels, the reported anxiety after the announcement of the speech should be increased relative to the baseline condition after relaxation training. The HRV should be decreased after the announcement of the speech and also during the speech (Friedman, 2007). Due to the short duration of the speech, adaptation processes are hypothesized not to occur. This could be interpreted as successful induction of anxiety (implementation control).

II. Correlations between HRV and state anxiety should be examined.

The relationship between HRV per se, changes in HRV after announcement of the speech as well as during the speech and self-report of the current anxiety should be investigated.

III. An overall overestimation of the retrospective reported anxiety is predicted.

At all levels of recall, there should be an overall overestimation of the reported anxiety after the announcement of the speech (e.g. Barrett, 1997; Parkinson et al., 1995; Thomas & Diener, 1990).

IV. There should be trait-consistent relationships between neuroticism, extraversion and social phobia with state levels of anxiety.

Anxiety levels after the announcement of the speech should be positively related to neuroticism (Bienvenu et al., 2007; Bienvenu et al., 2004; Hettema et al., 2006; Hoferichter & Raufelder, 2013; Schmidt & Riniolo, 1999) and social phobia (e.g. Gilbert, 2000; Rapee & Heimberg, 1997; Veale, 2003; Zeidner & Matthews, 2011) and negatively related to extraversion (Bienvenu et al., 2004; Bienvenu et al., 2007; Bienvenu & Stein, 2003; Schmidt & Riniolo, 1999).

V. Mood congruent recall will appear directly after the speech.

Directly after the speech, mood congruent recall is hypothesized to appear, indicating a decreasing overestimation the better the assessed mood is (Forgas, 1995; 2000; Forgas & Cariocci, 2002; Sedikides, 1994; Singer & Salovey, 1988).

VI. Mood incongruent recall will appear after four weeks.

At the state measurement after four weeks, mood incongruent recall will be observed (Forgas, 1995; 2000; Forgas & Cariocci, 2002; Sedikides, 1994; Singer & Salovey, 1988).

VII. Trait congruent recall will appear at all occasions of measurement.

The personality variables neuroticism and extraversion and also social phobia will be linked to personality congruent recall. This should be associated with an increasing overestimation of the pre-speech anxiety with increasing neuroticism and social phobia and a decreasing overestimation of the pre-speech anxiety with increasing extraversion (Barrett, 1997; Richards & Whittaker, 1990; Rusting, 1999).

VIII. Trait congruent recall will become more important over time.

The influence of the trait variables neuroticism, social phobia and extraversion on memory distortion will increase over time (Robinson & Clore, 2002a; 2002b).

IX. Neuroticism should be linked to negative mood maintenance and mood incongruent recall in positive mood.

Neuroticism is predicted to be linked to mood congruent recall in negative mood (mood maintenance; Ng & Diener, 2009; Rusting & DeHart, 2000) and hypothesized with mood incongruent recall in positive mood, due to findings indicating a positive relationship between neuroticism and negative affect (Kämpfe & Mitte, 2009; Tamir, 2005; Tamir & Robinson, 2004). It is hypothesized that these mechanisms should also be present for trait social phobia.

X. Extraversion should be linked to positive mood maintenance and negative mood repair.

Extraversion is predicted to be linked to mood congruent recall in positive mood (mood maintenance; Lischetzke & Eid, 2006; Ng & Diener, 2009), with a weaker influence in negative mood (mood repair; Kokkonen & Pulkkinen, 2001; Lischetzke & Eid, 2006).

XI. Engaging highly ruminative after the speech should lead to an overestimation in recalled anxiety.

As the appraisal congruence approach proclaims (Levine, 1997; Levine et al., 2001), the higher the rumination after giving the speech (assessed at the third occasion of measurement) the greater should the overestimation of the recalled anxiety be (Abbott & Rapee, 2004; Edward et al., 2003; Perini et al., 2006).

3.2 Method

3.2.1 Participants

Participants were recruited at the University of Kassel, Germany, using flyers, social media and short presentations of the study in several lectures. Students (N = 141) of 16 different study paths joined the study (see *Table 6,* for a detailed overview).

Table 6

Frequencies and Percentages of the Study Paths for All Participants

Study Path	Frequency	%
Business Education	7	5.0
Business Law	1	0.7
Economics	2	1.4
Electrical Engineering	1	0.7
Engineering Economics	6	4.3
Environmental Engineering	5	2.8
Environmental Law	1	0.7
History	1	0.7
Informatics	2	1.4
Machine Engineering	15	10.6
Physics	2	1.4
Political Science	2	1.4
Psychology	61	43.3
Social Work	8	5.7
Sociology	8	5.7
Teacher Training	8	5.7
I am no student at the moment	2	1.4
Missing	9	6.4
Total	141	100

The participants were on an average at the third semester (M = 2.59, SD = 1.97, range: 1-6). The study included 69 men and 63 women (with 9 missing values for sex). The mean age was 23.33 (SD = 4.28, range 18-41) years. 1.5 % had a secondary school certificate, 72.7 % had the "Abitur" certificate, 9.2 % reported a completed vocational training and 14.9 % had a university degree as their highest qualification.

3.2.2 Measures

MDBF. Actual mood was assessed using the good-bad subscale of the Multidimensional Mood Questionnaire MDBF (Steyer et al., 1997), as in study 1 (see 2.2.2). I included mean scores of the scale to conduct further analyses.

STAI-SKD. Actual Anxiety was assessed by the STAI-SKD (Englert, Bertrams & Dickhäuser, 2011), a short version of the German adaptation of the State-Trait Anxiety Inventory (Laux, Glanzmann, Schaffner & Spielberger, 1981) which allows a fast assessment of anxiety. This scale was also modified to assess remembered anxiety prior to the exam. The STAI-SKD consists of five items, for example "*I feel nervous*". There is a four-point Likert-type scale ranging from "1" (*not at all*) to "4" (*very much*). Chronbachs's alpha for the short version was at a satisfying level ($\alpha = .76$) in the validation study by Englert et al. (2011). I included mean scores of the scale to conduct further analyses.

NEO-FFI. Neuroticism and Extraversion were measured by the German translation of the corresponding scales of the German version of the NEO five-factor inventory NEO-FFI (Borkenau & Ostendorf, 2008). The description can be found at study 1. I included mean scores for the two scales neuroticism and extraversion to conduct further analyses.

SPIN. The German adaptation of the Social Phobia Inventory (SPIN, Connor et al., 2000) by Stangier and Steffens (2002) was used to assess social phobia severity. It consists of 17 items and is therefore the most economic measure for social phobia severity (Sosic, Gieler & Stangier, 2008). It includes three factors, fear of social situations, avoidance of social situations and physiological symptoms of anxiety. The instruction was modified to assess symptoms *lately* instead of in *the last week*. Each item has to be rated on a five-point Likert-type scale, ranging from "1" (*not at all*) to "5" (*extremely*). An example item is „*I avoid having to give speeches*". I included mean scores of the scale to conduct further analyses. The authors gave also an annotation for a presumable presence of a (clinical relevant) social phobia. Converted to the scale used in my study, this would be the case for values above $M = 1.32$.

Thoughts Questionnaire. To assess the tendency to ruminate after giving a speech, the thoughts questionnaire (TQ, Edwards, Rapee & Franklin, 2003) was used. It measures the tendency to engage in negative self-evaluative thoughts after social speech situations. Since there is no published German translation, an own version was created. The back-translation technique was used to make sure that the original meaning of the measure was

retained. Two bilingual psychologists translated the items into German. The German version was translated back into English. The translations were then evaluated by three bilingual psychological diagnosticians and the final version was discussed. The modified version consists of 21 items. The overall instruction was *„Please rate each statement as to how often you thought about that aspect in the time since you gave your speech. I thought about this in the past weeks:"* Ten items are forming the negative scale (e.g. „ *How bad my speech was* "; „*How fast my heart was pounding*", „*How anxious I felt*"), whilst the positive scale consists also of ten items (e.g. „*How well I handled it*"). Moreover, there is one unspecific Item ("*The situation overall.*"). The positive items were recoded inversely before one mean score was computed for each person. At a five-point Likert-type scale, ranging from „1" („*never*") to 5 ("*very often*"), subjects had to evaluate how often they ruminated at the special item since they had to hold their speech. The questionnaire is displayed at B.1.

Heart Rate Variability. Heart rate variability (HRV) offers non-invasive, unobtrusive information about modulation of heart rate by the autonomic nervous system (Cerruti, Golderberer & Yamamoto, 2006; Task Force, 1996). It was therefore assessed to measure physiological responses to the speech task. Heart rate was measured by the Polar Team² System (Polar Electro Deutschland GmbH, Büttelborn), an ambulatory, wireless heart rate monitor system. Subjects have to wear a chest strap, where a sensor is attached. The sensor is able to send beat-to-beat heart rate signals (R-R-intervals) at a base station which could be connected to a PC. Together with the Polar ProTrainer 5 Software (Polar, 2009), this allows an online-monitoring of current heart rate intervals. Markers could be set to mark intervals of interest. All recording sessions could be saved and evaluated later by using the ProTrainer 5 Software (Polar, 2009). There are different measures which could be used to analyze heart rate variability. In the current study, I used the RMSSD, the square root of mean squared difference of successive normal-to-normal (NN) intervals, which involves differences between inter-beat intervals in ms (Task Force, 1996). The RMSSD is thought to represent parasympathetic mediated HRV (Task Force, 1996). It focuses rapid fluctuations of the heart rate and therefore fast impulses of the vagus (Fenzl & Schlegel, 2010). Therefore it is an appropriate measure for short-term-period assessment of the HRV. Normal mean values have been found to be approximately $M = 27$ ($SD = 12$; Task Force, 1996).

3.2.3 Procedure

Data was collected at two points of measurement. The participants were recruited at the University of Kassel and their e-mail addresses were recorded. They had to perform one measurement at the laboratory and one follow-up via internet. Participants received mails with individualized hyperlinks to the relevant assessment, which they had to follow. The data was collected using the German online-survey platform *soscisurvey.de*. Participating students received credit for their participation. The schematic process of the study is shown at *Figure 18*. The maximum of participates taking part at one time slot was two. At the laboratory session, participants had to give a declaration of consent to participate the study. They were told that the main content of the study is the experience of intense emotions, but were not informed about the investigation of memory biases for speech anxiety. They had than to report, if they had consumed tobacco, coffee or medicaments, which influence the cardiovascular system during the last two hours. Participants were then informed about the functionality of the physiological measurement system. They had to wear a chest strap which permanently sent online information at a record unit and a monitoring screen. The application of the chest strap is depicted at B.2.

After checking for the correctness of the recording, subjects were invited to take part in a relaxation exercise, which was on an audio CD and combined positive imagination with a relaxing breathing technique and lasts about 5 minutes. After that, participants had to complete the STAI, which took only one minute. This is called the baseline condition for anxiety levels (STAI baseline).

After that, participants were informed by the research assistant that they had to give a three-minute speech right now. The speech should last about three minutes. The task was to discuss an actual political or social issue. There were 12 issues which were printed on small lots which had to be drawn (see B.3). The participants could have one change of their drawn issue, if they had no idea about it. If two participants were present at one time slot, they were told that their order for holding the speech will be declared after the preparation time. Participants were given a preparation time of three minutes, where they were allowed to make notices about pro and con arguments of their individual issue but were also informed that they were not allowed to take this notices with them for the speech itself. After preparation time they had to complete the STAI again. For further analyses, including the structural equation modelling, this will be the reference measure of actual anxiety right before the speech (STAI actual). The participants were then informed about their order to give the speech.

BASELINE	
✓ Application of Physiological Measurement System ✓ Implementation of a Relaxation Exercise ✓ Assessment of Beat-to-beat Heartrate	
STATE 1	
✓ Assessment of State Anxiety (STAI-SKD) ✓ Assessment of Beat-to-beat Heartrate	Directly after the announcement of the speech
GIVING THE SPEECH	
✓ Assessment of Beat-to-beat Heartrate	During the speech
STATE 2	
✓ Actual Mood (MDBF) ✓ Retrospective State Anxiety (STAI-SKD) ✓ Assessment of Beat-to-beat Heartrate	Directly after the speech
STATE 3	
✓ Actual Mood (MDBF) ✓ Retrospective State Anxiety (STAI-SKD) ✓ Rumination Since the Speech (Thoughts Questionnaire)	After 3 weeks
TRAIT ASSESSMENT	
✓ Assessment of Neuroticism, Extraversion (NEO-FFI) ✓ Assessment of Social Anxiety (SPIN) ✓ Socioeconomical Information	After 3 weeks, together with State 3

Figure 18. Schematic process of the study (simplified).
Note. NEO-FFI, NEO five-factor inventory; STAI-SKD, short version of the State-Trait Anxiety Inventory; MDBF, Multidimensional Mood Questionnaire; SPIN, Social Phobia Inventory.

The second participant had to complete a distraction task (completing matrices or reading some university news), whereby the first participant had to leave the laboratory to join the neighboring room, where a second student assistant was present and greeted him or her as neutral as possible. The participant was asked to go to a marked position, whereas the assistant had a seat at a chair. The chest strap sent the signals of the recording to room 1 the entire time. Two video cameras were located to record the participant's whole body and the upper body of the student assistant. The video cameras were visibly started to record by the assistant. Then the participant was asked to give his or her speech. The research assistant noted start and beginning time of the speech to synchronize them with the physiological measurement system later. At *Figure 19*, the experimental situation is depicted sche-

matically. After that, the participant was allowed to go back to room 1 and the second participant started to absolve the procedure equally.

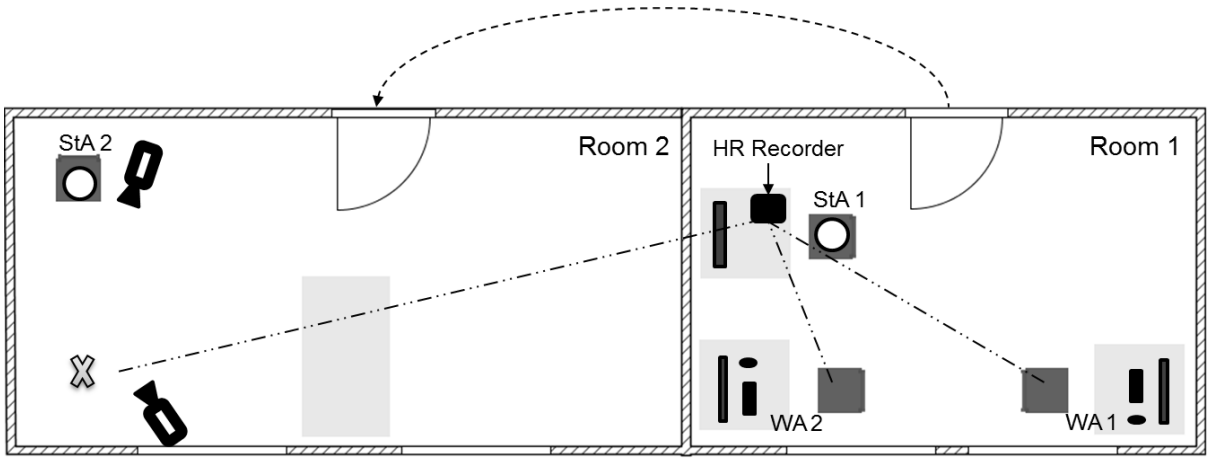

Figure 19. Laboratory Situation.
Note. StA, Student assistant; WA, Working area; X, Participant's position during the speech.

Back at room 1, the first participant had to complete the Multidimensional Mood Questionnaire (Steyer et al., 1997). Then he or she was asked to report his or her remembered anxiety right before giving the speech. Therefore I used a modified version of the short form of the State-Trait-Anxiety Inventory which focused on the past. Concerning the analyses, this is called the second (state) occasion of measurement (MDBF actual (2) and STAI retrospective (2)). Participants were then asked to take off the chest strap and reminded of the follow-up participation. They were asked not to talk about the content of the study to other potential participants.

After an average of four weeks, participants received an e-mail including a link to an online assessment. Firstly, they were asked to complete the MDBF and the modified version of the STAI-SKD to assess their remembered anxiety. This took about three minutes. In the following, this is called the third (state) occasion of measurement (MDBF actual (3) and STAI retrospective (3)). Secondly, they were asked to complete trait measures including the Thoughts Questionnaire, the Social Phobia Inventory and the neuroticism and extraversion subscales of the NEO-FFI. This took about 20 minutes. After completing this, they were told how to receive the expense allowance for their participation. Due to the longitudinal design of my study, there was also some drop-out. At the laboratory session there were $N = 141$ participants, at the retest after four weeks $N = 132$ participants took part. This represents a drop-out of 9 participants (6.38 %). The trait assessment was adminis-

tered at the second occasion of measurement. Therefore I could not discriminate between drop-out and participants at trait level. In the following, I would like to compare participants and drop out at state characteristics. To test the relevance of the differences concerning state characteristics between participants and drop-out, independent-samples t-tests for anxiety levels at baseline, before the speech and retrospective anxiety after the speech were conducted, as well as mood levels after the speech. No significant differences between participants and drop-out were obtained concerning state characteristics (see B.4).

3.2.4 Statistical Analyses

Preliminary statistical analyses like descriptive analyses were conducted using IBM SPSS Statistics 21 (IBM, 2012). T-tests for the differences between anxiety ratings and HRV levels were used to analyze hypothesis *I*, whereas a one-way repeated measures ANOVA for the differences between actual and retrospective reported anxiety at the second and third occasion of measurement addressed hypothesis *III*. Hypothesis *II* and *IV* were tested by using bivariate correlations. Further analyses including structural equation modeling were conducted using structural MPlus7 (Muthén & Muthén, 1998-2012), using the MLR, a maximum-likelihood estimation method with robust standard errors, to estimate parameters. This procedure was used to test hypotheses *V-XI*. The MLR has also the advantage that it is robust for non-normal distributed data (Muthén & Muthén, 1998-2012). The interaction effect of mood and personality on recall bias was examined using the latent moderated structural equations (LMS) approach (Klein & Moosbrugger, 2000). The items of the used measures were grouped into item parcels by computing their averages. I dealt with missing data by using the full-information maximum-likelihood (FIML) procedure in MPlus for estimating missing values in the analyses. The data analyzing procedure is comparable to Study 1. For a detailed description and discussion, see 2.2.4.

3.3 Results

3.3.1 Preliminary Analyses

The actual time lag between the first and the second occasion of measurement was $M = 30.79$ days, $SD = 10.57$ days). At *Table 7*, means, standard deviations and Cronbach's alpha for each scale are shown. The reliability was appropriate for each scale. Note that the mean for the SPIN is above the value which indicates a presumable presence of a (clinical

relevant) social phobia. Only 9.1 % of the sample had a score lower than this critical value (M_{crit} = 1.32). By contrast, 90.9 % showed a score above this value.

Table 7

Means, Standard Deviations and Cronbach's alpha for Each Scale

Scale	*M*	*SD*	α
STAI Baseline	1.76	.56	.74
STAI Actual	2.32	.62	.79
STAI Retrospective (2)	2.20	.62	.73
STAI Retrospective (3)	2.40	.70	.84
MDBF Actual (2)	3.89	.76	.79
MDBF Actual (3)	4.00	.78	.77
NEO Neuroticism	2.65	.73	.87
NEO Extraversion	3.34	.60	.83
SPIN	1.99	.56	.87
TQ Rumination	1.85	.72	.85

Note. STAI, State-Trait-Anxiety Inventory; MDBF, Multidimensional Mood Questionnaire; NEO, NEO five-factor inventory; SPIN, Social Phobia Inventory; TQ Rumination, negative rumination scale of the Thoughts Questionnaire; (2) second occasion of measurement; (3) third occasion of measurement.

Table 8 shows bivariate correlations between all scales. State anxiety prior to the speech was correlated, as expected, significantly with the retrospective reports of the former anxiety. The correlation between mood right after the speech and the corresponding retrospective anxiety-report was significant and negative indicating better mood could led to lower retrospective anxiety-ratings or vice versa. This was not the case for mood and the corresponding retrospective anxiety-report at the third occasion of measurement, where the correlation was not significant different from zero. Correlations between neuroticism and mood were negative, indicating that higher levels of trait neuroticism correspond with lower levels of mood. The relationship between neuroticism and anxiety prior to the speech was positive and significant, which was also expected. This held true for the relationship between social anxiety and neuroticism. Extraversion showed overall weak correlations with the other variables, apart from the negative correlation with neuroticism. Social anxiety and state levels of anxiety correlated significantly positive, which was the same for rumination. Rumination and social anxiety correlated also significantly negative with the mood scores.

Table 8

Bivariate Correlations for All Scales

Scale	2	3	4	5	6	7	8	9
1. STAI A	.50***	.56***	-.27**	-.11	.37***	-.17	.44***	.36***
2. STAI R (2)	-	.63***	-.34***	-.01	.08	-.10	.28**	.35***
3. STAI R (3)		-	-.40***	-.08	.22*	-.12	.31***	.58***
4. MDBF (2)			-	.29**	-.23**	.09	-.18*	-.50***
5. MDBF (3)				-	-.27**	.17	-.25**	-.21*
6. NEO N					-	-.36***	.60***	.23*
7. NEO E						-	-.45***	-.15
8. SPIN							-	.32***
9. TQ Rumi								-

Note. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; STAI A, STAI Actual; STAI R, State-Trait-Anxiety Inventory: Retrospective Rating; NEO N, NEO Neuroticism; NEO E, Extraversion; SPIN, Social Phobia Inventory; TQ Rumi, negative rumination scale of the Thoughts Questionnaire.

There was also applied a Kolmogorov-Smirnov test for normal distribution, shown at B.5. Results suggested normal distribution only for neuroticism, extraversion and social phobia. Due to the robustness of the MLR estimator, as explained above, it is acceptable to conduct the further analysis without some transformations. To test the relevance of the differences between anxiety levels, paired-sample t-tests were conducted. To check, whether the instruction to give a speech could induce anxiety, a paired samples t-test was conducted between anxiety levels after the relaxation exercise and after the announcement to give a speech, showing that the differences between the reported anxiety levels were significant ($t(140) = 11.03$, $p = .000$). The instruction led to a significant increase in reported anxiety levels.

A one-way repeated measures ANOVA was conducted to compare the actual and retrospective anxiety levels. There were significant differences between the reported anxiety levels ($F(2,264) = 8.78$, $p = .000$). Post hoc tests for the differences between the paired anxiety ratings were applied using the Bonferroni correction. There was a significant difference between the retrospective reported anxiety directly after the speech in comparison to the actual reported anxiety ($M_{Diff} = .14$, $SE = .05$, $p = .031$) but not between the retrospective reported anxiety after three weeks in comparison to the actual reported anxiety

(M_{Diff} = -.08, SE = .05, p = .501). The difference between the two retrospective anxiety ratings was significant (M_{Diff} = .22, SE = .05, p = .000). Thus, the overall retrospective anxiety rating showed an underestimation of the recalled anxiety directly after the speech and a correct estimation after three weeks.

At *Table 9*, means and standard deviations for the RMSSD, the marker of the HRV, are depicted. HRV decreased after announcement of the speech and also during the speech, indicating an increasing physiological arousal. The means have found to be comparable to a general mean of the RMSSD found by the Task Force (1996), which was 27, whereas the standard deviations are approximately twice as high as the reported one, indicating a higher variability.

Table 9

Means and Standard Deviations for the RMSSD

Scale	*M*	*SD*
RMSSD Baseline	38.19	22.07
RMSSD Announcement	34.11	20.00
RMSSD During Speech	26.70	25.81

Note. RMSSD, square root of mean squared difference of successive normal-to-normal intervals.

There were significant differences between the RMSSD scores (F(2,234) = 12.79, p = .000). Post hoc tests for the differences between the paired RMSSD scores were applied using the Bonferroni correction. There was no significant difference between HRV levels after the relaxation exercise and after the announcement to give a speech (M_{Diff} = 2.09, SE = 1.53, p = .525). The instruction led to a nonsignificant decrease of the HRV values. This pattern changed for the HRV values during the speech in comparison to the baseline level, which showed a significant decrease of HRV values (M_{Diff} = 11.07, SE = 2.70, p = .000). The difference in HRV values between the announcement of the speech and the speech itself was also significant (M_{Diff} = 8.98, SE = 2.56, p = .002). Therefore, during the speech itself, the HRV was significant lower compared to the other conditions. Taken together, the induction of psychological stress during the task at a physiological level was successful, especially during the speech.

To check relations to the self-report measures of perceived anxiety, bivariate correlations were computed (*Table 10*). There was no significant correlation between HRV values and

the corresponding anxiety levels at baseline or after the announcement of the speech. Moreover, retrospective reported anxiety was not correlated with any of the HRV values. There was also no significant relationship between the HRV measures and most of the used trait measures (see B.6). Only for rumination a significant correlation could be observed: the smaller the HRV during the talk, the more ruminated the participants after the speech *(r* = -.21, *p* = .03).

Table 10

Bivariate Correlations between HRV Values and Self-Reported Anxiety

Scale	2	3	4	5	6	7
1. RMSSD Baseline	.53**	.50**	-.08	-.12	-.03	-.08
2. RMSSD Announcement	-	.68**	.25*	-.11	-.06	-.09
3. RMSSD During speech		-	.02	-.11	.09	-.14
4. STAI Baseline			-	.47**	.25**	.32**
5. STAI Actual				-	.50**	.56**
6. STAI Retro (2)					-	.63**
7. STAI Retro (3)						-

Note. *$p < .05$; **$p < .01$.

3.3.2 Baseline Latent Change Model

I created latent variables for anxiety prior to the speech, retrospective anxiety directly after the speech and retrospective anxiety at the follow-up time of measurement. Each latent variable were represented by two parcel indicators. I also specified a latent method factor to control for method-specific influences due to parceling the data. Then I specified a baseline latent change model with two latent change variables to examine the changes in recalled anxiety compared to actual anxiety prior to the speech. This baseline latent change model shows good fit indices (χ2(9, 141) = 11.92, p = .22; RMSEA (root mean square error of approximation) = .048, CFI (comparative-fit index) = .992, SRMR (standardized root mean square residual) = .025). At the baseline model, the standardized mean of the first latent change variable was M = -0.23 (SE = .11, p = .028). For the second latent change variable it was M = 0.19 (SE = .10, p = .052).

3.3.3 Linear Structural Models for Neuroticism, Extraversion and Social Phobia

As a next step, I computed three different models to specify latent variables that could predict the latent change variables. These models include two latent mood variables, each for the second and third occasion of measurement. Moreover, I computed models for neuroticism and extraversion, comparable to study 1 and additionally for trait social anxiety. Mood and the personality variables were regressed on the latent change variables. The used predicting variables were all z-standardized.

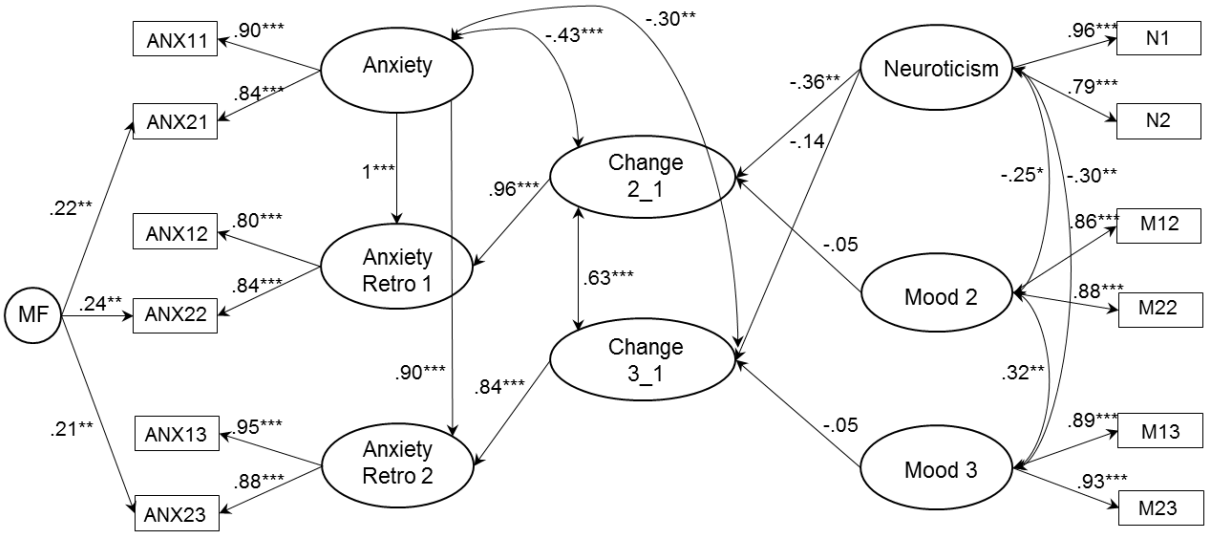

Figure 20. Linear structural model for neuroticism and mood.
Note. All factor loadings and regression coefficients are standardized; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; MF: Method Factor.

Figure 20 shows the linear structural model for neuroticism and mood without interaction terms. It includes standardized factor loadings for indicator variables, standardized covariances between latent variables and standardized regression coefficients for linear relationships between latent variables. This model shows good fit to the data ($\chi 2(46, 141) = 57.08$, $p = .127$; RMSEA = .041, CFI = .987, SRMR = .048). Neuroticism predicted the latent change in recalled anxiety for the second occasion of measurement. Mood was no significant predictor at all.

The procedure was the same for the linear structural model for extraversion and mood without interaction terms. This model shows inconsistent fit to the data, with a significant

Chi-Square test of model fit ($\chi 2(46, 141) = 64.91$, $p = .034$) and a high RMSEA (RMSEA = .054), but acceptable indices for the other mentioned model fit parameter (CFI = .978, SRMR = .049). Therefore, statistical interpretation has to be done carefully. For this model, neither extraversion, nor mood was a significant predictor at any occasions of measurement (see B.7, for the path model). The pattern was comparable for the linear structural model for social phobia and mood without interaction terms, which showed also a significant Chi-Square test of model fit ($\chi 2(46, 141) = 63.29$, $p = .046$) and a high RMSEA (RMSEA = .052), but acceptable indices for the other mentioned model fit parameter (CFI = .981, SRMR = .048). For this model, neither social phobia, nor mood was a significant predictor at any occasions of measurement (see B.8, for the path model).

3.3.4 Linear Structural Models for Neuroticism, Extraversion and Social Phobia Including Rumination

Moreover, I computed three different models to specify latent variables that could predict the latent change variables. These models included two latent mood variables, each for the second and third occasion of measurement and one latent rumination variable. Different models were computed for neuroticism, extraversion and social phobia as before. Mood, rumination and the personality variables were regressed on the latent change variables. The used predicting variables were all z-standardized. *Figure 21* shows the linear structural model for neuroticism, mood and rumination without interaction terms. It includes standardized factor loadings for indicator variables, standardized covariances between latent variables and standardized regression coefficients for linear relationships between latent variables. This model shows good fit to the data ($\chi 2(64, 141) = 73.05$, $p = .210$; RMSEA = .032, CFI = .992, SRMR = .033). Neuroticism predicted the latent change in recalled anxiety for both occasions of measurement. Mood was a significant predictor for the first occasion of measurement only. Rumination assessed at the third occasion of measurement was a significant predictor for the latent change variable as well.

The model for extraversion showed inconsistent fit to the data, with a significant Chi-Square test of model fit ($\chi 2(64, 141) = 86.92$, $p = .030$) and acceptable indices for the other mentioned model fit parameter (RMSEA = .050, CFI = .980, SRMR = .040). Therefore, statistical interpretation has to be done carefully. Neither extraversion, nor mood was a significant predictor for the memory distortion for this model. Only rumination could pre-

dict memory distortion at the last occasion of measurement. The path model is depicted at B.9.

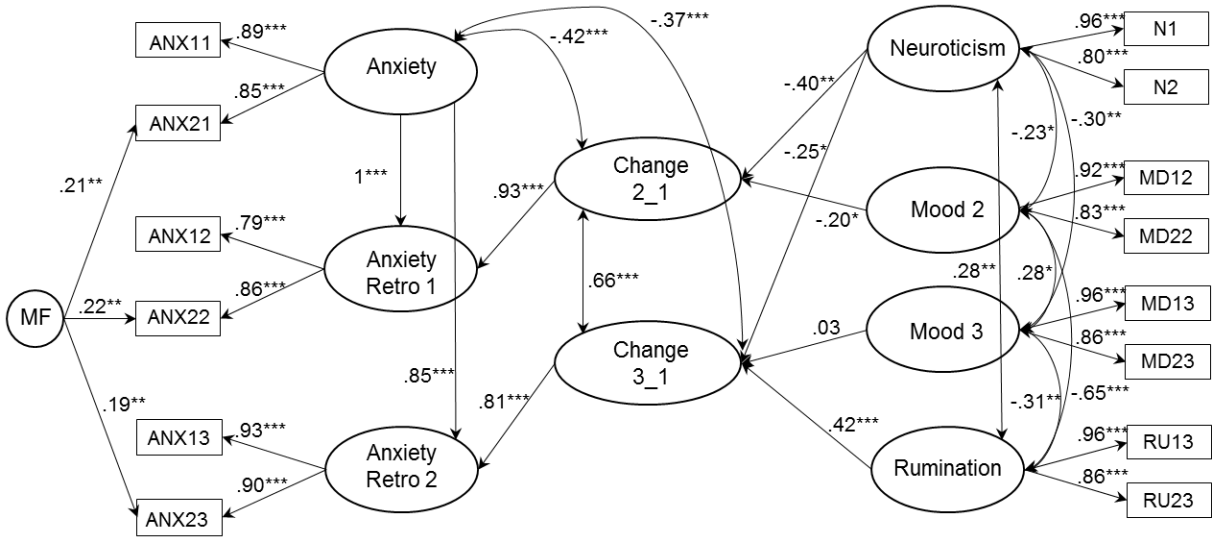

Figure 21. Linear structural model for neuroticism, mood and rumination.
Note. All factor loadings and regression coefficients are standardized; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; MF: Method Factor.

The third model for social phobia was computed comparable with the two models before. At *Figure 22* the linear structural model for social phobia, mood and rumination without interaction terms is displayed. It includes also standardized factor loadings for indicator variables, standardized covariances between latent variables and standardized regression coefficients for linear relationships between latent variables.

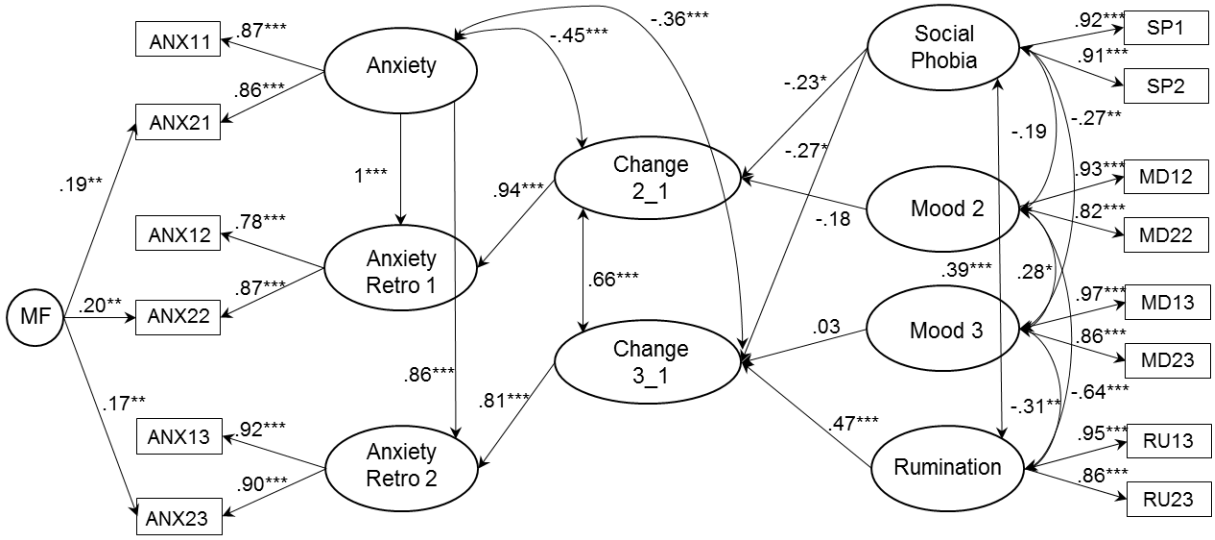

Figure 22. Linear structural model for social phobia, mood and rumination.
Note. All factor loadings and regression coefficients are standardized; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; MF: Method Factor.

This model shows good fit to the data ($\chi 2(64, 141) = 79.09$, $p = .097$; RMSEA = .041, CFI = .987, SRMR = .035). Social phobia predicted the latent change in recalled anxiety for both occasions of measurement. Mood was no significant predictor for any occasion of measurement. Rumination assessed at the third occasion of measurement was a significant predictor for the latent change variable as well.

3.3.5 Moderator Models for Neuroticism

To examine the interaction effect of personality and mood on the latent change in reported anxiety, I used the LMS approach. The used predictors were z-standardized. The procedure was as in Study 1.

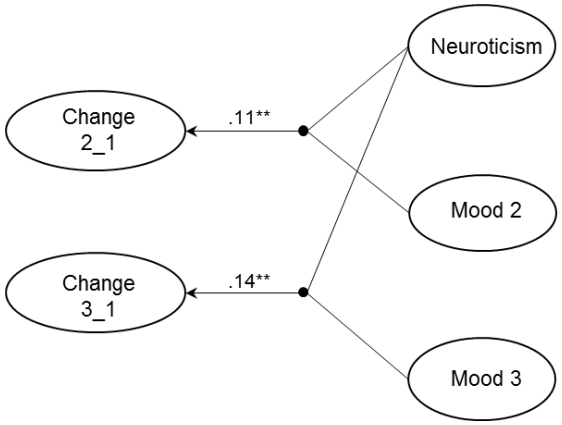

Figure 23. Schematic moderator model for mood and neuroticism predicting the memory distortion.
Note. Regression coefficients are unstandardized; $^{**}p < .01$.

Due to the lack of standard model fit indices I used the log-likelihood difference test to check the model fit (Muthén & Muthén, 2005). The moderator model for neuroticism fit the data better than the linear model without an interaction term ($\chi 2(2, 141) = 19.21$, $p \leq .001$). Therefore it is useful to include the interaction term when analyzing the data. *Figure 23* shows the schematic path model of the LMS model. The interaction between neuroticism and actual mood at the time of retrospective assessment of the anxiety prior to the speech was a significant predictor for the bias in remembered anxiety for both occasions of measurement.

Table 11

Unstandardized Regression Coefficients for the Linear and the LMS Model for Neuroticism

	Difference between Actual and Retrospective Reported Anxiety					
	Change 2_1			Change 3_1		
Models and Predictors	*b*	*SE*	*p*	*b*	*SE*	*p*
Linear Model						
MDBF Actual	-.03	.06	.651	.03	.07	.661
NEO Neuroticism	-.19	.07	.009	.08	.07	.255
LMS Model						
MDBF Actual	-.05	.06	.433	-.03	.06	.692
NEO Neuroticism	-.18	.07	.008	-.06	.06	.340
MDBF x Neuroticism	.11	.03	.001	.14	.05	.004

Note. "MDBF actual" means the assessed mood at the second (Change 2_1) and at the third (Change 3_1) occasion of measurement, respectively; *b*, regression coefficient.

Table 11 portrays the regression coefficients for the linear and the LMS model for neuroticism and mood predicting the memory distortion. The intercepts for the memory distortion at the second state (b_0 = -.10, *SE* = .05, *p* = .041) as well as at the third state (b_0 = .14, *SE* = .06, *p* = .018) were significant different from zero. Neuroticism was a negative predictor for the disparity between retrospective and actual reported anxiety only directly after the speech. Mood does not predict the gap in actual and retrospective reported anxiety at any occasion of measurement. This applies for the linear model as well as for the LMS model. The interactions between mood and neuroticism were significant at both occasions of measurement. All regression plots were created using the tool provided by Dawson (2015). The regression plot depicted at *Figure 24* shows the linear influence of the self-assessed neuroticism on the accuracy of remembered anxiety assessed directly after the speech. For subjects low in trait neuroticism, the *over*estimation decreased the better their mood was. Those high in neuroticism showed an *under*estimation of the prior anxiety, which became more accurate the better their mood was. The greater the neuroticism, the greater was the overestimation of the retrospective assessed anxiety.

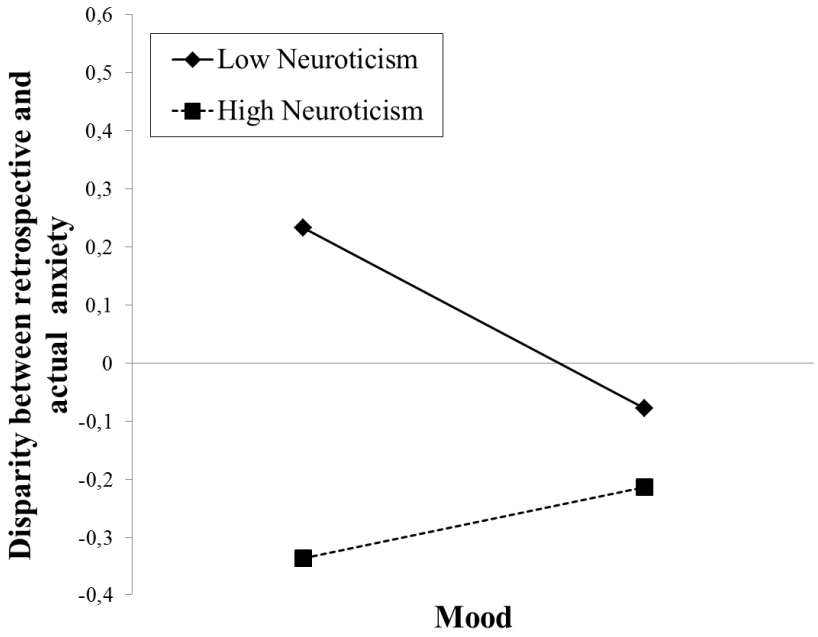

Figure 24. Regression plot for the interaction between mood and neuroticism predicting the latent change variable which indicates the disparity between retrospective and actual reported anxiety (Change 2_1).
Note. Mood is ranging from very bad mood on the left to very good mood on the right; only neuroticism and the interaction "mood x neuroticism" are significant predictors for this model.

At *Figure 25* the regression plot for the assessment for the follow-up point of measurement is depicted. People describing themselves as low in trait neuroticism showed an *over*estimation of prior anxiety when they are in bad mood, with decreasing values the better their mood was. For people describing themselves as high in neuroticism there pattern is different. The better the mood the bigger appears the overestimation of the retrospective assessed anxiety.

Simple slopes for the association between mood and memory distortion were tested using the tool by DeCoster & Iselin (2005), comparable to study 1. Therefore, the moderator function was tested to significance for several levels of the moderator. Simple slopes were tested for very low (-2 SD below the mean), low (-1 SD below the mean), moderate (mean), high (+1 SD above the mean) and very high (+2 SD above the mean) levels of neuroticism.

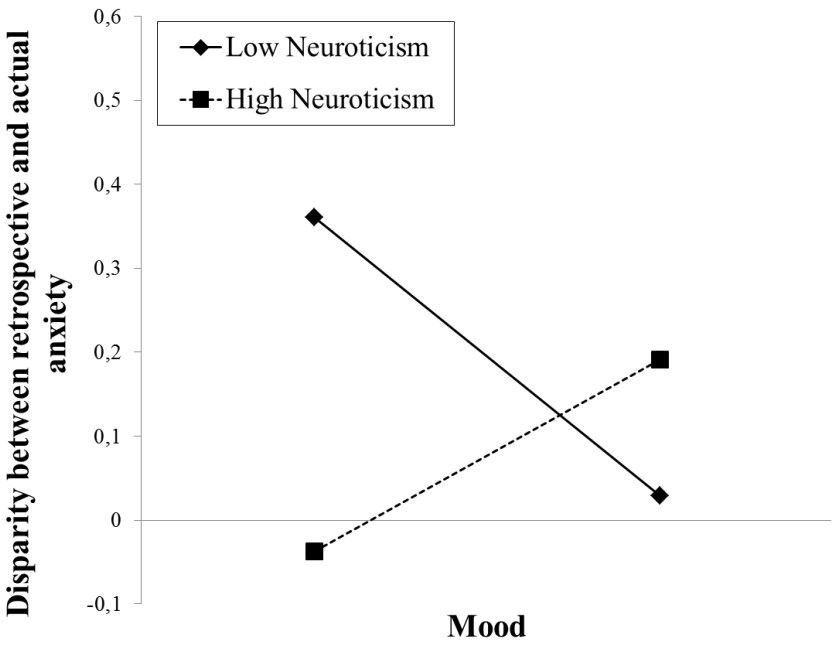

Figure 25. Regression plot for the interaction between mood and neuroticism predicting the latent change variable which indicates the disparity between retrospective and actual reported anxiety (Change 3_1).
Note. Only the interaction "mood x neuroticism" was a significant predictor for this model.

For the measurement right after giving the speech, the simple slopes were not significant different from zero for all values of neuroticism. In detail, simple slopes for very low neuroticism (b = -.26, $t(137)$ = 3.67, p = .001) and low neuroticism (b = -.16, $t(137)$ = 2.36, p = .020) indicated a significant negative relationship between mood and memory distortion, whereas the slope for very high neuroticism (b = .17, $t(137)$ = 2.02, p = .045) indicated a significant positive relationship between mood and memory distortion. In contrast, simple slopes for moderate neuroticism (b = -.05, $t(137)$ = 0.71, p = .480) and high neuroticism (b = .06, $t(137)$ = 0.72, p = .401) were not significant different from zero. The plot is depicted at *Figure 26.* To sum up, people very high in neuroticism tended to *under*estimate their prior anxiety, especially when they are in bad mood, with increasing accuracy the better their mood was. People very low and low in neuroticism showed a different pattern. They *over*estimated their prior anxiety when they are in bad mood. The better their mood was, the more accurate was the recall. For a better understanding of the data, the same procedure was applied to the model, with interchanged predictor and moderator, indicating the relationship between neuroticism and memory distortion moderated by mood. The results are shown at B.10 and B.11. The simple slopes showed a significant negative relationship with the memory distortion, except the simple slopes for high and very high levels of mood. The worse the mood, the bigger is the (negative) relationship between neuroticism

and memory distortion. Subjects in moderate to very bad mood overestimated the recalled anxiety if low in neuroticism and underestimated their prior anxiety if high in neuroticism.

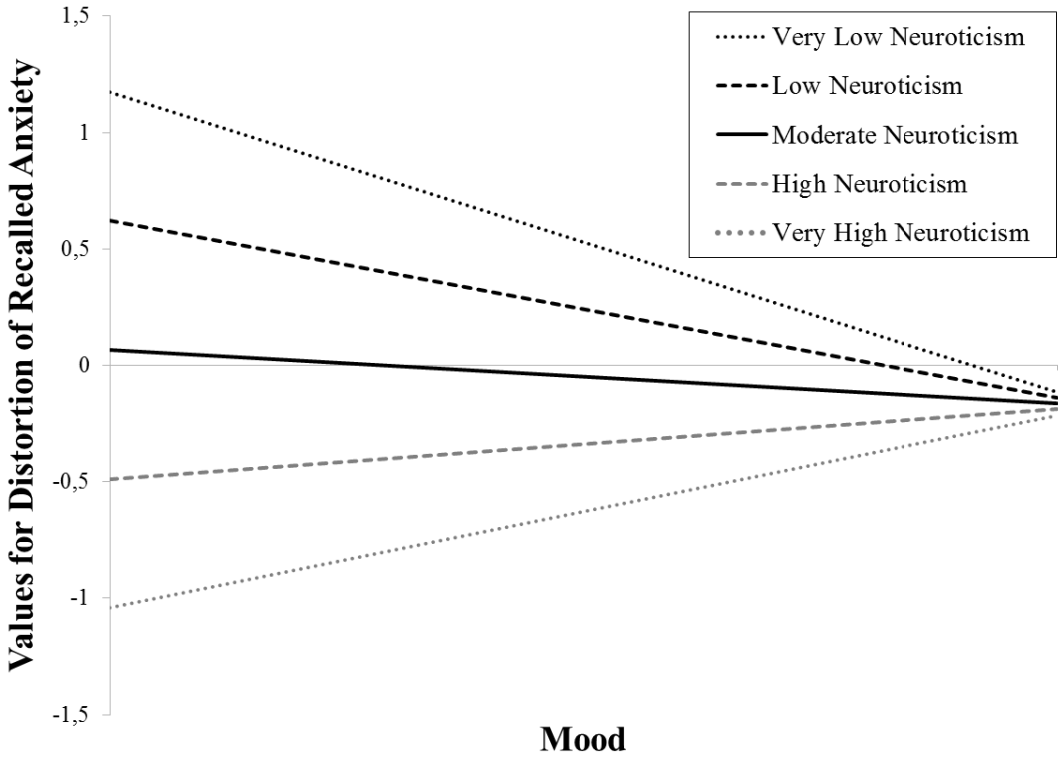

Figure 26. Plot of the simple slopes for the interaction between mood and neuroticism at the second occasion of measurement.
Note. Very low: -2 SD below the mean, low: -1 SD below the mean, moderate: mean, high: +1 SD above the mean, very high: +2 SD above the mean.

For the follow-up occasion of measurement, there was a similar pattern. Simple slopes for very low neuroticism (b = -.31, $t(137)$ = 3.01, p = .003) and low neuroticism (b = -.17, $t(137)$ = 2.21, p = .028) indicated a significant negative relationship between mood and memory distortion, whereas the slope for very high neuroticism (b = .25, $t(137)$ = 2.70, p = .008) indicated a significant positive relationship between mood and memory distortion. In contrast, simple slopes for moderate neuroticism (b = -.03, $t(137)$ = 0.42, p = .675) and high neuroticism (b = .11, $t(137)$ = 1.63, p = .110) were not significant different from zero. The plot is depicted at *Figure 27*. In sum, people very high in neuroticism tended to *under*estimate their prior anxiety, especially when they are in bad mood. The better their mood was the more accurate was their recall. In really good mood, an overestimation of the recalled anxiety was observed. People very low and low in neuroticism *over*estimated their prior anxiety when they are in bad mood, with an increasing accuracy the better their

mood was. After interchanging predictor and moderator (see B.12 and B.13) simple slopes for very low and low neuroticism indicated a significant negative relationship between mood and memory distortion. For very high neuroticism, the relationship was positive. Subjects in bad and very bad mood overestimated the recalled anxiety if they are low in neuroticism and underestimated their prior anxiety if they are high in neuroticism. People in very good mood showed the pattern vice versa: They underestimated the recalled anxiety if they are low in neuroticism and overestimated their prior anxiety if they are high in neuroticism.

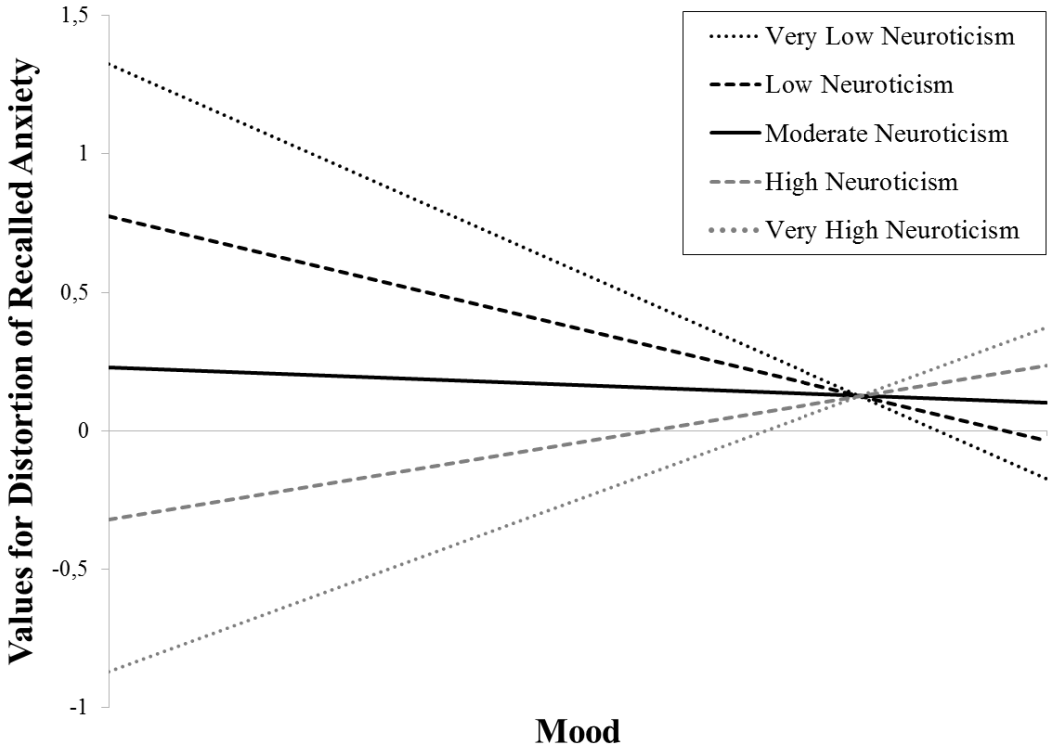

Figure 27. Plot of the simple slopes for the interaction between mood and neuroticism at the third occasion of measurement.
Note. Very low: -2 SD below the mean, low: -1 SD below the mean, moderate: mean, high: +1 SD above the mean, very high: +2 SD above the mean.

After examining the analyses with one interaction term, also rumination was included in the model, leading to four interaction terms for the full model. The *Equation 3* will result as an extension of the *Equation 2*, with corresponding parameter meanings.

$$\eta = \alpha + \beta_1\xi_1 + \beta_2\xi_2 + \beta_3\xi_3 + \gamma_1\xi_1\xi_2 + \gamma_2\xi_1\xi_3 + \gamma_3\xi_2\xi_3 + \gamma_4\xi_1\xi_2\xi_3 + \varepsilon \qquad (3).$$

The three-way interaction model for neuroticism, mood, rumination and their interactions showed no advantage in model fit compared to the model without interaction terms (χ2(5, 141) = 4.05, p = .416). Therefore it is not useful to include all interaction terms when analyzing the data. The regression coefficients for the linear and the LMS model could be found at B.14. If ignoring the three-way interaction when specifying the model, a more sufficient model could be computed. For this more complex model with three two-way interactions, the model fit shows advantage against the model without interaction terms (χ2(4, 141) = 17.54, p = .002). Note that only the third occasion of measurement is considered here, since rumination was only assessed at that time point.

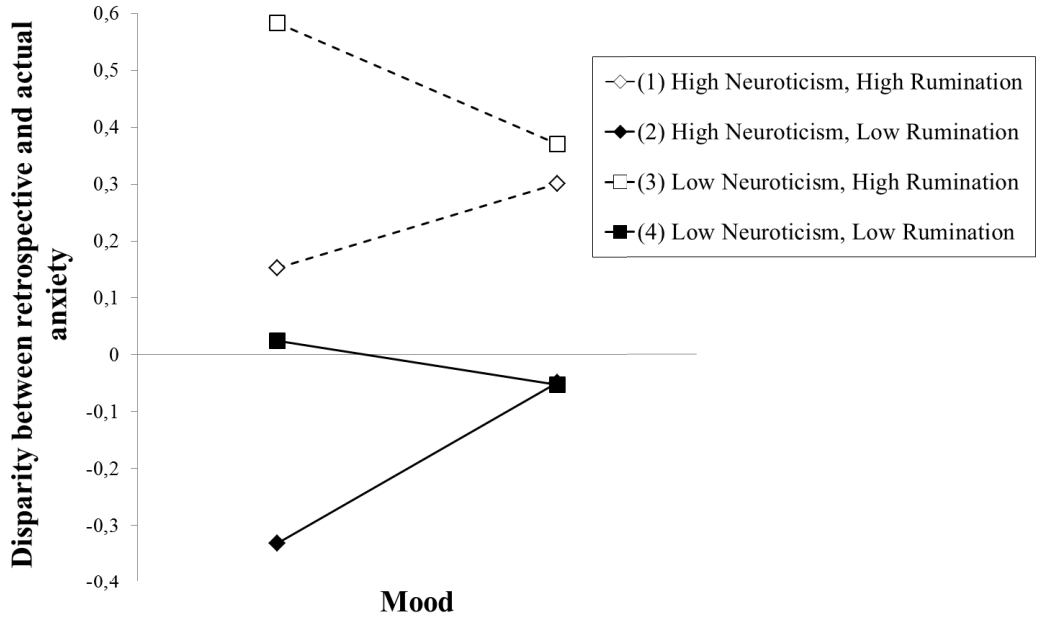

Figure 28. Regression plot for the LMS interaction model including mood, neuroticism, rumination and their interactions (without the three-way interaction) predicting the latent change variable which indicates the disparity between retrospective and actual reported anxiety (Change 3_1).
Note. Only rumination and the interaction between mood and neuroticism are significant predictors.

This model showed a significant intercept (b_0 = .13, SE = .05, p = .017) and significant regression parameters for rumination (b = .24, SE = .05, p = .000) and for the interaction between mood and neuroticism (b = .10, SE = .04, p = .008). Neuroticism (b = -.11, SE = .07, p = .083), Mood (b = .02, SE = .05, p = .691) and the interactions between mood and rumination (b = -.04, SE = .03, p = .207) as well as neuroticism and rumination (b = -.02, SE = .05, p = .655) were not significant different from zero.

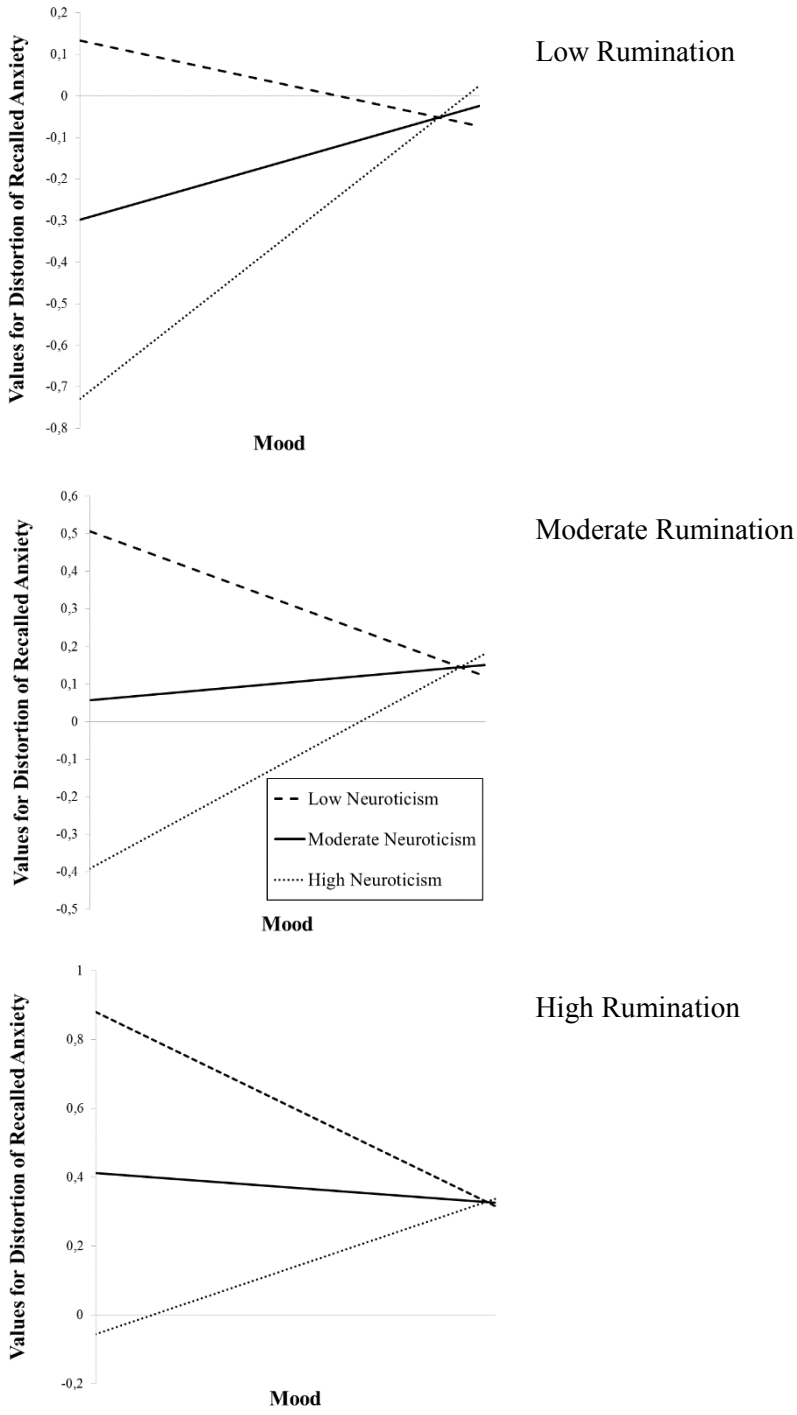

Figure 29. Plot of the simple slopes for the LMS interaction model including mood, neuroticism, rumination, and their interactions (without the three-way interaction) at the third occasion of measurement.
Note. Low: -1 SD below the mean, moderate: mean, high: +1 SD above the mean.

Simple slope analyses were also computed for different stages of rumination (see B.15, for a detailed table). The slopes for the relationship between personality and mood for the memory distortions were only significant for high neuroticism (+ 1 SD over the mean) in

low rumination ($b = .15$, $t(137) = 2.64$, $p = .009$) and moderate rumination ($b = .12$, $t(137) = 2.03$, $p = .045$). The remaining simple slopes were not significant different from zero. The plots are depicted at *Figure 29*. To sum up, people high in neuroticism tended to *under*estimate their prior anxiety, especially when they are in bad mood, with significant increasing accuracy the better their mood was if they ruminated low. In moderate rumination, the pattern was similar but with a tendency to *over*estimate the prior anxiety when they are in very good mood. In high rumination, there was an overall *over*estimation of the recalled anxiety independent from neuroticism. People low in neuroticism showed no significant mood-dependent effects. When analyzing the graphs visually, they showed a decreasing overestimation the better their mood was, although this relationship is not significant. Moreover, subjects low in neuroticism tend to show increasing overestimation the more they ruminated. Concerning mood itself, the pattern indicated similar ratings for all manifestations of neuroticism, if subjects showed good mood. The worse the mood, the more diverged the values for memory distortion.

3.3.6 Moderator Models for Extraversion

The moderator model for extraversion and mood did not fit the data better than the linear model without the interaction term ($\chi 2(2, 141) = 4.65$, $p = .100$). Therefore it is not useful to include the interaction term when analyzing the data. The regression coefficients for the linear and the LMS could be found at B.16.

After including rumination, the moderator model became significant ($\chi 2(2, 141) = 7.83$, $p = .020$). This was due to the effect of rumination, which showed a significant positive value for the regression coefficient ($b = .24$, $SE = .06$, $p = .000$). The intercept for the memory distortion at the third state ($b_0 = .10$, $SE = .05$, $p = .069$) was not significant different from zero. Mood ($b = .02$, $SE = .05$, $p = .776$), extraversion ($b = .08$, $SE = .08$, $p = .340$) and their interaction ($b = -.02$, $SE = .05$, $p = .640$) remained not significant different from zero for the follow-up measurement. Low rumination scores lead to underestimation of prior anxiety, whereas higher values are connected with an overestimation of the pre-speech anxiety.

The three-way interaction model for extraversion, mood, rumination and their interactions showed no advantage in model fit compared to the model without interaction terms

(χ2(5, 141) = 0.89, p = .977). Therefore it is not useful to include these interaction terms when analyzing the data. The regression coefficients for the linear and the LMS model are depicted at B.17.

3.3.7 Moderator Models for Social Phobia

The moderator model for social phobia showed no better fit than the linear model without an interaction term *(*χ2(2, 141) = 3.74, p = .154). The regression coefficients for the linear and the LMS could be found at B.18. The three-way interaction model for social phobia, mood, rumination and their interactions showed no advantage in model fit compared to the model without interaction terms *(*χ2(5, 141) = 6.31, p = .278). The regression coefficients for the linear and the LMS model are depicted at B.19. Also the other models containing less interaction terms showed no advantage in model fit and are therefore not reported.

3.4 Discussion

Study 2 aimed to investigate the memory bias for self-reported anxiety prior to an unheralded short speech in front of a camera and a student assistant in a laboratory setting. Four occasions of state measurement were realized: A baseline measurement after doing relaxation training, a state assessment just before giving the speech, a state assessment right after giving the speech and a follow-up assessment after four weeks. To begin with, I would like to sum up and discuss the results by linking them to the formulated hypotheses above.

3.4.1 Discussion of Hypotheses

Hypothesis I: The successful induction of anxiety through the speech task should be proved through anxiety ratings and HRV levels (implementation control).

Since the study took place at a laboratory setting, it seems crucial to check, weather the announcement of the speech and the speech itself could induce the predicted anxiety reaction. The difference test of the self-reported anxiety scores after relaxation training and after the announcement of the speech confirms this assumption. The same comparison was made for baseline HRV levels compared to HRV levels after the announcement of the speech as well as during the speech. These differences were all significant with lowest HRV levels during the speech, indicating highest psychophysiological arousal. It might be discussed that the announcement of the speech was not powerful enough for all participants. Some might have thought that this would be fake, leading to a more intensive HRV reaction when realizing that this was not the case. By contrast, intense reaction during the speech seems plausible, because of the need for a higher arousal during real acting compared to the imagination before. This is in accordance with previous findings by Erdmann and Voigt (1995). In a public speaking situation, they found that there are two components of stress, an emotional one because of the anxiety and a cognitive one. Prior to the speech, the emotional component is activated, whereas during the speech, both components are triggered leading to additively increased biological stress reactions. Therefore, the instruction led to a significant increase in reported anxiety levels as well as in HRV markers and could be seen as successful. This is in accordance to prior studies and assumptions which judge speech tasks to be an appropriate paradigm to study emotion, for instance due to the activation of emotional response tendencies leading to emotion behavior via emotional expression, negative affect and physiology (Egloff, Schmukle, Burns & Schwerdtfeger, 2006; Girdler, Turner, Sherwood & Light, 1990).

Hypothesis II: Correlations between HRV and state anxiety should be examined.

Interestingly and counterintuitive, there was no significant correlation between HRV values and the corresponding anxiety levels at baseline or after the announcement of the speech. Moreover, retrospective reported anxiety was not correlated with any of the HRV values. These results are not isolated findings. A number of researchers had observed that physiological measures and self-report measures of anxiety showed only weak or no relationship (e.g. Fahrenberg & Foerster, 1982; Feldman et al., 1999; Maier, Waldstein & Synowski, 2003; Schwerdtfeger, 2004). It was suggested that self-reports are hardly or not useful in predicting psychophysiological reactivity to stress (e.g. Campbell & Ehlert, 2012; Fahrenberg, 1992). It was argued that reasons for this phenomenon are the unawareness of participants of their current emotions or reluctance to report actual anxiety due to impression management processes (Egloff, Wilhelm, Neubauer, Mauss & Gross, 2002). In this context, one might connect these arguments to the so called repressive coping style, which is characterized through low self-reported anxiety scores and high defensiveness which is thought to be linked to an inhibition of negative emotions (Weinberger, Schwartz & Davidson, 1979). For the current study, this would imply that (repressive) people low in self-rated anxiety would have higher autonomic response values than expected, which influences the intuitive estimated positive relationship between the two measures among the other participants. On the other hand, in a recent study by Souza et al. (2015) was observed that subjects with higher trait anxiety showed less heart rate reaction to a speech task than those with lower trait anxiety. The authors argued that individuals with higher trait anxiety had less tachycardia in response to acute psychological stress than those with lower trait anxiety. This might provide an explanation for the findings in the current study: One might argue that the perceived emotional stress response differs from the adaptive physiological response in high anxious subjects. In turn, trait anxiety was positively related to state anxiety ratings. Together with the proposed positive relationship for low anxious people, this could disperse a possible effect between emotional self-report and heart rate response. Therefore, there might be a higher risk for more anxious individuals to react to stressful events due to insufficient autonomic arousal. It remains unclear, if and how the two explanations lead to the current findings. Furthermore, some authors pointed out the possibility that a laboratory situation could not produce realistic emotional reactivity, which could lead to a decreasing association between self-report and autonomic response (e.g. Feldman et al. 1999; Gerin et al., 1999; Schwerdtfeger, 2004). Therefore the paradigm should be tested also in natural occurring situations to examine, whether this is the case.

Hypothesis III: An overall overestimation of the retrospective reported anxiety is predicted.

The prediction of an overall overestimation of the reported anxiety after the announcement of the speech (e.g. Barrett, 1997; Parkinson et al., 1995; Thomas & Diener, 1990) could not be confirmed. There was a significant *under*estimation of the pre-speech anxiety at retrospective measurement right after the speech. For the third occasion of measurement, there was a descriptive overestimation which was not statistically significant. If taking the overall high levels of anxiety into account, it could be stated that the present sample showed high social anxiety scores. One might think about prior findings which failed to detect an *overall* explicit memory bias in social phobia (e.g. Coles & Heimberg, 2002; Rapee et al., 1994; Wenzel, Jackson & Holt, 2002; see also Hirsch & Clark, 2004, for a review). One might wonder if the nature of recall bias is dependent on the clinical status of the participants. Following the meta-analytic findings by Mitte (2008), there is no qualitative difference in information processing between anxiety patients and high-anxious subjects. However, it remains unclear, whether the current result is an artifact or has content-related reasons.

Hypothesis IV: There should be trait-consistent relationships between neuroticism, extraversion and social phobia with state levels of anxiety.

The anxiety level directly before the speech was positively related with neuroticism, as predicted (Bienvenu et al., 2007; Bienvenu et al., 2004; Hettema et al., 2006; Hoferichter & Raufelder, 2013; Schmidt & Riniolo, 1999). Social anxiety and state levels of anxiety correlated significantly positive, which was also found in recent publications (Morrison et al., 2016). As in study 1, the predicted negative relation with extraversion could not be shown, maybe due to the already mentioned finding by Jylha and Isometsa (2006) who found extraversion and anxiety symptoms to be uncorrelated when controlling for gender, age and education which were even distributed (gender) or showed small variance (age and education) in the current study.

Hypothesis V: Mood congruent recall will appear directly after the speech.

There was no significant influence of mood at the linear and moderator models including trait measures, which is comparable to study 1. One exception is a mean effect of mood when including neuroticism and also rumination in the model. For this model, mood was negatively related to the memory distortion, indicating better mood was associated with lower retrospective anxiety distortion. But following the already mentioned associative network models (Bower, 1981), the mood effect should have a more stable impact than the current study could work out. Therefore, the assumption that the recall of prior emotions is biased into the direction of the actual mood (Bower, 1981; Parkinson et al., 1995) could not to be underlined.

Hypothesis VI: Mood incongruent recall will appear after four weeks.

As the answer of hypothesis V indicated, mood has also no significant impact in terms of main effects for the second occasion of measurement. If having a look at differentiated results, including interaction effects, mood incongruent recall depending on personality occurred. But stable main effects could not be detected at all. Possible reasons for that should be discussed afterwards.

Hypothesis VII: Trait congruent recall will appear at all occasions of measurement.

Having a look at the structural equation models without rumination, there were only few personality-dependent effects for neuroticism. Neuroticism was only a significant predictor for the assessment directly after the speech, which was for the linear as well as for the interaction model. When including rumination into the model, this main effect was no longer significant. Against the hypothesis, neuroticism had a negative impact on memory distortion, with higher levels leading to lower recall bias. These findings are hardly to connect with personality congruent recall (Barrett, 1997; Rusting, 1999). Social anxiety showed only main effects in predicting memory distortion when controlling for rumination which were, like those for neuroticism, negatively related with memory distortion. For extraversion, no main effects could be observed at all. So, study 2 failed in detecting main effects of personality congruent recall. Possible reasons for that should be discussed afterwards.

Hypothesis VIII: Trait congruent recall will become more important over time.

As hypothesis VII indicates, trait congruent recall could not be observed at all. The negative influence of neuroticism on memory distortion was only observed directly after the exam, whereas social phobia has a significant negative influence at the follow-up occasion of measurement, when controlling for rumination. Therefore, the hypothesis deducted by the model by Robinson and Clore (2002a; 2002b) could not be confirmed. Possible reasons for that should be discussed afterwards.

Hypothesis IX: Neuroticism should be linked to negative mood maintenance and mood incongruent recall in positive mood.

Interaction effects between neuroticism and mood on memory bias were found at both retrospective assessments. For those high in neuroticism, increasing mood leads to an increasing overestimation of the pre-speech anxiety, which is in accordance with previous findings (Kämpfe & Mitte, 2009; Tamir, 2005; Tamir & Robinson, 2004). Thus, mood incongruent recall occurred for those high in neuroticism. For those low in neuroticism, mood congruent recall appears. If in bad mood, they overestimated their pre-speech anxiety. The better the mood, the more accurate was the retrospective anxiety rating. This slope pattern is present for both occasions of retrospective measurement. The absolute values of the regression seem to be problematic. In bad mood, low neurotic individuals showed greater memory distortion than high neurotic ones, which was already mentioned in hypothesis VII. Therefore, an interpretation seems difficult, although the slope hypothesis for those high in neuroticism seems to be confirmed. When taking rumination into account, the relationship between mood and neuroticism predicting memory distortion was comparable for high neurotics: in low and moderate rumination, they showed mood incongruent recall. The other relationships showed no significant slopes. As the moderator models concerning social phobia showed no advantage in model fit, there are no interaction effects between mood and social phobia. Therefore, social phobia-correlated memory bias seems not to be comparable to neuroticism-associated bias. In sum, these results differ from earlier results in study 1. As a consequence, methodological considerations have to be taken into account afterwards.

Hypothesis X: Extraversion should be linked to positive mood maintenance and negative mood repair.

Extraversion and mood showed no interacting effects when included in the moderator models without and with rumination. Therefore, no personality- or mood-dependent recall could be observed for extraversion, which is against the theoretical framework mentioned before and should also be discussed in respect of methodological aspects afterwards.

Hypothesis XI: Engaging highly ruminative after the speech should lead to an overestimation in recalled anxiety.

Rumination seems to be the most important predictor for the memory distortion at the current study. For all computed models, rumination had a stable positive influence on memory distortion, which is in contrast to mood and personality, which showed no overall main effects. The more subjects ruminated after giving the speech, the higher was the overestimation of the recalled anxiety, which strengthens the appraisal congruence approach (Levine, 1997; Levine et al., 2001).

3.4.2 Conclusion

The results of the current study suggest that the used speech task seems to be able to induce state anxiety. As some other authors before (e.g. Fahrenberg & Foerster, 1982; Feldman et al., 1999; Maier et al., 2003; Schwerdtfeger, 2004), no significant correlations between HRV values and the corresponding anxiety levels at baseline or after the announcement of the speech could be observed. It is discussed, whether this phenomenon appears due to one's unawareness of current emotions or reluctance to report them (Egloff et al., 2002), repressive coping style (Weinberger et al., 1979) or maladaptive emotional stress response in high anxious subjects (Souza et al., 2015). Interestingly, participants showed an *under*estimation of the pre-speech anxiety at retrospective measurement right after the speech and overall accurate recall after four weeks, which could confirm the hypothesis of an absence of an overall memory bias in high anxious subjects (e.g. Coles & Heimberg, 2002; Rapee et al., 1994; Wenzel et al., 2002).

As in study one, there are no hints confirming network theories linking mood and memory (e.g. Bower, 1981). Mood-dependent recall in terms of main effects of mood could not be observed. Concerning mood incongruent memory, the study shows evidence for the influence of neuroticism forming personality congruent effects. Those high in neuroticism

showed mood incongruent memory, whereas those low in neuroticism showed mood congruent memory. So far, the results seem plausible but the main effect of neuroticism does not fit this pattern: those high in neuroticism showed an overall *under*estimation, whereas low neurotics showed an *over*estimation. There is no theoretically based explanation for these findings. Nevertheless, neuroticism was the strongest (trait) predictor for the memory distortion, whereas social phobia and extraversion had weaker influences. One might argue that this is due to the strong link between neuroticism and negative affect (e.g. Komulainen et al., 2014; Rusting & Larsen, 1997; Watson, Clark & Tellegen, 1988). Neuroticism as stable personality trait is linked to stable patterns of emotional information processing and also manifested in neurophysiological correlates (e.g. Ikeda et al., 2015; Servaas et al., 2013), whereas social phobia was assessed depending on a limited time interval. These results give a hint of a less stable (negative) processing in social anxiety compared to neuroticism. But these conclusions seem hardly to be relevant, if one had again a look at the negative relationship between neuroticism and social phobia on memory distortion. This is not the case for rumination, which is strongly associated with social anxiety (e.g. Chen, Rapee & Abbott, 2013; Zou & Abbott, 2012). Overall, rumination showed the most stable pattern of memory bias: The more subjects ruminated after giving the speech, the higher was the overestimation of the recalled anxiety, which is predicted by the appraisal congruence approach (Levine, 1997; Levine et al., 2001), highlighting the outstanding role of this phenomenon in (negative) information processing. Taken together, no confirming results could be found for the validity of the associative network theory by Bower (1981), the Affect Infusion Model by Robinson and Clore (2002a) and personality congruency approaches (e.g. McAdams et al., 1997; Woike, 1995). Only the appraisal congruence approach (Levine, 1997; Levine et al., 2001) was reinforced.

To conclude, some authors pointed out the possibility that a laboratory situation could not produce realistic emotional reactivity (e.g. Feldman et al. 1999; Gerin et al., 1999; Schwerdtfeger, 2004). Although the anxiety induction was successful, one might argue that the emotional relevance of the laboratory paradigm is significant lower compared to a real-live-paradigm (Zanstra & Johnston, 2011). The results observed in the current study suggest the assumption that there are different underlying mechanisms in naturalistic and simulated anxiety evoking situations. I assume that this is the main reason why the mechanisms explained in hypotheses *VI-X* were not observable in the current study. Therefore the

paradigm should be tested also in natural occurring situations to examine, whether this is really the case.

3.4.3 Limitations

The methodological factors which could potentially limit the results of this study are comparable to those considered detailed in study 1. These are constrained construct validity due to the use of self-report trait measures, the sample size in the light of the usage of structural equation modeling and reduced external validity due to sample characteristics (see 2.4.3). Moreover, the already mentioned laboratory study context might have influence the study results. It is conceivable that some participants might have thought that the speech announcement is fake, leading to smaller anxiety ratings and also more accurate recall due to decreasing variance. Additionally, although the TQ is based on a standardized measure, the inventory was modified by translating it into German. The internal consistency was satisfying, but the results should be replicated in future research, nevertheless. In addition, since there is no cut-off value, it is not possible to identify over-average values for rumination.

3.4.4 Summary

Study 2 aimed to investigate the memory bias for self-reported anxiety prior to an impromptu speech task at a laboratory setting. Therefore, the initial anxiety rating after the announcement of the speech was compared to assessments directly after the speech and four weeks later. Mood assessments were made simultaneously to the retrospective assessments and the personality variables neuroticism and extraversion as well as trait social anxiety and rumination were measured. In sum, study 2 could not support the majority of the hypotheses, which is in contrast to the findings in study 1. Physiological and self-reported markers of anxiety increased due to the speech announcement. The presented results suggest that participants tend to underestimate their recalled anxiety directly after the speech and showed overall accurate recall four weeks later. Mood-dependent recall in terms of main effects of mood could not be observed in general, but as interactive effect for low neurotics. Mood incongruent memory was observed for high neurotics, but those high in neuroticism showed an overall *under*estimation, whereas low neurotics showed an *over*estimation of pre-speech anxiety, which is against the expected direction. Extraversion and social anxiety showed only weak influences. Altogether, rumination showed the most

stable pattern of memory bias: The more subjects ruminated after giving the speech, the higher was the overestimation of the recalled anxiety, supporting the appraisal congruence approach (Levine, 1997; Levine et al., 2001). The results are thought to have diminished ecological validity due to the laboratory setting. The results observed in the current study suggest the assumption that there are different underlying mechanisms in naturalistic and simulated anxiety evoking situations. Therefore the paradigm should be tested in a naturalistic setting to examine, if this would lead to comparable results.

4 Study 3

The third study is a transfer of study two into a naturalistic context. Students participating in different university courses where talks had to be given were asked to join the study. The aim was to investigate the memory bias for self-reported anxiety prior to the given talk in front of the class. Due to the special setting, no baseline rating could be realized, since the subjects were aware of giving their talk from the beginning. Therefore, three occasions of state measurement were realized: A state assessment just before giving the speech, a state assessment right after giving the speech and a follow-up assessment after three weeks.

4.1 Hypotheses

The hypotheses are comparable to those in study 2. Differences are due to the changed setting of the study. The hypotheses are as follows.

I. The successful induction of anxiety through the naturalistic speech task should be proved through HRV levels (implementation control).

At state levels, the HRV should show the smallest levels during the talk and directly before the talk. After completion of the talk, a recovery should be observed, indicating a decreasing arousal. Therefore, HRV values should be significantly higher at recovery, compared to the other two conditions. This could be interpreted as successful induction of anxiety through the naturalistic speech task (implementation control).

II. Correlations between HRV and state anxiety should be examined.

The relationship between HRV per se and changes in HRV before, during and after the talk with self-reports of the current anxiety should be investigated using.

III. An overall overestimation of the reported anxiety directly before the talk is predicted.

At all levels of recall, there should be an overall overestimation of the reported anxiety directly before the talk (e.g. Barrett, 1997; Parkinson et al., 1995; Thomas & Diener, 1990).

IV. There should be trait-consistent relationships between neuroticism, extraversion and social phobia with state levels of anxiety.

Anxiety levels directly before the talk should be positively related to neuroticism (Bienvenu et al., 2007; Bienvenu et al., 2004; Hettema et al., 2006; Hoferichter & Raufelder, 2013; Schmidt & Riniolo, 1999) and social phobia (e.g. Gilbert, 2000; Rapee & Heimberg, 1997; Veale, 2003; Zeidner & Matthews, 2011) and negatively related to extraversion (Bienvenu et al., 2004; Bienvenu et al., 2007; Bienvenu & Stein, 2003; Schmidt & Riniolo, 1999).

V. Mood congruent recall will appear directly after the talk.

Directly after the speech, mood congruent recall is hypothesized to appear, indicating a decreasing overestimation the better the assessed mood is (Forgas, 1995; 2000; Forgas & Cariocci, 2002; Sedikides, 1994; Singer & Salovey, 1988).

VI. Mood incongruent recall will appear after three weeks.

At the third occasion of state measurement, mood incongruent recall will be observed (Forgas, 1995; 2000; Forgas & Cariocci, 2002; Sedikides, 1994; Singer & Salovey, 1988).

VII. Trait congruent recall will appear at all occasions of measurement.

The trait variables neuroticism, extraversion and social phobia will be linked to personality congruent recall, indicating an increasing overestimation of the pre-talk anxiety with increasing neuroticism and social phobia and a decreasing overestimation of the pre-talk anxiety with increasing extraversion (Barrett, 1997; Richards & Whittaker, 1990; Rusting, 1999). For neuroticism and social phobia, there should be significant positive regression parameters at all occasions of measurement.

VIII. Trait congruent recall will become more important over time.

The influence of the trait variables neuroticism, social phobia and extraversion on memory distortion will be increasing over time (Robinson & Clore, 2002a; 2002b). This should lead to increasing regression coefficients for neuroticism and social phobia over time (and decreasing ones for extraversion, respectively).

IX. Neuroticism should be linked to negative mood maintenance and mood incongruent recall in positive mood.

Neuroticism is predicted to be linked to mood congruent recall in negative mood (mood maintenance; Ng & Diener, 2009; Rusting & DeHart, 2000) and hypothesized with mood incongruent recall in positive mood, due to findings indicating a positive relationship between neuroticism and negative affect (Kämpfe & Mitte, 2009; Tamir, 2005; Tamir & Robinson, 2004). It is hypothesized that these mechanisms should also be present for trait social phobia.

X. Extraversion should be linked to positive mood maintenance and negative mood repair.

Extraversion is predicted to be linked to mood congruent recall in positive mood (mood maintenance; Lischetzke & Eid, 2006; Ng & Diener, 2009), with a weaker influence in negative mood (mood repair; Kokkonen & Pulkkinen, 2001; Lischetzke & Eid, 2006).

XI. Engaging in high rumination after the talk should lead to an overestimation of the recalled anxiety.

Due to the appraisal congruence approach (Levine, 1997; Levine et al., 2001) engaging in negative rumination after giving the talk (assessed at the third occasion of measurement) should lead to increasing overestimation the more a subject ruminated about negative aspects (Abbott & Rapee, 2004; Edwards et al., 2003; Perini et al., 2006).

4.2 Method

4.2.1 Participants

Participants were recruited at the University of Kassel, Germany, using flyers and short presentations of the study in several lectures. Students ($N = 53$) of 4 different study paths joined the study (see *Table 12* for a detailed overview).

Table 12

Frequencies and Percentages of the Study Paths for All Participants

Study Path	Frequency	%
Teacher Training	36	68.0
Business Education	6	11.3
Social Work	5	9.4
Social Pedagogy	4	7.5
Missing	2	3.8
Total	53	100

Participants were on an average at the fourth semester ($M = 3.63$, $SD = 1.66$, range: 2-6). The study included 16 men and 35 women (with 2 missing values for sex). The mean age was 24.20 ($SD = 4.35$, range 19.35) years. 73.6 % had the "Abitur" certificate, 18.3 % had a university degree and 3.8 % reported a completed vocational training as their highest qualification.

4.2.2 Measures

The measures for this study were the same as in study 2. For a detailed description see *2.2.2* and *3.2.2*. I used the *MDBF* to assess actual mood, the *STAI-SKD* for measurement of actual and recalled anxiety, the *NEO-FFI* to assess trait neuroticism and extraversion, the *SPIN* to assess social phobia severity and the *Thoughts Questionnaire* to assess the tendency to ruminate after giving the talk. *Heart rate variability* was measured by the Polar Team² System using the RMSSD coefficient.

4.2.3 Procedure

Data was collected at two points of measurement. The participants were recruited at different university courses at the University of Kassel and their e-mail addresses were recorded. They had to perform one measurement at the class and one following via internet. Participants received mails with individualized hyperlinks to the relevant assessment, which they had to follow. The data was collected using the German online-survey platform *soscisurvey.de*. Participating students received credit for their participation. The schematic process of the study is shown at *Figure 18*.

The maximum of participants taking part at one time slot was two. Before the beginning of the university session, participants had to give a declaration of consent to participate the study. They were told that the main content of the study is the experience of intense emotions, but were not informed about the investigation of memory biases for speech anxiety. They had than to report, if they had consumed tobacco, coffee or medicaments, which influence the cardiovascular system during the last two hours. Participants were then informed about the functionality of the physiological measurement system. They had to wear a chest strap which permanently sent online information at a record unit and a monitoring screen as in study two.

After checking for the correctness of the recording, subjects completed the STAI-SKD. For further analyses, this will be the reference measure of actual anxiety right before the speech (STAI actual). The student assistant took place at the class and monitored the heartrate recording online during the speech. Start and beginning time of the first speech of each participant were set as markers. After finishing the session, participants had to complete the Multidimensional Mood Questionnaire (Steyer et al., 1997) and report their remembered anxiety right before giving the talk. Therefore I used a modified version of the short form of the State-Trait-Anxiety Inventory which focused on the past. Concerning the analyses, this is called the second (state) occasion of measurement (MDBF actual (2) and STAI retrospective (2)). Participants were then asked to take off the chest strap and reminded of the next occasion of measurement.

After three weeks, participants received an e-mail including a link to an online assessment. Firstly, they were again asked to complete the MDBF and the modified version of the STAI-SKD to assess their remembered anxiety. This took about three minutes. In the following, this is called the third (state) occasion of measurement (MDBF actual (3) and STAI retrospective (3)). Secondly, they were asked to complete some trait measures in-

cluding the Thoughts Questionnaire, the Social Phobia Inventory and the neuroticism and extraversion subscales of the NEO-FFI. This took about 20 minutes. After completing this, they were told how to receive the expense allowance for their participation.

STATE 1	
✓ Assessment of State Anxiety (STAI-SKD) ✓ Assessment of Beat-to-beat Heartrate	Directly before giving the talk
GIVING THE SPEECH	
✓ Assessment of Beat-to-beat heartrate	During the talk
STATE 2	
✓ Actual Mood (MDBF) ✓ Retrospective State Anxiety (STAI-SKD) ✓ Assessment of Beat-to-beat Heartrate	Directly after the talk
STATE 3	
✓ Actual Mood (MDBF) ✓ Retrospective State Anxiety (STAI-SKD) ✓ Rumination Since the Talk (Thoughts Questionnaire)	After 3 weeks
TRAIT ASSESSMENT	
✓ Assessment of Neuroticism, Extraversion (NEO-FFI) ✓ Assessment of Social Anxiety (SPIN) ✓ Socioeconomical Information	After 3 weeks, together with State 3

Figure 30. Schematic process of the study (simplified).
Note. NEO-FFI, NEO five-factor inventory; STAI-SKD short version of the State-Trait Anxiety Inventory; MDBF, Multidimensional Mood Questionnaire; SPIN, Social Phobia Inventory.

There was also some drop-out at the study. 62 students asked to take part of the study, 3 changed the course and could therefore no longer join the study. A total of 59 students started the study, whereas 53 completed it. This represents a drop-out of 6 participants (10.2 %).

4.2.4 Statistical Analyses

Statistical analyses were conducted using IBM SPSS Statistics 21 (IBM, 2012). T-tests for the differences between HRV levels were used to analyze hypothesis *I*, whilst a one-way repeated measures ANOVA for the differences between actual and retrospective reported anxiety at the second and third occasion of measurement was used to investigate hypothesis *III*. Hypothesis *II* and *IV* were tested by using bivariate correlations. Due to the low sample size, latent change modelling was not applicable for this study. To predict the difference between actual and remembered anxiety, simple difference scores could be used as criterion. On the one hand, several methodological problems are associated with the use of such scores. They are discussed to be unreliable (e.g. Embretson, 1995), show negative correlation between changes scores and initial scores and are therefore vulnerable to regression towards the mean (e.g. Cronbach & Furby, 1970; Embretson, 1995) and are impacted by correlations across occasions of measurement (Embretson, 1995).

Another possibility to predict the memory distortion in an interpretable way is the use of residual change scores. Therefore, standardized residuals from linear regressions of recalled anxiety scores on actual anxiety scores could provide a simple change score adjusted for baseline variance (Prochaska, Velicer, Nigg & Prochaska, 2008). These scores are thought to be "base-free" measures of change (Tucker, Damarin & Messick, 1966). On the other hand, difference scores are easy to calculate and interpret and could provide an estimate of the true change, which could be seen as "unbiased" (Rogosa, 1988). Having a look at Rogosa's (1988) work, regression toward the mean should not become a problem, if the variance of a measure increases over time, whereas a residual-change approach could not solve problems concerning regression to the mean per se. Concerning reliability, Rogosa (1988) has also shown that gain scores could indicate a reliable estimate of true change.

Another approach in multiple regression analysis is the prediction of posttest scores under control for pretest scores, called *regressor variable method* (Allison, 1990). This approach is thought to be preferable against simply predicting difference scores or predicting posttest scores without controlling for pretest scores (Cronbach & Furby 1970; Werts & Linn, 1970). Let Y_1 be the actual anxiety score before the talk, Y_2 be the retrospective score of the remembered anxiety and X be a predictor of interest. The corresponding *Equation 4* would be

$$Y_2 = \propto + \beta Y_1 + \gamma X + \varepsilon \quad (4).$$

For the current study, I am interested in the prediction of over- or underestimation of the prior anxiety. Therefore, I would like to predict the difference score as dependent variable. Including this leads to *Equation 5*

$$Y_2 - Y_1 = \propto + \beta Y_1 + \gamma X + \varepsilon \quad (5).$$

The two parametrizations produce the same coefficient for X and the same estimated standard error (Werts & Linn, 1970). There will only be differences for α and β estimators. Therefore, individual change scores were calculated for each subject. Positive values for the change score indicate an overestimation of the recalled anxiety, negative values are related to underestimation. These scores were used as dependent variable in multiple regression analyses to test hypothesis *V-XI*.

4.3 Results

4.3.1 Preliminary Analyses

The actual time lag between the first and the second occasion of measurement was $M = 22.34$ days ($SD = 2.62$ days). This was in accordance to the intended procedure. At *Table 13*, means, standard deviations and Cronbach's alpha for each scale are shown. The reliability was appropriate for each scale. Concerning the mean for the SPIN scale, it should be noted that the mean is above the value which indicates a presumable presence of a (clinical relevant) social phobia. Only 21.6 % of the sample had a score lower than this critical value ($M_{crit} = 1.32$), whereas 78.4 % showed a score above this value. *Table 14* shows bivariate correlations between all scales. State anxiety prior to the talk was correlated significantly positive with the retrospective reports of the former anxiety. Surprisingly, the correlations between actual mood and the corresponding retrospective anxiety-reports were not significant different from zero. Correlations between neuroticism and mood were negative, indicating that higher levels of trait neuroticism correspond with lower levels of mood. The relationship between neuroticism and anxiety prior to the talk was also not significant. Only the retrospective anxiety after three weeks had a positive relationship with neuroticism. Social anxiety and neuroticism correlated also positively.

Table 13

Means, Standard Deviations and Cronbach's alpha for Each Scale

Scale	*M*	*SD*	α
STAI Actual	2.20	.60	.84
STAI Retrospective (2)	2.25	.66	.82
STAI Retrospective (3)	2.18	.61	.85
MDBF Actual (2)	4.17	.70	.86
MDBF Actual (3)	3.98	.93	.94
NEO Neuroticism	2.61	.59	.82
NEO Extraversion	3.55	.49	.79
SPIN	1.99	.56	.88
TQ Rumination	1.78	.49	.81

Note. STAI, State-Trait-Anxiety Inventory; MDBF, Multidimensional Mood Questionnaire; NEO, NEO Five-Factor Inventory; SPIN, Social Phobia Inventory; TQ Rumination, negative rumination scale of the Thoughts Questionnaire; (2) second occasion of measurement; (3) third occasion of measurement.

Extraversion showed overall weak correlations with the other variables. There was a negative correlation with neuroticism and a positive relationship to mood at the follow-up occasion of measurement. Social anxiety and state levels of anxiety showed a positive correlation, which was the same for rumination. Rumination and social anxiety correlated not with the mood scores.

Table 14

Bivariate Correlations for All Scales

Scale	2	3	4	5	6	7	8	9
1. STAI Actual	.63**	.71**	-.25	-.11	.25	-.03	.29*	.63**
2. STAI R (2)	-	.72**	-.25	-.22	.24	-.26	.42**	.62**
3. STAI R (3)		-	-.04	-.01	.33*	-.14	.32*	.65**
4. MDBF (2)			-	.38**	-.14	.26	-.11	-.12
5. MDBF (3)				-	-.37**	.43**	-.14	-.11
6. NEO N					-	-.40**	.49**	.14
7. NEO E						-	-.34*	.13
8. SPIN							-	.17
9. TQ Rumi								-

Note. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

To test the variables for normal distribution, a Kolmogorov-Smirnov test was computed. The results are shown at C.1. All variables were normally distributed, apart from the state anxiety levels right before giving the talk, which showed skewness of 0.87 (*SE* = 0.33) and kurtosis of 0.72 (*SE* = 0.64). Therefore, the distribution has to be characterized as right-skewed. A corresponding histogram is depicted at *Figure 31*.

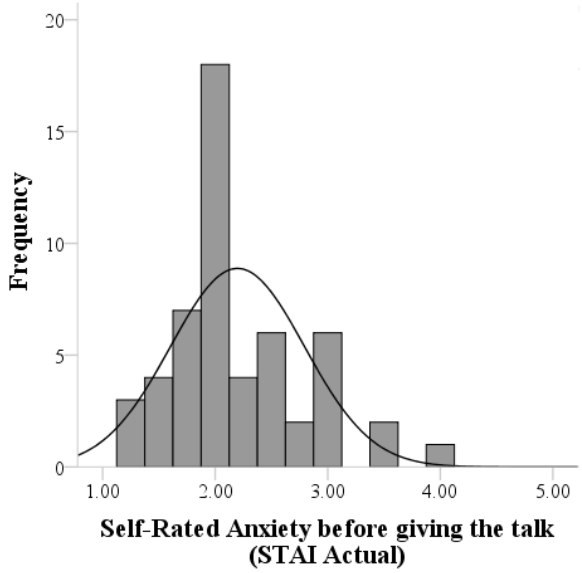

Figure 31. Distribution of the anxiety ratings directly before giving the talk.

As explained at *0*, difference variables were computed to use them in further analyses. The difference variable for the memory distortion right after the talk had a mean of *M* = 0.05 (*SD* = .55), the difference variable for the memory distortion at the follow-up occasion of measurement showed *M* = -0.02 (*SD* = .45). Both variables showed normal distribution (see C.2). Surprisingly, the difference scores were not correlated to the later predictive measures (see *Table 15*). The correlation between the two difference scores was *r* = .59 (*p* = .000). As the descriptive statistics indicated, the differences between the actual and retrospective reported anxiety levels were not statistically significant at mean levels, which was tested by a one-way repeated measures ANOVA ($F(2,102) = 0.25$, p = .776).

Table 15

Bivariate Correlations for the Difference Scores and the Remaining Measures

Scale	STAI Retrospective (2) – STAI Actual	STAI Retrospective (3) – STAI Actual
1. STAI Actual	-.33*	-.25
4. MDBF Actual (2)	-.03	.16
5. MDBF Actual (3)	-.14	.13
6. NEO Neuroticism	.02	.14
7. NEO Extraversion	-.26	-.15
8. SPIN	.18	.08
9. TQ Rumination	.07	.22

Note. * $p < .05$.

At *Table 16,* means and standard deviations for the RMSSD, the marker of the HRV, are shown. Due to participant's knowledge of giving the talk, no baseline measure could be computed. Therefore, a recovery measure after completing the talk was built. The talks itself had a mean duration of $M = 12.28$ minutes ($SD = 10.63$ minutes). To check, if the duration had an influence at the HRV, a three minute interval corresponding to study two was built. Following the descriptive statistics, HRV decreased between the state measure before the talk and the talk itself (and also the first three minutes of the talk), indicating an increasing physiological arousal. After completing the talk, HRV increased, indicating a decreasing physiological arousal, as expected. The means have found to be comparable to a general mean of the RMSSD ($M = 27$, $SD = 12$) found by the Task Force (1996).

Table 16

Means and Standard Deviations for the RMSSD

Scale	*M*	*SD*
RMSSD Before Talk	29.86	18.85
RMSSD During Talk	19.08	14.48
RMSSD During Talk (3 Minutes)	18.55	14.22
RMSSD Recovery	35.09	20.35

Note. RMSSD, square root of mean squared difference of successive normal-to-normal intervals.

To test the statistical relevance of the differences between the HRV values for the three conditions, a one-way repeated measures ANOVA was conducted. First, the equivalence between the complete talk duration was checked against the three-minute condition via a paired-samples t-test, showing no significant difference in HRV ($t(51) = 0.73$, $p = .468$). Therefore, the complete interval was used for further analyses, showing significant differences between the HRV values ($F(2,90) = 32.15$, $p = .000$). HRV values for the interval directly before the talk and during the talk showed a significant decrease of the HRV ($M_{Diff} = 12.31$, $SE = 2.24$, $p = .000$). At the recovery interval, the variability increased significantly relative to the talk itself ($M_{Diff} = -18.73$, $SE = 2.40$, $p = .000$) and the interval before the talk ($M_{Diff} = -6.42$, $SE = 2.47$, $p = .038$).

Table 17

Bivariate Correlations between HRV Values and Self-Reported Anxiety

Scale	1	2	3	4	5	6
1. RMSSD Before Talk	-	.61**	.63**	-.20	.02	.06
2. RMSSD During Talk		-	.34*	-.25	-.09	-.22
3. RMSSD Recovery			-	-.03	-.09	-.05
4. STAI Actual				-	.63**	.71**
5. STAI Retro (2)					-	.72**
6. STAI Retro (3)						-

Note. * $p < .05$; ** $p < .01$.

To check relations to the self-report measures of perceived anxiety, bivariate correlations were computed (*Table 17*). There was no significant correlation between HRV values and the corresponding anxiety levels at baseline. Moreover, retrospective reported anxiety was not correlated with any of the HRV values. This was also given for difference measures of anxiety and trait measures (see C.3), with one exception: the smaller the HRV during the talk, the more ruminated the participants after the talk ($r = -.32$, $p = .023$).

4.3.2 Linear Regressions for Neuroticism

As a first step, two linear regressions were estimated to predict the disparity in actual and remembered anxiety, one for each retrospective point of measurement. Therefore, simple difference variables were computed and used as regressands. As predictive variables, mood and neuroticism were included for the second occasion of measurement. For the third occasion, also rumination was included. This leads to the following *Equation 6* for the third occasion of measurement:

$$Y_2 - Y_1 = \propto + \beta Y_1 + \gamma_1 X_1 + \gamma_2 X_2 + \gamma_3 X_3 + \varepsilon \quad (6)$$

with Y_1 for the actual anxiety score before the talk, Y_2 for the retrospective score of the remembered anxiety and X_1 for mood, X_2 for neuroticism and X_3 for rumination (only at the third state occasion of measurement).

The predicting variables were z-standardized. Moreover, the anxiety score before the talk was included to control for the amount of the pre-talk anxiety. There were no hints for violations of assumptions concerning normality and homoscedasticity of the residuals or multicollinearity of the predictors for both models. The results of the regression are shown at *Table 18*. For the measurement directly after the talk, no significant effects of the predictors could be obtained. Therefore, if having a look at the mean effects directly after the talk, no mood or personality-dependent effects concerning memory distortion could be observed. Another pattern was observed for the measurement after three weeks. At that point, rumination since the talk was included additionally. The model showed good fit to the data and indicated positive relations between neuroticism and rumination predicting the memory distortion. The higher neuroticism values, the higher were the memory distortion values, which was the same relationship for rumination. The coefficient for mood showed only a tendential positive influence. People high in neuroticism who engaged also high in rumination showed the highest values of memory distortion, whereas those low in neuroticism and low in rumination showed the smallest (see C.4).

Table 18

Unstandardized Regression Coefficients for Linear Regressions of Memory Distortion on Mood, Neuroticism (and Rumination)

	Difference between Actual and Retrospective Reported Anxiety							
	Change 2_1				Change 3_1			
Predictors	*b*	*SE*	*p*	ΔR^2	*b*	*SE*	*p*	ΔR^2
Intercept	.04	.07	.627		.02	.05	.698	
STAI Actual	-.25	.08	.006	.01	-.29	.07	.000	.01
MDBF Actual	-.05	.08	.514	.01	.11	.06	.071	.07
NEO Neuroticism	.06	.08	.440	.04	.14	.06	.025	.20
TQ Rumination	*n. i.*	*n. i.*	*n. i.*	*n. i.*	.26	.07	.001	.01
Goodness of Fit	R^2 = .15, F (3,48) = 2.79, p = .051				R^2 = .33, F (4,46) = 5.75, p = .001			

Note. "MDBF actual" means the assessed mood at the second (Change 2_1) and at the third (Change 3_1) occasion of measurement, respectively; *b*, regression coefficient; n. i., not included in the model.

4.3.3 Moderator Models for Neuroticism

As a next step, the regression analysis for the memory distortion directly after the talk was computed with the inclusion of an interaction term. This led to *Equation 7* for the second and *Equation 8* for the third occasion of measurement, which are

$$Y_2 - Y_1 = \propto + \beta Y_1 + \gamma_1 X_1 + \gamma_2 X_2 + \gamma_3 X_1 X_2 + \varepsilon \quad (7)$$

$$Y_2 - Y_1 = \propto + \beta Y_1 + \gamma_1 X_1 + \gamma_2 X_2 + \gamma_3 X_3 + \gamma_4 X_1 X_2 + \gamma_5 X_1 X_3 + \gamma_6 X_2 X_3 + \gamma_7 X_1 X_2 X_3 + \varepsilon \quad (8).$$

For the second occasion of measurement, also the inclusion of the interaction term between mood and neuroticism showed poor model fit (R^2 = .18, F (4,47) = 2.07, p = .157). Therefore, the interaction model is not reported.

Table 19

Unstandardized Regression coefficients for the Moderated Regression of Memory Distortion on Mood, Neuroticism and Rumination after Three Weeks

	Difference between Actual and Retrospective Reported Anxiety at Follow-Up			
Predictors	*b*	*SE*	*p*	ΔR^2
Intercept	.10	.06	.812	
STAI Actual	-.32	.07	.000	.01
MDBF Actual	.07	.06	.273	.07
NEO Neuroticism	.14	.06	.020	.20
TQ Rumination	.32	.07	.000	.01
MDBF x Neuroticism	.05	.06	.348	.01
MDBF x Rumination	.00	.07	.977	.04
Neuroticism x Rumination	.00	.08	.992	.04
MDBF x Neuroticism x Rumination	.21	.09	.030	.07
Goodness of Fit	$R^2 = .45$, $F(8,42) = 4.34$, $p = .001$			

Note. "MDBF actual" means the assessed mood at the third occasion of measurement; *b*, regression coefficient.

For the measurement after three weeks, the predicting variables mood, neuroticism and rumination and also their interactions as well as the three-way interaction were included. The fully specified model showed good fit to the data. There were no hints for violations of assumptions concerning normality and homoscedasticity of the residuals or multicollinearity of the predictors. The results of the regression are shown at *Table 19*. As for the linear model without interaction terms, neuroticism and rumination were significant (positive) predictors. The two-way interactions remained all not significant different from zero. Only the three-way interaction between mood, neuroticism and rumination became significant. As *Figure 32* shows, people high in neuroticism showed the greatest memory distortion when they started to ruminate highly after the talk, especially when they are in good mood. Those low in both, rumination and neuroticism *under*estimated their pre-talk anxiety when they are in bad mood. People low in neuroticism and low in rumination showed accurate recall over all levels of mood. To have a closer look at the slopes, simple slope analyses for different stages of rumination were computed as in study 2.

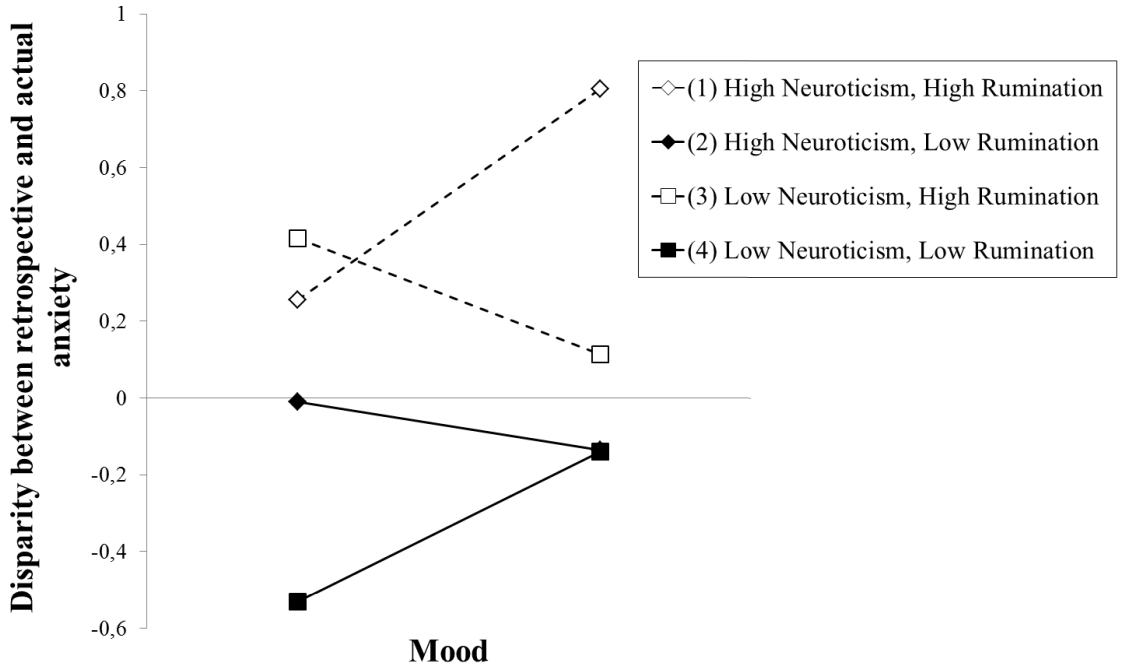

Figure 32. Regression plot for the regression of memory distortion on mood, neuroticism, rumination and all interactions after three weeks.
Note. Mood is ranging from very bad mood on the left to very good mood on the right; only neuroticism, rumination and the interaction between mood, neuroticism and rumination are significant predictors.

Simple slopes were tested for very low (-2 SD below the mean), moderate (mean) and very high (+2 SD above the mean) levels of rumination. The statistics for the simple slopes are depicted at C.5. For low rumination, the slopes for the relationship between neuroticism and mood for the memory distortion were only marginal significant for very high neuroticism (+ 2 SD over the mean) and very low neuroticism (- 2 SD below the mean). There were no significant simple slopes for moderate levels of rumination. For high rumination, the simple slopes for very high neuroticism (+ 2 SD over the mean) became significant, whereas the slope for very low neuroticism showed only a tendency. The corresponding plots for the simple slopes could be seen at *Figure 33*. The results for der moderated regression three weeks after the speech could be interpreted as follows: The significant (positive) simple slope for very high values of neuroticism for those engaging highly in rumination indicates that if in bad mood, those people show accurate memory for their own pre-talk anxiety. The better their mood, the higher was their overestimation of their further anxiety.

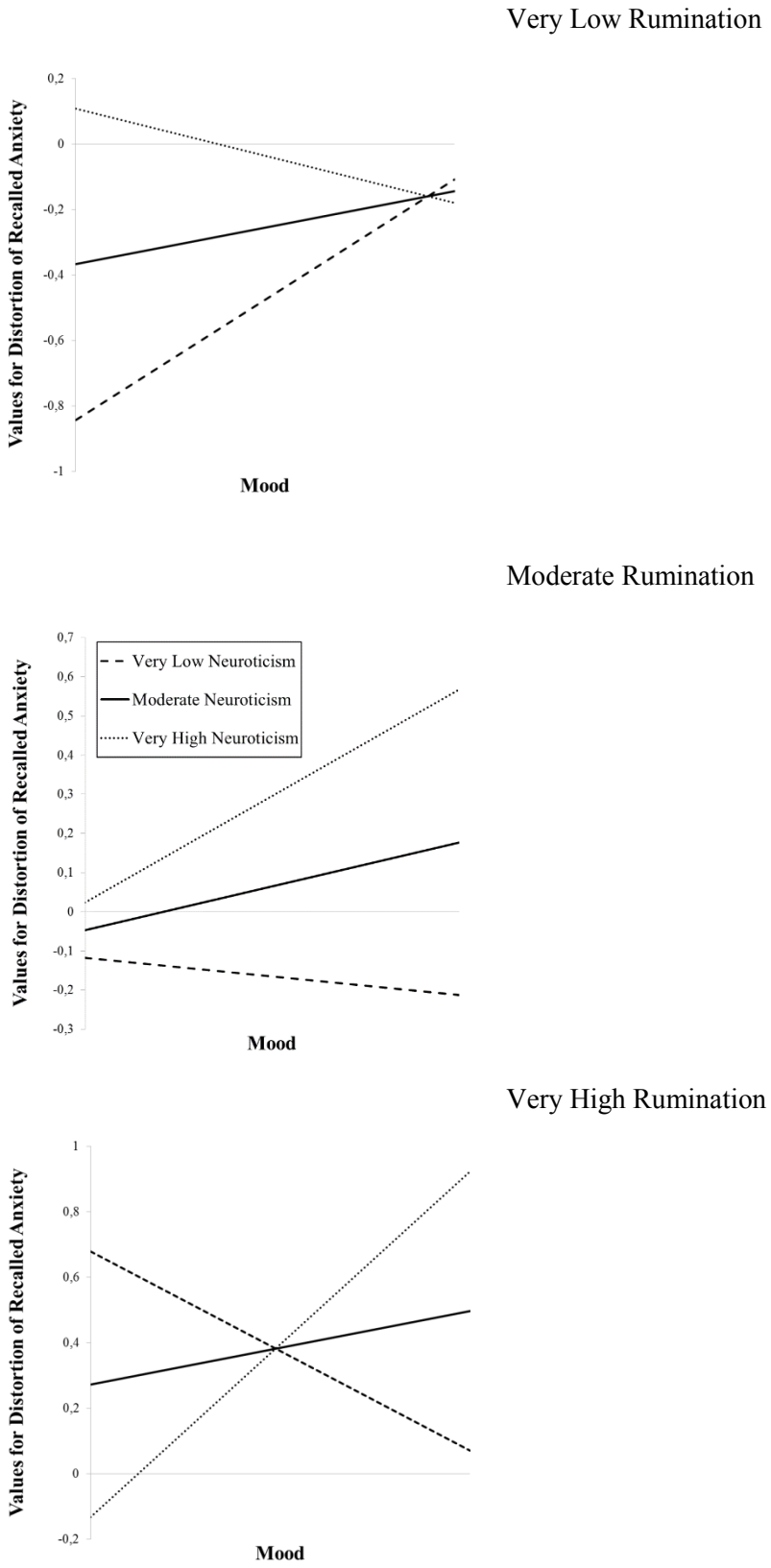

Figure 33. Plot of the simple slopes for the moderator model including mood, neuroticism, rumination and their interactions at the third occasion of measurement.
Note. Low rumination: -2 SD below the mean, moderate: mean, high: +2 SD above the mean.

The remaining simple slopes should be interpreted with caution. There are three more simple slopes which are statistically not significant but showed a tendency. Due to the small sample size and resulting (possible) power problems, I would like to interpret them nevertheless, with reservations. The simple slope for high rumination and low neuroticism was negative, indicating, together with *Figure 33*, the opposite pattern relative to high neurotic people. If these people are in bad mood, they show an overestimation of their further anxiety. With increasing mood, the overestimation decreased until they make accurate ratings if in good mood. Other relationships are present when having a look at low rumination levels. People very low in neuroticism showed a positive relationship with mood. If in very bad mood, they underestimated their pre-talk anxiety. With increasing mood, the ratings are getting more accurate. Very neurotic subjects showed a negative relationship with the memory distortion. The better their mood, the smaller was the overestimation of the recalled anxiety.

4.3.4 Linear Regressions for Extraversion

As for neuroticism, also two linear regressions were estimated for extraversion to predict the disparity in actual and remembered anxiety, one for each retrospective point of measurement. The procedure was as before, replacing neuroticism with extraversion. There were also no hints for violations of assumptions concerning normality and homoscedasticity of the residuals or multicollinearity of the predictors for both models. The results of the regression are shown at *Table 20.* For the measurement directly after the talk, extraversion showed a tendency to be negatively related with the memory distortion. The model showed good fit. For the measurement after three weeks, mood, extraversion and rumination became significant. The model showed good fit to the data and indicated positive relations between mood and rumination predicting the memory distortion. The better the mood, the higher were memory distortion values, which was the same relationship for rumination. By contrast, extraversion showed a negative relationship with the memory distortion. Higher values will therefore lead to smaller values of memory distortion.

Table 20

Unstandardized Regression Coefficients for Linear Regressions of Memory Distortion on Mood, Extraversion (and Rumination)

	Difference between Actual and Retrospective Reported Anxiety							
	Change 2_1				Change 3_1			
Predictors	*b*	*SE*	*p*	ΔR^2	*b*	*SE*	*p*	ΔR^2
Intercept	.04	.07	.504		.03	.05	.510	
STAI Actual	-.22	.08	.007	.13	-.27	.07	.000	.06
MDBF Actual	-.02	.08	.821	.01	.14	.06	.024	.01
NEO Extraversion	-.14	.08	.056	.06	-.17	.06	.005	.06
TQ Rumination	*n. i.*	*n. i.*	*n. i.*	*n. i.*	.29	.07	.000	.25
Goodness of Fit	R^2 = .15, F (3,48) = 2.79, p = .051				R^2 = .33, F (4,46) = 5.75, p = .001			

Note. "MDBF actual" means the assessed mood at the second (Change 2_1) and at the third (Change 3_1) occasion of measurement, respectively; *b*, regression coefficient; n. i., not included in the model.

According to Paternoster, Brame, Mazerolle and Piquero (1998), a z-test was used to examine the statistical relevance of the difference between the parameter estimators for extraversion for the two linear models, indicating that the difference is not statistically significant (z = -0.3, p = .764).

4.3.5 Moderator Models for Extraversion

The regression analysis for the memory distortion directly after the talk was computed with the inclusion of an interaction term. For the second occasion of measurement, the inclusion of the interaction term between mood and neuroticism showed acceptable model fit (R^2 = .20, F (4,47) = 2.97, p = .029) but no advantage against the linear model without interaction terms (ΔR^2 = .00, ΔF(1,47) = .02, p = .893). Therefore, the interaction model is not reported.

Table 21

Unstandardized Regression coefficients for the Moderated Regression of Memory Distortion on Mood, Neuroticism and Rumination after Three Weeks

	Difference between Actual and Retrospective Reported Anxiety at Follow-Up			
Predictors	*b*	*SE*	*p*	ΔR^2
Intercept	.00	.06	.995	
STAI Actual	-.27	.07	.001	.06
MDBF Actual	.15	.07	.025	.01
NEO Extraversion	-.20	.06	.002	.06
TQ Rumination	.31	.07	.000	.25
MDBF x Extraversion	.08	.06	.174	.03
MDBF x Rumination	-.03	.07	.635	.02
Extraversion x Rumination	-.15	.07	.032	.06
MDBF x Extraversion x Rumination	-.02	.06	.698	.00
Goodness of Fit	$R^2 = .46$, $F(8,42) = 4.55$, $p = .000$			

Note. "MDBF actual" means the assessed mood at the third occasion of measurement; *b*, regression coefficient.

For the measurement after three weeks, the predicting variables mood, extraversion and rumination and also their interactions as well as the three-way interaction were included. The fully specified model showed good fit to the data. The results of the regression are shown at *Table 21.* As for the linear model without interaction terms, mood and rumination were significant (positive) predictors. Extraversion showed a negative relationship with the memory distortion. Having a look at the two-way interactions, only the interaction between extraversion and rumination was a significant (negative) predictor. The three-way interaction between mood, extraversion and rumination was not significant. As *Figure 34* shows, people low in extraversion showed the greatest memory distortion when they ruminated highly after the talk. High extraverts showed underestimation of prior anxiety when they are in bad mood and overestimation when they are in good mood if they became highly ruminative. If subjects ruminated less, they showed an underestimation of the pre-talk anx-

iety. To have a closer look at the slopes, simple slope analyses for different stages of rumination were computed comparable to neuroticism before.

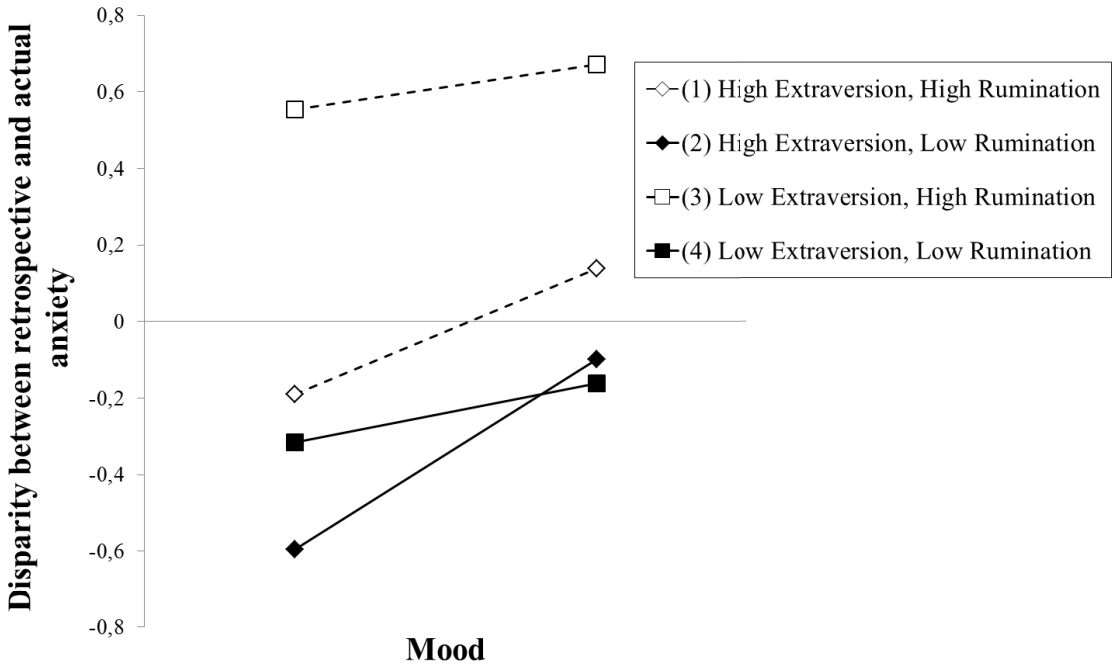

Figure 34. Regression plot for the regression of memory distortion on mood, extraversion, rumination and all interactions after three weeks.
Note. Mood, extraversion, rumination and the interaction between extraversion and rumination are significant predictors.

Simple slopes were tested for very low (-2 SD below the mean), moderate (mean) and very high (+2 SD above the mean) levels of rumination (see C.6, for a detailed table). Contrary to the visual impression, only the simple slopes for very low (b_1 = .31, p = .050) and moderate extraversion (b_1 = .15, p = .023) in moderate rumination are significant different from zero. The corresponding plots for the simple slopes could be seen at *Figure 35*. The significant (positive) simple slopes for very high and moderate values of extraversion for those engaging moderately in rumination indicate that if in bad mood, those people show *under*-estimation of their pre-talk anxiety. The better their mood was, the higher was their anxiety rating with accurate ratings when they are in good mood. There are no significant simple slopes for the relationship between extraversion and mood in predicting the memory distortion for very high rumination. Nevertheless, the pattern is interesting if looking at very low extraverted subjects: they showed consistent *over*estimation of the pre-talk anxiety independent from their actual mood.

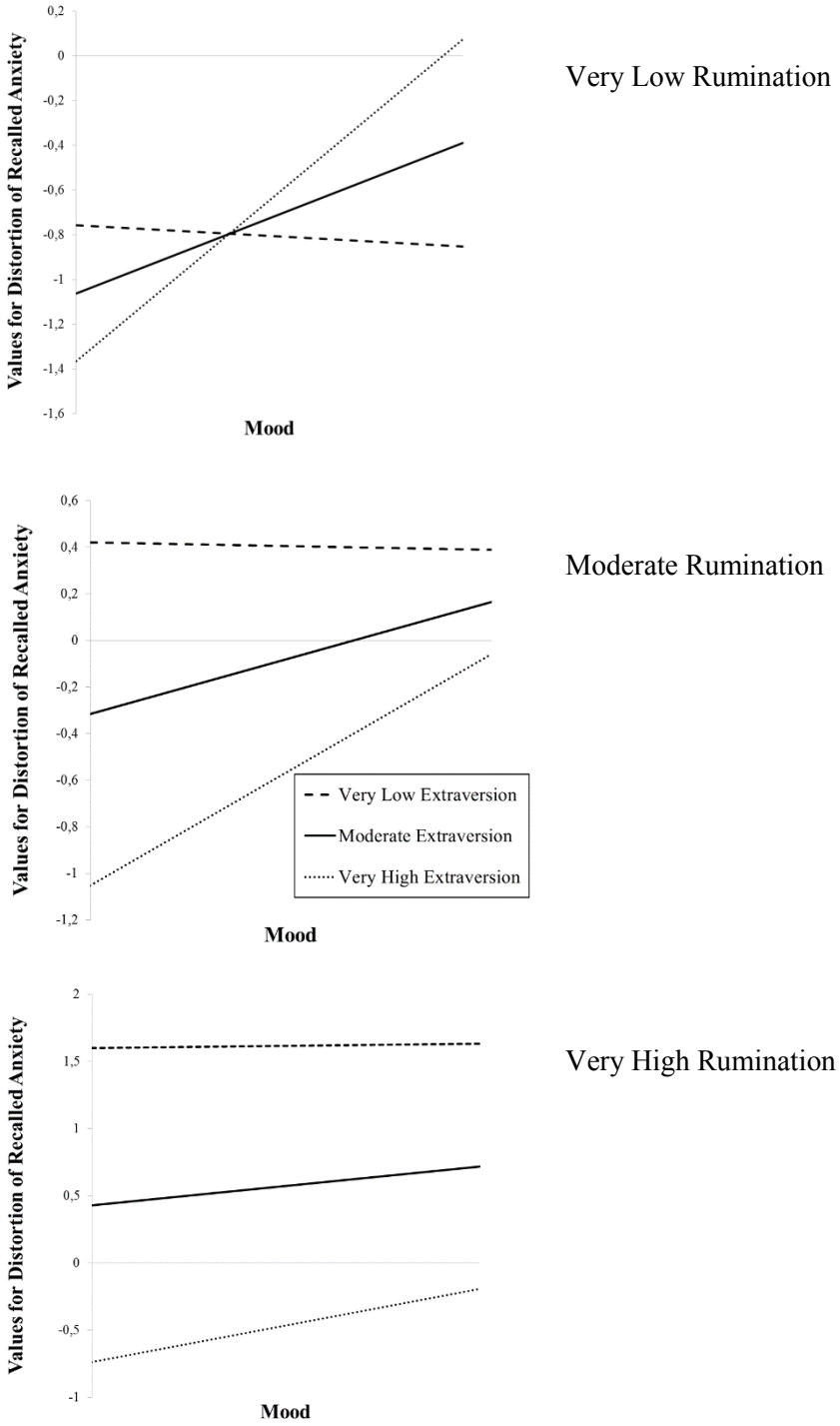

Figure 35. Plot of the simple slopes for the moderator model including mood, extraversion, rumination and their interactions at the third occasion of measurement.
Note. Low rumination: -2 SD below the mean, moderate: mean, high: +2 SD above the mean.

4.3.1 Linear Regressions for Social Phobia

As for neuroticism and extraversion, two linear regressions were estimated for social phobia to predict the disparity in actual and remembered anxiety, one for each retrospective point of measurement. There were also no hints for violations of assumptions concerning normality and homoscedasticity of the residuals or multicollinearity of the predictors for both models. The results of the regression are shown at *Table 22*.

Table 22

Unstandardized Regression Coefficients for Linear Regressions of Memory Distortion on Mood, Social Phobia (and Rumination)

	Difference between Actual and Retrospective Reported Anxiety							
	Change 2_1				Change 3_1			
Predictors	*b*	*SE*	*p*	ΔR^2	*b*	*SE*	*p*	ΔR^2
Intercept	.05	.07	.530		.03	.06	.577	
STAI Actual	-.28	.08	.001	.14	-.27	.08	.001	.06
MDBF Actual	-.03	.08	.682	.01	.07	.06	.211	.02
SPIN	.17	.08	.031	.09	.08	.06	.173	.03
TQ Rumination	*n. i.*	*n. i.*	*n. i.*	*n. i.*	.24	.07	.002	.18
Goodness of Fit	R^2 = .23, F (3,47) = 4.56, p = .007				R^2 = .28, F (4,45) = 4.46, p = .004			

Note. "MDBF actual" means the assessed mood at the second (Change 2_1) and at the third (Change 3_1) occasion of measurement, respectively; *b*, regression coefficient; n. i., not included in the model.

The model for the measurement directly after the talk showed good fit to the data (see *Table 22*). Social phobia was significant positive related with the memory distortion. For the measurement after three weeks, only rumination became significant. The model showed good fit to the data and indicated a positive relation for rumination to predict the memory distortion. The higher the subjects ruminated, the higher were memory distortion values. According to Paternoster et al. (1998), a z-test was used to examine the statistical relevance of the difference between the parameter estimators for social phobia for the two linear models, indicating that the difference is not statistically significant (z = -0.9, p = .368).

4.3.2 Moderator Models for Social Phobia

As for neuroticism and extraversion, a regression analysis for the memory distortion directly after the talk was computed with the inclusion of an interaction term. For the second occasion of measurement, the inclusion of the interaction term between mood and social phobia showed acceptable model fit (R^2 = .23, F (4,46) = 3.35, p = .017) but no advantage against the linear model without interaction terms (ΔR^2 = .00, ΔF(1,46) = .01, p = .920). Therefore, the interaction model is not reported.

For the model after three weeks, the predicting variables mood, social phobia and rumination and also their interactions as well as the three-way interaction were included. The fully specified model showed good fit to the data. There were no hints for violations of assumptions concerning normality and homoscedasticity of the residuals or multicollinearity of the predictors. The results of the regression are shown at *Table 23*.

Table 23

Unstandardized Regression coefficients for the Moderated Regression of Memory Distortion on Mood, Social Phobia and Rumination after Three Weeks

	Difference between Actual and Retrospective Reported Anxiety at Follow-Up			
Predictors	*b*	*SE*	*p*	ΔR^2
Intercept	.04	.06	.493	
STAI Actual	-.27	.08	.001	.06
MDBF Actual	.08	.06	.132	.02
SPIN	.05	.06	.400	.03
TQ Rumination	.22	.07	.003	.18
MDBF x SPIN	.07	.06	.239	.01
MDBF x Rumination	.13	.07	.068	.02
SPIN x Rumination	.03	.06	.602	.02
MDBF x SPIN x Rumination	.20	.08	.016	.09
Goodness of Fit	R^2 = .42, F (8,41) = 3.73, p = .002			

Note. "MDBF actual" means the assessed mood at the third occasion of measurement;
b, regression coefficient.

As for the linear model without interaction terms, only rumination was significant positive predictor concerning main effects. The two-way interactions remained all not significant different from zero. Only the three-way interaction between mood, social phobia and rumination became significant. As *Figure 36* shows, people high in social phobia showed the greatest memory distortion when engaging highly ruminative after the talk, especially when they are in good mood. Those low in both, rumination and neuroticism *under*estimated their pre-talk anxiety. To have a closer look at the slopes, simple slope analyses for different stages of rumination were computed. Simple slopes were tested for very low (-2 SD below the mean), moderate (mean) and very high (+2 SD above the mean) levels of rumination (see C.7, for a detailed table). In low rumination, only the simple slope for very high social phobia (b_1 = -.84, p = .030) was significant different from zero. For moderate rumination, no simple slope was significant. At high levels of rumination, very high (b_1 = 1.28, p = .006) and moderate levels (b_1 = .34, p = .045) of social phobia led to significant simple slopes. The corresponding plots for the simple slopes could be seen at *Figure 37*.

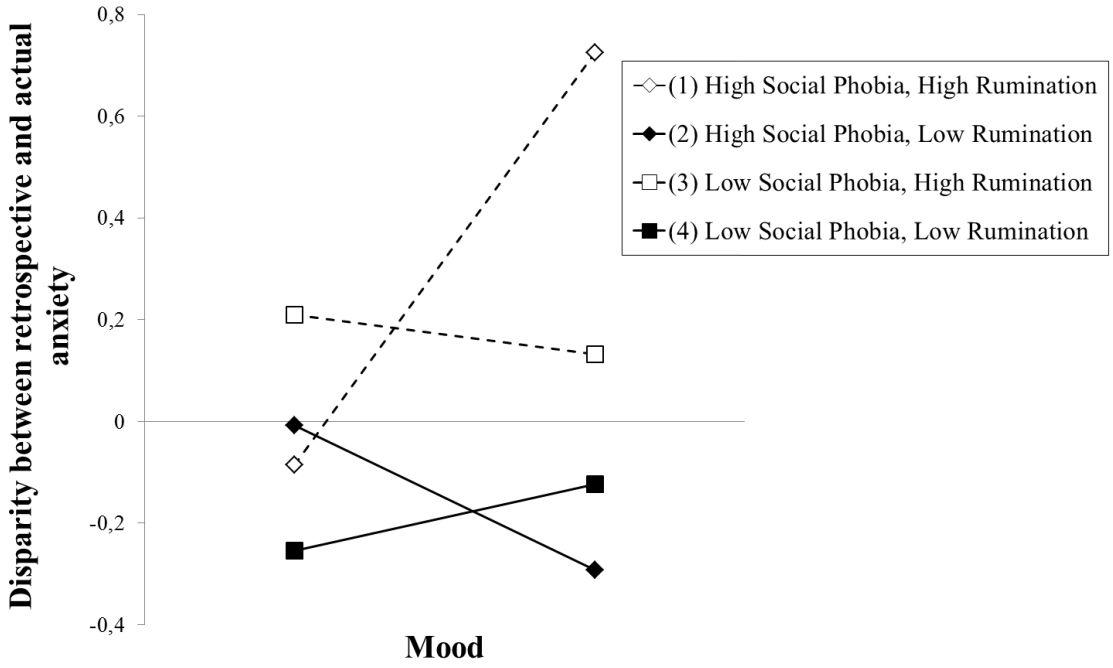

Figure 36. Regression plot for the regression of memory distortion on mood, social phobia, rumination and all interactions after three weeks.
Note. Only rumination and the interaction between mood, social phobia and rumination are significant predictors.

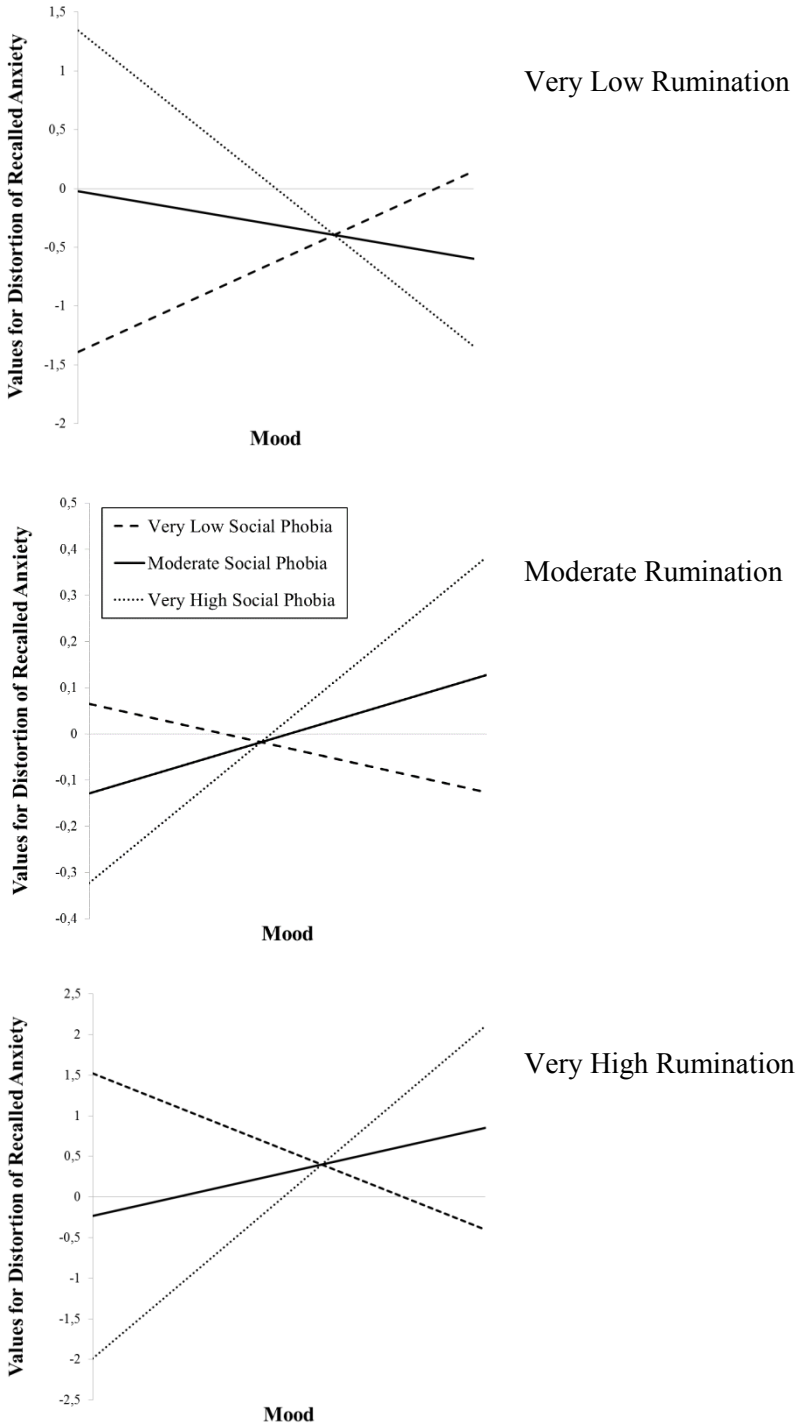

Figure 37. Plot of the simple slopes for the moderator model including mood, social phobia, rumination and their interactions at the third occasion of measurement.
Note. Low rumination: -2 SD below the mean, moderate: mean, high: +2 SD above the mean.

These results could be interpreted as follows: Subjects who ruminated less *under*estimated their recalled anxiety, if they are very low or moderate in social phobia. If very high in social phobia, they *over*estimated their pre-talk anxiety when they are in bad mood and *under*estimated it when they are in good mood. For moderate levels of rumination, no effects could be identified. For subjects engaging highly ruminative, a different pattern could be seen. If those subjects have at least moderate levels in social phobia, they *under*estimated their anxiety, if in bad mood and *over*estimated it if in good mood, which is incongruent to their actual mood states.

All presented models were additionally tested under control of the HRV before the talk (corresponding to the self-report measure of state anxiety) and also for the HRV during the talk, since maximal physiological arousal could be observed for that interval. Moreover, the models were tested including sex as a covariate. The presented results held all under control for either HRV before or during the talk as well as for sex.

4.4 Discussion

The third study aimed, to transfer study two into a naturalistic context. Addressed was again the memory bias for self-reported anxiety prior to a given talk in front of a university class. Therefore, three measurements were realized: A state assessment just before giving the speech, a state assessment right after giving the speech and a follow-up assessment after three weeks. To begin with, I would like to sum up and discuss the results for and against the formulated hypotheses.

4.4.1 Discussion of Hypotheses

Hypothesis I: The successful induction of anxiety through the naturalistic speech task should be proved through HRV levels (implementation control).

The HRV values were as predicted, with smallest levels during the talk, higher levels directly before the talk and highest levels after recovery. These results indicate the maximum psychophysiological arousal during the talk. Directly before the talk, the arousal was significantly higher than after recovery. These results could be interpreted as successful induction of anxiety through the naturalistic speech task.

Hypothesis II: Correlations between HRV and state anxiety should be examined.

There was no significant correlation between HRV values and the corresponding anxiety levels at baseline or any retrospective reported anxiety score, which is comparable to the results observed in study 2. Some authors argued that a laboratory situation could not produce realistic emotional reactivity, which could lead to a decreasing association between self-report and autonomic response (e.g. Feldman et al. 1999; Gerin et al., 1999; Schwerdtfeger, 2004). As the same result occurred in a naturalistic as well as in a laboratory setting in a comparable design, this explanation seems rather improbable. Moreover, other, already mentioned reasons should be taken into account, which are unawareness of one's current emotions or impression management processes (Egloff et al., 2002), repressive coping style (Weinberger et al., 1979) or maladaptive emotional stress response in high anxious subjects (Souza et al., 2015).

Hypothesis III: An overall overestimation of the reported anxiety directly before the talk is predicted.

The differences between the actual and retrospective reported anxiety levels were not statistically significant at mean levels, for both retrospective occasions of measurement. Therefore, the predicted overall overestimation of the recalled anxiety (e.g. Barrett, 1997; Parkinson et al., 1995; Thomas & Diener, 1990) could not be identified. As in study 2, the participants of the current study showed overall high levels of anxiety, which could be linked to previous failures in detecting an overall explicit memory bias in social phobia (e.g. Coles & Heimberg, 2002; Rapee et al., 1994; Wenzel et al., 2002). As these results occurred in the laboratory as well as in the naturalistic setting, context-related reasons for these findings seem to be rather unlikely.

Hypothesis IV: There should be trait-consistent relationships between neuroticism, extraversion and social phobia with state levels of anxiety.

The relationship between neuroticism and anxiety prior to the talk was not significant, which is against the hypothesis which was built on several studies before (Bienvenu et al., 2007; Bienvenu et al., 2004; Hettema et al., 2006; Hoferichter & Raufelder, 2013; Schmidt & Riniolo, 1999). Only the retrospective anxiety after three weeks had a positive relationship with neuroticism. The same pattern occurred for extraversion, which was predicted to show negative correlations with state anxiety levels (Bienvenu et al., 2004; Bienvenu et al., 2007; Bienvenu & Stein, 2003; Schmidt & Riniolo, 1999). This could also not be observed. By contrast, social anxiety and state levels of anxiety correlated significantly positive, as predicted following the literature (Gilbert, 2000; Rapee & Heimberg, 1997; Veale, 2003; Zeidner & Matthews, 2011). This was the same for rumination.

Hypothesis V: Mood congruent recall will appear directly after the talk.

There was no significant influence of mood at any model concerning the assessment directly after the talk, therefore, no mood congruent recall could be observed. There are no hints for the validity of network theories concerning mood and memory in association with the current study.

Hypothesis VI: Mood incongruent recall will appear after three weeks.

The influence of mood changed over time. After three weeks, mood had only a statistically relevant influence for the linear model and moderator model including extraversion and rumination at main effect levels. For these models, mood showed a positive slope parameter, indicating higher levels of mood leading to higher levels of memory distortion, which is linked to mood incongruent recall, as predicted (Forgas, 1995; 2000; Forgas & Cariocci, 2002; Sedikides, 1994; Singer & Salovey, 1988). For the models including neuroticism and social phobia, no main effects of mood could be identified.

Hypothesis VII: Trait congruent recall will appear at all occasions of measurement.

Neuroticism had no predicting influence on the memory distortion directly after the talk, but showed a positive influence after three weeks, as predicted (e.g. Barrett, 1997; Rusting, 1999). As predicted, extraversion showed stable negative slope coefficients directly after the talk and three weeks later, too (Barrett, 1997; Rusting, 1999). Social anxiety had a significant positive influence on memory distortion directly after the talk, as expected (e.g. Richards & Whittaker, 1990). By contrast, the regression parameter was no longer significant different from zero after three weeks. In sum, the hypothesis indicating increasing overestimation of the pre-talk anxiety with increasing neuroticism and social phobia and a decreasing overestimation of the pre-talk anxiety with increasing extraversion could be retained, with only few exceptions, which had no influence on the predicted directions of the relationships.

Hypothesis VIII: Trait congruent recall will become more important over time.

Neuroticism had no predicting influence on the memory distortion directly after the talk. After three weeks, a positive influence was present, which is consistent with the model and findings by Robinson and Clore (2002a; 2002b). For extraversion, the increase of the slope values for the linear models directly after the talk and three weeks later was not statistically significant. Therefore, the influence of extraversion remains stable over time. Social anxiety had a significant influence on memory distortion directly after the talk, with a decreasing influence after three weeks, where the regression parameter was no longer significant different from zero. Therefore, social anxiety lost its influence at main effect levels after three weeks. To sum up, the hypothesis that the influence of (personality) traits will increase after three weeks could only be accepted for neuroticism and has to be rejected for extraversion as well as for social phobia.

Hypothesis IX: Neuroticism should be linked to negative mood maintenance and mood incongruent recall in positive mood.

Concerning the fully specified model including mood, trait variables and rumination, neuroticism showed patterns which were as predicted. For subjects high in neuroticism, the overestimation of the recalled anxiety was higher, the better their mood was, which indicates a mood incongruence effect. This pattern could only be observed for those people engaging highly ruminative whereas high neurotics engaging low ruminative showed no memory distortion. Subjects low in neuroticism and high in rumination showed a tendency to mood congruent memory distortion. This is characterized through a decreasing anxiety overestimation the better their mood was, with accurate recall in very good mood. For low rumination, subjects low in neuroticism showed an underestimation of the recalled anxiety if in very bad mood. This is typically observed in mood repair mechanisms. Note that this effect should be interpreted with caution, because the effect was only tendentially statistically significant. To sum up, the results suggest that people high in neuroticism tend to maintain their negative mood, giving realistic estimations of their prior anxiety (Ng & Diener, 2009; Rusting & DeHart, 2000). If in positive mood, they showed an overestimation which could be interpreted as downward regulation of the positive mood. Note that these results hold only for high ruminating individuals. By contrast, people low in neuroticism showed a tendency to engage in mood repair, if they are low in rumination. The pattern for social phobia differs from the findings for neuroticism. Subjects scoring moderate and high at social phobia showed comparable patterns if they also engaged highly ruminative: This lead to mood incongruent recall. Subjects high in social phobia showed an underestimation of their pre-talk anxiety if in bad mood. The underlying mechanism explaining this finding remains unclear. Interestingly, the pattern was different for low rumination. People very high in social phobia showed an increasing *under*estimation, the better their mood was, which indicates mood congruent recall. This is contrary to people which score high in neuroticism. Therefore, different mechanisms seemed to be present for neuroticism and social phobia.

Hypothesis X: Extraversion should be linked to positive mood maintenance and negative mood repair.

For very high rumination, extraversion showed mood-independent effects, which were only personality congruent. People very low in extraversion showed a stable overestimation of the recalled anxiety, whereas those very high in extraversion showed accurate re-

call. These results indicate that high extraversion could be a protective factor against negative memory distortion, even after engaging highly ruminative. These findings underline an earlier work by Tamir (2009), who found that extraversion is linked to trait-specific preferences to increase happiness independent of concurrent feelings. Individuals low in extraversion might be less motivated to increase their happiness, which was in contrast to those high in extraversion. In moderate rumination, another pattern was observable. Subjects moderate and high in extraversion showed a decreasing *under*estimation of the recalled anxiety. Therefore, they showed the greatest underestimation in very bad mood, which is thought to indicate mood repair, as predicted (Kokkonen & Pulkkinen, 2001; Lischetzke & Eid, 2006). In positive mood, they showed mood maintenance via accurate recall (Lischetzke & Eid, 2006; Ng & Diener, 2009).

Hypothesis XI: Engaging highly ruminative after the talk should lead to an overestimation in recalled anxiety.

Rumination seems to be the most important predictor for the memory distortion at the current study. For all computed models, rumination had a stable positive influence on memory distortion. The more subjects were engaging in rumination after giving the talk, the higher was the overestimation of the recalled anxiety. This is in accordance to the appraisal congruence approach (Levine, 1997; Levine et al., 2001) and several studies assessed before (Abbott & Rapee, 2004; Edwards et al., 2003; Perini et al., 2006).

4.4.2 Conclusion

As in studies one and two, no isolated mood congruency effects could be observed, which is against the prediction made by network theories linking mood and memory (e.g. Bower, 1981). After three weeks, mood incongruent effects appear for the extraversion model, indicating higher levels of mood leading to higher levels of memory distortion. Directly after the talk, extraversion and social phobia had personality congruent influences on memory distortion, which held until three weeks later for extraversion. Neuroticism was a significant predictor after three weeks only. In sum, predicted personality congruent effects could be observed, with only few exceptions, but no diametrically opposed effects as in study 2.

The already mentioned mood incongruent memory in high neurotic and high ruminative participants was again observable, indicating an *over*estimation of anxiety during *good*

mood for those subjects. This strengthens the idea that hedonically unpleasant information processing could be beneficial for individuals high in trait neuroticism (Kämpfe & Mitte, 2009; Tamir, 2005; Tamir & Robinson, 2004) to recreate a personality congruent mood state. By contrast, people low in neuroticism showed a tendency to engage in mood repair, if they are low in rumination. Subjects scoring moderate and high at social phobia showed also mood incongruent recall if they engaged highly ruminative, whereas subjects very high in social phobia showed mood congruent recall if they ruminated low, which is contrary to high neurotics. In contrast, extraversion showed no mood-interaction effects in high rumination. Instead, high levels of extraversion seem to operate as a protecting factor against overestimation of prior anxiety, whereas low levels lead to mood-independent overestimation of anxiety. In moderate rumination, subjects moderate and high in extraversion showed mood repair, if in bad mood and mood maintenance if in good mood. Taken together, these results strengthens the idea that subjects high in extraversion and low in neuroticism are protected against the negative memory bias due to their personality style (see Schneider & Jackson, 2014), whereas low extraversion and high neuroticism are found to be risk factors for social phobia (Bienvenu et al., 2007).

Concerning the recall strategy, it could again be stated that influences of the current mood became more important after three weeks, mostly in interaction with trait variables. Different trait variables showed influence on the recall bias at both occasions of measurement, but the proclaimed increasing relevance of in trait information through the Affect Infusion Model by Robinson and Clore (2002a) could not be observed. Therefore, the episodic-to-semantic shift could not be supported by the current data.

As expected, rumination showed the most stable pattern of memory bias: The more subjects ruminated after giving the talk, the higher was the overestimation of the recalled anxiety, which is predicted by the appraisal congruence approach (Levine, 1997; Levine et al., 2001). It seems plausible, that high rumination produces largest overestimation especially in combination with high levels of neuroticism and social phobia, whereas high extraversion could operate as a buffer. People high in social phobia but low in rumination showed diametrically opposite patterns of information processing compared to the high ruminating ones, which highlights the outstanding role of high rumination in social phobia again.

Another main aim of study 3 was the comparison to study 2 by changing the research setting. The already mentioned hypothesis suggesting that a laboratory setting could not produce realistic emotional reactivity (e.g. Feldman et al., 1999; Gerin et al., 1999; Schwerdtfeger, 2004; Zanstra & Johnston, 2011) compared to real-live-paradigms could be supported. The findings differ tremendously between the two studies, although the design was comparable. Moreover, the main results of study 3 are in accordance with those by study 1, which was also realized in a naturalistic setting. Therefore, the presented results suggest that laboratory settings seem not appropriate to produce realistic emotional information processing studying autobiographical memory bias for state anxiety.

4.4.3 Limitations

The methodological factors which could potentially limit the results of this study are comparable to those considered detailed in study 1. The constrained construct validity due to the use of self-report trait measures was examined in a recent study by Krammer and Pflanzl (2015), who studied undergraduates in teacher training and showed that they are able to fake personality measures in a desired direction. This seems relevant since the current sample consisted mainly of undergraduates in teacher training. On the other hand, as explained earlier, the use of self-report personality measures seems acceptable due to a lack of reliable and economical alternatives. Moreover, the low variability in academic disciplines and the exclusive recruitment from the University of Kassel restricts external validity substantially. Moreover, since the trait assessment was at the end of the study, no differences in person characteristics between participants and dropout (which was 10 %) could be computed and could therefore not be ruled out. Another potential problem focuses the sample size which was too small to allow structural equation modeling. Also the chosen multiple regression analyses grounding on manifest variables could be influenced in the sense of lacking power or diminished accuracy in parameter estimation in detecting important effects (e.g. Kelley & Maxwell, 2003). As explained in study 2, the validity and reliability of the TQ is not given per se due to the translation into German. The internal consistency was satisfying and the results were comparable to those by study 2, which reduced the possibility of methodological caused influences on the study findings. Concerning the social phobia inventory, one should mention that high levels are not equal with the diagnosis of a clinical diagnosed social anxiety disorder; therefore the results should be carefully transferred into clinical contexts. However, the meta-analysis by Mitte (2008)

suggests that there is no qualitative difference in information processing between anxiety patients and high-anxious subjects.

4.4.4 Summary

The third study is a transfer of study two into a naturalistic context. Students participating in different university courses where talks had to be given were asked to join the study. The aim was to investigate the memory bias for self-reported anxiety prior to the given talk in front of the class. Due to the special setting, no baseline rating could be realized, since the subjects were aware of giving their talk from the beginning. Therefore, three occasions of state measurement were realized: A state assessment just before giving the speech, a state assessment right after giving the speech and a follow-up assessment after three weeks. The results suggest that participants showed overall accurate recall of prior anxiety, which is hypothesized to depend on overall high trait anxiety scores. As in studies 1 and 2, common network models predicting mood congruent recall are not able to explain the results of the current study. Mood congruent recall in terms of main effects could not be observed, whereas mood incongruent recall occurred after three weeks, mostly dependent on personality traits neuroticism and extraversion as well as on social phobia. Beside mood repair effects in high extraversion and low neuroticism, downward regulation of positive mood was observed for subjects high in neuroticism and social phobia, which could be explained via homeostatic principles linked to individual benefit through affective states. These results seem to be linked to health aspects, since the sustained experience of negative affect seems to be linked to mental disorders (Bienvenu et al., 2007). Increasing meaning of semantic-related personality as a function of elapsed time deducted by the accessibility model (Robinson & Clore, 2002a) could not be approved. Another stable influencing factor was rumination. The more subjects ruminated after giving the talk, the higher was the overestimation of the recalled anxiety, supporting the appraisal congruence approach (Levine, 1997; Levine et al., 2001). In sum, the results suggest complex interactions of elapsed time since the event, actual mood, personality traits and post-event-processing in causing memory distortions of real-life anxiety. These results differ tremendously by those observed in a comparable laboratory study.

5 General Discussion

The current paper aimed to investigate memory distortions for state anxiety using three longitudinal studies. A special aim was the simultaneous investigation of the influence factors elapsed time since the event, mood at retrieval, personality and post-event-processing. Moreover, it should be assessed whether laboratory settings could produce comparable results to naturalistic settings. Memory biases for state anxiety were observed and could be linked to presumed influencing factors, although the extent concerning the impact of the factors differs. In the following section, I would like to sum up and discuss the findings of the three studies. Afterwards, I will draw theoretical conclusions which should be linked to further research. Finally I will examine possible consequences for psychotherapy.

5.1.1 Discussion of Superordinate Hypotheses

Hypothesis 1: An overall overestimation of the reported anxiety directly before the event is predicted.

The prediction of an overall overestimation of the reported anxiety is linked to inconsistent findings. Whereas study 1 confirmed this prediction, study 2 and study 3 did not. A possible explanation grounds on the fact that samples 2 and 3 showed high social anxiety scores. Some prior studies failed in detecting an overall explicit memory bias in social phobia (e.g. Coles & Heimberg, 2002; Rapee et al., 1994; Wenzel et al., 2002; see also Morrison, Gordon & Heimberg, 2012; Peschard & Philippot, 2016, for recent reviews). In turn, the meta-analysis by Mitte (2008) elucidated that there is no qualitative difference in information processing between anxiety patients and high-anxious subjects, therefore these findings might be applicable to the current work. Moreover, study 2 and 3 took place in laboratory as well as in naturalistic settings, which may enhance external validity. The findings are in accordance with a recent work by Kaplan, Levine, Lench and Safer (2016), who found that reports of the intensity of past emotion are relatively accurate. By contrast, past mood was found to be more prone to an overall memory bias. It is hypothesized that this is due to effects of emotional arousal on attention and on the stability of the appraisals concerning emotional intensity. Therefore, the results may provide hints for the absence of an overall autobiographical memory bias of experienced emotions in high anxious individuals.

Hypotheses 2 & 3: Mood congruent recall will appear directly after the event, whereas mood incongruent recall should be observable after a few weeks.

There was no consistent mood congruent recall directly after the events. The assumption that the recall of prior emotions is biased into the direction of the actual mood (Bower, 1981; Forgas, 1995; 2000; Forgas & Cariocci, 2002; Parkinson et al., 1995; Sedikides, 1994; Singer & Salovey, 1988) could not to be confirmed. Concerning the assessments after a few weeks, the influence of mood changed and became more important in studies 1 and 3. Thus, the prediction that increasing overestimation is linked to better mood after a few weeks (Forgas, 1995; 2000; Forgas & Cariocci, 2002; Sedikides, 1994; Singer & Salovey, 1988) could be confirmed, although this pattern was not consistent for all models. In sum, these results are against the prediction basing on already mentioned associative network models (Bower, 1981).

Hypothesis 4: Trait congruent recall will become more important over time.

Trait congruent recall was observed in studies 1 and 3, whereby neuroticism seems to have most stable influences. In sum, the predicted increasing relevance of traits on memory distortion over time (Mill et al., 2016; Robinson & Clore, 2002a; 2002b) could not be confirmed, although some single findings followed the estimated direction at descriptive levels.

Hypothesis 5: Neuroticism should be linked to negative mood maintenance and mood incongruent recall in positive mood.

Mood influences on memory bias moderated by neuroticism consistent with the hypotheses were observed in studies 1 and 3, partially in study 2, too. Interaction effects between mood and neuroticism were only present for the assessments after a few weeks. Therefore, mood incongruent recall was observed for subjects who are in positive mood and reported high values of neuroticism. In sum, the results suggest that people high in neuroticism tend to maintain their negative mood, giving realistic estimations of their prior anxiety (Ng & Diener, 2009; Rusting & DeHart, 2000). If in positive mood, they showed an overestimation which could be interpreted as downward regulation of the positive mood. This could be due to the relationship between neuroticism and negative affect (Kämpfe & Mitte, 2009; Tamir, 2005; Tamir & Robinson, 2004). These results seem to be linked to individuals engaging highly ruminative. There are hints that in low rumination, low neurotic subjects might engage in mood repair.

Different mechanisms seemed to be present for neuroticism and social phobia. In study 3, the results for people engaging highly ruminative were comparable between high neurotics and people scoring at least moderate on social phobia: the showed mood incongruent recall. But this pattern was different for low rumination. People very high in social phobia showed an increasing *under*estimation, the better their mood was, which indicates mood congruent recall. This highlights again the special role of rumination in high socially anxious individuals.

Hypothesis 6: Extraversion should be linked to positive mood maintenance and negative mood repair.

Mood influences on memory bias moderated by extraversion consistent with the hypotheses were observed in studies 1 and 3. Moderately ruminating subjects in study 3 with at least moderate levels of extraversion showed the biggest underestimation of anxiety in very bad mood, which is associated with mood repair (Kokkonen & Pulkkinen, 2001; Lischetzke & Eid, 2006). In positive mood, they showed accurate recall. This finding should be analyzed more detailed. It should be investigated, whether mood maintenance in positive mood is represented via accurate or underestimated recall. Lischetzke et al. (2012) suggested that a hedonic mood regulation intention is linked to extraversion and pleasant–unpleasant mood. Extraverts should have an intention to improve their mood or actively maintain an already pleasant mood. Acting extraverted could be a way to experience more pleasant effect (Lischetzke et al., 2012). Therefore, one could estimate an underestimation of prior anxiety if talking about mood maintenance. By contrast, the current data indicate different patterns: Mood maintenance seems to be linked to accurate recall. A possible explanation for this finding may be linked with the study design. The current study focuses only anxiety, which is evaluated as negative affect. It was not possible, to recall positive emotions for the participants. Positivity is here seen as *less negativity*, which could explain, why no positivity bias could be observed.

The results suggest that at least moderate levels of extraversion may have a protective influence against dysfunctional negative memory distortions, whereas participants low in extraversion showed comparable results to those high in neuroticism or an overall mood-independent overestimation. These results strengthens the idea that extraversion might protect against stressors (see Schneider & Jackson, 2014) which potentially could lead to negative memory distortions and, in turn, a more negative affect. Moreover, extraversion is

linked to subjective well-being (e.g. Cheng et al., 2016; Costa & McCrae, 1980; Steel, et al., 2008) and better health prospects (e.g. Pressman & Cohen, 2005). This is in accordance with a study by Bienvenu et al. (2007) who identified low extraversion and high neuroticism to be risk factors for social phobia. In sum, the idea that the effect of mood on cognitive processes depends on individual differences in emotion-related personality traits (Rusting, 1999) could be confirmed for extraversion.

Hypothesis 7: Appraisal congruent memory should be observable.
Rumination seems to be the most important predictor for the memory distortion at the current work. For all computed models in study 2 and 3, rumination had a stable positive influence on memory distortion. The more subjects were engaging in rumination after giving the talk, the higher was the overestimation of the recalled anxiety. This is in accordance to the appraisal congruence approach (Levine, 1997; Levine et al., 2001) and several studies assessed before (Abbott & Rapee, 2004; Edwards et al., 2003; Perini et al., 2006). Increasing rumination therefore produces increasing memory bias.

5.1.2 Conclusion and Prospect of Further Research

The current findings should be linked to theoretical models described before or mentioned additionally. As memory distortions occurred directly after the targeting event and also a few weeks later, the reconstructive self-memory-system proclaimed by Conway and Pleydell-Pearce (2000) could be underpinned. Due to a lack of isolated mood-congruence-effects, network models of mood and memory could not be confirmed. On the other hand, there are consistent hints for the idea that individuals regulate their mood by using motivated memory retrieval strategies like proposed by the dual-process mood-management-model by Forgas (2000) to reach affective homeostasis. Although mood repair strategies are found in high extraverts and sometimes in low neurotics, the conclusion that this is in accordance to hedonic principles would only be half the story. Moreover, mechanisms in high neuroticism and sometimes also in low extraversion might be linked to emotional downward regulation in good mood. For example, subjects higher in neuroticism seem to be more motivated to experience negative emotions (e. g. Ford & Tamir, 2014). This is in accordance with the *dynamic multivariate setpoint model* proclaimed by Vachon & Krueger (2015). They argued that there are person-specific set points which are determined through traits and affect state emotions. Therefore, emotions fluctuate around those set points, whereas individuals are motivated to regulate these emotions in a set-point direc-

tion. This strengthens prior work by Tamir, Robinson and Clore (2002), who proposed an *affective certainty model*. They found, to some extent, that positive mood states could make subjects with low values of extraversion uncomfortable or uncertain. This is assumed to be connected to *epistemic verification motives*, which address emotions that provide self-consistent positive or negative information (Tamir, 2015). Therefore, subjects might be motivated to experience familiar emotions that validate their self-referred knowledge, regardless of whether this is positive or negative (cf. Tamir, 2015). This provides compelling evidence why positive affect is not desirable for everyone. This might have influences on self-regulatory models (e.g. Carver & Scheier, 1990) which proclaim positive emotions to be associated with an acceptable rate of discrepancy reduction in the goal system. There are hints that these assumptions are not valid for everyone. On the other hand, negative emotionality on both, state and trait levels, are presumed to be risk factors for several mental disorders (e.g. Bienvenu et al., 2007).

Another important finding concerns the interaction between rumination and personality. As study 3 pointed out, the amount of high post-event rumination plays an important role in the relationship between personality and mood in predicting memory distortions. High levels of post-event rumination in combination with high levels of neuroticism, low levels of extraversion and high levels of social anxiety seems to be most harmful for engaging in memory bias. On the other hand, low rumination provides different patterns. This is most interesting in social phobia, because rumination is seen as one core symptom of social phobia (e.g. Brozovich & Heimberg, 2008). For social anxious individuals with low levels of rumination, the pattern differs extremely from those engaging highly ruminative. These subjects show an overestimation of prior anxiety if in bad mood, but the better their mood was, the smaller became this overestimation. Therefore, from a mood-regulation point of view, they are able to maintain naturally occurring positive affect, whereas high ruminating social anxious individuals are not. This elucidates the maintaining role of rumination concerning memory-related information processing in socially anxious individuals.

Concerning the level of trait importance on memory distortion, the accessibility model (Robinson & Clore, 2002a; 2002b) could not be supported. Against the hypotheses drawn by this model, even the assessments directly after the targeting events were influenced by personality variables which are linked to semantic processing. Thus, semantic processes seem to influence retrospective assessments within hours. This might be a hint that the

proposed shift from episodic to semantic memory may come across either earlier than expected or might be steadily increasing in nature, which would fit the current data best.

Consistent evidence could be found for the appraisal congruence approach (Levine, 1997; Levine et al., 2001). Although interactions between mood and personality seemed to be influenced through the laboratory design of study 2, appraisal congruence occurred even in this study, which may reflect the strength of this influencing factor. Nevertheless, it has to be mentioned that the assessment of rumination itself might be influenced by memory bias, since the instruction was to estimate the extent of rumination since the target event. One might argue that diary methods would be more useful in studying rumination since the event. On the other hand, the usage of diary methods may prompt individuals to engage in post-event processing on an artificial basis, which might bias the results as well (Brozovich & Heimberg, 2008). Since there is no research in addressing this problem, this should be subject of further investigation. Moreover, rumination was assessed using a state-like perspective since the event, instead of assessing overall trait rumination. State and trait rumination are found to differ, for example in cardiovascular consequences (Key, Campbell, Bacon & Gerin, 2008). Trait rumination is associated with an overall enhanced processing of negatively toned contents (e.g. Brozovich & Heimberg, 2011; Kuo et al., 2012). Since trait and state rumination are associated to each other (e.g. Key et al., 2008), the results could also rely on a general overestimation of stimuli of negative valence in people high in trait rumination, instead of being linked directly to post-event processing concerning the target event. On the other hand, it seems plausible that the influence of state rumination was of high impact in the current thesis.

Another conclusion of the current work is the tremendous difference between laboratory and natural occurring situations. The findings of the current thesis suggest that laboratory settings seem not appropriate to produce realistic emotional information processing studying autobiographical memory bias for state anxiety, which provides evidence for limited ecological validity, as some authors argued before (Löffler & Peper, 2014). Real life situations may differ in some aspects like the processing of possible relevant distractors or conflictual information, which could infer with memory processes (Beblo et al., 2010).

Overall, it should be noticed that the examined situations in the current thesis could be classified as *strong* situations in terms of Mischel's (1977) conception. Therefore, these

situations lead different people to behave in comparable ways. It is hypothesized that situation strength moderates the relationship between personality and information processing or behavior. Thus, the relationship between traits and memory distortions might be underestimated, since the usage of weaker situations would have had the potential to produce more variability in emotional response and therefore in occasions to observe memory bias. On the other hand, empirical verification concerning this hypothesis often failed (see Cooper & Withey, 2009, for a review). Therefore, the relevance of this limitation might be exaggerated.

Mood incongruent effects were explained as mood regulative effects in the current thesis, which seems plausible in the light of the presented theoretical considerations. Nevertheless, it remains unclear, if the results are really relying on mood regulation principles, since there are some alternative explanations of the mood incongruent memory effects which I would like to outline. Concerning overestimating of prior recall, it is conceivable that participants understated their pre-event anxiety. This may be due to mechanisms of denial, which allows participants to cope with the target event (exam or speech), to avoid decreasing performance capability. After dealing with the event, one might tolerate the real amount of anxiety (see Devito & Kubis, 1983). Further, participants may remember a more vivid or worse moment (in the sense of higher emotional intensity) at recall (Keuler & Safer, 1998). Moreover, personality effects could be associated with these findings. Patterns of memory distortion may provide a base for one's own personality perceptions and ratings. Interestingly, memories of undergone emotions may be more consistent with self-reported traits than the actual emotional reactions after socially relevant interactions (Kulik & Mahler, 1986; Pietromonaco & Feldman Barrett, 1997; see also Safer et al., 2002). Therefore, memory distortions could work as an instrument of correction by shifting emotional reactions into a more trait consistent direction in retrospect. Nevertheless, this could hardly explain the interactive findings between mood and personality.

Nevertheless, it has to be mentioned that the results were not statistically controlled for actual depression. There are findings that depressed patients show a tendency to process and remember stimuli with negative valence (e.g. Elliott, Rubinsztein, Sahakian & Dolan, 2002). The prolonged processing of negative information including negative affect, rumination and reduced emotional regulation is discussed to be a risk factor in etiology of depressive disorders (e.g. De Raedt & Koster, 2010; Koster, DeRaedt, Leyman & Lissnyder,

2010). Moreover, depressive symptoms seem to increase state effects of neuroticism and extraversion (Karsten et al., 2012). Moreover, clinically depressed subjects seem to use emotion-regulation strategies in a direction that is likely to maintain or increase negative emotions (Millgram, Joormann, Huppert & Tamir, 2015), which might have an impact on the findings of the current work. Some authors suggest that depressive symptomatology should be systematically controlled for in neuroticism research (Bianchia & Laurent, 2016). On the other hand, individuals scoring high on neuroticism are thought to process negative information about themselves even when not depressed (Martin, Ward & Clark, 1983). Moreover, a recent comment by Riese, Ormel, Aleman, Servaas and Jeronimus (2016) pointed out that depression is a part of neuroticism, like hostility and self-consciousness. Controlling for all high-correlation aspects would lead to uninterpretable results. Therefore, it seems acceptable to rely on the findings concerning memory processing in neuroticism.

To conclude, assessments of anxiety or depression focus typically upon retrospective self-report in clinical practice, which was criticized before (e.g. Ebner-Priemer & Trull, 2009). The current results indicated that there seem to be no overall bias in retrospective reported anxiety, but subgroups of participants may rely on over- or underestimating reports. This should be kept in sight in clinical diagnostics.

Future research should applicate the current paradigms in clinical samples to increase clinical validity. This research may include assessments of depressive symptoms as well as trait-like rumination. Influences of post-event-knowledge should be included more systematically. Moreover, the role of future anticipation of anxiety-provoking events should be addressed, to examine, whether vicious cycles of anticipated, perceived and remembered state anxiety could be validated using the current paradigm.

5.1.3 Implications for Psychotherapy

Cognitive behavioral therapy (CBT) is considered to be generally effective for patients with social anxiety disorder, but there are still patients who could not benefit from CBT (e.g. Acarturk, Cuijpers, van Straten & de Graaf, 2009; Mayo-Wilson et al., 2014; Wersebe, Sijbrandij & Cuijpers, 2013). Already mentioned cognitive behavioral models (e.g. Clark & Wells, 1995; Heimberg et al., 2012; Rapee & Heimberg, 1997) are predicting self-perpetuated effects of anxiety related thoughts, feelings, physiological changes and behavior. These reactions cause amplifications of negative schemata via their association with negative (interpersonal) outcomes which, in turn, provoke anxiety responses again. A recent study by Morrison et al. (2016) found evidence for elevated absolute anxiety levels in social anxious people during anticipation of a feared social situation compared to healthy controls. After CBT, social anxious individuals showed a significant decline in anxiety from pre- to post-speech, whereas pre-speech levels of anxiety remained stable. It is hypothesized that exposure of social situations leads to enhanced safety-learning during performance. Nevertheless, focusing exposure of anticipation of feared social situations may increase therapy effects measurably, since high anticipatory anxiety itself is linked to avoidance behavior, which maintains social anxiety (Foa & Kozak, 1986). Moreover, high anxiety levels are thought to increase negatively biased post-event processing which is also supposed to increase the likelihood of future avoidance (Heimberg et al., 2012). Therefore, elevated anxiety levels in anticipation seemed to be linked (but not limited) to increased post-event-rumination rates. Moreover, rumination is considered to be a transdiagnostic process (Harvey, Watkins, Mansell & Shafran, 2004) and therefore strongly associated with a variety of other mental disorders like depression, post-traumatic stress disorder, psychosis and eating disorders (see Ehring & Watkins, 2008, for a review). Therefore, focusing rumination may provide an advance in treatment outcomes by dealing also with comorbidity, for example between depression and anxiety (e.g. Topper, Emmelkamp & Ehring, 2010). As the recent review by Watkins (2015) indicates, rumination is included in several CBT treatments, but most trials of CBT have not assessed rumination, which is why it remains unclear, if standard CBT really reduces rumination. For example, rumination is addressed in metacognitive therapy (Wells et al., 2012), rumination-focused CBT (Watkins et al., 2011), mindfulness-based CBT (Piet & Hougaard, 2011) and cognitive bias modification (Hertel & Mathews, 2011), but there is still some research needed (e.g. O'Toole, Watson, Rosenberg & Berntsen, 2016). The current thesis provides evidence that rumination is strongly linked to an overestimating memory bias of pre-event anxiety. An

extension concerning existent therapy could be the application of feedback practices following the rationale of the current studies. Repeated discovery of one's own memory bias could be included into cognitive restructuring, by identification of dysfunctional cognitions and their cognitive distortions, allowing rational disputation and development of helpful cognitions like positive self-instructions. For example, this could be made within and between therapeutic sessions, as the results of the current studies provide evidence that such distortions occur even within hours. The used paradigm could therefore have diagnostic importance and therapeutically introduced for those subjects, which seemed to be influenced by the examined memory bias. Therefore, making memory distortions and their relationship with rumination transparent may transform their symptomatically character into a chance for modification. This strategy could be embedded into existing therapy approaches.

Moreover, the current thesis examined the role of neuroticism as a risk factor and extraversion as a protective factor for and against maladaptive memory distortions of anxiety, which was also found in prior research (e.g. Aldinger et al., 2014). The influences of these personality traits are not only limited to social anxiety, but also present in other disorders. For example, neuroticism is related to higher rates of depression (e.g. Everaerd, Klumpers, van Wingen, Tendolkar & Fernández, 2015; Noteboom, Beekman, Vogelzangs & Penninx, 2015), eating disorders (e.g. Lee-Winn, Townsend, Reinblatt & Mendelson, 2016) and substance use (e.g. Hakulinen et al., 2015; Sattler & Schunck, 2016). On the other hand, extraversion is for instance linked to lower risk of depression (e.g. Noteboom et al., 2015; Spinhoven, Elzinga, van Hemert, de Rooij & Penninx, 2014) and diminished symptom severity in psychosis (e.g. Compton, 2015). Following the five-factory theory of personality (McCrae & Costa, 2008), these traits are thought to be stable over the lifespan and hardly to change due to their biological and genetic determination. By contrast, personality development became an important field of research during the last years, leading to findings which indicate that personality variables like extraversion and neuroticism are subjects of modification with highest potentials of change in young adulthood and old age (Hutteman, Hennecke, Orth, Reitz & Specht, 2014; Specht, Luhmann & Geiser, 2014). Decreasing neuroticism seems naturally occurring between 18 and 30 years, with a peak at the age of 20 (Aldinger et al., 2014). Moreover, recent work gives evidence that environmental factors and life events could influence changes in personality (e.g. Jeronimus, Ormel, Aleman, Penninx & Riese, 2013; Zimmermann & Neyer, 2013) without being ge-

netically determined (Kandler, Bleidorn, Riemann, Angleitner & Spinath, 2012), which increases the important role of divergent and new experiences in personality development. This is in accordance to the already mentioned dynamic multivariate setpoint model by Vachon & Krueger (2015). They argue that the individual emotional set point is not per se stable or genetically determined. Moreover, they assume that biological and environmental outputs interact to sculpt the set point. Biological changes, developmental milestones and cultural proceedings may push traits in a maturation direction.

Psychotherapy could be a large field of making such new experiences. Interestingly, there is only little research on personality change via psychotherapy, but there are hints that indicate the possibility to change personality traits via psychoanalytic therapy (e.g. Wilczek, Barber, Gustavsson, Asberg & Weinryb, 2004) as well as via CBT (e.g. Agüera et al., 2012; Gi, Egger, Kaarsemaker & Kreutzkamp, 2010; Hedman et al., 2014; Johansson, Lyssarides, Andersson & Rousseau, 2013). Since the current thesis underlines the importance of positive and negative affectivity, they should be explicitly addressed in psychotherapy. As avoidance goals (less negative affectivity) are difficult to reach, an increasing of positive affectivity should be focused. A lack of positive affectivity was for example found in social anxious individuals (Kashdan & Steger, 2006). Therefore, enhancing positive emotionality should be a more central overall treatment goal (e.g. Spinhoven et al., 2014), at least in social anxiety. One strategy to reach this goal might be seen in mindfulness. Mindfulness was basically developed in Buddhism and is seen as part of the *noble eightfold path* (Gethin, 1998) and was later mentioned by psychoanalysts like Sigmund Freud (Freud, 1912). For example, the *evenly suspended attention* could be seen as strongly related to mindfulness (Michal, 2009). The so called "third wave" in CBT included mindfulness-based strategies into CBT, which seem to be linked to increased experience of positive emotions and enhanced responsiveness to pleasant activities (Geschwind, Peeters, Drukker, van Os & Wichers, 2011). In turn, positive actions may elevate positive affectivity in social anxious individuals (Alden & Trew, 2013). In a recent article, Garland, Farb, Goldin and Fredrickson (2015) propose the *mindfulness-to-meaning theory*, which links mindfulness to flexibility in the generation of cognitive appraisals by enhancing interoceptive attention. This broadens the cognitive repertoire and enables individuals to engage in positive reappraisal after adverse experiences or enjoy positive experience. It is supposed that individuals could become mindfully aware of negative thoughts, which means making no judgements and trying not to suppress or avoid these thoughts. This may

enable these individuals not to confirm their negative beliefs via direct experience or distorted memories (Morgan & Banerjee, 2008). Due to the link between appraisals and mindfulness, the recent finding by Petrocchi and Ottaviani (2016) seems not to be surprising: The authors found that rumination mediates the impact of mindfulness facets on (depressive) symptoms over time, enhancing the interaction of these concepts concerning maintenance and therapy in mental disorders.

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Danksagung

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Eidesstattliche Erklärung und Versicherung

Hiermit versichere ich, dass ich die vorliegende Dissertation selbstständig, ohne unerlaubte Hilfe Dritter angefertigt und andere als die in der Dissertation angegebenen Hilfsmittel nicht benutzt habe. Alle Stellen, die wörtlich oder sinngemäß aus veröffentlichten oder unveröffentlichten Schriften entnommen sind, habe ich als solche kenntlich gemacht. Dritte waren an der inhaltlich-materiellen Erstellung der Dissertation nicht beteiligt; insbesondere habe ich hierfür nicht die Hilfe eines Promotionsberaters in Anspruch genommen. Kein Teil dieser Arbeit ist in einem anderen Promotions- oder Habilitationsverfahren verwendet worden.

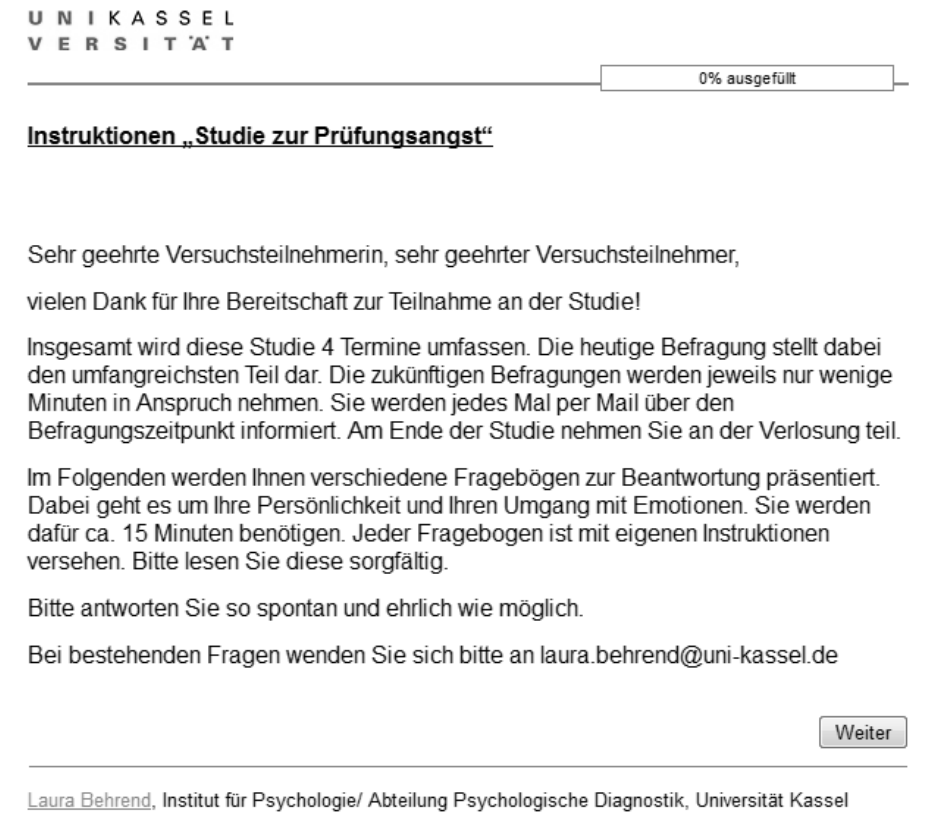
Ort, Datum

Unterschrift

Appendix

Appendix A - Study 1

A.1 Instructions, Enlightenment and Informed Consent Prior to the Trait-Assessment



UNIKASSEL
VERSITÄT

0% ausgefüllt

Instruktionen „Studie zur Prüfungsangst“

Sehr geehrte Versuchsteilnehmerin, sehr geehrter Versuchsteilnehmer,

vielen Dank für Ihre Bereitschaft zur Teilnahme an der Studie!

Insgesamt wird diese Studie 4 Termine umfassen. Die heutige Befragung stellt dabei den umfangreichsten Teil dar. Die zukünftigen Befragungen werden jeweils nur wenige Minuten in Anspruch nehmen. Sie werden jedes Mal per Mail über den Befragungszeitpunkt informiert. Am Ende der Studie nehmen Sie an der Verlosung teil.

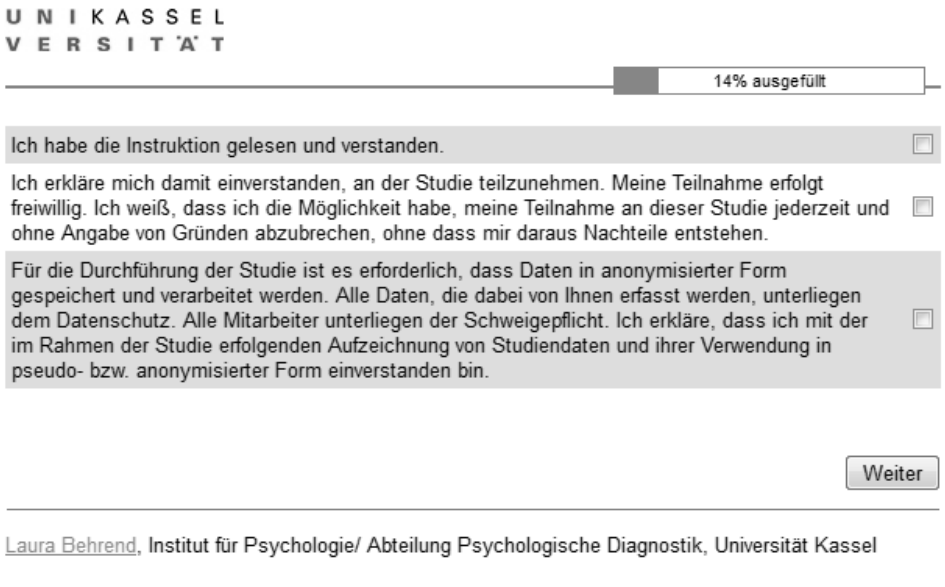
Im Folgenden werden Ihnen verschiedene Fragebögen zur Beantwortung präsentiert. Dabei geht es um Ihre Persönlichkeit und Ihren Umgang mit Emotionen. Sie werden dafür ca. 15 Minuten benötigen. Jeder Fragebogen ist mit eigenen Instruktionen versehen. Bitte lesen Sie diese sorgfältig.

Bitte antworten Sie so spontan und ehrlich wie möglich.

Bei bestehenden Fragen wenden Sie sich bitte an laura.behrend@uni-kassel.de

Weiter

Laura Behrend, Institut für Psychologie/ Abteilung Psychologische Diagnostik, Universität Kassel



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VERSITÄT

14% ausgefüllt

Ich habe die Instruktion gelesen und verstanden. ☐

Ich erkläre mich damit einverstanden, an der Studie teilzunehmen. Meine Teilnahme erfolgt freiwillig. Ich weiß, dass ich die Möglichkeit habe, meine Teilnahme an dieser Studie jederzeit und ohne Angabe von Gründen abzubrechen, ohne dass mir daraus Nachteile entstehen. ☐

Für die Durchführung der Studie ist es erforderlich, dass Daten in anonymisierter Form gespeichert und verarbeitet werden. Alle Daten, die dabei von Ihnen erfasst werden, unterliegen dem Datenschutz. Alle Mitarbeiter unterliegen der Schweigepflicht. Ich erkläre, dass ich mit der im Rahmen der Studie erfolgenden Aufzeichnung von Studiendaten und ihrer Verwendung in pseudo- bzw. anonymisierter Form einverstanden bin. ☐

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A.2 NEO-FFI, Dimensions Extraversion und Neuroticism

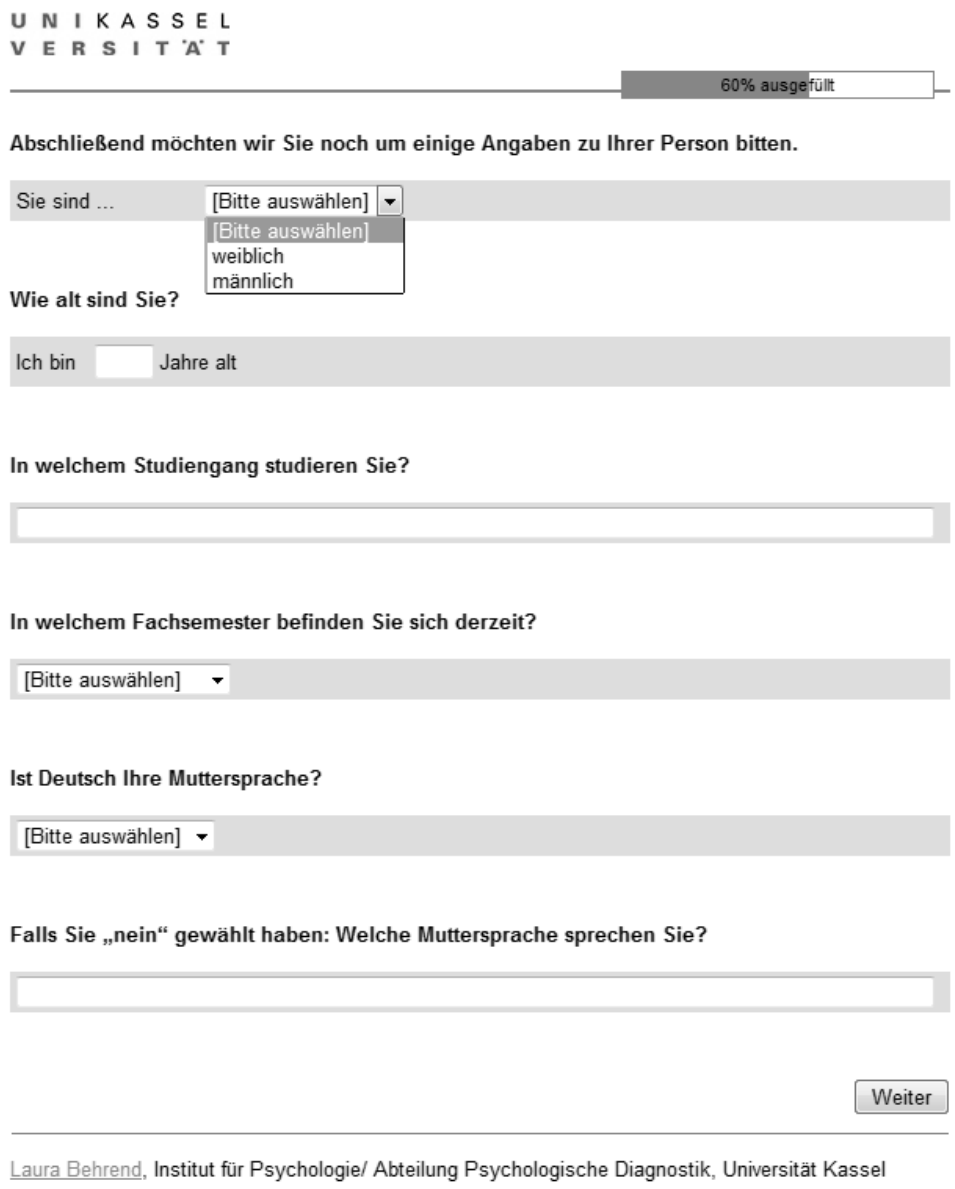
29% ausgefüllt

Dieser Fragebogen enthält Aussagen, welche sich zur Beschreibung der eigenen Person eignen könnten. Lesen Sie bitte jede dieser Aussagen aufmerksam durch und überlegen Sie, ob diese Aussage auf Sie persönlich zutrifft oder nicht. Zur Bewertung jeder der 24 Aussagen steht Ihnen eine fünffach abgestufte Skala zur Verfügung.

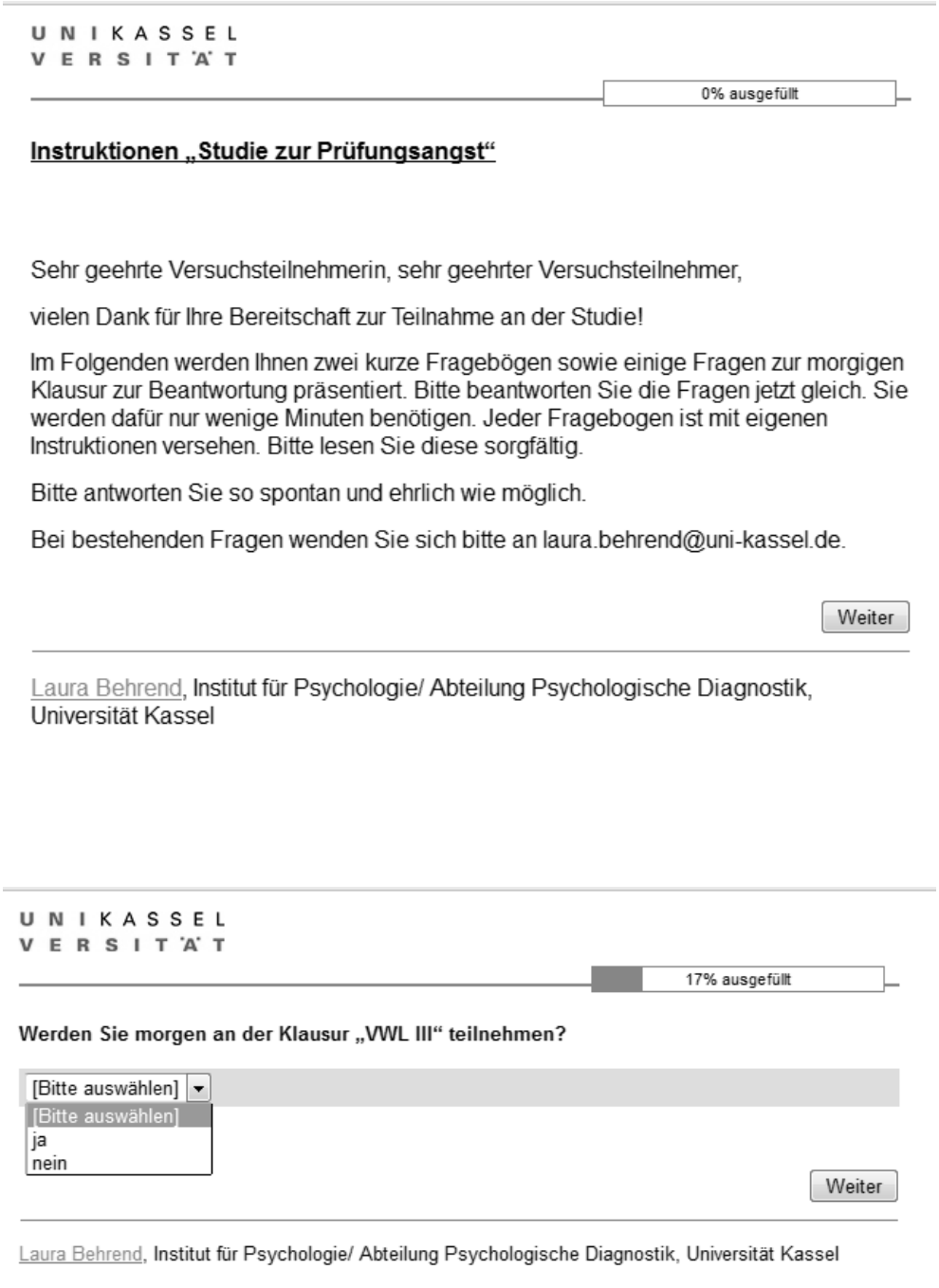
Bitte lesen Sie jede Aussage genau durch und kreuzen Sie als Antwort die Kategorie an, die Ihre Sichtweise am besten ausdrückt. Bitte bewerten Sie die 24 Aussagen zügig, aber sorgfältig.

	Starke Ablehnung	Ablehnung	Neutral	Zustimmung	Starke Zustimmung
Ich bin **nicht** leicht beunruhigt.	○	○	○	○	○
Ich habe gern viele Leute um mich herum.	○	○	○	○	○
Ich fühle mich anderen oft unterlegen.	○	○	○	○	○
Ich bin leicht zum Lachen zu bringen.	○	○	○	○	○
Wenn ich unter starkem Stress stehe, fühle ich mich manchmal, als ob ich zusammenbräche.	○	○	○	○	○
Ich halte mich **nicht** für besonders fröhlich.	○	○	○	○	○
Ich habe oft das Gefühl, vor Energie überzuschäumen.	○	○	○	○	○
Ich fühle mich selten einsam und traurig.	○	○	○	○	○
Ich unterhalte mich wirklich gerne mit anderen Menschen.	○	○	○	○	○
Ich fühle mich oft angespannt und nervös.	○	○	○	○	○
Ich bin gerne im Zentrum des Geschehens.	○	○	○	○	○
Manchmal fühle ich mich völlig wertlos.	○	○	○	○	○
Ich ziehe es gewöhnlich vor, Dinge allein zu tun.	○	○	○	○	○
Ich empfinde selten Furcht oder Angst.	○	○	○	○	○
Ich ärgere mich oft darüber, wie andere Leute mich behandeln.	○	○	○	○	○
Ich bin ein fröhlicher, gut gelaunter Mensch.	○	○	○	○	○
Zu häufig bin ich entmutigt und will aufgeben, wenn etwas schief geht.	○	○	○	○	○
Ich bin **kein** gut gelaunter Optimist.	○	○	○	○	○
Ich bin selten traurig oder deprimiert.	○	○	○	○	○
Ich führe ein hektisches Leben.	○	○	○	○	○
Ich fühle mich oft hilflos und wünsche mir eine Person, die meine Probleme löst.	○	○	○	○	○
Ich bin ein sehr aktiver Mensch.	○	○	○	○	○
Manchmal war mir etwas so peinlich, dass ich mich am liebsten versteckt hätte.	○	○	○	○	○
Lieber würde ich meine eigenen Wege gehen, als eine Gruppe anzuführen.	○	○	○	○	○

A.3 Sociodemographical Information



A.4 Instructions and Enlightenment Concerning the State-Assessment at the Evening before the Exam and Examination of the Intended Participation of the Exam



A.5 Multidimensionaler Befindlichkeitsfragebogen (MDBF), Assessment of the Actual Mood

UNIKASSEL
VERSITÄT

33% ausgefüllt

Bitte geben Sie im Folgenden an, wie Sie sich im Moment fühlen!

Im Moment fühle ich mich

	überhaupt nicht				sehr
zufrieden	○	○	○	○	○
ruhelos	○	○	○	○	○
schlecht	○	○	○	○	○
gelassen	○	○	○	○	○
gut	○	○	○	○	○
unruhig	○	○	○	○	○
unwohl	○	○	○	○	○
entspannt	○	○	○	○	○

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A.6 State-Trait-Anxiety-Depression Inventory (STADI), Assessment of the Actual Anxiety

UNIKASSEL
VERSITÄT

67% ausgefüllt

Sie finden im Folgenden eine Reihe von Aussagen, mit denen Sie Ihren augenblicklichen Zustand beschreiben können. Welche Gefühle empfinden Sie, was geht Ihnen durch den Kopf?

Bitte schätzen Sie ein, inwieweit jede der nachstehenden Aussagen jetzt, d. h. in diesem Moment, auf Sie zutrifft.

	überhaupt nicht	ein wenig	ziemlich	sehr
Mein Herz schlägt schnell.	○	○	○	○
Ich grüble über meine Situation nach.	○	○	○	○
Ich bin froh.	○	○	○	○
Mir ist zum Heulen zumute.	○	○	○	○
Ich bin kribbelig.	○	○	○	○
Ich mache mir Gedanken über meine Situation.	○	○	○	○
Ich bin gut drauf.	○	○	○	○
Ich bin schlechter Stimmung.	○	○	○	○
Ich bin unruhig.	○	○	○	○
Ich mache mir Sorgen über das, was auf mich zukommt.	○	○	○	○
Ich bin gut gelaunt.	○	○	○	○
Mir geht es schlecht.	○	○	○	○
Ich bin nervös.	○	○	○	○
Ich bin unsicher, ob alles gut gehen wird.	○	○	○	○
Ich fühle mich beschwingt.	○	○	○	○
Ich bin deprimiert.	○	○	○	○
Ich bin aufgeregt.	○	○	○	○
Ich mache mir viele Gedanken.	○	○	○	○
Ich bin in guter Stimmung.	○	○	○	○
Ich bin unglücklich.	○	○	○	○

Weiter

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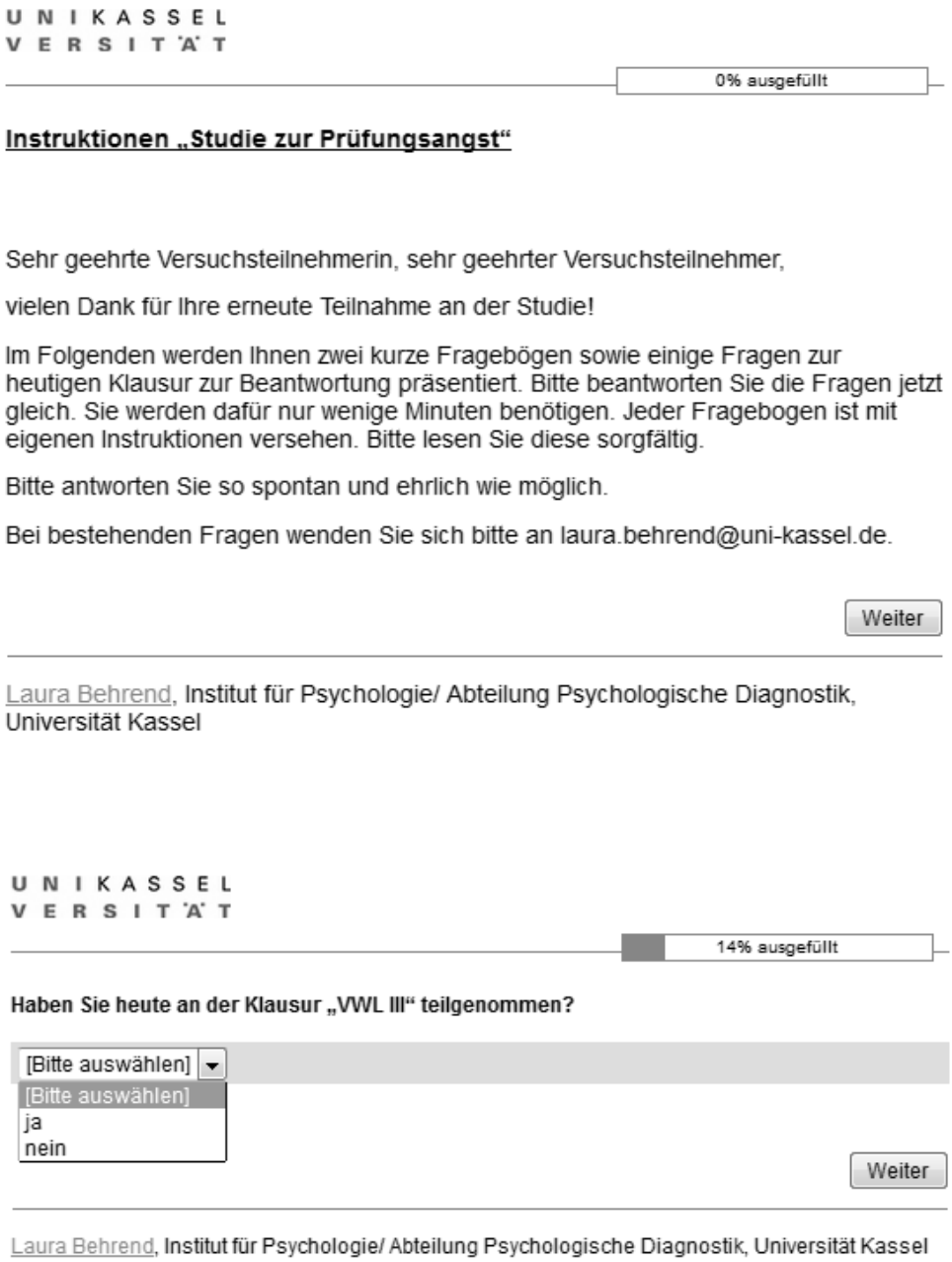
A.7 Instructions and Enlightenment Concerning the State-Assessment at Directly After the Exam and Examination of the Factual Participation of the Exam



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VERSITÄT

0% ausgefüllt

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Sehr geehrte Versuchsteilnehmerin, sehr geehrter Versuchsteilnehmer,

vielen Dank für Ihre erneute Teilnahme an der Studie!

Im Folgenden werden Ihnen zwei kurze Fragebögen sowie einige Fragen zur heutigen Klausur zur Beantwortung präsentiert. Bitte beantworten Sie die Fragen jetzt gleich. Sie werden dafür nur wenige Minuten benötigen. Jeder Fragebogen ist mit eigenen Instruktionen versehen. Bitte lesen Sie diese sorgfältig.

Bitte antworten Sie so spontan und ehrlich wie möglich.

Bei bestehenden Fragen wenden Sie sich bitte an laura.behrend@uni-kassel.de.

Weiter

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VERSITÄT

14% ausgefüllt

Haben Sie heute an der Klausur „VWL III“ teilgenommen?

[Bitte auswählen]

[Bitte auswählen]
ja
nein

Weiter

Laura Behrend, Institut für Psychologie/ Abteilung Psychologische Diagnostik, Universität Kassel

A.8 Multidimensionaler Befindlichkeitsfragebogen (MDBF), Assessment of the Actual Mood and Instruction to Emphazize with Oneselves Own Situation Prior to the Exam


UNIKASSEL
VERSITÄT

28% ausgefüllt

Bitte geben Sie im Folgenden an, wie Sie sich im Moment fühlen!

Im Moment fühle ich mich

	überhaupt nicht				sehr
zufrieden	○	○	○	○	○
ruhelos	○	○	○	○	○
schlecht	○	○	○	○	○
gelassen	○	○	○	○	○
gut	○	○	○	○	○
unruhig	○	○	○	○	○
unwohl	○	○	○	○	○
entspannt	○	○	○	○	○

Weiter

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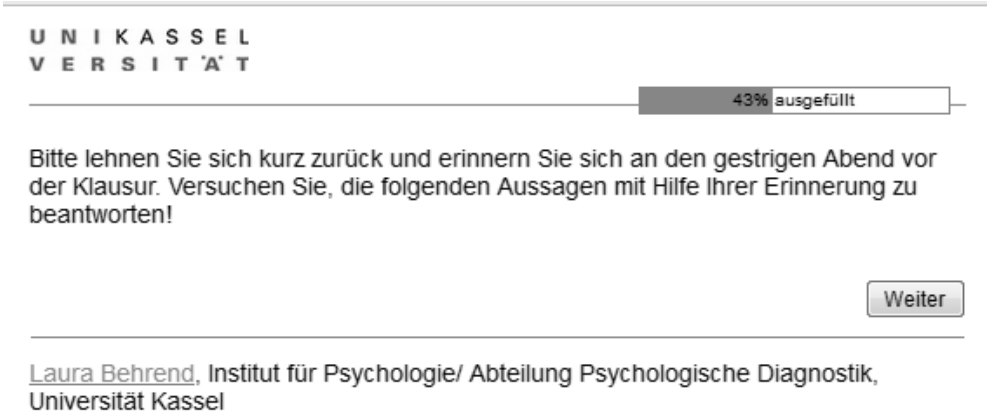

UNIKASSEL
VERSITÄT

43% ausgefüllt

Bitte lehnen Sie sich kurz zurück und erinnern Sie sich an den gestrigen Abend vor der Klausur. Versuchen Sie, die folgenden Aussagen mit Hilfe Ihrer Erinnerung zu beantworten!

Weiter

Laura Behrend, Institut für Psychologie/ Abteilung Psychologische Diagnostik, Universität Kassel

A.9 State-Trait-Anxiety-Depression Inventory (STADI), Assessment of the Retrospective Anxiety

UNIKASSEL
VERSITÄT

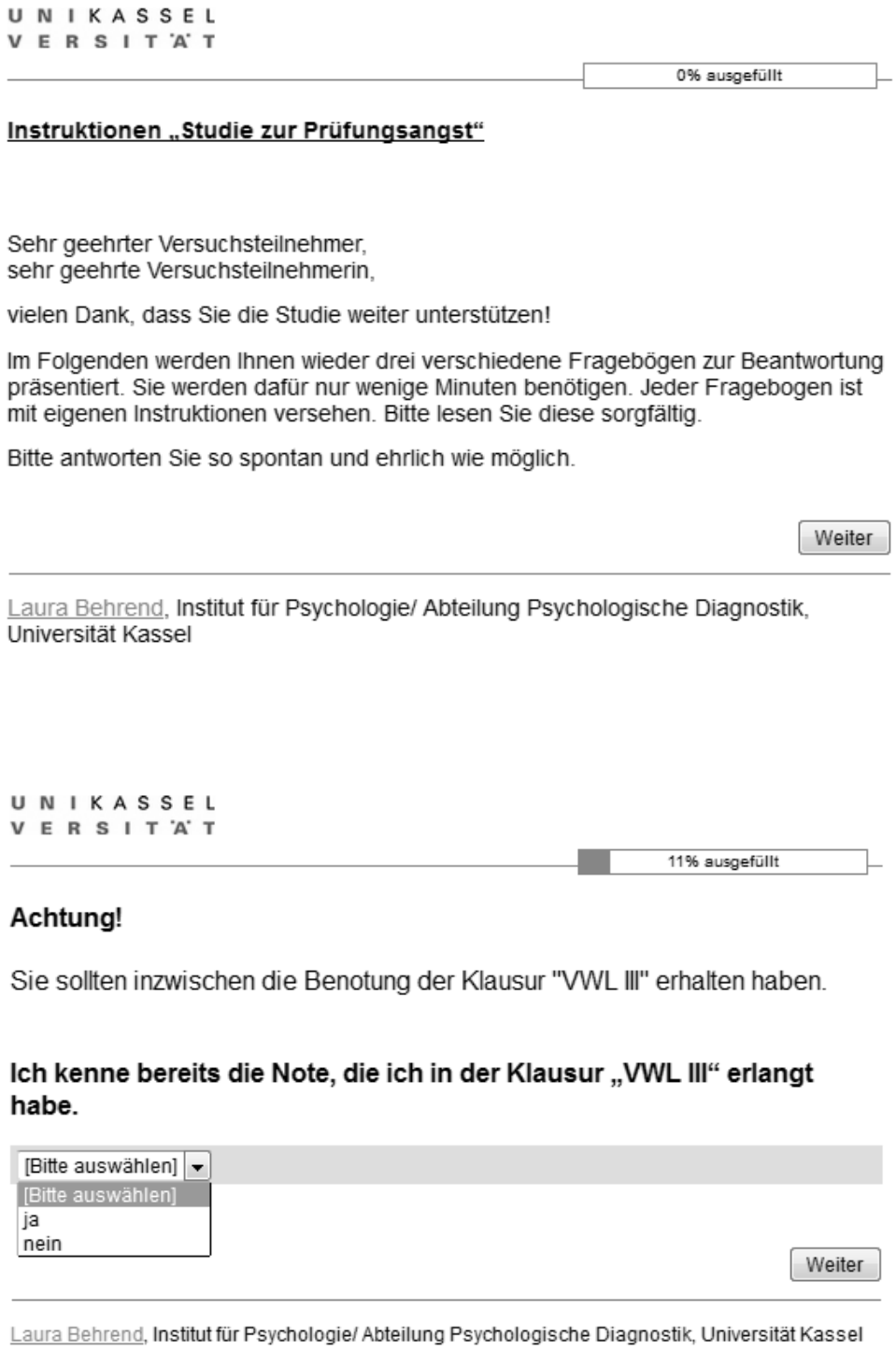
57% ausgefüllt

Sie finden im Folgenden eine Reihe von Aussagen, mit denen Sie Ihren Zustand in einer konkreten Situation beschreiben können. Welche Gefühle empfanden Sie, was ging Ihnen durch den Kopf?

Bitte schätzen Sie ein, inwieweit jede der nachstehenden Aussagen am Abend vor der Klausur auf Sie zutraf!

	überhaupt nicht	ein wenig	ziemlich	sehr
Mein Herz schlug schnell.	○	○	○	○
Ich grübelte über meine Situation nach.	○	○	○	○
Ich war froh.	○	○	○	○
Mir war zum Heulen zumute.	○	○	○	○
Ich war kribbelig.	○	○	○	○
Ich machte mir Gedanken über meine Situation.	○	○	○	○
Ich war gut drauf.	○	○	○	○
Ich war schlechter Stimmung.	○	○	○	○
Ich war unruhig.	○	○	○	○
Ich machte mir Sorgen über das, was auf mich zukam.	○	○	○	○
Ich war gut gelaunt.	○	○	○	○
Mir ging es schlecht.	○	○	○	○
Ich war nervös.	○	○	○	○
Ich war unsicher, ob alles gut gehen wird.	○	○	○	○
Ich fühlte mich beschwingt.	○	○	○	○
Ich war deprimiert.	○	○	○	○
Ich war aufgeregt.	○	○	○	○
Ich machte mir viele Gedanken.	○	○	○	○
Ich war in guter Stimmung.	○	○	○	○
Ich war unglücklich.	○	○	○	○

A.10 Instructions and Enlightenment Concerning the State-Assessment after Receiving the Results and Declaration of Ones Own Knowledge of the Received Mark



UNIKASSEL
VERSITÄT

0% ausgefüllt

Instruktionen „Studie zur Prüfungsangst“

Sehr geehrter Versuchsteilnehmer,
sehr geehrte Versuchsteilnehmerin,

vielen Dank, dass Sie die Studie weiter unterstützen!

Im Folgenden werden Ihnen wieder drei verschiedene Fragebögen zur Beantwortung präsentiert. Sie werden dafür nur wenige Minuten benötigen. Jeder Fragebogen ist mit eigenen Instruktionen versehen. Bitte lesen Sie diese sorgfältig.

Bitte antworten Sie so spontan und ehrlich wie möglich.

Weiter

Laura Behrend, Institut für Psychologie/ Abteilung Psychologische Diagnostik, Universität Kassel

UNIKASSEL
VERSITÄT

11% ausgefüllt

Achtung!

Sie sollten inzwischen die Benotung der Klausur "VWL III" erhalten haben.

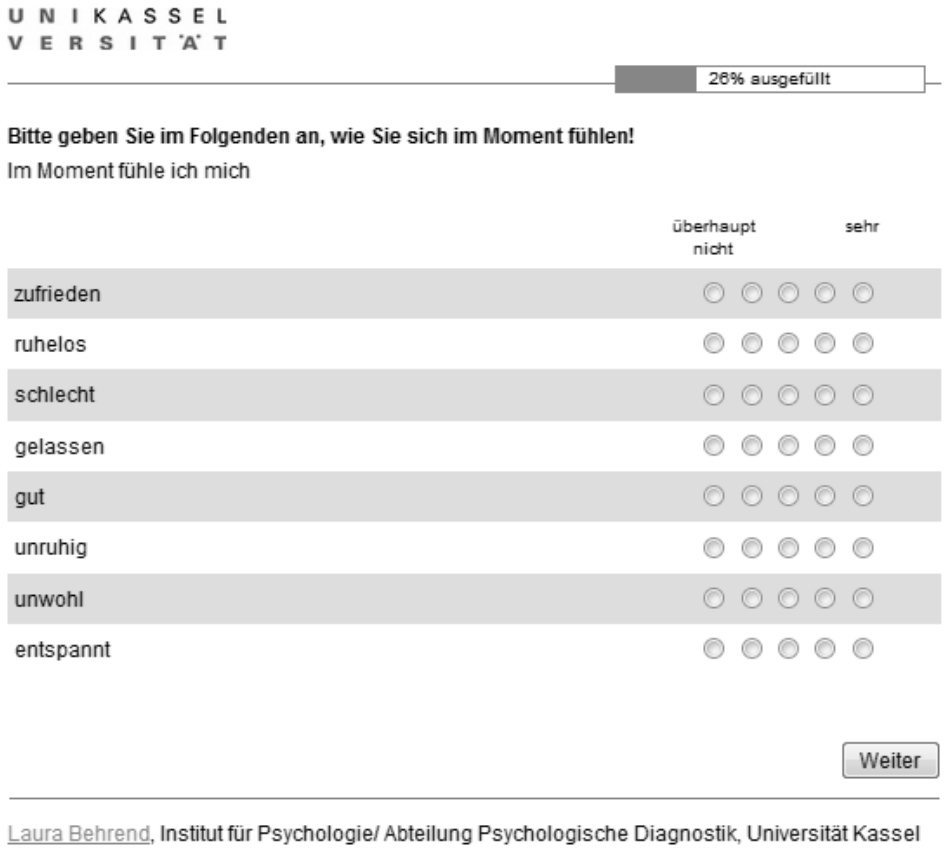
Ich kenne bereits die Note, die ich in der Klausur „VWL III“ erlangt habe.

[Bitte auswählen]
[Bitte auswählen]
ja
nein

Weiter

Laura Behrend, Institut für Psychologie/ Abteilung Psychologische Diagnostik, Universität Kassel

A.11 Multidimensionaler Befindlichkeitsfragebogen (MDBF), Assessment of the Actual Mood and Instruction to Emphazize with Oneselves Own Situation Prior to the Exam



UNIKASSEL
VERSITÄT

26% ausgefüllt

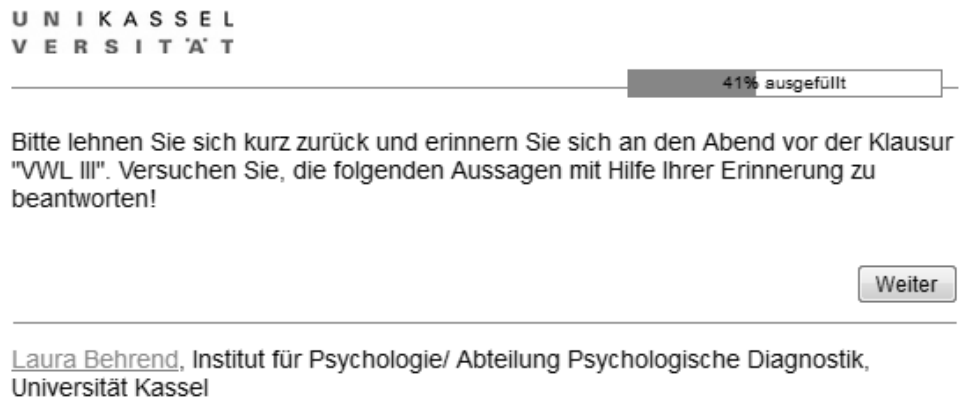
Bitte geben Sie im Folgenden an, wie Sie sich im Moment fühlen!

Im Moment fühle ich mich

	überhaupt nicht				sehr
zufrieden	○	○	○	○	○
ruhelos	○	○	○	○	○
schlecht	○	○	○	○	○
gelassen	○	○	○	○	○
gut	○	○	○	○	○
unruhig	○	○	○	○	○
unwohl	○	○	○	○	○
entspannt	○	○	○	○	○

Weiter

Laura Behrend, Institut für Psychologie/ Abteilung Psychologische Diagnostik, Universität Kassel



UNIKASSEL
VERSITÄT

41% ausgefüllt

Bitte lehnen Sie sich kurz zurück und erinnern Sie sich an den Abend vor der Klausur "VWL III". Versuchen Sie, die folgenden Aussagen mit Hilfe Ihrer Erinnerung zu beantworten!

Weiter

Laura Behrend, Institut für Psychologie/ Abteilung Psychologische Diagnostik, Universität Kassel

A.12 State-Trait-Anxiety-Depression Inventory (STADI), Assessment of the Actual Anxiety

UNIKASSEL
VERSITÄT

56% ausgefüllt

Sie finden im Folgenden eine Reihe von Aussagen, mit denen Sie Ihren Zustand in einer konkreten Situation beschreiben können. Welche Gefühle empfanden Sie, was ging Ihnen durch den Kopf?

Bitte schätzen Sie ein, inwieweit jede der nachstehenden Aussagen am Abend vor der Klausur auf Sie zutraf!

	überhaupt nicht	ein wenig	ziemlich	sehr
Mein Herz schlug schnell.	○	○	○	○
Ich grübelte über meine Situation nach.	○	○	○	○
Ich war froh.	○	○	○	○
Mir war zum Heulen zumute.	○	○	○	○
Ich war kribbelig.	○	○	○	○
Ich machte mir Gedanken über meine Situation.	○	○	○	○
Ich war gut drauf.	○	○	○	○
Ich war schlechter Stimmung.	○	○	○	○
Ich war unruhig.	○	○	○	○
Ich machte mir Sorgen über das, was auf mich zukam.	○	○	○	○
Ich war gut gelaunt.	○	○	○	○
Mir ging es schlecht.	○	○	○	○
Ich war nervös.	○	○	○	○
Ich war unsicher, ob alles gut gehen wird.	○	○	○	○
Ich fühlte mich beschwingt.	○	○	○	○
Ich war deprimiert.	○	○	○	○
Ich war aufgeregt.	○	○	○	○
Ich machte mir viele Gedanken.	○	○	○	○
Ich war in guter Stimmung.	○	○	○	○
Ich war unglücklich.	○	○	○	○

A.13 Questions Concerning the Exam

A.14 Test statistics, degrees of freedom and statistical significances of the Kolmogorov-Smirnov-Test for normal distribution

	TS	*df*	*p*
STADI Actual	1.13	131	.159
STADI Retrospective (2)	1.05	131	.218
STADI Retrospective (3)	0.96	116	.298
MDBF Actual (2)	2.09	131	.000
MDBF Actual (3)	2.33	116	.000
NEO Neuroticism	1.01	131	.260
NEO Extraversion	1.02	131	.248

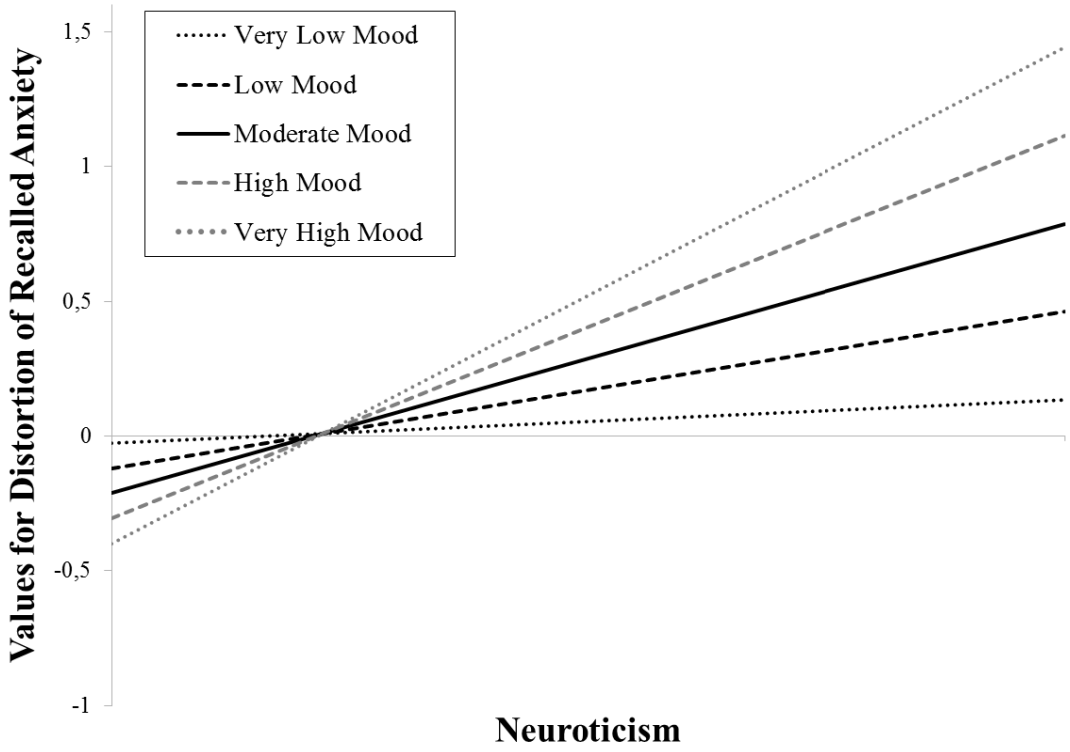
Note. STADI, State-Trait-Anxiety-Depression Inventory; MDBF, Multidimensional Mood Questionnaire; NEO, NEO five-factor inventory; (2) second occasion of measurement; (3) third occasion of measurement.

A.15 Statistics for the Simple Slopes of the Interaction between Mood and Neuroticism Predicting Memory Distortion. The Moderator is Mood.

Values of Moderator	Simple Slopes Statistics		
	b	*t*	*p*
- 2 SD	0.04	0.83	.412
- 1 SD	0.12	3.26	.001
Mean	0.20	4.53	.000
+ 1 SD	0.28	4.29	.000
+ 2 SD	0.36	3.96	.000

Note. Degrees of freedom are 127.

A.16 Plot of the simple slopes for the interaction between Mood and Neuroticism with Mood as Moderator.



Note. Very low: - 2 SD below the mean, low: -1 SD below the mean, moderate: mean, high: +1 SD above the mean, very high: +2 SD above the mean

A.17 Unstandardized Regression coefficients for the LMS model for neuroticism when including the received mark as a manifest covariate

	Difference between Actual and Retrospective Reported Anxiety (Change 3_1)		
Predictors	*b*	*SE*	*p*
MDBF Actual	.08	.05	.075
NEO Neuroticism	.20	.05	.000
MDBF x Neuroticism	.09	.03	.005

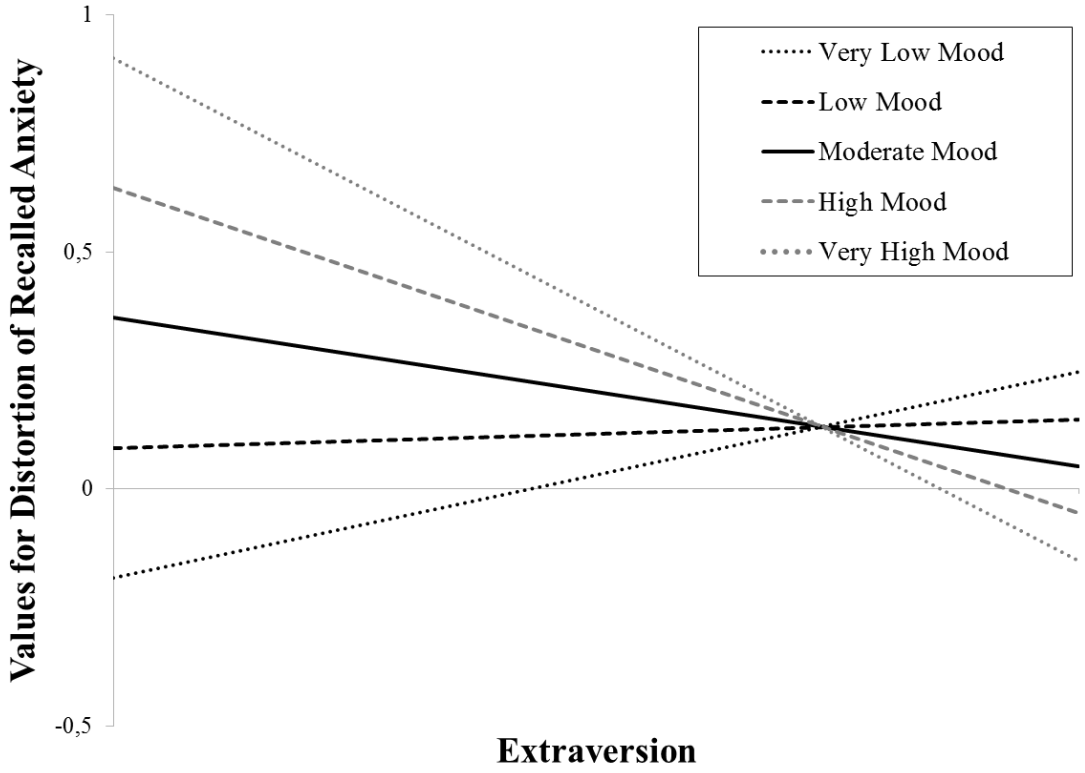
Note. b, regression coefficient.

A.18 Statistics for the Simple Slopes of the Interaction between Mood and Extra-version Predicting Memory Distortion. The Moderator is Mood.

	Simple Slopes Statistics		
Values of Moderator	*b*	*t*	*p*
- 2 SD	.07	1.95	.053
- 1 SD	.01	0.28	.782
Mean	-0.05	-0.99	.326
+ 1 SD	-0.11	-1.50	.136
+ 2 SD	-0.17	-1.73	.086

Note. Degrees of freedom are 127.

A.19 Plot of the simple slopes for the interaction between Mood and Neuroticism.



Note. Very low: - 2 SD below the mean, low: -1 SD below the mean, moderate: mean, high: +1 SD above the mean, very high: +2 SD above the mean.

A.20 Unstandardized Regression coefficients for the LMS model for extraversion when including the received mark as a manifest covariate

	Difference between Actual and Retrospective Reported Anxiety (Change 3_1)		
Predictors	*b*	*SE*	*p*
MDBF Actual	.04	.04	.330
NEO Extraversion	.19	.08	.016
MDBF x Extraversion	-.06	.03	.016

Note. b, regression coefficient.

Appendix B - Study 2

B.1 Thoughts Questionnaire, Assessment of Rumination since the Speech

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86% ausgefüllt

Bitte entscheiden Sie für jede Aussage, wie oft Sie in der Zeit seit Ihrem Vortrag an diesen Aspekt gedacht haben.

Ich habe in der letzten Woche an folgendes gedacht:

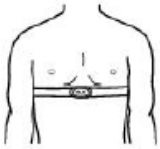
	nie	nicht oft	manchmal	oft	sehr oft
Mein Vortrag war gut	○	○	○	○	○
Ich hätte deutlich besser sein können	○	○	○	○	○
Die Untersuchungsleiter mochten mich	○	○	○	○	○
Ob mein Erröten/Schwitzen/trockener Mund/Zittern sichtbar war	○	○	○	○	○
Wie gut ich es gehändelt habe	○	○	○	○	○
Wie schlecht mein Vortrag war	○	○	○	○	○
Ich habe einen Narren aus mir gemacht	○	○	○	○	○
Wie sehr ich solche Situationen genieße	○	○	○	○	○
Ich muss dumm ausgesehen haben	○	○	○	○	○
Wie reibungslos alles gelaufen ist	○	○	○	○	○
Wie selbstbewusst ich mich gefühlt habe	○	○	○	○	○
Was ich für ein Reinfall war	○	○	○	○	○
Wie viele Fehler ich gemacht habe	○	○	○	○	○
Wie sicher ich mich gefühlt habe	○	○	○	○	○
Ich kam selbstbewusst rüber	○	○	○	○	○
Wie unbeholfen ich mich gefühlt habe	○	○	○	○	○
Dass ich mich von meiner besten Seite gezeigt habe	○	○	○	○	○
Wie schnell mein Herz geschlagen hat	○	○	○	○	○
Ich habe keinen guten Eindruck gemacht	○	○	○	○	○
Die Situation an sich	○	○	○	○	○
Wie ängstlich ich mich gefühlt habe	○	○	○	○	○

Weiter

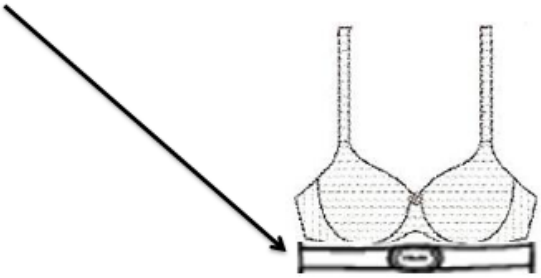
Claudia Gebhardt, Institut für Psychologie, Uni Kassel

B.2 Instructions how to wear the chest strap

Wie lege ich den Brustgurt richtig an?

	1. Befestigen Sie die Sendeeinheit am Gurt.
	2. Legen Sie den Gurt unterhalb der Brustmuskulatur um die Brust und hängen Sie den Haken am anderen Ende des Gurtes ein.
	3. Stellen Sie die Gurtlänge so ein, dass der Gurt fest, jedoch nicht zu eng anliegt. Stellen Sie sicher, dass die Elektroden flach auf Ihrer Haut aufliegen und das Polar Logo der Sendeeinheit mittig und aufrecht sitzt.

Hinweis für Frauen: Es wird empfohlen, den Brustgurt direkt unterhalb des BHs zu tragen:



B.3 Overview about the issues for the speech task

Übersicht Referatsthemen

Instruktion jeweils:

„Bitte diskutieren Sie folgende Aussage! Finden Sie Argumente für und gegen die Frage und erklären Sie diese. Kommen Sie am Ende zu einem begründeten persönlichen Urteil!“

Thema 1: **Sollten homosexuelle Paare in Deutschland Kinder adoptieren dürfen?**
Thema 1: **Sollte Cannabis in Deutschland legalisiert werden?**
Thema 1: **Sollten Tierversuche in Deutschland verboten werden?**
Thema 4: **Sollte in Deutschland eine allgemeine Autobahn-Maut eingeführt werden?**
Thema 5: **Sollte Prostitution in Deutschland wieder verboten werden, um Zwangsprostitution auszuschließen?**
Thema 6: **Sollte die direkte Demokratie in Deutschland durch Einführung von Volksabstimmungen gestärkt werden?**
Thema 7: **Sollte in Deutschland ein flächendeckender Mindestlohn eingeführt werden?**
Thema 8: **Sollte eine allgemeine Frauenquote verpflichtend für alle Unternehmen eingeführt werden?**
Thema 9: **Sollte das Betreuungsgeld (auch bekannt als „Herd-Prämie“) wieder abgeschafft werden?**
Thema 10: **Sollte die Haltung von Wildtieren im Zirkus verboten werden?**
Thema 11: **Sollte ein Veggie-Day in Deutschland eingeführt werden?**
Thema 12: **Sollten Manager-Gehälter begrenzt werden?**

B.4 Independent-samples t-tests for state characteristics between participants and drop-out

Scale		*M*	*SD*	*T*	*p*
STAI Baseline	Participants	1.76	.56	.35	.729
	Drop-Out	1.69	.56		
STAI Actual	Participants	2.33	.63	.09	.926
	Drop-Out	2.31	.62		
STAI Retrospective (2)	Participants	2.18	.59	-1.52	.132
	Drop-Out	2.50	.88		
MDBF Actual (2)	Participants	3.89	.77	-.21	.831
	Drop-Out	3.94	.54		

Note. *N* for Participants was 132, *N* for Drop-Out was 9; *df* = 139.

B.5 Test Statistics, Degrees of Freedom and Statistical Significances of the Kolmogorov-Smirnov-Test for Normal Distribution

	TS	*df*	*p*
STAI Baseline	1.65	141	.009
STAI Actual	1.56	141	.016
STAI Retrospective (2)	1.98	141	.001
STAI Retrospective (3)	1.58	141	.013
MDBF Actual (2)	1.73	141	.005
MDBF Actual (3)	2.13	133	.000
NEO Neuroticism	1.10	132	.178
NEO Extraversion	0.69	132	.731
SPIN	1.05	132	.220
TQ Rumination	1.52	131	.019

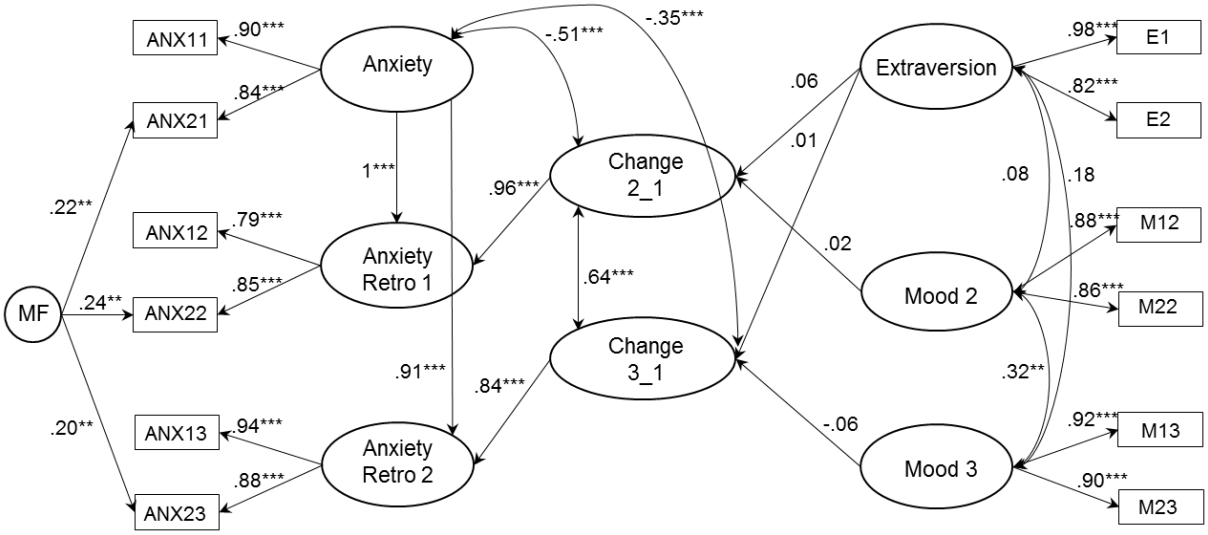
Note. STADI, State-Trait-Anxiety Inventory; MDBF, Multidimensional Mood Questionnaire; NEO, NEO five-factor inventory; SPIN, Social Phobia Inventory; (2) second occasion of measurement; (3) third occasion of measurement.

B.6 Bivariate Correlations between HRV values and trait measures

Scale	2	3	4	5	6	7
1. RMSSD Baseline	.53**	.50**	-.14	.14	-.06	-.09
2. RMSSD Announcement	-	.68**	.03	.13	.02	.10
3. RMSSD During Speech		-	-.01	-.01	-.02	-.21*
4. NEO Neuroticism			-	-.36	.60**	.23*
5. NEO Extraversion				-	-.45	-.15
6. SPIN					-	.32***
7. TQ Rumination						-

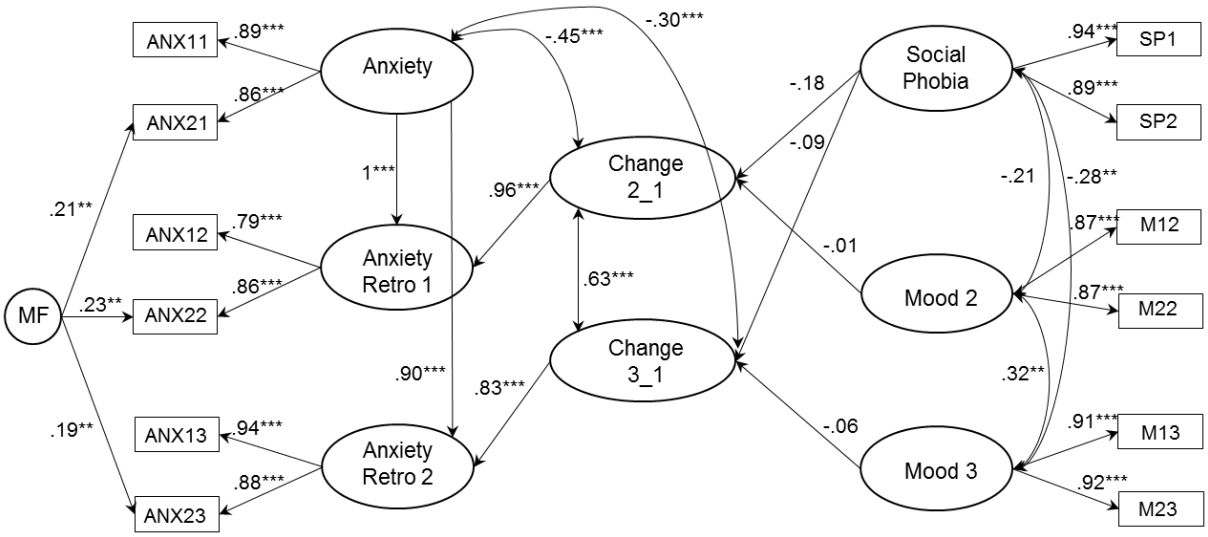
Note. $^{*}p < .05$; $^{**}p < .01$.

B.7 Linear structural model for extraversion and mood



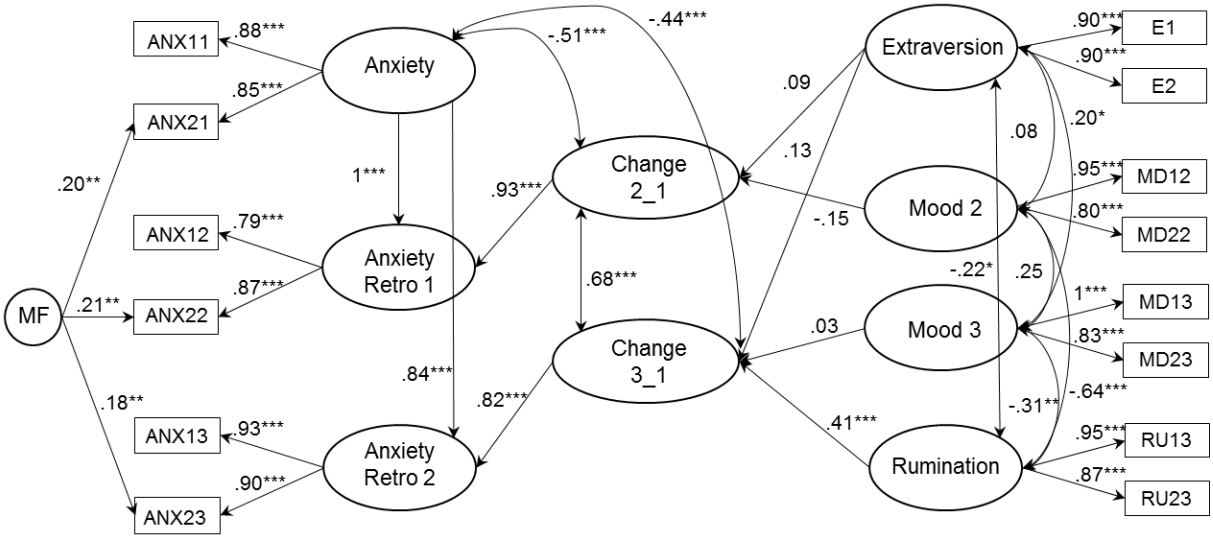
Note. All factor loadings and regression coefficients are standardized; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; MF: Method Factor.

B.8 Linear structural model for social phobia and mood



Note. All factor loadings and regression coefficients are standardized; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; MF: Method Factor.

B.9 Linear structural model for extraversion, mood and rumination



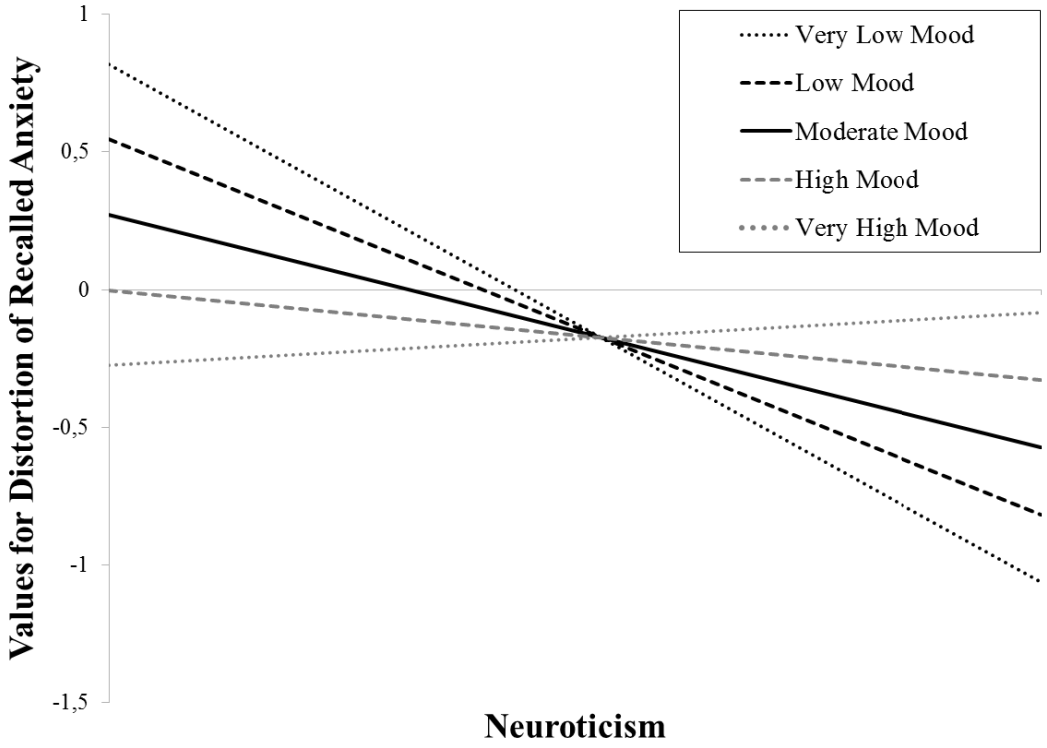
Note. All factor loadings and regression coefficients are standardized; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; MF: Method Factor.

B.10 Statistics for the Simple Slopes of the Interaction between Mood and Neuroticism Predicting Memory Distortion at the second occasion of measurement. The Moderator is Mood.

Values of Moderator	Simple Slopes Statistics		
	b	*t*	*p*
- 2 SD	-0.39	-4.33	.000
- 1 SD	-0.28	-3.83	.000
Mean	-0.18	-2.91	.004
+ 1 SD	-0.07	-1.31	.191
+ 2 SD	0.04	0.79	.430

Note. Degrees of freedom are 137.

B.11 Plot of the simple slopes for the interaction between Mood and Neuroticism



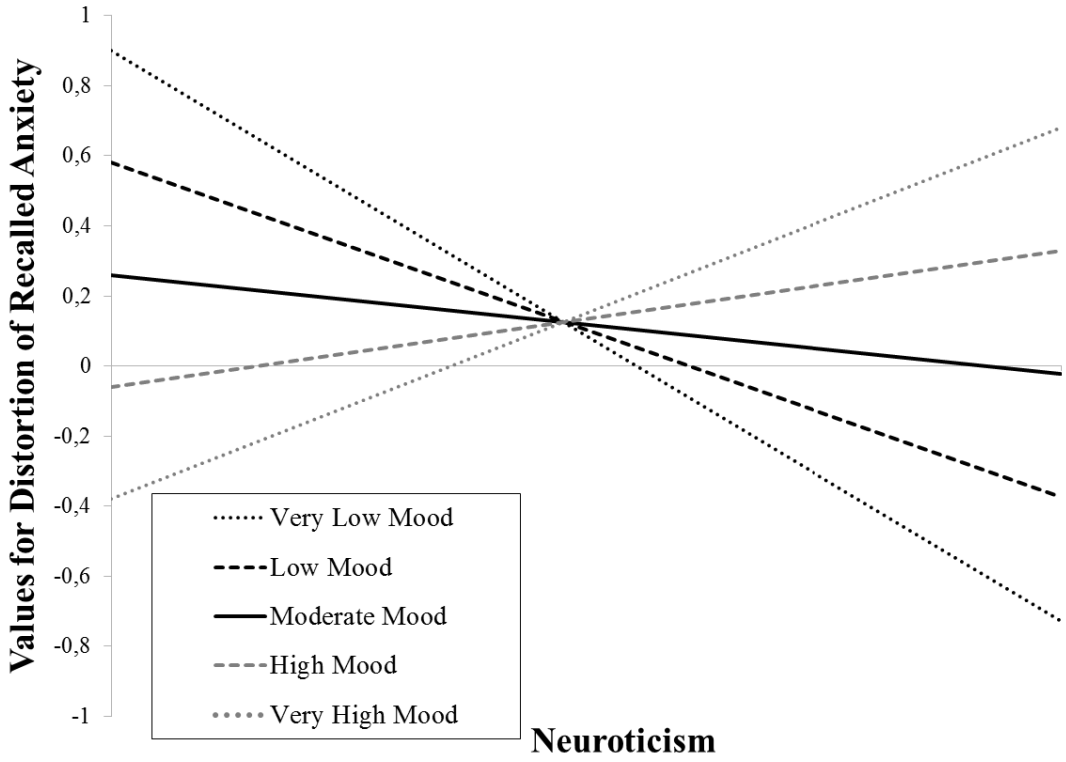
Note. Very low: - 2 SD below the mean, low: -1 SD below the mean, moderate: mean, high: +1 SD above the mean, very high: +2 SD above the mean.

B.12 Statistics for the Simple Slopes of the Interaction between Mood and Neuroticism Predicting Memory Distortion at the third occasion of measurement. The Moderator is Mood.

	Simple Slopes Statistics		
Values of Moderator	*b*	*t*	*p*
- 2 SD	-0.34	-3.05	.003
- 1 SD	-0.20	-2.40	.018
Mean	-0.06	-0.90	.367
+ 1 SD	0.08	1.20	.231
+ 2 SD	0.22	2.52	.013

Note. Degrees of freedom are 137.

B.13 Plot of the simple slopes for the interaction between Mood and Neuroticism.



B.14 Unstandardized Regression coefficients for the linear and the LMS model for neuroticism, mood and rumination

	Difference between Actual and Retrospective Reported Anxiety					
	Change 2_1			Change 3_1		
Models and Predictors	*b*	*SE*	*p*	*b*	*SE*	*p*
Linear Model						
MDBF Actual	-.10	.06	.045	.02	.05	.716
NEO Neuroticism	-.21	.08	.007	-.14	.07	.061
TQ Rumination	*n. i.*	*n. i.*	*n. i.*	.24	.05	.000
LMS Model						
MDBF Actual	-.14	.06	.015	.02	.05	.687
NEO Neuroticism	-.21	.07	.001	-.12	.07	.087
TQ Rumination	*n. i.*	*n. i.*	*n. i.*	.24	.05	.000
MDBF x N	.11	.04	.004	.11	.04	.007
Neuro x Rumination	*n. i.*	*n. i.*	*n. i.*	-.04	.03	.201
MDBF x Rumination	*n. i.*	*n. i.*	*n. i.*	-.02	.05	.653
MDBF x N x Rumi	*n. i.*	*n. i.*	*n. i.*	.00	.03	.957

Note. "MDBF actual" means the assessed mood at the second (Change 2_1) and at the third (Change 3_1) occasion of measurement, respectively; N, neuroticism; b, regression coefficient; n. i., not included in the model.

B.15 Statistics for the Simple Slopes of the Interaction between Mood and Neuroticism for different stages auf Rumination at the third occasion of measurement.

	Simple Slopes Statistics		
Values of Neuroticism	*b*	*t*	*p*
Low Rumination			
- 1 SD	-0.04	-0.59	0.556
Mean	0.06	1.05	0.298
+ 1 SD	0.15	2.64	0.009
Moderate Rumination			
- 1 SD	-0.08	-1.18	0.239
Mean	0.02	0.38	0.703
+ 1 SD	0.12	2.03	0.045
High Rumination			
- 1 SD	-0.12	-1.55	0.123
Mean	-0.02	-0.28	0.779
+ 1 SD	0.08	1.13	0.259

B.16 Unstandardized Regression coefficients for the linear and the LMS model for extraversion

Models and Predictors	Difference between Actual and Retrospective Reported Anxiety					
	Change 2_1			Change 3_1		
	b	*SE*	*p*	*b*	*SE*	*p*
Linear Model						
MDBF Actual	.01	.07	.890	-.03	.06	.576
NEO Extraversion	.03	.06	.584	.01	.07	.937
LMS Model						
MDBF Actual	.09	.07	.895	-.04	.06	.565
NEO Extraversion	.04	.06	.518	.01	.07	.844
MDBF x Extraversion	.10	.04	.020	-.01	.06	.904

Note. "MDBF actual" means the assessed mood at the second (Change 2_1) and at the third (Change 3_1) occasion of measurement, respectively; b, regression coefficient.

B.17 Unstandardized Regression coefficients for the linear and the LMS model for extraversion, mood and rumination

	Difference between Actual and Retrospective Reported Anxiety					
	Change 2_1			Change 3_1		
Models and Predictors	*b*	*SE*	*p*	*b*	*SE*	*p*
Linear Model						
MDBF Actual	-.08	.07	.214	.01	.05	.766
NEO Extraversion	-.05	.06	.423	.08	.09	.361
TQ Rumination	*n. i.*	*n. i.*	*n. i.*	.24	.06	.000
LMS Model						
MDBF Actual	-.08	.08	.314	.02	.08	.810
NEO Extraversion	.08	.07	.253	.12	.07	.063
TQ Rumination	*n. i.*	*n. i.*	*n. i.*	.28	.07	.000
MDBF x E	.08	.07	.243	-.03	.05	.630
Extra x Rumination	*n. i.*	*n. i.*	*n. i.*	.05	.07	.503
MDBF x Rumination	*n. i.*	*n. i.*	*n. i.*	.02	.08	.775
MDBF x E x Rumi	*n. i.*	*n. i.*	*n. i.*	.04	.06	.582

Note. "MDBF actual" means the assessed mood at the second (Change 2_1) and at the third (Change 3_1) occasion of measurement, respectively; E, extraversion; *b*, regression coefficient; n. i., not included in the model.

B.18 Unstandardized Regression coefficients for the linear and the LMS model for social phobia

Models and Predictors	Difference between Actual and Retrospective Reported Anxiety					
	Change 2_1			Change 3_1		
	b	*SE*	*p*	*b*	*SE*	*p*
Linear Model						
MDBF Actual	-.01	.07	.943	-.03	.06	.594
SPIN	-.10	.06	.084	-.05	.06	.390
LMS Model						
MDBF Actual	-.00	.06	.951	-.03	.06	.606
SPIN	-.10	.05	.075	-.05	.06	.387
MDBF x SPIN	.04	.06	.555	.11	.05	.041

Note. "MDBF actual" means the assessed mood at the second (Change 2_1) and at the third (Change 3_1) occasion of measurement, respectively; b, regression coefficient.

B.19 Unstandardized Regression coefficients for the linear and the LMS model for social phobia, mood and rumination

	Difference between Actual and Retrospective Reported Anxiety					
	Change 2_1			Change 3_1		
Models and Predictors	*b*	*SE*	*p*	*b*	*SE*	*p*
Linear Model						
MDBF Actual	-.10	.06	.091	.01	.05	.766
SPIN	-.12	.06	.029	-.16	.07	.023
TQ Rumination	*n. i.*	*n. i.*	*n. i.*	.26	.06	.000
LMS Model						
MDBF Actual	-.09	.05	.021	.01	.05	.778
SPIN	-.12	.06	.099	-.13	.06	.033
TQ Rumination	*n. i.*	*n. i.*	*n. i.*	.27	.06	.000
MDBF x SPIN	.04	.06	.478	.09	.05	.061
SPIN x Rumination	*n. i.*	*n. i.*	*n. i.*	-.06	.04	.075
MDBF x Rumination	*n. i.*	*n. i.*	*n. i.*	-.03	.05	.533
MDBF x SPIN x Rumi	*n. i.*	*n. i.*	*n. i.*	.02	.04	.537

Note. "MDBF actual" means the assessed mood at the second (Change 2_1) and at the third (Change 3_1) occasion of measurement, respectively; *b*, regression coefficient; n. i., not included in the model.

Appendix C - Study 3

C.1 Test Statistics, Degrees of Freedom and Statistical Significances of the Kolmogorov-Smirnov-Test for Normal Distribution

	TS	*df*	*p*
STAI Actual	1.71	53	.006
STAI Retrospective (2)	0.96	53	.321
STAI Retrospective (3)	1.26	52	.082
MDBF Actual (2)	1.21	53	.109
MDBF Actual (3)	1.26	53	.086
NEO Neuroticism	0.66	52	.771
NEO Extraversion	0.68	52	.751
SPIN	0.88	51	.410
TQ Rumination	0.48	52	.977

Note. STAI, State-Trait-Anxiety Inventory; MDBF, Multidimensional Mood Questionnaire; NEO, NEO five-factor inventory; SPIN, Social Phobia Inventory; (2) second occasion of measurement; (3) third occasion of measurement.

C.2 Test Statistics, Degrees of Freedom and Statistical Significances of the Kolmogorov-Smirnov-Test for Normal Distribution

	TS	*df*	*p*
STAI Retrospective (2) – STAI Actual	1.14	53	.146
STAI Retrospective (3) – STAI Actual	1.23	52	.096

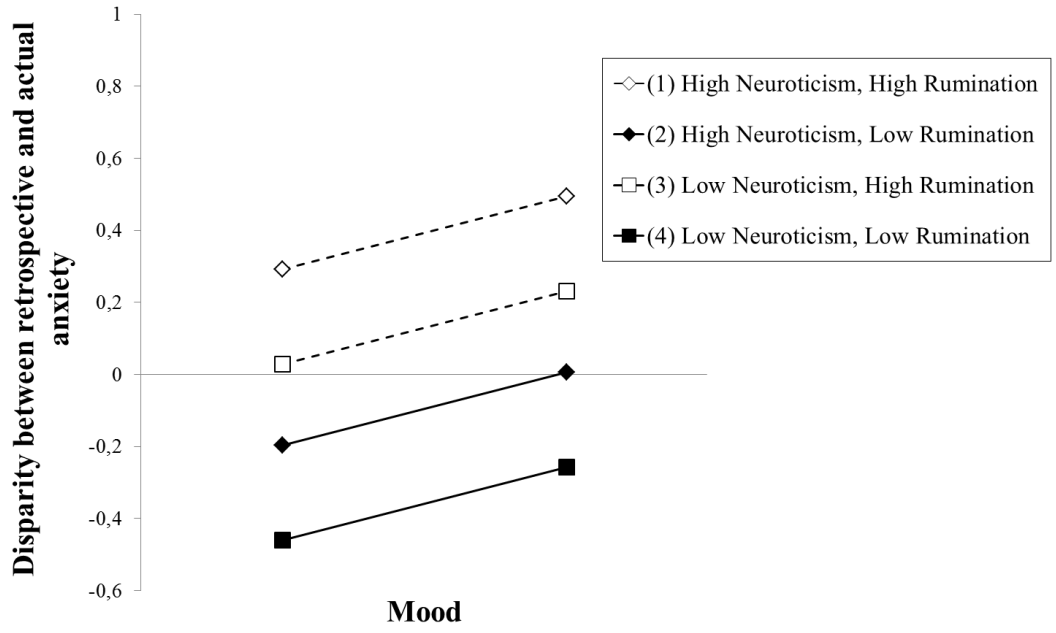
Note. STAI, State-Trait-Anxiety Inventory; (2) second occasion of measurement; (3) third occasion of measurement.

C.3 Bivariate Correlations between HRV values and trait measures

Scale	4	5	6	7	8	9
1. RMSSD Before Talk	.25	.28	-.03	.01	.02	-.01
2. RMSSD During Talk	.17	-.02	.03	-.03	-.03	-.32*
3. RMSSD Recovery	-.08	-.12	.02	-.03	.05	-.20
4. STADI Retrospective (2) – STADI Actual	-	.59**	.02	-.26	.18	.07
5. STADI Retrospective (3) – STADI Actual		-	.14	-.15	.08	.22
6. NEO Neuroticism			-	-.40**	.49**	.14
7. NEO Extraversion				-	-.31*	.13
8. SPIN					-	.17
9. TQ Rumination						-

Note. $^{*}p < .05$; $^{**}p < .01$.

C.4 Regression plot for the regression of memory distortion on mood, neuroticism and rumination after three weeks



Note. Only neuroticism and rumination are significant predictors for this model.

C.5 Statistics for the Simple Slopes of the Interaction between Mood and Neuroticism for different stages auf Rumination at the third occasion of measurement

	Simple Slopes Statistics		
Values of Neuroticism	*b*	*t*	*p*
Low Rumination			
- 2 SD	0.81	1.76	0.086
Mean	0.07	0.49	0.623
+ 2 SD	-0.67	1.79	0.081
Moderate Rumination			
- 2 SD	-0.03	0.21	0.833
Mean	0.07	1.11	0.275
+ 2 SD	0.17	1.55	0.129
High Rumination			
- 2 SD	-0.87	1.73	0.091
Mean	0.07	0.42	0.678
+ 2 SD	1.01	2.97	0.005

C.6 Statistics for the Simple Slopes of the Interaction between Mood and Extraversion for different stages auf Rumination at the third occasion of measurement

	Simple Slopes Statistics		
Values of Extraversion	*b*	*t*	*p*
Low Rumination			
- 2 SD	-.03	0.12	0.906
Mean	.21	1.25	0.217
+ 2 SD	.45	1.30	0.202
Moderate Rumination			
- 2 SD	-.01	0.08	0.937
Mean	.15	2.37	0.023
+ 2 SD	.31	2.00	0.050
High Rumination			
- 2 SD	.01	0.03	0.979
Mean	.09	0.64	0.528
+ 2 SD	.17	0.55	0.586

C.7 Statistics for the Simple Slopes of the Interaction between Mood and Social Phobia for different stages auf Rumination at the third occasion of measurement

	Simple Slopes Statistics		
Values of Social Phobia	*b*	*t*	*p*
Low Rumination			
- 2 SD	0.48	1.59	0.120
Mean	-0.18	1.31	0.199
+ 2 SD	-0.84	2.25	0.030
Moderate Rumination			
- 2 SD	-0.06	0.44	0.666
Mean	0.08	1.46	0.152
+ 2 SD	0.22	1.60	0.119
High Rumination			
- 2 SD	-0.60	1.77	0.085
Mean	0.34	2.07	0.045
+ 2 SD	1.28	2.90	0.006