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Cognitive Bias Modification-Memory: a Computer-Based Emotional Memory Training as Add-On Treatment in Patients with Major Depressive Disorder

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1. Introduction

1.1. Topic and Context

Over the past decade, depression has become the subject of public focus. It was the leading cause of disability worldwide in 2020, according to the Global Burden of Disease Study (Lopez & Murray, 1998). The major symptoms of depression include depressed mood, diminished interest or pleasure in everyday activities, and lack of drive. Secondary symptoms may include feelings of worthlessness, guilt or hopelessness, changes in appetite, sleep disturbances, loss of energy, reduced concentration, indecisiveness, restlessness, and thoughts of self-harm or suicide (American Psychiatric Association, 2013; World Health Organization, 1992). Depression can lead to a significant reduction in not only the quality of life and life expectancy but also productivity; it is a burden for affected families and the social environment (Stoppe et al., 2006).

Driven by the considerable impairments caused by depression on different levels, many efforts have already been made to develop helpful treatment options. Both the American Psychological Association and the Association of the Scientific Medical Societies (Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften) have recommended a number of significant and effective pharmacological and psychotherapeutic approaches and other therapeutic interventions in their treatment guidelines (American Psychological Association, 2019; DGPPN et al., 2015). However, since relapse rates are high for psychotherapeutic and pharmacological treatments (Steinert et al., 2014), no definitive treatment option for depression has been identified. In addition, there is insufficient treatment capacity for existing treatment options with psychotherapy and waiting lists for treatment places are long (BPtK, 2018). Thus, it is important to offer a variety of shorter-term and less invasive interventions to patients in addition to existing treatment options such as psychotherapy and pharmacotherapy. The effects of existing and applied therapies could be enhanced. Short-term interventions would also relieve the suffering of patients who are on waiting lists for treatment.

To develop therapy targets, it is essential to understand the possible causes and mechanisms of depression. Because these are complex, they are not listed in the official, purely descriptive classification systems of the World Health Organisation and the American Psychiatric Association. Therefore, the scientific findings from the abovementioned treatment guidelines are used as a basis for research on a new and optional form of treatment. Although these guidelines do not differentiate between the efficacy (outcome under laboratory conditions), effectiveness (outcome under real-life conditions in clinical practice), or efficiency (view of cost-benefit ratio) of different psychotherapeutic schools, they indicate cognitive behavioural therapy (CBT) as the most researched and operationalized form of treatment for depression (DGPPN et al., 2015). The theoretical basis of CBT for emotional disorders is that cognitive actions play a role in the development of emotional resilience or emotional vulnerability. It is widely known that cognitive biases in the processing of emotional information are an important factor in the development, persistence, and recurrence of

depression. Distorted thinking occurs in different cognitive domains, such as attention, interpretation, and memory. Biased memory of negative emotional information is especially relevant in the onset and maintenance of depression with relatively enhanced memory for emotionally negative information (Beck, 1967; Gotlib & Joormann, 2010; Mathews & MacLeod, 2005; Nolen-Hoeksema, 1991).

1.2. Focus and Scope

In recent years, computer trainings that attempt to modify the abovementioned attention and interpretation biases – a practice known as cognitive bias modification (CBM) – have been developed to address anxiety and depression. A new computer-based CBM training was designed for the present study. The innovation of this work was a focus on reversing negative memory bias. It was also intended to be easily applicable and cost-effective. While comparable trainings have rarely been conducted with patients who are currently suffering from depression, this study focused on a clinical population.

1.3. Relevance

The evaluation of this computer training is relevant because the integration of previous psychological-psychotherapeutic knowledge has been incorporated into its development, and previous findings on cognitive processes affecting memory could be confirmed and extended. It thus contributes to process research. In addition, it can answer questions about the effectiveness of therapeutic options whereby it contributes to outcome research, thereby helping to reduce the problem of the ‘psychotherapeutic care gap’. In today's digitized era, this study adds to the understanding of depressive disorders and modern treatment options.

1.4. Thesis Outline and Reading Order

Understanding the historical development and foundation of the cognitive theories and models used to explain the onset, maintenance, and recurrence of affective disorders such as depression enables the classification of the new training presented in this study according to familiar schools of thought. Therefore, an overview of cognitive models and inherent tendencies to process information – so-called cognitive biases – is provided in the theoretical background in the next section. The latter explains how these biases are related to each other and to emotional imbalance (the main feature of depression) to use them as a basis for the development of a new therapeutic approach: CBM. Since this study is concerned with changes in memory bias, relevant results from previous studies are presented. Rumination is cited and described as a possible mechanism of negative memory bias. Based on these key findings, five main research questions and related hypotheses are derived. In Chapter 2, the development process for the training and the methodology used in the study are described. In Chapter 3, the results of the study are presented. Chapter 4 contains

a discussion based on these results; the main findings are summarized and critically appraised, and the study's limitations are mentioned. Additionally, suggestions for future research are made. The conclusion presents an evaluation of the findings.

1.5. Theoretical Background and Literature Review

Several explanatory models for depression have been proposed, and the CBT approach is based on these. Databases such as PsychInfo were used to search relevant literature on the underlying theories and ideas for these models. Research began with the identification of vulnerability factors for the onset and maintenance of depression.

In his prominent cognitive theory of depression, Beck (1967) stated that automatic negative thoughts and underlying negative assumptions (schemas) about oneself, others, and the future (collectively known as 'the cognitive triad') are acquired in infancy and account for the *onset* of depressed mood.

Teasdale (1988) built on this knowledge with his differential activation hypothesis by contributing to the explanation of the onset and *persistence* of depression as well as its *severity* and *endurance*. He differentiated between onset vulnerability and persistence vulnerability and described a reciprocal relationship not only between dysfunctional cognitive processes and ongoing events (onset vulnerability) but also between dysfunctional cognitive processes and past events (persistence vulnerability). According to Teasdale (1988), once a person is depressed, depression is reinforced and maintained through a vicious cycle of negatively evaluating not only current difficult events, but also past difficult events. This occurs through differential memory recall of global negative self-referential constructs. Singer and Salovey (1988) investigated this idea in greater depth through Bower's (1981) network theory of affect. The latter posits that depressed mood is at the basis of memory retrieval insofar as 'material with affective tone that is congruent with current mood is most easily retrieved from memory'. In other words, once the spiral of depressed mood has been cognitively triggered, mood-congruent negative content is more easily retrieved and leads to further negative thoughts. Thus, cognition and emotion are in a mutually influencing relationship.

This is also supported by the response styles theory (RST) (Nolen-Hoeksema, 1991), which specifies another type of dysfunctional cognition that contributes to the maintenance of depressive mood. It proposes that the way in which people respond to their own depressive indicators influences the duration of these indicators. The duration of depression is longer among people who fixate on their symptoms and their possible causes and consequences than among people who take actions to distract themselves from their symptoms. This is because members of the former group 'allow' their depressed mood to negatively bias their thinking and interfere with instrumental behaviours and problem-solving; this is known as a 'ruminative response style'.

Vulnerability arising from the interaction between dysfunctional cognitive-emotional processes unfolds in the context of the individual's environment. To explain how this vulnerability

is interconnected with the incidents that people encounter, the learned helplessness theory proposes that depression results from the real or perceived absence of control over the outcome of a situation (Miller & Seligman, 1975). Abramson, Metalsky, and Alloy's (1989) hopelessness theory of depression, which builds on the learned helplessness theory, proposes that people are more susceptible to developing depression if a negative life event joins their vulnerability. Cognitively, negative conclusions about the 'causes, consequences, and self-worth implications' of unfavourable events are reached. For example, a detrimental situation, which is seen as being caused by things that will always happen again, leads to more negativity and makes a statement about the worthlessness of that person (e.g., "I failed the exam because I am unintelligent thus, I won't be able to manage my life."). People who experience these thoughts are more likely to be at risk for hopelessness, which is a 'proximal and sufficient cause of depression'.

Over the past three to four decades, the abovementioned theories about cognitive models were developed and have influenced each other. They only partially overlap and have been evaluated, questioned, reviewed, and revised in different research streams. Although few attempts have been made to integrate them, they have all stated that cognitive appraisals determine whether an emotion is experienced and, if so, which one. Thus, emotions can be cognitively regulated. Through this common ground, the theories enabled more precise research into the cognitive processes associated with depression – later known as 'cognitive biases'. In the definition of 'bias', neither accuracy nor imprecision is implied. It is also not about 'wrong' or 'right' information processing of the brain. 'Bias' refers to a tendency to process information in a way that favours certain types of emotional valence or meaning. Mathews and MacLeod (2005) distinguished between multiple types of cognitive processes. Basic cognitive operations such as selective attention, memory, and interpretation, which occur early in the information processing sequence and often independently of consciousness or intention, are distinct from later reportable cognitive products such as rumination (which is explained in more detail below). In depression, bias is evident in all the above areas. A sad mood results in increased attention to negative words (Bradley et al., 1997). Depressed study participants have been found to favour negative information. Rather than enhanced engagement with negative information, they experience impairments in terms of disengagement of attention from the processing of negative information (Gotlib & Joormann, 2010; Koster et al., 2005). Depressed study participants have reported negatively interpreting ambiguous situations (Lawson et al., 2002) and enhanced memory of emotionally negative information (Mathews & MacLeod, 2005). According to the combined cognitive bias hypothesis, biased attention, interpretation, and memory are intertwined and influence each other (Everaert et al., 2012). In their evaluative paper, Hertel and Mathews (2011) concluded that evidence of a negative memory bias is well-established especially for depressed individuals. The latter are more likely to remember negative self-descriptive words and sad faces than healthy individuals. This was confirmed in a study by Vrijsen, Oostrom, et al. (2014). They

found that, in contrast to attention bias, memory bias was particularly associated with previous depressive episodes and might be an indicator of vulnerability to depression.

Although the nature of the dysfunctional link between the cognitive distortions and emotions that underlie depression is not explicitly named by all authors, the question of the causality of this relationship is important in the context of influencing recovery from depression through therapy. Beyond merely measuring and observing biases, several experiments have demonstrated that biases can also be induced or manipulated in non-psychiatric populations. Furthermore, it has been shown that through inducing a bias, emotional vulnerability to stress can also be induced (Mathews & MacLeod, 2002).

A decade after the first studies on the manipulability of cognitive biases and emotional vulnerability were published, a meta-analysis by Hallion and Ruscio (2011) summarized studies that manipulated familiar biases not only in non-clinical patients but also in psychiatric patients. Several previously validated procedures (e.g., the dot-probe task) were changed and new paradigms were developed with the intention of changing particular styles of cognitive processing that are considered to contribute to undesirable emotional reactions or disorders. As a result, a new approach called 'cognitive bias modification' was established by using systematic practices in alternative processing styles. However, in Hallion and Ruscio's (2011) meta-analysis, only CBM procedures related to attention and interpretation bias were evaluated, mostly among anxiety-prone individuals. The authors found that CBM exerted a small and positive effect on anxiety and depression symptoms. Beard et al. (2012) conducted a meta-analysis that confirmed this finding. They found small effect sizes with regard to changes in emotional states through CBM and an effect on bias, which means that the manipulation procedure worked. However, a difference between this meta-analysis and that of Hallion and Ruscio (2011) was that it only included attention bias procedures. In addition, Cristea et al. (2015) obtained contradictory results and did not find any effects of CBM in their own meta-analysis. They cited possible explanations, including low study quality, the inclusion of non-clinical samples in some studies (although intending to represent therapeutic interventions for clinical purposes), a lack of clear description of underlying mechanisms, the heterogeneity of modification procedures and thus non-comparability of processes, and publication bias. Moreover, no CBM memory studies were included in this meta-analysis.

Thus, some studies confirm the functionality of CBM, while others refute it. However, the current body of literature on the malleability of biases and emotional states has only referred to attentional and interpretive biases to date. Since memory bias is inherent to depression, the final disutility of CBM memory is debatable and the question of how memory bias could be changed remains unresolved. The few existing CBM memory procedures mainly work through the mechanism of manipulated interpretation processes, because attentional and interpretative biases influence what is recognized and memorized (according to the combined cognitive bias hypothesis).

Hertel and Mathews (2011) called for the development of new and direct CBM memory paradigms ‘either to alter the contents of memory, to impair memory for the undesirable thought or event, or to improve memory for the desirable thought or event’. Becker et al. (2015) conducted an evaluation of computerized CBM memory interventions in a review. They stated that there are different kinds of memory trainings. General memory trainings that target the improvement of working memory functioning respectively the improvement of an absence of functioning, rather than changing a dysfunction of working memory. In contrast there is a different kind of training that targets biased long-term memory processing (i.e., change a ‘dysfunction’ resp. bias). On the one hand these latter work through modification of other cognitive domains (see above). On the other hand, there are emotional memory trainings that directly target biased memory processing. While general memory trainings use non-emotional material to improve working memory functioning, emotional memory trainings seek to attenuate memory biases through emotional stimuli. According to Becker et al. (2015), ‘unsuccessful emotional memory suppression might be a core process in depressive rumination, providing an alternative during suppressing recall of negative material might be a successful strategy to alter emotional memory’. With this statement, they confirm Hertel and Mathews (2011) and suggest the usefulness of a paradigm that changes negative memory content by replacing the negative content with more functional content. The authors also suggest that an active way of interrupting subjects from recalling negative material seems more promising than a passive way. Specifically, this could work through providing a functional substitute and an alternative way of supressing rather than distracting subjects from negative content or ‘simply’ asking them to forget negative content.

When designing new paradigms, it is thus important to address possible mechanisms that contribute to memory biases. Gotlib and Joormann (2010) identified ruminative responses to negative mood states and negative life events as a potential link between biased attentional, interpretational and memory processes and emotional deviation in depression, among other mechanisms. To define ‘ruminative responses’ one can look at the word origin. The word ‘rumination’ comes from the Latin verb *ruminates*, which means ‘to think deeply’ but also ‘to chew the cud’ so to repeat a thought over and over again. As indicated above, defines RST rumination as repeated mental preoccupation with the symptoms of one's own depressive illness or negative condition. Rumination is regarded as a dysfunctional emotion regulation strategy. According to Marchetti et al. (2018), can rumination be seen in terms of both a state and a trait.

> Rumination has been viewed as a state episode or a temporary cognitive response that is highly dependent on situational cues and may be triggered by momentary perceived discrepancies between one’s goals and current state. Moreover, confirming its momentary nature, state rumination appears to fluctuate over the day, with a decrease at midday and an increase in the morning and evening. (Marchetti et al., 2018)

Alternatively, rumination can be seen as a trait or ‘a habitual tendency to engage in repetitive and passive self-focus in response to depressed mood’. A ruminative retrieval process of information from memory thus concerns the content and form of thoughts. The content is negative and centred on problems, the form is repetitive, rotatory or circling, abstract and automatic.

Specifically, it has been shown that difficulty in removing negative and irrelevant words from working memory is highly correlated with self-reported rumination (Joormann & Gotlib, 2008), that dysphoric participants who are induced to ruminate report more negative interpretations of hypothetical situations and use less effective problem-solving strategies (Lyubomirsky & Nolen-Hoeksema, 1995), and that the occurrence of mood-congruent memory retrieval as opposed to mood-repair processes is critically determined by dysphoria and rumination (Joormann & Siemer, 2004). Experimental studies have also demonstrated the causal role of rumination in generalized autobiographical memory (Watkins & Teasdale, 2001, 2004). Thus, the link between depressed mood and mood-congruent negative memories (i.e., biased memory) may function via the repeated recollection of negative aspects (i.e., rumination; see RST by Nolen-Hoeksema (1991)). Repeatedly recalling positive aspects could thus be helpful in reversing a negative bias.

Vrijsen, Becker, et al. (2014) attempted to use these implications in direct memory practice. They created a new cued emotional retrieval training. By using verbal information with a positive or negative emotional valence, they aimed to establish a training-congruent mode of processing – in other words, a bias in one direction or the other. In the training, participants were expected to memorize 10 positive and 10 negative words. After the memorizing phase, they were repeatedly shown fragments of these words. To acquire a bias in a particular direction, participants had to complete fragments of either positive or negative words by recalling the whole word and write it down. To measure whether the induction of bias worked, after the training, participants were asked to write down as many words they could remember, by freely recalling them. After repeated retrieval through completing the word fragments, global increases in the training-congruent accessibility of negative information in memory were observed. Participants in a community sample in a negative learning condition with a pre-existing negative memory bias retrieved more incorrectly negative words (words that were not learned before) than participants in the positive learning condition. However, the researchers could not achieve an effect on specific verbal memory bias (words that were learned before) but found evidence for the principal changeability of the retrieval of emotional memory contents.

Subsequently, a positive memory change was demonstrated in a clinical sample through change of an interpretation bias and corresponding changes in memory bias (Joormann et al., 2015). Vrijsen et al. (2016) aimed to elaborate on the direct modification of memory bias and build on their own results. Beyond increasing the global accessibility of training-congruent emotional information in memory, they tried to evoke specific training-congruent recall. To this end, they developed their earlier idea about cued emotional retrieval. By focusing on cued emotional retrieval practice they

attempted to model emotionally biased retrieval, which, as previously mentioned, is a central element of ruminative episodes and a key characteristic of depression (Nolen-Hoeksema et al., 2008). In contrast to free retrieval, cued retrieval enables specific memory functions. Because the cue has a reference function to another concept (positive or negative), targeted remembering in one direction or another (ergo positive or negative) can be forced. Moreover, Vrijsen et al. (2016) reasoned that 'retrieval practice is not only a process of interest because of its association with rumination; basic cognitive psychological research consistently showed that retrieval practice also serves to enhance performance on later tests of memory'. In this regard Vrijsen et al. (2016) refer to Karpicke and Roediger (2008), who have shown that repeated tests (retrieval practice or training) but not repeated study episodes (memorize) facilitate recall a week later. Thereby, each retrieval opportunity influences the later recall of the material. In their 2016 study, Vrijsen et al.'s objective was to mimic or oppose rumination as a mechanism of negative memory bias in healthy individuals. The retrieval practice simulated a resilient thinking style in the positive training condition, whereas the training aimed to induce a ruminative bias in the negative training condition. Therefore, the training contained a study phase, in which the participants were asked to memorize emotional word pairs (20 positive, 20 negative). That was followed by a cued retrieval task of only the training-congruent word pairs. In a test phase 10 positive and 10 negative cues were given for bias assessment. The results of this study showed specific training-congruent recall of word pairs, which indicated the successful induction of a training-congruent bias. Furthermore, the positive retrieval practice resulted in a stable positive mood, whereas participants in the negative condition experienced a decline in mood. In addition, evidence of cognitive transfer was shown through congruent valence of a freely recalled life event (i.e., the chance that participants recalled more positive life events was higher when they recalled more positive word pairs and lower when they recalled more negative word pairs). Most strikingly, the effects of the training remained present at the one-week follow-up.

Hertel et al. (2017) tied in with the idea of practicing negative recall to map the aspect of habit in rumination. They chose a similar methodology as Vrijsen et al. (2016) and stratified their sample along the vulnerability factor of rumination. They found in their student sample with high vs. low ruminators, a large practice effect of training congruent recall for both groups and mood improvement for high ruminators who practiced positive pairs. The researchers concluded that, positive retrieval practice has a counteractive effect on ruminative recall and depressive mood. They stated that 'repetitive positive retrieval shows promise in counteracting ruminative recall and its consequences'.

In recent years, there has been increasing evidence that CBM memory training through the methodology of cued retrieval practice leads to both specific training-congruent biases and transfer products, such as altered mood and training-congruent everyday biases. Building on response style theory (Nolen-Hoeksema, 1991) and underlining the automatic and thus habitual aspect of rumination (Watkins & Nolen-Hoeksema, 2014), retrieval practice (resp. training) may act as a form

of habit reversal. This might be accomplished by allowing participants to engage in a specific cognitive action that replaces rumination. Cued repetitive positive retrieval might serve as an incompatible and competing response to rumination (by reciprocal inhibition). Through repeated remembering (i.e., cued retrieval) rather than simple memorization, the consolidation of material in memory is facilitated (Karpicke & Roediger, 2008). Combined with the induction of positive stimulus content, these mechanisms might be the helpful components in CBM memory. As in standard psychological treatment of depression, the intervention is cognitive but on a different, automatic level (Hertel & Mathews, 2011). In summary, memory bias may be influenced by change of both: *content* of thought during retrieval (i.e., positive, solution-centred thoughts, for example *positive* word pairs rather than negative and problem centred thoughts like in rumination) and *form* of thought during retrieval (*specific* thoughts for example word pairs, rather than abstract thoughts like 'Why do I feel depressed?').

Because non-clinical populations were involved in the above-cited studies, it remains unclear whether the results also apply to clinical populations and specifically to depressed patients, as opposed to healthy subjects or subjects who are at increased risk for depression. Furthermore, due to the inclusion of healthy individuals, mood was previously measured by directly asking participants about it rather than in the form of symptom questionnaires. Therefore, a change in mood that manifests itself through a change in symptoms would be interesting for clinical effects of CBM. Furthermore, it remains unclear whether rumination could be a potential target for training in a patient population.

Thus, the CBM memory training presented in this thesis is based on earlier paradigms (Vrijsen, Becker, et al., 2014; Vrijsen et al., 2016) and is designed to induce a positive memory bias with retrieval practice (cued repetitive positive retrieval). Its aim is to change the negative content of thought and dysfunctional form of recalled thoughts (i.e., rumination) in an in-patient population that includes participants with depression. This new and computer-based CBM memory training was tested in a randomized controlled trial (RCT) in four training sessions over the course of one week. The results of participants in the positive CBM memory training condition (intervention group) were compared to those of participants in a neutral CBM memory training condition (control group). In the positive training group, patients were instructed to retrieve positive verbal information, while participants in the neutral training group were advised to retrieve neutral verbal information. Main effects were assessed through changes in symptom levels and rumination.

1.6. Derived Study Objectives

To date, evaluations of CBM have focused mostly on the changeability of biases and moods. This training aims to go beyond these two steps. It aims to explore possible immediate therapeutic effects in the form of reduced depressive symptoms as well as deeper therapeutic effects such as increased positive memories. In addition, the role of rumination, as a mechanism of depressed mood

will be clarified as a possible starting point for CBM. This training could contribute to the development of a new therapeutic agent.

1.7. Research Questions and Hypotheses

Based on available knowledge about the role of rumination in memory bias and depressive symptomatology, the following five research questions and associated hypotheses were posed. There is one main research question and four sub-research questions.

- Research question 1 (main research question): Will patients in the positive CBM training condition (intervention group) show a significant decrease in depressive symptoms in contrast to participants in the neutral condition (control group), as measured through clinician and self-ratings? A greater decrease in symptoms was expected for participants in the positive training condition in contrast to participants of the neutral training condition, as assumed in a similar study by Vrijsen et al. (2018).

Because rumination can be differentiated into a state and a trait (Marchetti et al., 2018), the second and third research questions concerned the topic of rumination.

- Research question 2: Will a trait-like ruminative mindset be changed through the positive CBM memory training and can a subsequent reduction in this pattern of thinking be observed? Again, a greater decrease in trait rumination was expected for participants in the positive training group than for participants in the neutral training group.
- Research question 3: Will positive CBM memory training immediately reduce state-like rumination and thus depressive symptoms? According to Spasojevic and Alloy (2001), rumination mediates between depressive risk factors and depression. This finding, in combination with the expectation that CBM memory training could reverse the ruminative habit and thereby lead to a reduction in depressive symptoms, led to the analysis of state rumination as a mediator.
- Research question 4: Will the positive CBM memory training affect autobiographical memory as a transfer of training to real-life emotional memory performance, as mentioned in Vrijsen et al. (2016)? It was expected that more participants in the positive training condition (intervention group) would recall a positive life event and a positive recent event than participants in the neutral training condition (control group) (Everaert et al., 2012; Vrijsen et al., 2016).
- Research question 5: Will CBM memory training achieve the aim of inducing a positive memory bias, resulting in the condition-congruent recall of verbal information like in Hertel et al. (2017) and Vrijsen et al. (2016)? It was expected that participants in the positive training condition would remember more positive than neutral content and that

participants in the neutral training condition would remember more neutral than positive content.

2. Methodology

2.1. Design of the Training Procedure

A new computer-based CBM memory training for treatment of participants during 4 sessions on the course of one week was created for evaluation in this study. For this purpose, previous paradigms from the studies of Vrijsen, Becker, et al. (2014) and Vrijsen et al. (2016) were used as a basis. In general, the training consists of 3 phases. The first phase (study phase) is about memorizing verbal stimulus material. The second phase (practice phase) is about retrieving verbal stimulus material. The third and last phase (test phase) is again about retrieving verbal stimulus material. Retrieving stimulus material is used for different purposes. In the practice phase, retrieval serves the purpose to acquire a bias in a certain direction. In the test phase, retrieval serves the purpose of assessing the previously acquired bias. Because this is an emotional memory training, emotionally ‘loaded’ stimulus material was used. To utilize the aspect of 'cued repetitive retrieval', word pairs were created consisting of a cue word and a target word. Like the whole paradigm, also the stimulus material was based on previous CBM memory trainings, including the German adaptation of Affective Norms for English Words (ANEW) (Schmidtke et al., 2014) and the Berlin Affective Word List Reloaded (BAWL-R) (Vo et al., 2009). The BAWL-R contains words with positive, neutral, and negative valences. For the cued retrieval training, word pairs had to be generated. Therefore, a neutral word was paired with an emotionally valenced word. The neutral word thereby served as cue for the emotional target word. Words were selected on the strength of emotional valence scores. For obtaining valence ratings for words, participants in the evaluation study of the BAWL-R were presented with the verbal anchors ‘positive’ and ‘negative’, defining the ends of a bipolar scale ranging from −3 to +3, with ‘neutral’ (0) in the centre. For this study, very positive words (+3) were used as positive target words, very negative words (-3) were used as negative target words, and words without a specific valence (0) were used as neutral cue and target words. Word pairs were matched according to associative conjunction. Three types of word pairs were created. For positive training, a neutral cue word was paired with a positive target word. For neutral training, a neutral cue word was paired with a neutral target word. Additionally, word pairs were created in which a neutral cue word was paired with a negative target word. The purpose of the negative pairs was to check, whether participants intrusively confabulated or retrieved negative target words even though they had practiced only neutral or positive target words. Negative word pairs were therefore only used in the first phase of the study (study phase), which was concerned with learning the word pairs but not with practicing the word pairs. By

enhanced exposure (practice phase) to either neutral/positive or neutral/neutral combinations through the retrieval of only either positive or neutral target words, a condition-congruent bias should be induced. In the positive training condition, only positive target words were asked to recall by presentation of the corresponding neutral cues, respectively in the neutral condition. Participants were instructed to type in the target words that corresponded with the presented neutral cues. The Programming for the training software was performed in E-Prime by Janna Vrijsen.

A pilot study was conducted to test the comprehensibility and feasibility of the designed tasks and to indicate the direction of effects to lay the foundation for a highly efficacious and effective CBM memory training (Onken et al., 2014). A five-month period was needed to tailor the CBM memory training to the patient population from the LVR Clinic Essen. Modifications made in the pre-pilot and three pilot stages are described and evaluated hereafter. The pilot studies answered the question, which adjustments had to be taken to develop a promising CBM memory training that was able to induce a positive memory bias to eventually reduce the severity of depressive symptoms.

The word pairs used in the training always contained an equal number of neutral, positive, and negative combinations. Valences were equally distributed among the intervention and control group. In addition to the number of word pairs, several characteristics of the training configuration like repetitions of memorizing and practicing and the duration of presentation and retrieval times had to be adjusted over the pre-pilot and three pilot stages (see Table 1).

Table 1: Overview of Differences Between the Pre-Pilot and Three Pilot Versions of the Cognitive Bias Modification Memory Training

Version	Number of word pairs to memorize in the study phase	Presentation time per word pair (in seconds) in the study phase	Number of words pairs to retrieve in the practice phase	Retrieval time for target words in the practice phase	Repetitions of the study and practice phases	Distraction time (in seconds) between study and practice phase
Pre-pilot	45	10	15	12	3	30
1	51	10	17	12	3	30
2	51	5	17	10	2	60
3	144 (36 per day)	5	12	10	2	60

- **Pre-pilot**: The basic version of the training consisted of a list of 45 word pairs. In this basic version, study, practice, and test phases were executed on all four training days. During the study phase, the participants were required to memorize the list of 45 word pairs. The word pairs were consecutively shown on the computer screen for a duration of 10 seconds. Between the study and practice phases, participants were required to engage in a distraction task in the form of addition calculations for 30 seconds. To induce a condition-congruent bias in the subsequent practice phase, neutral cue words were used as a prime to enable participants to retrieve target words of the corresponding valence. In this way, it was possible to induce a bias and boost learning and memory consolidation in the intended direction. The participants had 12 seconds to type in the corresponding words. During this run, the training contained three consecutive study and practice phases in which the word pairs were offered in the same order. Then, a daily distraction phase of 240 seconds took place, in which the participants had to solve as many Raven puzzles as possible. Standard and advanced progressive Raven matrices (Bulheller & Häcker, 1998; Raven J.C., 1996) were used to induce a distraction effect, ensure memory consolidation, and minimize negative effects on the mood of participants that could result from an exhausting training. Next, a test phase took place for bias assessment. The list of all 45 cue words was presented, and participants were asked to type in all the target words, irrespective of valence. The basic version was pre-tested by three patients in terms of comprehensibility and possible mistakes in the description of the tasks. After the mistakes were corrected and the recommendations were implemented, another patient pre-tested a complete run of the computer training. Each training session lasted approximately 35 minutes. The participants gave the feedback that the training was too easy.
- **First pilot version of the training**: After the pre-pilot, six word pairs were added to the training to raise its difficulty. Thus, the first pilot version contained a total of 51 word pairs to learn. One patient in each of the two conditions (positive training vs. neutral training) tested this version. The daily training procedure lasted approximately 45 minutes. Participants were still able to remember all the word pairs. Thus, a ‘ceiling learning effect’ occurred. That means, there was no possibility for participants to learn even more pairs, in order to increase the strength of the to be induced bias. However, it was aimed that no learning saturation occurs to

promote the greatest possible bias induction. In the second pilot version, again modifications were made to increase the difficulty of the training.

- **Second pilot version of the training**: The second version of the training was piloted by two other participants. The number of repetitions and presentation, distraction, and retrieval times were changed. The study phase was shortened, with word pairs only shown for five seconds. The distraction task in the form of addition calculations was prolonged to 60 seconds, and the retrieval time for target words in the subsequent practice phase was shortened to 10 seconds. In contrast to the first version, participants only underwent two consecutive study and practice phases. At the end of each training, the participants had to recall the 51 target words in the test phase for bias assessment.
- **Third pilot version of the training**: Despite the increased difficulty, the ceiling learning effect remained in the second pilot version of the training. Therefore, the word list was expanded to a total of 144 word pairs (48 word pair combinations of each valence). The third version was also piloted by two participants to enable each condition (positive training vs. neutral training) to be tested. In this version, each training day consisted of two consecutive study phases, containing 36 word pairs. As mentioned before, one third of the target words had a clear positive valence, one third had a neutral valence, and one third had a distinct negative valence. During the practice phases, patients had to recall 12 target words of the allocated positive or neutral valence. The presentation of the cue words was randomized over four versions per condition (for the four consecutive training days) to neutralize possible order effects. Study, distraction, and practice times stayed the same as in the second version of the training. After the two consecutive study and practice phases, the distraction and test phases (bias assessment) were removed from the daily training procedure in the third version of the training to shorten sessions to 30 minutes. The test phase for bias assessment only took place on the fourth day of training (post). Therefore, participants were asked to retrieve the entire list of 144 cue words. In the test phase for the third pilot, participants were asked to type in the 36 word pairs that were learned and practiced on the fourth day of training, followed by the word pairs from the other three days of training in random order.

At follow-up one week after the last training session, only a test phase took place. Participants were shown all the cue words and had to retrieve all the target words that they remembered from the initial trainings.

2.1.1.Final Training Procedure and Data Collection Steps

The third pilot version became the final CBM memory training (see Figure 1).

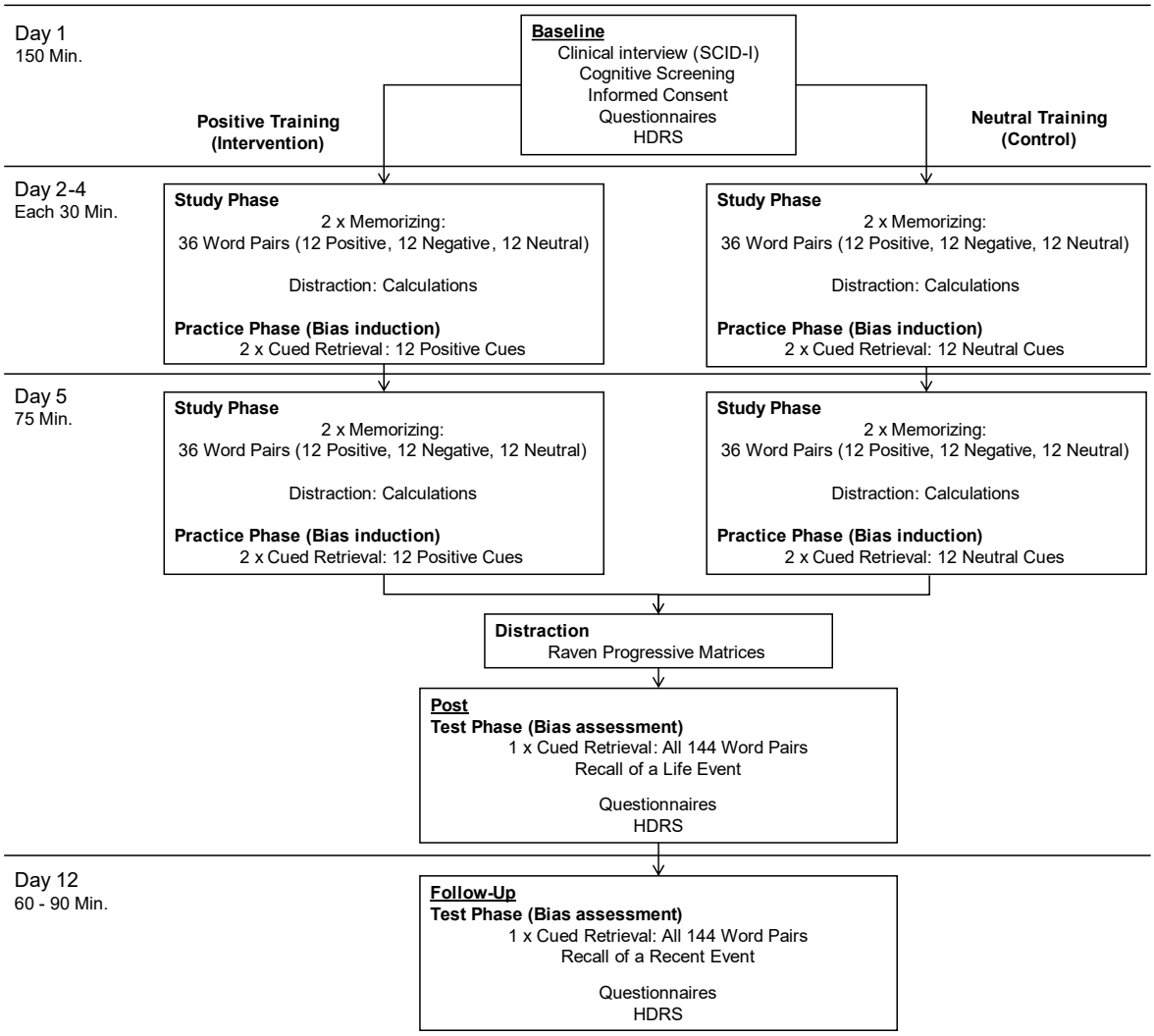

Figure 1: Overview of Final Cognitive Bias Modification Memory Training Procedure

On day 1, the intake assessments took place (see section 2.2 for detailed description). Additionally, participants filled out the baseline questionnaires. The assessments lasted around two and a half hours. After that, the data collection phase was divided into four training sessions on consecutive days (day 2 – 5). The four training days lasted about 30 minutes. On the fourth training day (day 5), in addition to the training, outcome measures were taken. Due to the post-measurements, the fifth day took 45 minutes in addition to the 30-minute training session. The follow-up took place one week after the last training session (day 12). First, the cued-retrieval test of all word pairs was absolved, then dependent variables were assessed. The session took about 60 to 90 minutes.

The outcome measures were assessed at three points in the study: before the training (baseline), after four training sessions (post), and one week after the final training (follow-up).

Outcome variables for mood and rumination were scores on two symptom questionnaires (the BDI-II and HRSD, described in section 2.5) and rumination questionnaires (the RSQ and the MRSI, described in section 2.5). Outcome measures for training success (i.e., bias induction) were computer data in form of correctly remembered and typed in (on the computer keyboard) word pairs. Outcome measure for a real-life emotional memory performance was the free recall of an emotional life and a recent event. Participants were asked to indicate how positive or negative these events had been to them. After completion patients were thanked and debriefed.

The training sessions took place on a computer in an office room of the LVR Clinic Essen. It was endeavoured to keep the training location and time of assessment constant, although local conditions and participants' therapy agendas occasionally interfered. While patients participated in the CBM memory training, detailed onscreen instructions were given (see Appendix I for an exemplary part of the instructions), which explained the different tasks and guided the participants through the training. In addition, a master's student researcher was present the whole time for guidance through the complete procedure (computer tasks, paper pencil questionnaire survey) and for answering questions if necessary. Within the computer program, the tasks were presented to participants with a white-on-black interface. During study and practice phases a single word pair was shown at the centre of a black screen (see Figure 2). In Figure 2, three word pairs are shown for the screen simulations of the 'study phase'. This is to show that the three types of word pairs (positive, neutral, and negative) were studied. In the actual training, the three types of word pairs were shown one after the other.

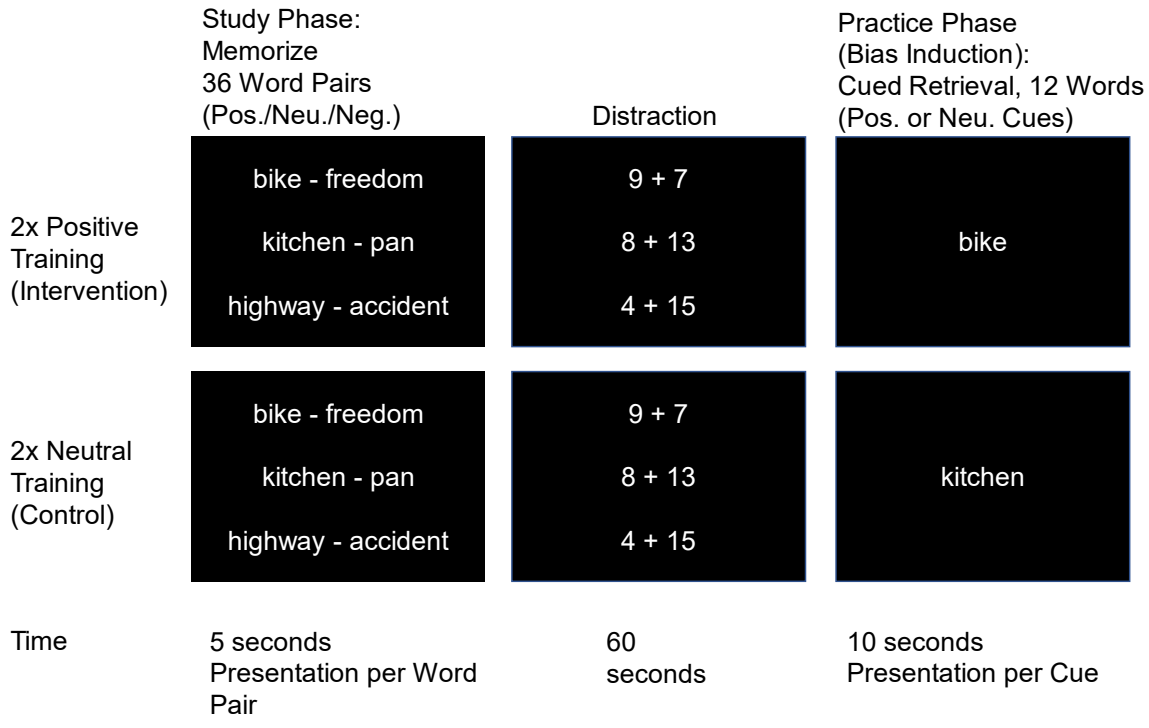

Figure 2: Example of One Day CBM Computer Training (Exemplary Simulation of PC Screen).

2.2. Recruitment and Inclusion of Participants

After the pilot stages, the recruitment and selection process for the main study began, (see Figure 3).

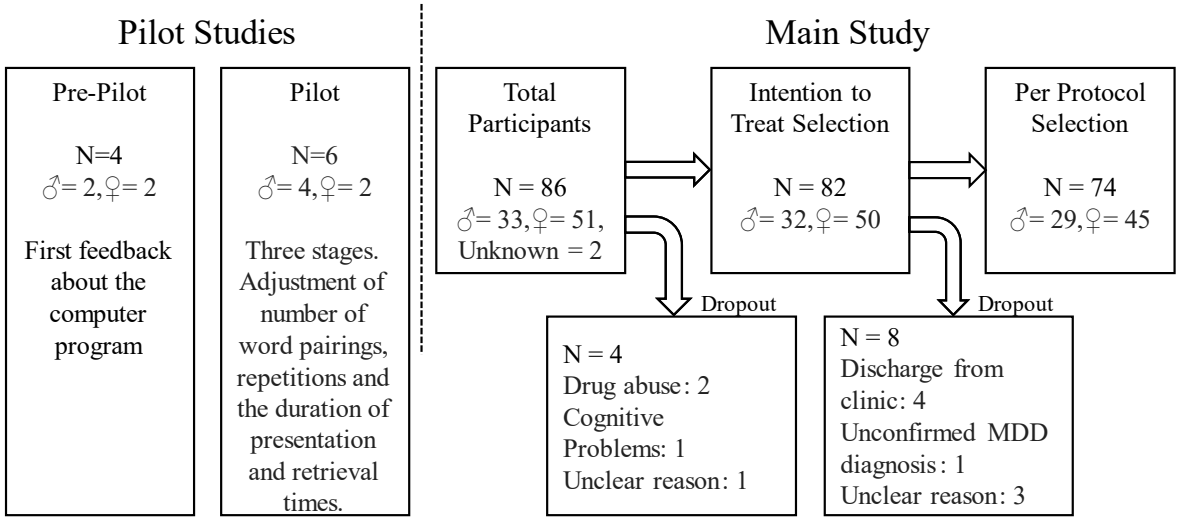

Figure 3: Overview of Recruitment and Selection Process for the Randomized Controlled Trial

The initial selection of participants was based on the main diagnosis registered in the clinical documentation system. Participants were personally recruited by the study investigator or one of the master's student researchers providing written participant information. Then the patients provided their written informed consent to participate in the study. To ensure eligibility, the intake began with a clinical assessment. The main diagnosis of major depressive disorder (MDD) was confirmed using the Structured Clinical Interview I– SCID-I for the Diagnostical and Statistical Manual-IV (DSM-IV) (Wittchen et al., 1999). Diagnostic criteria were adapted to the actual Diagnostical and Statistical Manual-V (DSM-V) (American Psychiatric Association, 2013) and ICD-10 criteria. A cognitive screening, including a memory assessment, was performed using the Mehrfachwahl-Wortschatztest (MWT-B) and the Syndrom-Kurz-Test (SKT) (see section 2.5). A supervised master's student researcher implemented the interview and tests. If in doubt about ratings, they consulted with the study investigator. At first 86 participants were included in the main sample. Four of these were excluded after the clinical assessment. The remaining 82 patients were randomly assigned to a condition. The study investigator assessed the level of depressive symptomatology using the Hamilton Depression Rating Scale (HDRS) (Hamilton M., 1960), see section 2.5 for detailed description. All HDRS measurements (baseline, post, and follow-up) were exclusively taken by the study investigator who was double blinded to each participant's condition. Before the data were analysed inclusion criteria and necessary measures were checked again for the remaining 82 participants. After that, two different sample selections were made (see section 2.6).

2.3. General Regulations

In conformance with the ethical principles of the Declaration of Helsinki, participants were recruited from the open wards and day clinic at the Division for Psychiatry and Psychotherapy at the LVR Clinic Essen. The latter is part of the Faculty of Medicine at the University of Duisburg-Essen. Official approval from the responsible ethics commission was obtained before the beginning of the study. The study was conducted by a trained psychologist (study investigator) who worked on one of the open wards. Assistance was provided by master's student researchers from the Department of Psychiatry and Psychotherapy at the LVR Clinic Essen as well as of the University of Duisburg-Essen, and the Department of Psychiatry at the Radboud University Medical Centre in Nijmegen. The project was funded by the Euregio Rhein-Waal, INTERREG V Deutschland-Nederland WP7 grant from the Ministry of Economic Affairs, Innovation, Digitalisation and Energy of the State of North Rhine-Westphalia to J.N. Vrijsen, B.W. Müller, and I. Tendolkar.

2.4. Participants

Participants were informed of any scheduled measurements by one of the master's student researchers and received a written information sheet about them. Patients were required to provide their written informed consent for participation and data handling within the study (see Appendix A). Study-related data were pseudonymised. Personal data and individual test results were kept confidential at the clinic, will be archived for 15 years, and will not be disclosed to third parties. Patients voluntarily participated in the study and did not receive any monetary reward or any other kind of reimbursement. Travel costs were not incurred, because the participants were all hospitalized or day clinic patients.

Exclusion criteria included acute severe psychiatric diseases other than a current episode of depressive or mood disorder (e.g., sleep disorder, psychosis, or substance misuse or dependency), major neurological or somatic disorders (including ischemic or haemorrhagic insults) in the patient's history, endocrinological diseases (e.g., thyroid dysfunction, hypercortisolism, or adrenal dysfunction), and febrile illness within the three days before participation in the study. In addition, patients with severe cognitive impairments – as assessed through the Syndrom-Kurz-Test (SKT) – and an intelligence quotient (IQ) of less than 70 – as assessed through the Mehrfachwahl-Wortschatztest – MWT-B (Lehrl et al., 1991) – were not included.

The CBM memory training was added to the treatment as usual (TAU). All patients were integrated into a normal clinical treatment routine consisting of one psychotherapy session per week, one open group therapy session, psychoeducational group sessions on depression, and several other indicational treatments, such as occupational therapy (ergotherapy), musical therapy, physical therapy, social competence training, and mindfulness-based groups. Study participation or drop-out

did not affect patients' primary psychiatric treatment in any way. Researchers did not interfere with TAU, and the CBM memory training was not expected to interfere with TAU.

The health risk to participating study volunteers was deemed to be extremely low. Therefore, the possible benefit of the CBM memory training must be stressed. The positive CBM memory training with positive content was expected to yield the strongest beneficial effects on depressive symptoms. However, the neutral CBM memory training was also expected to yield clinically relevant results because it would similarly require patients to train their memory processing. While a distinction was made between training memory for positive and neutral verbal content, training-related adverse events were not expected to occur. In consideration of patient safety, a negative verbal content practice condition was omitted from the study. Participants were informed in advance of their right to withdraw their participation at any time without any consequences on their psychiatric treatment. After the completion of the study, subjects were informed about their experimental condition (i.e., positive vs. neutral training). If the patient was part of the neutral training, they were offered the opportunity to also participate in the positive training. If the patient was part of the positive training, it was also possible continuing the positive training after the study. Although participants were given these options, none chose to do so.

Patients were asked for information on their demographic background (see Table 2). In total, 70 of the 82 participants spoke German as their native language. Two patients each spoke Polish and Turkish. One patient each listed Bulgarian, Croatian, Portuguese, and Russian as their native language, while four patients did not provide any information about the latter. However, all participants were fluent German speakers. Due to oversight, from participant no. 60 onwards, documentation of comorbid diagnoses was mostly missing. Therefore, comorbid diagnoses were not included as a covariate variable and did not affect the analysis per se. However, because comorbid diagnoses were not included as a confounding variable, they may be part of the error variance.

Table 2: Counts (N) for Sociodemographic Variables of ITT Selection.

Gender	Male	32
	Female	50
Language	German	70
	Other	12
Diagnoses:		
Depression	Single Episode	47
	Recurrent	30
	Unknown	5
Comorbidity with	History of substance misuse/dependency	3
	Double Depression/Dysthymia	3
	Anxiety Disorder	23
	Trauma and Stress Related Disorder	3
	Eating Disorder	7
	Somatic Symptom Disorder	2
	Personality Disorder	5
Medication at baseline	No Medication	28
	Antidepressant	36
	Antidepressant combined with Neuroleptics, Anxiolytics or Antiepileptics	18
Medication at follow-up	No medication	34
	Antidepressant	27
	Antidepressant combined with Neuroleptics, Anxiolytics or Antiepileptics	21
Educational Level	No graduation certificate	1
	Lower Secondary (Hauptschule & Realschule)	37
	Apprenticeship	13
	Upper Secondary (Abitur)	14
	Tertiary/University Degree	12
	Missing Values	5

2.5. Materials and Data Collection Tools

The study-related assessments included cognitive screenings, symptom interviews, and self-assessment questionnaires. These instruments have all been routinely used in clinical settings. There is no evidence that they cause harm to patients who participate in a study. First, the interview tools and cognitive screenings are described, then the self-assessments.

The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) is an interview that aims to make standardised and accurate diagnoses that incorporate DSM-IV through a systematic probe for symptoms. The SCID-I covers the DSM-IV diagnoses that are most frequently seen by clinicians and includes full diagnostic criteria for these disorders, with corresponding interview questions (Wittchen et al., 1999).

The Hamilton Depression Rating Scale (HDRS) (Hamilton M., 1960) is a clinician-rated semi-structured interview that focuses on the severity of depression. It is used for progress monitoring. Symptom severity is rated on 21 items, with a score range of 0 to 65 on the German version (Collegium Internationale Psychiatriae Scalarum, 2015). Items are rated from 0 to 1, 2, 3, 4 according to the severity of difficulties experienced. The scores are then summed up. However, as the HDRS is used for progress monitoring and not diagnostic purposes, there is no standardized interpretation of score ranges (Möller, 2017). Psychometric properties are adequate (Cusin et al., 2010). For more details, see Appendix B.

The Mehrfachwahl-Wortschatztest-B (MWT-B) is a standardised, multiple-choice-word-test that is used to measure general crystalline intelligence. The B-Form is one of four parallel tests. Since it does not consider the test taker's current mental state, the MWT provides an estimate of premorbid IQ. Scores range from 0 to 37, with higher scores indicating a higher IQ. The authors have stated that there is a possibility of error due to the simplicity of the measurement. Rather than precise IQ values, IQ ranges are given (e.g., scores of 0 to 72 indicates extremely low intelligence, 73 to 90 indicates low intelligence, 91 to 109 indicates average intelligence, 110 to 127 indicates high intelligence, and 128 and over indicates extremely high intelligence), which are inspired by Wechsler's gradation (Lehrl et al., 1991). For more details, see Appendix C.

The Syndrom-Kurz-Test (SKT), or 'syndrome short test', is a simple test for assessing cognitive impairments in memory and attention. It consists of nine subtests, each limited to a maximum performance time of 60 seconds. Scoring the SKT requires converting the raw scores for each subtest into norm values and adding these up into a total score. The latter allows for the interpretation of SKT results based on classifying the total score as typical for one of six degrees of cognitive impairment. As norm values for each subtest range from 0 to 3, SKT total scores vary between 0 and 27, with higher scores indicating more severe cognitive disturbances. In several studies, reliability coefficients (i.e., Cronbach's alpha) between .86 and .93 were found. Studies pertaining to test-retest reliability revealed coefficients between .88 and .90. The validity of the SKT has been demonstrated in numerous studies, indicating substantial correlations between the SKT and

other performance tests that assess cognition, neurophysiological measures and imaging techniques that reflect impaired brain functioning, and clinical global assessments of cognitive decline (Lehfeld & Erzigkeit, 1997). For more details, see Appendix D.

The Becks Depression Inventory-II (BDI-II) is a 21-item depression questionnaire that assesses overall symptom severity experienced in the past two weeks on a four-point Likert scale, with scores ranging from 0 to 63. The questionnaire's internal consistency is considered to be high (Cronbach's alpha = .92), its convergent validity and test-retest reliability are moderate ($r \approx .72$ and .65 to .72, respectively), Cusin et al. (2010). Each item is rated from 0 to 3 according to the severity of difficulties experienced. Scores are summed up, and depression can then be interpreted as not depressed (< 13), mild (13 to 19), moderate (20 to 28), or severe (≥ 29), Steer et al. (2001). For more details, see Appendix E.

The German version of the Response Style Questionnaire (RSQ-D), Kühner et al. (2007) is a 32-item trait rumination questionnaire that measures two different reaction styles (rumination vs. distraction) to depressed mood on a four-point Likert scale. For example, possible responses to the statement 'When I am feeling sad, I think about how lonely I feel' are 1 (almost never), 2 (sometimes), 3 (often), and 4 (mostly). The internal consistency is considered 'satisfying to good' (d = .75 to .88) and has an acceptable test-retest reliability over a five-month interval (rtt = .54 to .70). As only rumination is seen as a dysfunctional way of reacting to depressed mood, only the 21-item rumination subscale was of interest for this study (Geue et al., 2016). Thus, scores range from 0 to 84, with a higher score indicating a greater tendency to ruminate. For more details, see Appendix F.

The Momentary Ruminative Self-Focus Inventory (MRSI), Mor et al. (2013) is a six-item self-rating scale for assessing state rumination. Participants were asked to indicate their degree of agreement with statements on a seven-point Likert scale in which 1 means 'strongly disagree' and 7 means 'strongly agree'. The maximum total score is 42. The MRSI has shown good internal reliability and concurrent validity. The inventory was evaluated in depth after the beginning of the present study (Marchetti et al., 2018). This did not affect this research. For more details, see Appendix G.

2.6. Analysis and Statistics

All statistical analyses were carried out using the "Statistical Package for the Social Sciences" - SPSS © version 26 by IBM. An a priori power analysis aimed for about 100 participants, this number was not achieved. A post-hoc analysis was done to see how big the power was in comparison to the expected power or rather effect size. Therefore G*Power (Faul et al., 2007) was used based on the main analysis (2x2 repeated-measures ANOVA, time (baseline to post) x condition (positive training vs. neutral training) for main outcome) and with an alpha of .05.

For each participant of the sample, it was checked, which parts of the procedure they completed. An intention-to-treat selection (ITT) and a per-protocol selection (PP) were defined,

based on the completion of the main outcome variables and participation in the training, see Figure 3. The ITT consisted of 82 participants, who accomplished BDI-II at baseline and HDRS at baseline. The PP consisted of 74 participants who are in the ITT and who did the training at least twice.

Missing item scores on the main outcome variables (BDI-II and HDRS), were imputed according the "person mean imputation" method (PMI). The mean score of the items per subject was calculated, and for each subject missing item scores were imputed with this 'personal mean score' (Eekhout et al., 2014). If there were completely missing data for an outcome variable, like a whole missing questionnaire after baseline, those data were imputed according to the 'last observation carried forward' method (LOCF) for post- and follow-up measurements. That means the last total score was carried forward to the next measurement, assuming the score of the person stayed the same. For the subordinated outcome variables (RSQ and MRSI), only the last imputation method needed to be applied besides in one case for the MRSI.

Table 3 and Table 4 show the percentages of completely missing questionnaires that were imputed with the LOCF-method as well as partly missing questionnaires thus missing item-scores that were imputed with the PMI- method for the outcome variables.

Table 3: Percentages of Missing Participants or Values per Imputation Method Used in ITT

		LOCF [%]		PMI [%]	
		positive training	neutral training	positive training	neutral training
BDI-II	baseline	-	-	0.2	0.0
	post	17.1	14.6	0.7	0.0
	follow-up	17.1	14.6	1.5	0.0
HDRS	baseline	-	-	1.0	0.6
	post	14.6	14.6	0.3	1.0
	follow-up	14.6	17.1	0.7	0.9
RSQ	baseline	-	-	0.0	0.0
	post	17.1	17.1	0.0	0.0
	follow-up	17.1	14.6	0.0	0.0
MRSI	baseline	-	-	0.4	0.0
	post	17.1	19.5	0.0	0.0
	follow-up	17.1	24.4	0.0	0.0

Table 4: Percentages of Missing Participants or Values per Imputation Method Used in PP

		LOCF [%]		PMI [%]	
		positive training	neutral training	positive training	neutral training
BDI-II	baseline	-	-	0.3	0.0
	post	5.6	10.5	0.7	0.0
	follow-up	5.6	10.5	1.5	0.0
HDRS	baseline	-	-	0.7	0.6
	post	8.3	10.5	0.3	1.0
	follow-up	8.3	13.2	0.7	0.9
RSQ	baseline	-	-	0.0	0.0
	post	5.6	10.5	0.0	0.0
	follow-up	5.6	10.5	0.0	0.0
MRSI	baseline	-	-	0.4	0.0
	post	5.6	13.2	0.0	0.0
	follow-up	5.6	18.4	0.0	0.0

For being able to analyse more clearly any group differences, the analyses were done twice. One time for the ITT selection and the other time for the PP selection.

To test the main/ first hypothesis, whether positive CBM memory training reduced depressive symptoms more than neutral CBM memory training, two repeated measures ANOVA´s were executed. Independent variable was time with two levels (baseline vs. post and baseline vs. follow-up) and between-subject factor was CBM memory training condition (positive training vs. neutral training) next to the dependent variable of depressive symptoms measured either with the BDI-II or the HDRS.

For analysing the second hypothesis, if trait rumination was reduced more in the positive training condition than in the neutral training condition, two repeated measures ANOVA´s were applied. The independent variable was time with two levels (baseline vs. post and baseline vs. follow-up) and the between-subject factor was CBM memory training condition (positive training vs. neutral training) next to the dependent variable trait rumination as measured by the RSQ. The RSQ has not been any requirement for inclusion in the ITT or PP selection. In the ITT selection two persons did not fill out the RSQ at baseline. For this reason, those participants were excluded from the analyses and the *df's* are lower. In the PP selection one person has not filled out RSQ at baseline and was therefore excluded.

To test the third hypothesis, whether the effect of CBM memory training on depressive symptoms was mediated by state rumination, mediation analyses were performed. State rumination as the mediator was assessed with the MRSI to capture immediate and current dysfunctional

cognitions in contrast to deeper rooted ruminative response styles. Depressive symptoms are indicated with BDI-II and HDRS. For the analyses, the PROCESS Macro by Steven Hayes was installed in SPSS (Hayes, 2018). A difference score for MRSI was calculated to account for the change of state rumination during the course of training. This was done through subtraction of MRSI scores at post from MRSI scores at baseline. Positive and higher scores indicate an increase in state rumination.

Exploring the fourth hypothesis of transfer of the CBM memory training to a real-life emotional memory performance over and above symptoms, patients had to recall an important autobiographical life event and a recent important event and name their emotional valence. To analyse these effects, the descriptions of personal important events were scored by two independent raters, blind to training conditions, as being positive or negative. Inconsistent scores were resolved by a third rater. Two chi-square tests were done, one for the rating at post and one for the rating at follow-up with 'CBM memory training condition' (positive training vs. neutral training) as the independent variable and 'important event' (positive vs. negative) as the dependent variable. Naming an important emotional event has not been requirement for inclusion in the ITT or PP selection. Because there are missing values for 24 participants of the ITT selection, these participants were excluded from the analysis. Furthermore, participants whose answer had an ambiguous emotional valence (N=7), were excluded from the selection, resulting in N=51 valid cases at post. At follow-up, three cases needed to be excluded because of ambiguous emotional answers, resulting in N=55 valid cases. In the PP selection there were missing values for 16 participants. Furthermore, participants whose answer had an ambiguous emotional valence N=7, were excluded from the selection, resulting in N=51 valid cases at post. At follow-up, N=3 cases needed to be excluded because of ambiguous emotional valence of the answers, resulting in N=55 valid cases.

For testing the fifth hypothesis, whether the CBM memory training fulfilled the aimed bias-inducing function, with the positive training creating a differential recall of emotional information, both at immediate recall (post) and at delayed recall (follow-up) an approach analogue to that of Vrijsen et al. (2018) was executed. The absolute number of correctly recalled word pairs (dependent variable) was submitted to two ANOVA´s. Within-subject factor was valence of word pairs (positive, neutral, or negative) and between-subject factor was CBM memory training condition (positive training vs. neutral training). Recall-data (word pairs) were edited by hand to control for spelling mistakes, intrusions, and forms of intrusion. In scoring correct recall, spelling errors were permitted. There were missing data for the recalled word pairs as for the other dependent variables. Missing data regarding the word pairs to be remembered exist for two reasons, respectively, the participants who did not enter word pairs into the computer program divide into two groups. The first group consists of participants who did not partake till the post measure because computer data (retrieved word pairs/bias assessment) have not been any requirement for inclusion in the ITT or PP selection. Thus, there were participants in the selections without existing measurement data. The second group

of people with no computer data compromises participants who attended the measure but did not type in answers in the program. The data of participants who attended the session but did not fill in answers could not be imputed since they were not missing randomly. It is not known whether these participants either just did not remember anything or did not want to fill out the test, maybe because it was too stressful, too confronting, too tiring, or too boring. For the ITT selection at post 12 subjects were not attending, 5 did not fill in answers, resulting in *N*=65 participants. At follow-up 12 subjects were not attending and 3 did not fill in answers, resulting in *N*=67 valid measures. For the PP selection, the final valid measurements stayed the same. Therefore, no different analyses were carried out in relation to these data. At post, 4 subjects were not attending and 5 did not answer, resulting in *N*=65 measures. At follow-up, 4 subjects were not attending and 3 did not type in answers, resulting in *N*=67 measures. Therefore, the *N* and *df* are lower for these tests.

3. Results

The post-hoc power analysis revealed a sufficient power of .898

3.1. Analyses in the Intention to Treat Selection

The following analyses were done with the ITT selection.

3.1.1. Assumption Testing

The participants in the two conditions (positive training N=41; neutral training N=41) did not significantly differ in terms of gender ($\chi^2_{(1)} = 1.85$, $p = .17$), educational level ($\chi^2_{(1)} = 1.69$, $p = .19$), age ($t(80) = -.35$, $p = .73$) or the initial values of the major outcome variables: depression severity as indexed by depression scores on the BDI-II ($t(80) = 1.48$; $p = .14$) and the HDRS ($t(80) = -.24$; $p = .81$). Finally, there was no difference on the subordinate outcome variables: rumination as indexed by scores on MRSI ($t(79) = -.01$; $p = .99$) and RSQ ($t(78) = 1.61$; $p = .11$). Hence, potential changes in outcome can be attributed to the differences in intervention and not to baseline differences between the participants. See Table 5 for an overview.

Table 5: Percentages or Means (SE) on Demographic and Outcome Measures Including Baseline Group Comparisons for ITT.

	Condition		
	Positive Training	Neutral Training	*t*(80)
Age (*M* (*SE*) years)	35.0 (1.96)	35.9 (1.79)	-.35, $p = .73$
Sex (% female)	54	68	
Education (% level 4-7)[1]	66	83	
BDI-II (*M (SE)*)[2]	28.76 (1.46)	25.12 (1.64)	1.48; $p = .14$
HDRS (*M(SE)*)[3]	13.76 (1.09)	14.21 (1.11)	-.24; $p = .81$
RSQ (*M(SE)*)[4]	56.24 (1.41)	53.00 (1.44)	$t(78) = 1.61$; $p = .11$
MRSI (*M*(*SE*))[5]	22.61 (1.11)	22.63 (1.11)	$t(79) = -.01$; $p = .99$

[1] Educational level 4 to 7 (Realschulabschluss - Hochschulabschluss) represent the German degrees after 10th grade till university level education.
[2] Range of BDI-II scores: 0-63
[3] Range of HDRS scores:0-67
[4] Range of RSQ scores: 0-84
[5] Range of MRSI scores: 0-42

As indicated by visual inspection of histograms, checking of skewness- and kurtosis values and testing with Levene's test on homogeneity of variances and Kolmogorov-Smirnov test on normality of distribution, requirement for parametric testing was fulfilled.

3.1.2. Testing the Main Hypothesis – Change in Symptoms

There was a significant main effect of time on BDI-II $F(1, 80) = 15.70$, $p = .00$, $\eta p2 = .16$ and on HDRS $F(1, 80) = 22.94$, $p = .00$, $\eta p2 = .22$ from baseline to post but no significant interaction effect of time and CBM memory training condition, neither for BDI-II $F(1,80) = 2.20$, $p = .14$, nor for HDRS $F(1,80) = .41$, $p = .52$.

From baseline to follow-up there was a significant main effect of time on BDI-II $F(1, 80) = 23.65$, $p = .00$, $\eta p2 = .23$ and on HDRS $F(1, 80) = 36.50$, $p = .00$, $\eta p2 = .31$. For BDI-II there was a marginally significant interaction effect of time and CBM memory training condition $F(1,80) = 3.87$, $p = .053$, $\eta p2 = .05$ (see Figure 4) but no significant interaction effect of time and CBM memory training condition for HDRS $F(1,80) = .26$, $p = .61$.

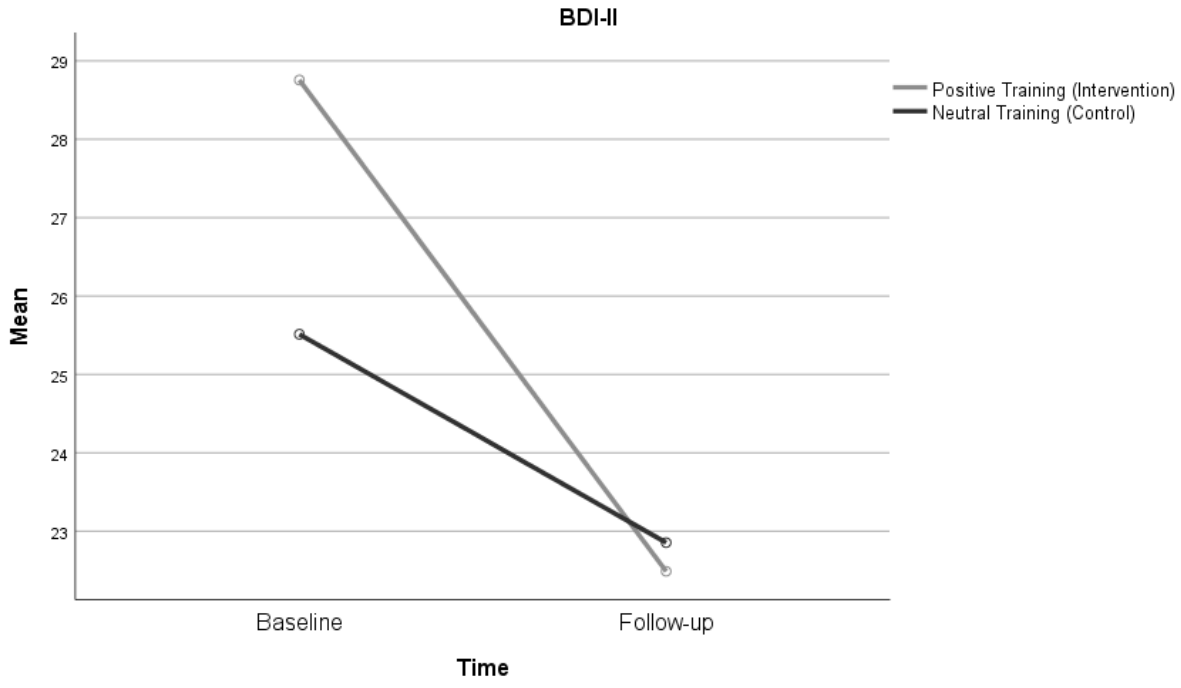

Figure 4: Interaction Effect of Time (Baseline to Follow-Up) and Condition on Depressive Symptoms Indexed on BDI-II for ITT

Table 6 Means and SE of Main Outcome Measures per Condition for ITT.

		Condition	
		Positive Training	Neutral Training
BDI-II	Baseline *M*(*SE*)	28.76 (1.46)	25.51 (1.64)
	Post *M*(*SE*)	24.90 (1.39)	23.76 (1.58)
	Follow-Up *M*(*SE*)	22.49 (1.36)	22.85 (1.76)
HDRS	Baseline *M*(*SE*)	13.76 (1.09)	14.12 (1.11)
	Post *M*(*SE*)	11.07 (.90)	12.07 (.96)
	Follow-Up *M*(*SE*)	10.17 (.93)	11.10 (.99)

3.1.3. Testing the Second Hypothesis – Change in Trait Rumination

For baseline to post there was no significant main effect of time on RSQ $F(1, 78) = .94$, $p = .34$ nor for the interaction of time and CBM memory training condition on RSQ $F(1,78) = 2.93$, $p = .09$.

For baseline to follow-up there was a significant main effect of time on RSQ $F(1, 78) = 9.46$, $p = .003$ $\eta p2 = .11$ and a significant interaction effect of time and CBM memory training condition on RSQ $F(1,78) = 5.41$, $p = .023$ $\eta p2 = .07$., for means see Table 7.

Table 7: Means and SE of RSQ per Condition for ITT.

		Condition	
		Positive Training	Neutral Training
RSQ	Baseline *M*(*SE*)	56.24 (1.41)	53.00 (1.44)
	Follow-Up *M*(*SE*)	52.73 (1.57)	52.51 (1.41)

3.1.4. Testing the Third Hypothesis – Mediation Analysis

A simple mediation was performed to analyse whether CBM memory training predicts change in depressive symptoms (measured on the BDI-II at follow-up) and whether the direct path would be mediated by rumination (measured on the MRSI, representing state rumination). The BDI-II measure at baseline was added as covariate.

A direct effect of CBM memory training on depressive symptoms was not observed, $B = 2.61$, $p = .12$. After entering the mediator (rumination) into the model, CBM memory training did still not predict the mediator (rumination), $B = -.34$, $p = .81$ nor did the mediator (rumination) predict depressive symptoms significantly, $B = .14$, $p = .43$ (see Figure 5).

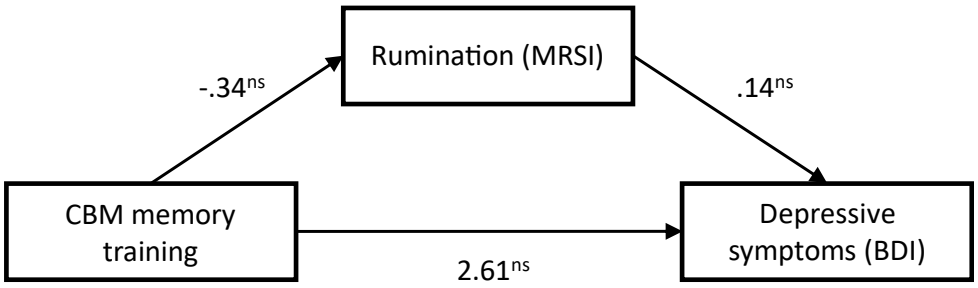

Figure 5: Mediation of CBM Memory Training on Depressive Symptoms (BDI-II) through Rumination in the ITT Selection.

To analyse whether CBM memory training predicts change in depressive symptoms (measured on the HDRS at follow-up) and whether the direct path would be mediated by rumination (measured on the MRSI, representing state rumination), a simple mediation was performed. The HDRS measure at baseline was added as covariate.

No direct effect of CBM memory training on depressive symptoms was observed, B = .61, p =.53. After entering the mediator (rumination) into the model, CBM memory training did still not predict the mediator (rumination), B = -.39, p =.78 nor did the mediator (rumination) predict depressive symptoms significantly, B = -.02, p = .87 (see Figure 6)

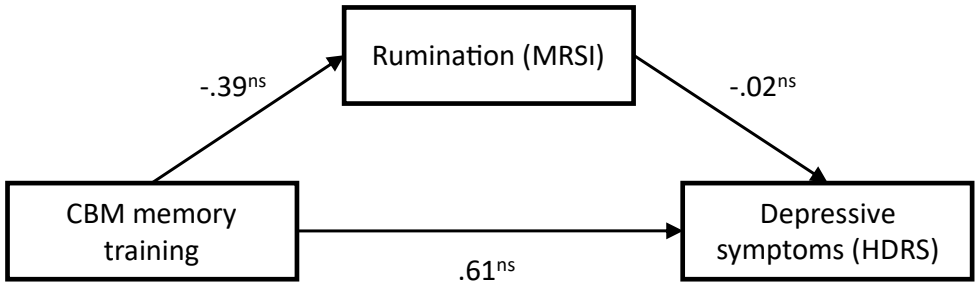

Figure 6: Mediation of CBM Memory Training on Depressive Symptoms (HDRS) through Rumination in the ITT Selection.

For descriptive statistics see Table 8.

Table 8: Means and SE of MRSI per Condition for ITT

		Condition	
		Positive Training	Neutral Training
MRSI	Baseline *M*(*SE*)	22.61 (1.11)	22.63 (1.11)
	Post *M*(*SE*)	24.85 (1.33)	24.53 (1.05)
	Follow-Up *M*(*SE*)	21.07 (1.29)	21.05 (1.20)
$MRSI_{DiffScore}$[6]	$MRSI_{Post}$ - $MRSI_{Baseline}$	2.24 (.93)	1.90 (.97)

3.1.5. Testing the Fourth Hypothesis – Real-Life Transfer of Training

There was no significant effect of the condition of CBM memory training on the emotional valence the recalled life event or the recalled recent event had. Neither directly after the training (post) $\chi^2_{(1)} = 2.37$, $p = .12$ nor one week later (follow-up) $\chi^2_{(1)} = .01$, $p = .92$.

3.2. Analyses in the Per Protocol Selection

The same kind of analyses as reported under 3.1 were repeated with the PP selection for completeness.

3.2.1. Assumption Testing

The participants in the two conditions (positive training N=36, neutral training N=38) did still not significantly differ in terms of gender ($\chi^2_{(1)} = .81$, $p = .37$), educational level ($\chi^2_{(1)} = 1.92$, $p = .16$), age ($t(72) = .18$, $p = .85$) or the initial values of the major outcome variables: depression severity as indexed by depression scores on BDI-II ($t(72) = 1.31$, $p = .19$) and HDRS ($t(72) = 0.25$, $p = .80$). Also here, no significant difference on the subordinate outcome: rumination as indexed by scores on MRSI ($t(72) = .62$, $p = .54$) and RSQ ($t(71) = 1.90$, $p = .06$) was obtained. In keeping with results on the ITT selection, potential changes in outcome can be attributed to the differences in intervention and are not subject to baseline differences between the participants. See Table 9 for an overview.

[6] $MRSI_{Post}$ - $MRSI_{Baseline}$; Positive and higher scores indicate an increase in state rumination

Table 9: Percentages or Means (SE) on Demographic and Outcome Measures Including Baseline Group Comparisons for PP.

	Condition		
	Positive Training	Neutral Training	*t*(72)
Age (*M* (*SE*) years)	36.6 (2.02)	36.1 (1.86)	.18, *p* = .85
Sex (% female)	56	66	
Education (% level 4-7)[7]	67	84	
BDI-II (*M(SE)*)[8]	28.86 (1.58)	25.89 (1.62)	1.31; *p* = .19
HDRS (*M(SE)*)[9]	15.14 (1.01)	14.76 (1.09)	0.25; *p* = .80
RSQ (*M(SE)*)[10]	56.53 (1.47)	52.57 (1.48)	*t*(71) = 1.90; *p*= .06
MRSI (*M*(*SE*))[11]	23.50 (1.13)	22.50 (1.16)	0.62; *p* = .54

In the PP selection, the requirement for parametric testing was also fulfilled. For this purpose, the checks already mentioned above (see section 3.1.1) were carried out.

3.2.2.Testing the Main Hypothesis – Change in Symptoms

Also here a significant main effect of time on BDI-II $F(1, 72) = 16.46$, $p = .000$, $\eta p2 = .19$ and on HDRS $F(1, 72) = 23.87$, $p = .000$, $\eta p2 = .25$ from baseline to post was obtained but no significant interaction effect of time and CBM memory training condition, neither for BDI-II $F(1,72) = 2.59$, $p = .11$, nor for HDRS $F(1,72) = .65$, $p = .44$.

And again from baseline to follow-up there was a significant main effect of time on BDI-II $F(1, 72) = 25.25$, $p = .000$, $\eta p2 = .26$ and on HDRS $F(1, 72) = 38.62$, $p = .000$, $\eta p2 = .35$. The marginally significant interaction effect of time and CBM memory training condition on BDI-II $F(1,72) = 4.60$, $p = .035$, $\eta p2 = .06$ got significant in this selection (see Figure 7). The non-significant interaction effect of time and CBM memory training condition on HDRS in the ITT selection stayed non-significant in the PP selection $F(1,72) = .48$, $p = .49$.

[7] Educational level 4 to 7 (Realschulabschluss - Hochschulabschluss) represent the German degrees after 10th grade till university level education.
[8] Range of BDI-II scores: 0-63
[9] Range of HDRS scores:0-67
[10] Range of RSQ scores: 0-84
[11] Range of MRSI scores: 0-42

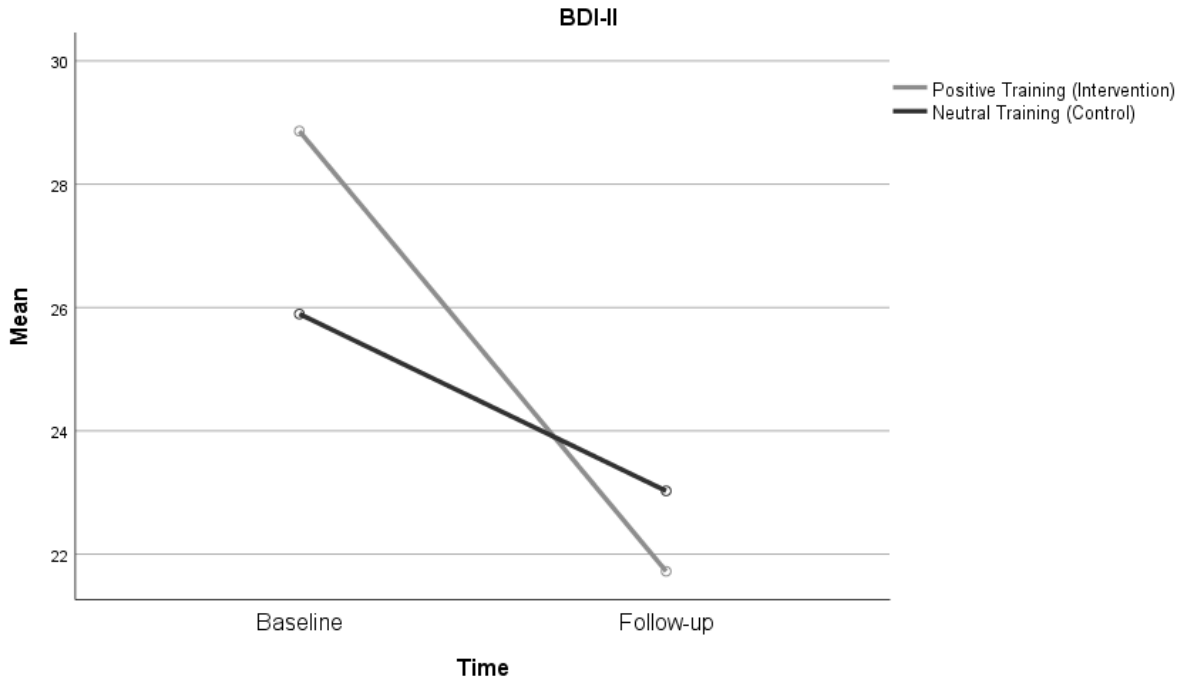

Figure 7: Interaction Effect of Time (Baseline to Follow-Up) and Condition on Depressive Symptoms Indexed on BDI-II for PP

A series of t-tests have shown that the positive training produced a higher (M = 7.19, SE = 1.26) and significant $t(35) = 5.68$, $p = .000$; $r = .69$ mean difference in BDI-II from baseline to follow-up in contrast to the neutral training (M = 2.87, SE = 1.53), $t(37) = 1.88$, $p = .07$; $r = .30$.

Since there has been a significant interaction effect for BDI-II from baseline to follow-up, but not from baseline to post, an analysis was executed to test whether the effect occurred mostly in the time between post and follow-up. For that matter, a repeated measures ANOVA using the independent variable time with two levels (post vs. follow-up) and the between-subject factor CBM memory training condition (positive training vs. neutral training) and dependent variable BDI-II was performed.

A significant main effect of time on BDI-II $F(1, 72) = 6.37$, $p = .014$, $\eta p2 = .08$ was observable but no interaction effect of time and CBM memory training condition $F(1,72) = 1.45$, $p = .23$, $\eta p2 = .02$. This analysis thus did not unveil when the symptom reduction occurred.

Table 10: Means and SE of Main Outcome Measures per Condition for PP.

		Condition	
		Positive Training	Neutral Training
BDI-II	Baseline *M*(*SE*)	28.86 (1.58)	25.89 (1.62)
	Post *M*(*SE*)	24.47 (1.48)	24.00 (1.56)
	Follow-Up *M*(*SE*)	21.72 (1.41)	23.03 (1.77)
HDRS	Baseline *M*(*SE*)	15.41 (1.01)	14.76 (1.09)
	Post *M*(*SE*)	12.08 (.86)	12.55 (.95)
	Follow-Up *M*(*SE*)	11.06 (.93)	11.50 (.99)

3.2.3. Testing the Second Hypothesis – Change in Trait Rumination

As seen in the ITT selection, here, in the PP selection from baseline to post there was no significant main effect of time on RSQ $F(1, 71) = 1.08$, $p = .30$ nor a significant interaction effect of time and CBM memory training condition on RSQ $F(1,71) = 3.07$, $p = .084$.

For baseline to follow-up there was a significant main effect of time on RSQ $F(1,71) = 10.29$, $p = .002$, $\eta p2 = .13$ and a significant interaction effect of time and CBM memory training condition on RSQ $F(1,71) = 6.14$, $p = .016$, $\eta p2 = .08$, see Table 11 for means.

A series of t-tests showed that the positive training produced a higher ($M = 4.00$, $SE = .92$) and significant $t(35) = 4.37$, $p = .000$; $r = .59$ mean difference on RSQ from baseline to follow-up in contrast to the neutral training ($M = .51$, $SE = 1.06$), $t(36) = .483$, $p = .632$; $r = .08$.

Table 11: Means and SE of RSQ per Condition for PP.

		Condition	
		Positive Training	Neutral Training
RSQ	Baseline *M*(*SE*)	56.53 (1.47)	52.57 (1.48)
	Follow-Up *M*(*SE*)	52.53 (1.67)	52.05 (1.44)

Since there was a significant interaction effect for RSQ from baseline to follow-up, but not from baseline to post, an analysis has been executed to test whether the effect occurred mostly in the time between post and follow-up. For that matter, a repeated measures ANOVA with independent variable time with two levels (post vs. follow-up), between-subject factor CBM memory training condition (positive training vs. neutral training) and dependent variable RSQ was performed.

No significant main or interaction effect was observed. Neither of time on RSQ $F(1, 71) = 3.50$, $p = .07$, $\eta p2 = .05$ nor of time and CBM memory training condition on RSQ $F(1,71) = .21$, $p = .65$, $\eta p2 = .00$. This analysis thus did not unveil when symptom change occurred.

3.2.4.Testing the Third Hypothesis – Mediation Analysis

A simple mediation was performed to analyse whether CBM memory training predicts change in depressive symptoms (measured on the BDI-II at follow-up) and whether the direct path would be mediated by rumination (measured on the MRSI, representing state rumination). The BDI-II measure at baseline was added as covariate.

A direct effect of CBM memory training on depressive symptoms was not observed, B = 3.14, p =.08. After entering the mediator (rumination) into the model, CBM memory training did still not predict the mediator (rumination), B = -.54, p = .72 nor did the mediator (rumination) predict depressive symptoms significantly, B = .17, p = .33 (see Figure 8).

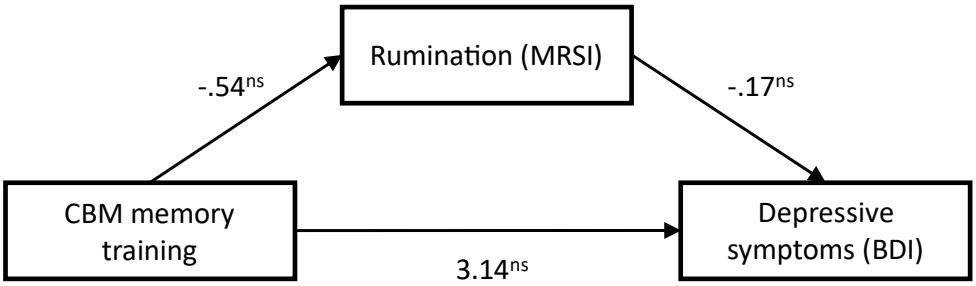

Figure 8: Mediation of CBM Memory Training on Depressive Symptoms (BDI-II) Through Rumination in the PP Selection.

Another simple mediation was performed to analyse whether CBM memory training predicts change in depressive symptoms (measured on the HDRS at follow-up) and whether the direct path would be mediated by rumination (measured on the MRSI, representing state rumination). The HDRS measure at baseline was added as covariate.

Again, no direct effect of CBM memory training on depressive symptoms was observed, B = .67, p =.53. After entering the mediator (rumination) into the model, CBM memory training did still not predict the mediator (rumination), B = -.52, p =.73 nor did the mediator (rumination) predict depressive symptoms significantly, B = -.01, p = .88 (see Figure 9).

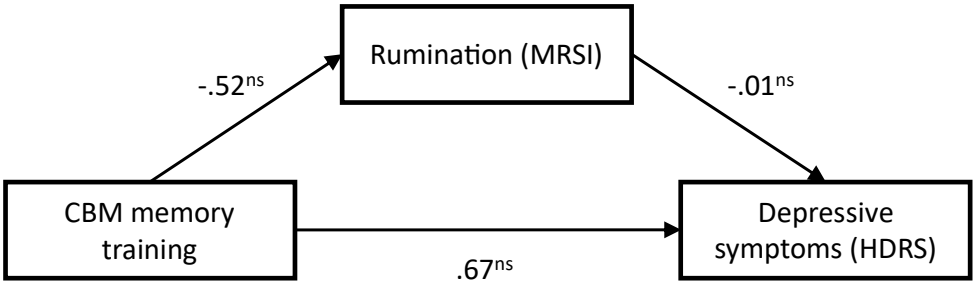

Figure 9: Mediation of CBM Memory Training on Depressive Symptoms (HDRS) Through Rumination in the PP Selection.

For descriptive statistics see Table 12.

Table 12: Means and SE of MRSI per Condition for PP

		Condition	
		Positive Training	Neutral Training
MRSI	Baseline *M*(*SE*)	23.50 (1.13)	22.50 (1.16)
	Post *M*(*SE*)	26.06 (1.35)	24.05 (1.11)
	Follow-Up *M*(*SE*)	21.75 (1.39)	20.84 (1.25)
$MRSI_{DiffScore}$[12]	$MRSI_{Post}$ - $MRSI_{Baseline}$	2.56 (1.05)	2.00 (1.02)

3.2.5. Testing the Fourth Hypothesis – Real-Life Transfer of Training

Again, there was no significant effect of the condition of the CBM memory training on the emotional valence the recalled life event or the recalled recent event had. Neither directly after the training (post) $\chi^2_{(1)} = 2.37$, $p = .12$ nor one week later (follow-up) $\chi^2_{(1)} = .01$, $p = .92$.

3.3. Testing the Fifth Hypothesis – Analysis of Bias Assessment

As described in section 2.6, valid measurements were equal in both selections, therefore only one run of this analysis was executed. Because the dependent variable represents count data instead of scale-data, parametric assumptions are not applicable.

As predicted, the condition-valence interaction was significant both at immediate, $F(2,126) = 151.99$, $p = .000$, $\eta p2 = .71$ and delayed recall $F(2,130) = 62.70$, $p = .000$, $\eta p2 = .49$, respectively. The training thus created a differential recall of emotional target words.

A series of t-tests was performed to explore the specific differences between the positive and the neutral CBM memory training. At immediate recall (post), participants in the positive training on average recalled more positive word pairs ($M = 19.2$, $SE = 1.4$) than participants in the neutral training ($M = 10.4$, $SE = 1.0$). This difference was significant $t(63) = 5.31$, $p = .000$; $r = .55$. Participants in the positive training recalled less neutral word pairs ($M = 11.1$, $SE = 1.2$) than participants in the neutral training ($M = 22.5$, $SE = 1.7$). This difference was also significant $t(63) = -5.56$, $p = .000$; $r = .57$. Participants in both conditions recalled about the same amount of negative word pairs (positive training: $M = 9.2$, $SE = 1.1$; neutral training: $M = 9.7$, $SE = 0.9$), the difference was not significant $t(63) = .29$, $p > .05$, see Table 13 and Figure 10.

[12] $MRSI_{Post}$ - $MRSI_{Baseline}$; Positive and higher scores indicate an increase in state rumination

Table 13: Absolute Number of Recalled Word Pairs per Valence and Condition at Post (Immediate Recall)

		Condition	
		Positive Training	Neutral Training
Valence	Positive, *N*	19	10
	Neutral, *N*	11	23
	Negative, *N*	9	10

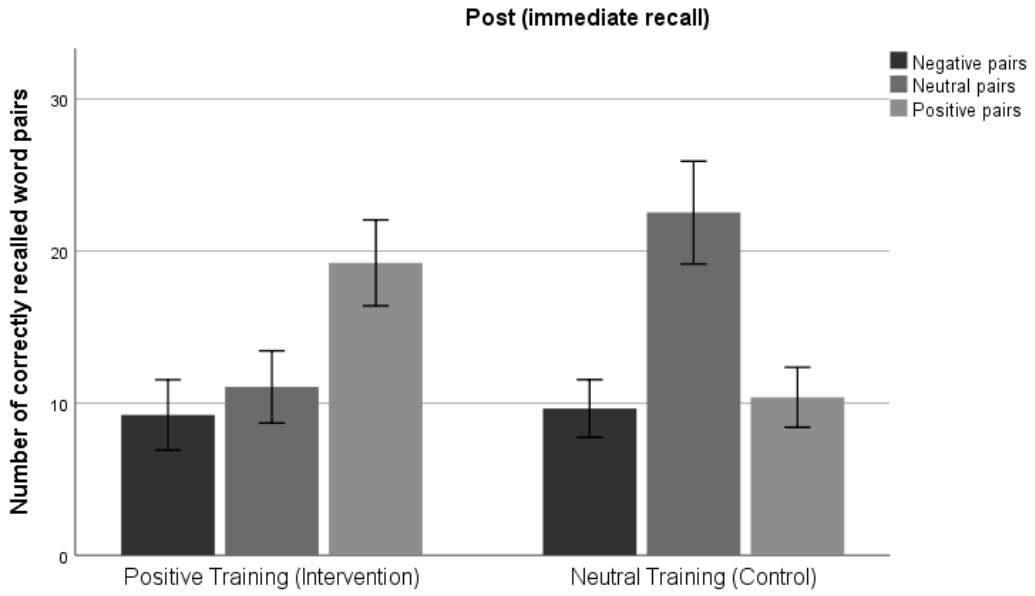

Figure 10: Absolute Number of Correctly Recalled Word Pairs per Valence and Condition at Post (Immediate Recall)

At delayed recall (follow-up), the picture stayed the same. Participants in the positive training condition on average recalled more positive word pairs (*M*=11.4, *SE*=1.5) than participants in the neutral training condition (*M*=5.8, *SE* = 0.8). This difference was significant *t*(65) = 3.36, *p* =.001; r = .15. Participants in the positive training condition recalled less neutral word pairs (*M* = 6.8, *SE* = 1.1) than participants in the neutral training condition (*M* = 16.5, *SE* = 1.9). This difference was also significant *t*(65) = -4.44, *p* = .000; *r* = .23. Participants in both conditions recalled about the same amount of negative word pairs (positive training: *M* = 4.6, *SE* = 0.9; neutral training: *M* = 5.2, *SE* = 0.9), the difference was not significant *t*(65) = -.50, *p* >.05, see Table 14 and Figure 11.

Table 14: Absolute Number of Recalled Word Pairs per Valence and Condition at Follow-Up (Delayed Recall)

		Condition	
		Positive Training	Neutral Training
Valence	Positive, *N*	11	6
	Neutral, *N*	7	17
	Negative, *N*	5	5

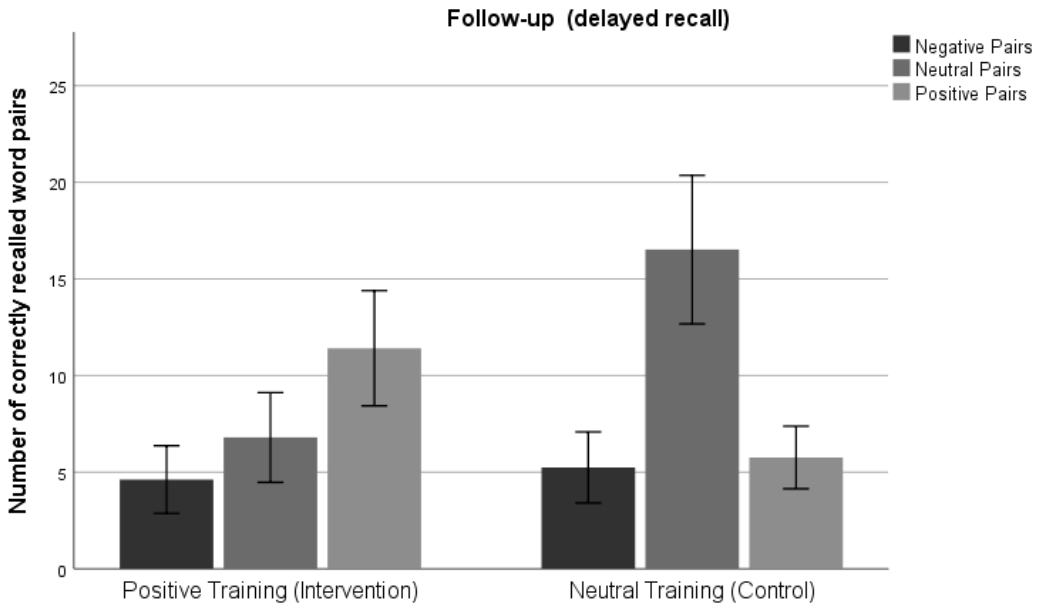

Figure 11: Absolute Number of Correctly Recalled Word Pairs per Valence and Condition at Follow-Up (Delayed Recall)

4. Discussion

4.1. Review of Main Findings

This study examined whether four sessions of a novel computer-based CBM memory training could influence depression-related symptoms and depression-maintaining mechanisms. The procedure used to achieve this was repetitive cued retrieval of positive verbal stimulus material. The study is the first one of its kind to take place in a clinical population (i.e., psychiatric in-patients with one or more episodes of a depressive disorder and comorbid diagnoses). The following five research questions were examined.

- Research question 1 (main question): Did CBM memory training reduce depressive symptoms and was this decrease greater for participants in the positive training than for participants in the neutral training?
- Research question 2: Did positive CBM memory training reduce trait rumination? And again, was this decrease greater for participants in the positive training than for participants in the neutral training?
- Research question 3: Did the positive training immediately reduce state rumination and through that depressive symptoms? Thus, did state rumination mediate the effect of positive training on depressive symptoms?
- Research question 4: Did positive CBM memory training affect autobiographical memory as a transfer of training to a real-life emotional memory performance and lead to more positive autobiographical memory than the neutral CBM memory training?
- Research question 5: Did the CBM memory training promote a training-congruent recall bias and did the positive training induce a positive recall bias?

Three of the five hypotheses (1, 2, and 5) were validated. As expected, the positive CBM memory training led to greater reduction in depressive symptoms and trait rumination over a period of two weeks compared to the neutral CBM memory training. Consistent with previous studies (Hertel et al., 2017; Vrijsen et al., 2016), the results revealed that the cued repetitive retrieval training resulted in training-congruent recall of emotional verbal information and thus a positive memory bias.

However, the two remaining hypotheses (3 and 4) were refuted. Contrary to expectations, the positive CBM memory training did not lead to a greater change in positive autobiographical memory than the neutral CBM memory training. Thus, the positive training did not stimulate positive autobiographical recall. Furthermore, state rumination was not found to mediate the effect of CBM memory training on depressive symptoms. These findings are reviewed in greater detail in the next section.

4.2. Critical Appraisal

The results are discussed in order, beginning from the main research question and hypothesis, and moving on to sub-research questions and hypotheses. All results were the same for both sample selections (ITT and PP). However, the results for the PP selection were clearer, as expected.

Due to the time-consuming nature of the data collection and the onset of the COVID-19 crisis, data collection was stopped before the 100 desired participants could be included. Nevertheless, sufficient power was achieved because the actual effect may be larger than the expected effect. If the planned number of participants had been reached, the results might have been more significant.

From baseline to post, participants of both CBM memory training groups did not demonstrate a different reduction in depressive symptoms, either in terms of self-ratings (BDI-II) nor clinician ratings (HDRS). From baseline to follow-up, no significant differences between the groups were observed in terms of the clinician ratings (HDRS). However, the positive CBM memory training group had a significant and medium effect on self-ratings of depressive symptoms (BDI-II), according to Cohen's guidelines (Cohen, 1988). The positive training condition produced a higher mean difference in BDI-II scores than the neutral training condition from baseline to follow-up. As expected, this effect was more prominent in the stricter PP selection than in the ITT selection.

There may be several explanations for the absence of group differences in terms of BDI-II and HDRS scores from baseline to post and partially absent group differences in terms of HDRS from baseline to follow-up, but significant main effects of time (similar reduction of symptoms in both groups over the time from baseline to post and from baseline to follow-up). In fact, regardless of the CBM memory training condition, depressive symptoms declined over time, from baseline to post and from baseline to follow-up. This was confirmed through BDI-II self-ratings and HDRS clinician ratings. These effects indicate that time and TAU helped reduce depressive symptoms in any event. Alternative explanations that do not take into account time and TAU are related to the design of this study with the active instead of a no training control group and follow two lines of reasoning. These argumentation lines are related to the mechanisms (*form* of thoughts and *content* of thoughts during retrieval) that might sustain depressive thinking. First, in contrast to a no-training control group, an active control group could have changed the *form* of depressive thoughts (abstract rumination) through the same specific approach (cued repetitive retrieval) used in the intervention group. By requiring the mind to engage in a mental action incompatible with rumination, depressive thinking and symptoms might have decreased. Second, the study design was such that the control group had to remember neutral content rather than negative or no content. Neutral content could have acted like positive content in this case because it is not negative and fills available memory space that otherwise might have been occupied by negative thoughts. Thus, neutral CBM memory training may have worked like a mock training by stimulating participants to actively learn and recall neutral word pairs. Vrijsen et al. (2018) used this explanation to explain findings about comparable symptom change over time; they stated that their neutral training may have functioned as a 'lower dose' version

of their positive training. Thus, the neutral training may have trained memory away from a depressogenic negative memory bias, albeit less than the positive training condition in theory. Hence, the effects of the two conditions on memory bias and depressive symptoms may be similar. Also, Vrijsen et al. (2016) provide support for this idea; in their study, retrieval accuracy (percentage of recalled word pairs) was approximately the same for all conditions (positive training, negative training, and no training), and specific retrieval practice (cued repetitive positive retrieval) rather than retrieval accuracy led to the maintenance of a positive mood. Another argument for the lack of group differences concerns the omission of a negative control group. As in Vrijsen et al.´s (2016) study, a comparison with a negative content control group could not be conducted in the present study for ethical reasons. Thus, in this study, expected differences between conditions at the content level (neutral vs. positive) may have been too small or not as contrasting as they would be with a negative control group to show detectable group differences in the outcome variables used to detect symptom change.

In another line of thought, one could say that without a no-training condition and the use of a mock training, it is unclear whether the current findings are at all attributable to the targeted processes of cued repetitive positive retrieval practice or whether effects that are non-specific to training were found. However, previous CBM memory studies by Vrijsen et al. (2016) and Hertel et al. (2017) have countered this argument. These researchers included a no-training condition and showed that the expected working mechanism in the training was indeed cued repetitive retrieval practice. Hertel et al. (2017) stated that ‘Retrieval practice more than doubled recall levels a week later. Even unpractised positive pairs were better recalled in the negative retrieval practice condition than those who merely studied [merely study = no-training condition = no retrieval practice]’. Nevertheless, since the participants in this study differ from those in the aforementioned studies, it would be valuable to include a no-training condition with depressed individuals who ‘only’ receive therapy (TAU), to minimize possible sources of error. This would clearly show the differences between the results of a CBM intervention and TAU. However, it is ethically questionable to withhold a possibly helpful treatment from patients who are already sick, which is why an active control condition was chosen in the first place.

Within this study, the results related to rumination are also worth noting. According to Marchetti et al. (2018), rumination can be viewed as both a trait and a state. In this study, both of these conditions were measured for different purposes. To evaluate whether a deep-rooted ruminative mindset (i.e., trait rumination) can be changed through training, the RSQ was included. To assess whether CBM memory training could have an immediate effect on current dysfunctional cognition and thus depressive symptoms, the MRSI was included. A significant decrease in trait rumination was found from baseline to follow-up in both groups, but the effect was more pronounced for participants in the positive training condition. However, this decrease was not significant from baseline to post. The non-significant differences between the two training conditions on change in

trait rumination directly after training may relate to the fact that trait rumination takes longer than a week to change, as seen in a significant change at follow-up. This is confirmed by Vrijsen et al. (2018), who found a small but significant decrease in rumination from baseline to follow-up for ruminators and dysphoric students. The non-significant total and indirect mediation effects of state rumination on depressive symptoms and increases in state rumination immediately after training may reflect 'the labour' that a week of training implies for patients, especially since MRSI values fell to their lowest at follow-up, when completion of the study was 'ensured' (see Table 12). This means that the effort that participants experience through training could have a direct negative effect on state rumination.

The CBM memory training had no transfer effect on the emotionality of recall of an important (life) event. Possibly, the timing of the autobiographical recall test may help explain the 'missing' result. Questions about autobiographical memory that operationalize a transfer of training to a real-life emotional memory performance were asked immediately following the training sessions. A transfer like this may take a longer time to develop than half an hour or a week. This idea is supported by Vrijsen et al. (2018), who stated that 'If the training affects which new experiences are remembered, the transfer of the training to autobiographical memory bias should be stronger one week later [a week after the last training session]'. In contrast to the latter, a question about an autobiographical event was asked directly after the training (post) and one week later (follow-up) in this study; however, no effect was observed. This may be because the generalization time is still too short for effects to appear. In general, the fact that this study was conducted with inpatients – in contrast to a student or community sample – could also explain the lack of transfer of rumination and symptom change to the real-life measure (autobiographical emotional memory performance), since inpatients experience more extreme symptoms (cf. Vrijsen et al. (2018) from baseline almost to follow-up). Furthermore, Vrijsen et al. (2018) showed that *one* session of positive CBM memory training did not affect autobiographical memory bias in individuals who are considered at-risk for depression. Maybe this number (one session) 'equals' the number of *several sessions* (four) for individuals who have already developed a manifest depression, as in this study. Thus, perhaps for an at-risk sample, as opposed to a depressed sample, one training session is equivalent to four training sessions in terms of change or lack of change in autobiographical memory content. There are two other reasons why inpatients may have more difficulty recalling a recent and positive life event. The first is that they lack a normal daily routine when they are at a ward and may thus lack positive reinforcement in their daily routine. The second is that they experience positive (life) events but do not evaluate and memorize them as such, which is why they cannot remember them as positive events at a later time.

When considering whether the intervention was valid in terms of the intended effect (i.e., whether the 'manipulation' was successful), it is necessary to examine the valence of what was recalled and remembered. The training led to the differential recall of emotional target words. The

positive training condition produced the highest correct recall of positive word pairs, while the neutral training condition showed the highest correct recall of neutral word pairs. There was no significant difference between the conditions in terms of the correct recall of negative word pairs. This was true for both immediate and delayed recall. The direction of all these outcomes met expectations. The intended emotional bias induction is therefore confirmed, which replicates the findings of Hertel et al. (2017) and Vrijsen et al. (2016).

4.3. Limitations

There are some limitations that warrant consideration. First, the fact that more significant outcomes were related to the BDI-II than the HDRS was unexpected. Normally, clinician-rated depression measures (HDRS) are more sensitive to change, whereas self-report measures (BDI-II) tend to be more conservative (Cuijpers et al., 2010). However, in the current study, the training effect was exclusively detected through the patient-rated BDI-II. An explanation may be that the symptom severity of HDRS scores at baseline ranged from M = 13.8 to M = 15.4. According to the National Disease Management Guideline for Unipolar Depression (DGPPN et al., 2015), these scores indicate mild depression, if based on a 17-item HDRS version in contrast to the here used 21-item version. That is, the low scores assigned, estimated depressiveness proportionately even lower for 21 items than for 17 items. Furthermore, the averaged BDI-II scores at baseline ranged from M = 25.9 to M = 28.9, which represent moderate to severe depression (DGPPN et al., 2015). Thus, observer ratings were in another range and lower than the introspective perception (self-ratings). This seems to be an artefact of measurement and may represent a rater as well as a questionnaire bias, which will be elaborated further. Differences in item content between the BDI-II and the HDRS may have led to a variance in symptom severity. While the BDI-II contains more psychological items of depression, the HDRS emphasizes transdiagnostic and somatic depressive symptoms (see Appendix B and Appendix E). First, on the HDRS, higher ratings (score 3 or 4) seem to represent the extreme end of depression (e.g., Item 1 – depressive mood: ‘patient ALMOST ONLY communicates this mood, verbal or non-verbal’; Item 2 – feelings of guilt: ‘accusing acoustic or visual hallucination’; Item 3 – Suicide: ‘suicide attempts’). These ratings seem to reflect the severity of depression seen in patients on a closed ward, who are different from the open ward patients in this study. Thus, these high ratings were rarely given by the study investigator, which means that the nevertheless strong depressive symptoms among patients in this study may not have been detected and were thus underestimated. Second, sleeping problems were covered by three items of the HDRS but only if patients were not medicated (only mentioned in the interview guideline). The study investigator often gave a rating of zero on these items because most patients took medication and still did not sleep well. Therefore, it is once again possible that their condition was not accurately captured in the available answers. Third, there were about 11 more items that were trans-diagnostic in nature and did not adequately represent depressive experiences (e.g., Items 11 and 12 covered overall bodily and gastrointestinal symptoms).

These were also sometimes given a rating of zero. In summary, these measurement artefacts may have resulted in a floor effect for the recorded depressive symptoms, which may have prevented a differential survey of the training effect on depressive symptoms recorded with the HRSD.

Regarding the creation of the word pairs used in the study, the procedure was deemed to be adequate. Since the word pairs were based on evaluated and validated scientific sources (ANEW and BAW-L, Vo et al. (2009)). Nevertheless, some restrictions arose when taking into account Hertel et al. (2017) views. They stated that, 'in typical experiments designed to reveal valence-related differences in recall, the to-be-recalled words differ [on other dimensions than valence, see below]'. This same was true of this study (see Appendix H). Thus, it is possible that 'any resulting recall differences, however, cannot be attributed entirely to emotional meaning, because the words differ concomitantly on other characteristics – for example, negative words are more abstract – and controlling for these potentially confounding variables sometimes produces word sets that seem unusual in other ways'.

Therefore, Hertel et al. (2017)

> 'took a different approach by asking all participants to learn the same nouns after imbuing them with differential emotional meaning through their learned associations with the cues. Whereas some participants studied disgusting habits, for example, just as many studied constructive habits. Using emotionally meaningful cues also has the advantage of modelling situations in which current feelings cue concepts, connected to those feelings (Bower, 1981)'. Hertel et al. (2017).

This approach may have led to a stronger effect on mood or symptoms, respectively.

4.4. Future Aims and Recommendations for Further Research

In future research, a different clinician-rated depression scale may be useful for comparing self-rated and clinician-rated symptom severity and differential training effects. In addition to the aforementioned improvements to word pair construction, another aim of future research could be to include self-relevant stimuli in the training. In other words, stimuli that have a personal meaning for someone. It is known that subsequent memory performance is more likely when the information to be processed is self-relevant to participants (Turk et al., 2008). Furthermore, self-relevant stimuli enhance the effect of learning on implicit memory, which has only been studied in the context of negative information in depressive groups to date (Gaddy & Ingram, 2014). Since implicit memory is automatic and habitual, next to the advantage of fast processing it can be used with the here presented kind of training through the hypothesized mechanism of habit reversal (Watkins & Nolen-Hoeksema, 2014). Based on these findings, it would be interesting to develop CBM memory trainings that include positive self-relevant stimuli to enhance their effect on depression in subsequent studies.

Moreover, it would be compelling for future treatment to make the trainings easily accessible to clients by offering them for at-home use on the computer or even on a smartphone. This could

motivate participants to adhere to the treatment, since there would be fewer barriers to overcome. Motivation is known to be an important predictive factor in the improvement of depression symptoms (Burns et al., 2013). In particular, smartphone-based treatments may represent a new generation of interventions due to their accessibility, which would be independent of time and location. A systematic review of RCT´s involving smartphone apps for depression confirmed that the use of such apps led to a reduction in depressive symptoms. However, symptom reduction depended on whether the app featured active treatment components (e.g., components based on CBT or behavioural activation) and targeted symptom reduction in clinical or subclinical populations (Kerst et al., 2020).

4.5. Conclusion

In summary, the here presented study confirmed earlier research by showing that a memory bias can be induced through differential cued repetitive retrieval practice. The positive CBM memory training condition was more effective in reducing the severity of self-rated – but not clinician-rated – depressive symptoms. Anyway, participants who repeatedly practiced positive or neutral 'biased' retrieval, reported fewer symptoms and less rumination one week after the completion of training. Thus, CBM memory training can be seen as another step to implementing simple, shorter-term and cost-effective additional treatments to the currently applied treatment methods such as pharmacotherapy and psychotherapy. Such a training with a more user-friendly interface would be a valuable complement in the treatment of clinical depression. In addition to the further development of therapeutic approaches, the creation of this direct emotional memory training was of great value for a deeper understanding and extension of former psychological research. It identifies specific anchors for helpful interventions by using previously developed ideas and confirming them. This was achieved through the identification of different memory functions (memorizing and retrieving), memory bias and memory dysfunctions underlying depression (i.e., repetitive retrieval of negative content: rumination). Since the study outcomes are promising, future research that engages in long-term investigation of CBM memory training over the course of several weeks should be considered.

Conflicts of interest: There are no conflicts of interest to report.

Synopsis

Depression is an affective disorder with the major symptoms including depressed mood, diminished interest or pleasure, and lack of drive that can lead to a significant reduction in not only the quality of life and life expectancy but also productivity. Driven by these considerable impairments, many efforts have been made to develop helpful treatment options. However, no definitive treatment option for depression has been identified and available treatment capacities are scarce.

Psychological research over the past 50 years has identified cognitive biases in different domains (attention, interpretation, and memory) and has shown that cognitive biases in the processing of emotional information play a role in the development of emotional resilience or emotional vulnerability for depression. Biased memory of negative emotional information is especially salient in the onset and maintenance of depression with relatively enhanced memory for emotionally negative information. It is also known that rumination, the repeated cognitive recollection of one's own stressful circumstances and depressive symptoms, is associated with negative memory bias.

In recent years, computer trainings that attempt to modify these cognitive biases – a practice known as cognitive bias modification (CBM) – have been developed to address anxiety and depression. A new computer-based CBM memory training was designed for the here presented study. The innovation of this work was a focus on reversing negative memory bias by cued repetitive positive retrieval (‘retrieval practice’). In this way, training was intended to address rumination as a possible mechanism behind negative memory bias. While comparable trainings have rarely been conducted with acutely ill patients, this study focused on a clinical population. 82 participants were randomly assigned to either a positive (intervention) or a neutral (control) CBM memory training condition and treated during 4 sessions on the course of one week. In the positive condition, patients were trained to preferentially retrieve positive verbal information and in the neutral condition, they were trained to retrieve neutral information. The main research question in this randomized controlled trial was, whether patients in the positive condition showed a significant decrease in depressive symptoms in contrast to participants in the neutral condition. Of further interest was, whether rumination was also affected by positive CBM memory training. Effects were assessed by the Beck Depression Inventory and by the Hamilton Depression Rating Scale as well as by the Response Style Questionnaire, a measure for rumination. As expected, the positive CBM memory training led to greater reduction in self-assessed depressive symptoms and trait rumination over a period of two weeks compared to the neutral CBM memory training. These findings are promising since a training like that can be implemented as an easy and cost-effective add-on to the current clinical routine treatment of depression.

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Abbreviations

ANEW ..... *Affective norms for english words*
BAW-L ..... *Berlin Affective Word List*
BDI-II ..... *Becks Depression Inventory-II*
CBM ..... *Cognitive Bias Modification*
DSM-IV ..... *Diagnostical and Statistical Manual-IV*
DSM-V ..... *Diagnostical and Statistical Manual-V*
HDRS ..... *Hamilton Depression Rating Scale*
ITT ..... *Intention to Treat*
LOCF ..... *Last Observation Caried Forward*
LVR ..... *Landschaftsverband Rheinland*
MDD ..... *Major Depressive Disorder*
MRSI ..... *Momentary Ruminative Self-Inventory*
MWT-B ..... *Mehrfachwahl Wortschatztest B (Version B)*
PMI ..... *Person Mean Imputation*
PP ..... *Per Protocol*
RCT ..... *Randomized Controlled Trial*
RSQ-D ..... *Response Styles Questionnaire-D (deutsche Version)*
RST ..... *Response Style Theory*
SCID-I ..... *Structured Clinical Interview for DSM-IV Axis-I Disorders*
SKT ..... *Syndrom-Kurz-Test, Syndrom-Kurz-Test*
TAU ..... *Treatment as Usual*

Appendix A Patient Information Sheet and Consent Form

LVR-Klinikum Essen
Kliniken und Institut der Universität Duisburg-Essen

LVR Qualität für Menschen
LVR-Klinikverbund

Teilnehmerinformation für die wissenschaftliche Untersuchung zur:

Modifikation des emotionalen Gedächtnis bei Depression: Studie zur Wirksamkeit eines kurzen computergestützten Trainings bei Patienten mit Depression (CBMM Studie)

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Sehr geehrte/r Patient/in,

im Rahmen eines Forschungsprojektes suchen wir Patienten im Alter zwischen 18 und 60 Jahren, die an einer depressiven Erkrankung leiden und daran interessiert sind, an einer wissenschaftlichen Studie teilzunehmen.

Was ist der Zweck dieser Studie?
Es wird davon ausgegangen, dass eine besondere Verarbeitung emotionaler Reize zur Entstehung und Aufrechterhaltung von Depressionen beiträgt. Im Gegensatz zu Menschen, die nicht unter einer Depression leiden, neigen depressive Patienten verstärkt dazu, vor allem negative Informationen wahrzunehmen, zu verarbeiten und zu erinnern. Diese veränderte Verarbeitungsweise kann sich negativ auf die Aufmerksamkeit, das Gedächtnis und die Stimmung auswirken. In dieser Studie soll untersucht werden, inwieweit sich die veränderte Wahrnehmung und Reaktion von Patienten mit Depressionen, mit Hilfe von einem kurzen Computertraining, wieder positiv beeinflussen lässt. Hierzu soll geschaut werden, wie verschiedene Informationen empfunden und behalten werden und ob die Verarbeitung dieser Informationen veränderbar ist. Sollte sich das Computerprogramm in der Studie bewähren, kann es in der Zukunft ein weiterer Baustein in der Behandlung von Depressionen werden.

Wie läuft die Studie ab?
Nachdem Sie sich über die Studie informiert haben und Sie schriftlich Ihr Einverständnis zur Teilnahme an der Studie erklärt haben, verläuft die Studie in drei Abschnitten.

Im ersten Abschnitt wird in einer Untersuchung mit Ihnen geprüft, ob Sie für die Teilnahme geeignet sind. Dabei werden zum Beispiel Fragen zu Ihrem Alter und Ihren Beschwerden gestellt. Des Weiteren werden eine Reihe kurzer Aufgaben zu Aufmerksamkeit und Gedächtnis durchgeführt und Sie werden gebeten, einige kurze Fragebögen zu Denk- & Reaktionsstilen, Angst- & depressiven Symptomen und zum subjektiven Wohlergehen auszufüllen.

Im zweiten Abschnitt folgen innerhalb einer Woche 4 Trainingseinheiten von ca. 35 Minuten des neu entwickelten Computerprogramms. Sie werden zufällig in eines von unterschiedlichen Trai-

nings eingeteilt. In den Trainingseinheiten erscheinen auf dem Computerbildschirm verschiedene Wortpaare. Sie werden gebeten sich diese Paare zu merken, um sie später wieder abzurufen und auf der Computertastatur einzugeben.

Im dritten Abschnitt, der in der darauf folgenden Woche stattfindet, werden Sie erneut einmalig das Computertraining durchführen und anschließend werden Sie gebeten, erneut die Fragebögen vom Anfang der Studie auszufüllen.

Worin liegt der Nutzen einer Teilnahme an der Studie?
In dieser Studie sollen grundlegende Fragen über die Brauchbarkeit und Zweckdienlichkeit dieses neu entwickelten Computerprogramms zur Normalisierung der negativen Wahrnehmung geklärt werden. Diese Untersuchung dient dem Grundlagenverständnis der Depression und der Erforschung geeigneter unterstützender Behandlungsmethoden bei depressiven Erkrankungen. Es wird von Seiten der Studienleiter kein Einfluss auf Ihre Behandlung in der Klinik genommen.

Gibt es Risiken?
Es sind keine negativen Auswirkungen der Durchführung der in dieser Studie geplanten Übungen zu erwarten. Sie können Ihre Teilnahme an der Studie jederzeit ohne Angaben von Gründen und ohne Auswirkung auf ihre sonstige Behandlung abbrechen, indem Sie dem Studienleiter Ihren Wunsch mitteilen. Die bis zu dem Zeitpunkt von Ihnen erhobenen Daten werden in diesem Fall nicht weiter verwendet.

Information zum Datenschutz
Im Rahmen des Forschungsprojektes werden persönliche Daten und medizinische Befunde über Sie erhoben. Die im Rahmen dieses Forschungsprojektes erhobenen Daten werden in Computersystemen der Klinik in pseudonymisierter (verschlüsselter) Form auf unbestimmte Zeit gespeichert. Befunde (z.B. auch Fragebögen) aus der klinischen Versorgung, die in die Studienakte übernommen werden, werden vor der Übernahme in die Studienakte ebenfalls pseudonymisiert, d.h. Ihr Name wird entfernt und durch Ihren Verschlüsselungscode ersetzt. Diese Studienunterlagen werden von den zu Ihrer Behandlung benötigten Unterlagen getrennt in einem verschlossenen Raum aufbewahrt.
Die Namensliste, die allein eine Zuordnung der Forschungsdaten zu Ihrer Person gestattet, verbleibt unter Verschluss. Sobald der Forschungszweck erreicht ist – ein Zeitpunkt lässt sich derzeit nicht angeben – wird diese Namensliste gelöscht. Bis zu diesem Zeitpunkt wird die Namensliste in einem verschlossenen Raum der Klinik aufbewahrt.
Dieses Projekt wird in Kooperation mit Wissenschaftlerinnen der Universität in Nijmegen in den Niederlanden durchgeführt. Im Rahmen dieser Zusammenarbeit werden wissenschaftliche Daten dieser Studie ausgetauscht. Auch hierbei werden die Namen von Ihnen als Patient/in in keinem Fall weitergegeben. Kooperierende Wissenschaftler außerhalb der Klinik haben keinen Einblick in die Namensliste dieser Studie und arbeiten mit den Daten wissenschaftlich nur in pseudonymisierter (verschlüsselter) Form.

Einwilligungserklärung

zur Teilnahme an der Studie
Modifikation des emotionalen Gedächtnis bei Depression: Studie zur Wirksamkeit eines kurzen computergestützten Trainings bei Patienten mit Depression (CBMM Studie)

Name des Patienten in Druckbuchtstaben:.....

Geburtsdatum:..... Studiennummer:.....

Ich habe die Aufklärung zur Studie "Modifikation des emotionalen Gedächtnis bei Depression: Studie zur Wirksamkeit eines kurzen computergestützten Trainings bei Patienten mit Depression" sorgfältig gelesen. Ich wurde von Frau/Herrn _____ ausführlich und verständlich über Ziel, Wesen, Bedeutung, Tragweite, sowie über die mit der Teilnahme an der Studie verbundenen Risiken und den möglichen Nutzen einer Teilnahme an der Studie aufgeklärt. Ich hatte ausreichend Gelegenheit, Fragen zu stellen. Meine Fragen wurden mir ausreichend beantwortet.

Ich hatte ausreichend Zeit, mich zur Teilnahme an dieser Studie zu entscheiden, und weiß, dass die Teilnahme an dieser Studie freiwillig ist. Ich weiß, dass ich jederzeit und ohne Angaben von Gründen diese Zustimmung widerrufen kann, ohne dass hieraus Nachteile für meine weitere Behandlung entstehen.

Ich habe eine Kopie der Studieninformation und dieser Einwilligungserklärung erhalten.

Information und Einwilligungserklärung zum Datenschutz
Im Rahmen des Forschungsprojektes werden persönliche Daten und medizinische Befunde über Sie erhoben. Diese Daten werden pseudonymisiert (d.h. ohne Nennung Ihres Namens) gespeichert. Die Zuordnung von Studiennummer zu Ihrem Namen erfolgt über eine Namensliste, die getrennt von den Studienunterlagen in einem verschlossenen Raum in der Klinik aufbewahrt wird. Die Weitergabe, Speicherung und Auswertung dieser projektbezogenen Daten erfolgt nach gesetzlichen Bestimmungen und setzt vor Teilnahme an dem Projekt folgende freiwillige Erklärung voraus:

Ich erkläre mich einverstanden, dass im Rahmen der Studie erhobene Daten auf Fragebögen und / oder elektronischen Datenträgern aufgezeichnet und ohne Namensnennung (pseudonymisiert) ausgewertet werden dürfen. Außerdem bin ich damit einverstanden, dass die Studiendaten in anonymisierter Form für wissenschaftliche Darstellungen und Veröffentlichungen verwendet werden dürfen.

Ich erkläre hiermit meine freiwillige Teilnahme an dieser Studie.

Name des Patienten/in (Blockschrift)	Adresse des Patienten/in
Telefon des Patienten/in	Ort, Datum und Unterschrift des Patienten/in (eigenhändig)

Ich bestätige, dass ich oben genannten Patienten/in, der/die sein/ihr Einverständnis für die Teilnahme gegeben hat, bezüglich Zweck, Nutzen, Art und Risiken der Studie aufgeklärt habe.

Name des Studienmitarbeiters	Ort, Datum und Unterschrift (eigenhändig)

Appendix B Hamilton Depression Rating Scale (HDRS)

CIPS
Collegium
Internationale
Psychiatriae Scalarum

HAMD
Hamilton Depression Scale

Anleitung
Bitte jeweils nur die zutreffende Ziffer ankreuzen! **Bitte alle Feststellungen beantworten!**

1. Depressive Stimmung (Gefühl der Traurigkeit, Hoffnungslosigkeit, Hilflosigkeit, Wertlosigkeit)
- Keine [0]
- Nur auf Befragen geäußert [1]
- Vom Patienten spontan geäußert [2]
- Aus dem Verhalten zu erkennen (z.B. Gesichtsausdruck, Körperhaltung, Stimme, Neigung zum Weinen) [3]
- Patient drückt FAST AUSSCHLIESSLICH diese Gefühlszustände in seiner verbalen und nicht verbalen Kommunikation aus [4]

2. Schuldgefühle
- Keine [0]
- Selbstvorwürfe, glaubt Mitmenschen enttäuscht zu haben [1]
- Schuldgefühle oder Grübeln über frühere Fehler und „Sünden" [2]
- Jetzige Krankheit wird als Strafe gewertet, Versündigungswahn [3]
- Anklagende oder bedrohende akustische oder optische Halluzinationen [4]

3. Suizid
- Keiner [0]
- Lebensüberdruß [1]
- Todeswunsch, denkt an den eigenen Tod [2]
- Suizidgedanken oder entsprechendes Verhalten [3]
- Suizidversuche (jeder ernste Versuch ≙ 4) [4]

4. Einschlafstörung
- Keine [0]
- Gelegentliche Einschlafstörung (mehr als 1/2 Stunde) [1]
- Regelmäßige Einschlafstörung [2]

5. Durchschlafstörung
- Keine [0]
- Patient klagt über unruhigen oder gestörten Schlaf [1]
- Nächtliches Aufwachen bzw. Aufstehen (falls nicht nur zur Harn- oder Stuhlentleerung) [2]

6. Schlafstörungen am Morgen
- Keine [0]
- Vorzeitiges Erwachen, aber nochmaliges Einschlafen [1]
- Vorzeitiges Erwachen ohne nochmaliges Einschlafen [2]

7. Arbeit und sonstige Tätigkeiten
- Keine Beeinträchtigung [0]
- Hält sich für leistungsunfähig, erschöpft oder schlapp bei seinen Tätigkeiten (Arbeit oder Hobbies) oder fühlt sich entsprechend. [1]
- Verlust des Interesses an seinen Tätigkeiten (Arbeit oder Hobbies), muß sich dazu zwingen. Sagt das selbst oder läßt es durch Lustlosigkeit, Entscheidungslosigkeit und sprunghafte Entschlußänderungen erkennen. [2]
- Wendet weniger Zeit für seine Tätigkeiten auf oder leistet weniger. Bei stationärer Behandlung Ziffer 3 ankreuzen, wenn der Patient weniger als 3 Stunden an Tätigkeiten teilnimmt. Ausgenommen Hausarbeiten auf der Station. [3]
- Hat wegen der jetzigen Krankheit mit der Arbeit aufgehört. Bei stationärer Behandlung ist Ziffer 4 anzukreuzen, falls der Patient an keinen Tätigkeiten teilnimmt, mit Ausnahme der Hausarbeit auf der Station, oder wenn der Patient die Hausarbeit nur unter Mithilfe leisten kann. [4]

8. Depressive Hemmung (Verlangsamung von Denken und Sprache; Konzentrationsschwäche, reduzierte Motorik)
- Sprache und Denken normal [0]
- Geringe Verlangsamung bei der Exploration [1]
- Deutliche Verlangsamung bei der Exploration [2]
- Exploration schwierig [3]
- Ausgeprägter Stupor [4]

9. Erregung
- Keine [0]
- Zappeligkeit [1]
- Spielen mit den Fingern, Haaren usw. [2]
- Hin- und herlaufen, nicht still sitzen können [3]
- Händeringen, Nägelbeißen, Haareraufen, Lippenbeißen usw. [4]

10. Angst – psychisch
- Keine Schwierigkeit [0]
- Subjektive Spannung und Reizbarkeit [1]
- Sorgt sich um Nichtigkeiten [2]
- Besorgte Grundhaltung, die sich im Gesichtsausdruck und in der Sprechweise äußert [3]
- Ängste werden spontan vorgebracht [4]

11. Angst – somatisch
Körperliche Begleiterscheinungen der Angst wie: Gastrointestinale (Mundtrockenheit, Winde, Verdauungsstörungen, Durchfall, Krämpfe, Aufstoßen) – Kardiovasculäre (Herzklopfen, Kopfschmerzen) – Respiratorische (Hyperventilation, Seufzen) – Pollakisurie – Schwitzen
- Keine [0]
- Geringe [1]
- Mäßige [2]
- Starke [3]
- Extreme (Patient ist handlungsunfähig) [4]

CIPS
Collegium
Internationale
Psychiatriae Scalarum

HAMD
Hamilton Depression Scale

12. Körperliche Symptome – gastrointestinale

- Keine [0]
- Appetitmangel, ißt aber ohne Zuspruch. Schweregefühle im Abdomen [1]
- Muß zum Essen angehalten werden. Verlangt oder benötigt Abführmittel oder andere Magen-Darmpräparate [2]

13. Körperliche Symptome – allgemeine

- Keine [0]
- Schweregefühl in Gliedern, Rücken oder Kopf. Rücken-, Kopf- oder Muskelschmerzen. Verlust der Tatkraft, Erschöpfbarkeit [1]
- Bei jeder deutlichen Ausprägung eines Symptoms 2 ankreuzen [2]

14. Genitalsymptome wie etwa: Libidoverlust, Menstruationsstörungen etc.

- Keine [0]
- Geringe [1]
- Starke [2]

15. Hypochondrie

- Keine [0]
- Verstärkte Selbstbeobachtung (auf den Körper bezogen) [1]
- Ganz in Anspruch genommen durch Sorgen um die eigene Gesundheit [2]
- Zahlreiche Klagen, verlangt Hilfe etc. [3]
- Hypochondrische Wahnvorstellungen [4]

16. Gewichtsverlust (entweder a oder b ankreuzen)

a. Aus Anamnese

- Kein Gewichtsverlust [0]
- Gewichtsverlust wahrscheinlich in Zusammenhang mit jetziger Krankheit [1]
- Sicherer Gewichtsverlust laut Patient [2]

b. Nach wöchentlichem Wiegen in der Klinik, wenn Gewichtsverlust

- weniger als 0,5 kg/Woche [0]
- mehr als 0,5 kg/Woche [1]
- mehr als 1 kg/Woche [2]

17. Krankheitseinsicht

- Patient erkennt, daß er depressiv und krank ist [0]
- Räumt Krankheit ein, führt sie aber auf schlechte Ernährung, Klima, Überarbeitung, Virus, Ruhebedürfnis etc. zurück [1]
- Leugnet Krankheit ab [2]

18. Tagesschwankungen

a. Geben Sie an, ob die Symptome schlimmer am Morgen oder am Abend sind. Sofern KEINE Tagesschwankungen auftreten, ist = (= keine Tagesschwankungen) anzukreuzen.

- Keine Tagesschwankungen [0]
- Symptome schlimmer am Morgen [1]
- Symptome schlimmer am Abend [2]

b. Wenn es Schwankungen gibt, geben Sie die Stärke der SCHWANKUNGEN an. Falls es KEINE gibt, kreuzen Sie 0 (= keine) an.

- Keine [0]
- Gering [1]
- Stark [2]

19. Depersonalisation, Derealisation wie etwa: Unwirklichkeitsgefühle, nihilistische Ideen

- Keine [0]
- Gering [1]
- Mäßig [2]
- Stark [3]
- Extrem (Patient ist handlungsunfähig) [4]

20. Paranoide Symptome

- Keine [0]
- Mißtrauisch [1]
- Beziehungsideen [2]
- Beziehungs- und Verfolgungswahn [3]
- [ ]

21. Zwangssymptome

- Keine [0]
- Gering [1]
- Stark [2]
- [ ]

Bitte prüfen Sie, ob Sie alle Feststellungen zutreffend beantwortet haben!

Score 1

❑❑

Appendix C Mehrfachwahl-Wortschatztest (MWT-B)

Anweisung:

Sie sehen hier mehrere Reihen mit Wörtern. In jeder Reihe steht **höchstens ein Wort**, das Ihnen vielleicht bekannt ist. Wenn Sie es gefunden haben, streichen Sie es bitte durch.

1. Nale – Sahe – Nase – Nesa – Sehna
2. Funktion – Kuntion – Finzahm – Tuntion – Tunkion
3. Struk – Streik – Sturk – Strek – Kreik
4. Kulinse – Kulerane – Kulisse – Klubihle – Kubistane
5. Kenekel – Gesonk – Kelume – Gelenk – Gelerge
6. siziol – salzahl – sozihl – sziam – sozial
7. Sympasie – Symmofeltrie – Symmantrie – Symphonie – Symplanie
8. Umma – Pamme – Nelle – Ampe – Amme
9. Krusse – Surke – Krustelle – Kruste – Struke
10. Kirse – Sirke – Krise – Krospe – Serise
11. Tinxur – Kukutur – Fraktan – Tinktur – Rimsuhr
12. Unfision – Fudision – Infusion – Syntusion – Nuridion
13. Feudasmus – Fonderismus – Föderalismus – Födismus – Föderasmus
14. Redor – Radium – Terion – Dramin – Orakium
15. kentern – knerte – kanzen – kretern – trekern
16. Kantate – Rakante – Kenture – Krutehne – Kallara
17. schalieren – waschieren – wakieren – schackieren – kaschieren
18. Tuhl – Lar – Lest – Dall – Lid
19. Dissonanz – Diskrisanz – Distranz – Dinotanz – Siodenz

bitte wenden

Name _____ Punkte _____

Beruf _____ Alter _____

Untersuchungsdatum _____ männlich – weiblich ____

Sonstiges _____

_____

---

20. Ferindo – Inferno – Orfina – Firanetto – Imfindio

21. Rilkiase – Kilister – Riliker – Klistier – Linkure

22. kurinesisch – kulinarisch – kumensisch – kulissarisch – kannastrisch

23. Rosto – Torso – Soro – Torgos – Tosor

24. Kleiber – Beikel – Keibel – Reikler – Biekerl

25. Ralke – Korre – Ruckse – Recke – Ulte

26. Lamone – Talane – Matrone – Tarone – Malonte

27. Tuma – Umat – Maut – Taum – Muta

28. Sorekin – Sarowin – Rosakin – Narosin – Kerosin

29. beralen – gerältet – anälteren – untären – verbrämen

30. Kapaun – Paukan – Naupack – Aupeck – Ankepran

31. Sickaber – Bassiker – Kassiber – Sassiker – Askiber

32. Pucker – Keuper – Eucker – Reuspeck – Urkane

33. Spirine – Saprin – Parsin – Purin – Asprint

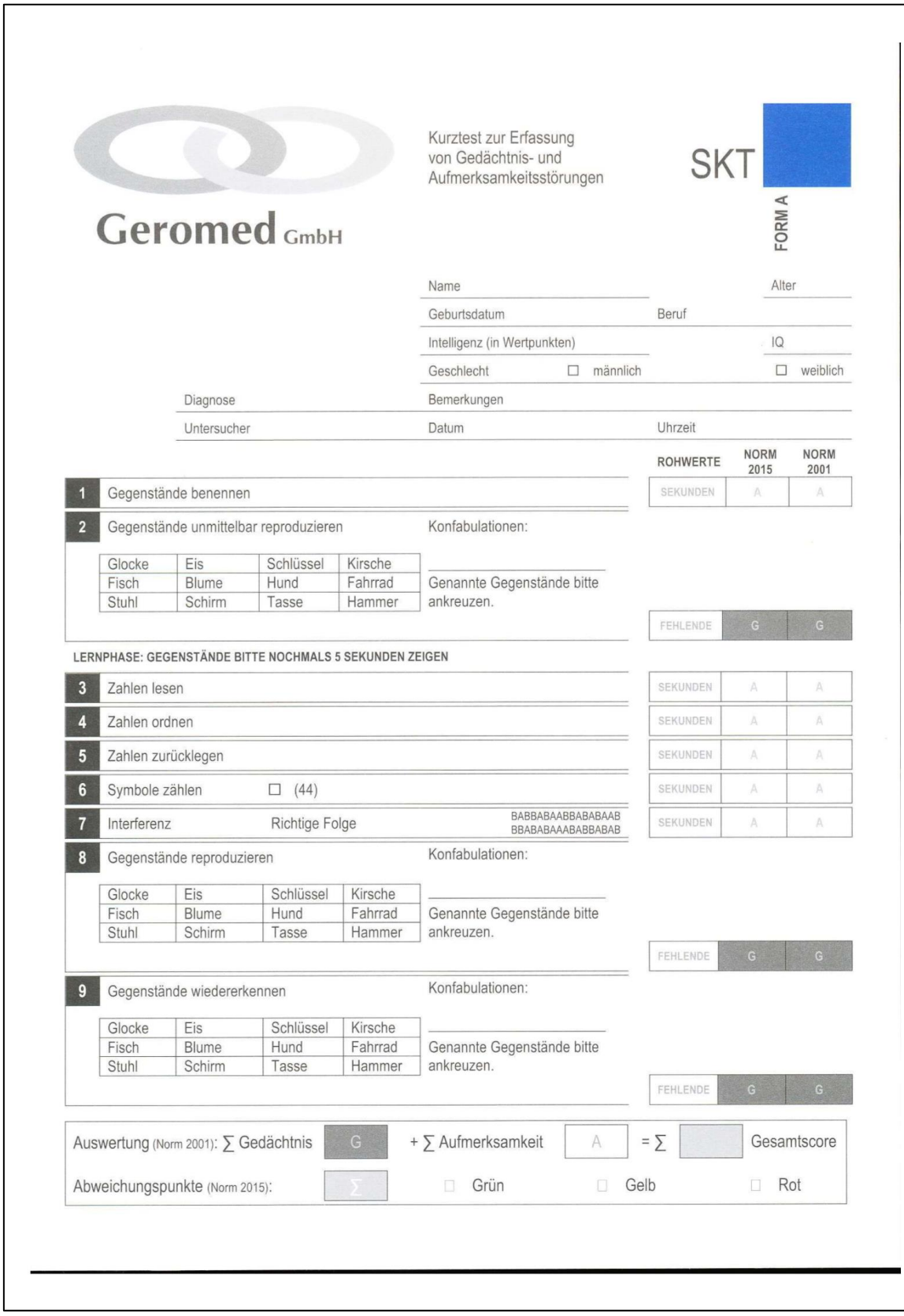
34. Kulon – Solgun – Koskan – Soran – Klonus

35. Adept – Padet – Edapt – Epatt – Taped

36. Gindelat – Tingerat – Indigenat – Nitgesaar – Ringelaar

37. Berkizia – Brekzie – Birakize – Brikazie – Bakiria

Appendix D Syndrom-Kurz-Test (SKT)



Geromed GmbH

Kurztest zur Erfassung von Gedächtnis- und Aufmerksamkeitsstörungen

SKT FORM A

Name | Alter

Geburtsdatum | Beruf

Intelligenz (in Wertpunkten) | IQ

Geschlecht ☐ männlich ☐ weiblich

Diagnose | Bemerkungen

Untersucher | Datum | Uhrzeit

		ROHWERTE	NORM 2015	NORM 2001
1	Gegenstände benennen	SEKUNDEN	A	A
2	Gegenstände unmittelbar reproduzieren			

Konfabulationen:

Glocke	Eis	Schlüssel	Kirsche
Fisch	Blume	Hund	Fahrrad
Stuhl	Schirm	Tasse	Hammer

Genannte Gegenstände bitte ankreuzen.

FEHLENDE G G

LERNPHASE: GEGENSTÄNDE BITTE NOCHMALS 5 SEKUNDEN ZEIGEN

3	Zahlen lesen	SEKUNDEN	A	A
4	Zahlen ordnen	SEKUNDEN	A	A
5	Zahlen zurücklegen	SEKUNDEN	A	A
6	Symbole zählen ☐ (44)	SEKUNDEN	A	A
7	Interferenz Richtige Folge BABBABAABBABABAAB BBABABAAABABBABAB	SEKUNDEN	A	A
8	Gegenstände reproduzieren			

Konfabulationen:

Glocke	Eis	Schlüssel	Kirsche
Fisch	Blume	Hund	Fahrrad
Stuhl	Schirm	Tasse	Hammer

Genannte Gegenstände bitte ankreuzen.

FEHLENDE G G

9 Gegenstände wiedererkennen

Konfabulationen:

Glocke	Eis	Schlüssel	Kirsche
Fisch	Blume	Hund	Fahrrad
Stuhl	Schirm	Tasse	Hammer

Genannte Gegenstände bitte ankreuzen.

FEHLENDE G G

Auswertung (Norm 2001): ∑ Gedächtnis G + ∑ Aufmerksamkeit A = ∑ Gesamtscore

Abweichungspunkte (Norm 2015): ∑ ☐ Grün ☐ Gelb ☐ Rot

Appendix E Becks Depression Inventory-II (BDI-II)

BDI-II Fragebogen

Name	Alter	Geschlecht m / w	Datum

Anleitung: Dieser Fragebogen enthält 21 Gruppen von Aussagen. Bitte lesen Sie jede dieser Gruppen von Aussagen sorgfältig durch und suchen Sie sich dann in jeder Gruppe **eine Aussage** heraus, die am besten beschreibt, wie Sie sich **in den letzten zwei Wochen, einschließlich heute, gefühlt haben**. Kreuzen Sie die Zahl neben der Aussage an, die Sie sich herausgesucht haben (0, 1, 2 oder 3). Falls in einer Gruppe mehrere Aussagen gleichermaßen auf Sie zutreffen, kreuzen Sie die Aussage mit der höheren Zahl an. Achten Sie bitte darauf, dass Sie in jeder Gruppe nicht mehr als eine Aussage ankreuzen, das gilt auch für Gruppe 16 (Veränderungen der Schlafgewohnheiten) oder Gruppe 18 (Veränderungen des Appetits).

1.) Traurigkeit
- **0** Ich bin nicht traurig.
- **1** Ich bin oft traurig.
- **2** Ich bin ständig traurig.
- **3** Ich bin so traurig oder unglücklich, dass ich es nicht aushalte.

2.) Pessimismus
- **0** Ich sehe nicht mutlos in die Zukunft.
- **1** Ich sehe mutloser in die Zukunft als sonst.
- **2** Ich bin mutlos und erwarte nicht, dass meine Situation besser wird.
- **3** Ich glaube, dass meine Zukunft hoffnungslos ist und nur noch schlechter wird.

3.) Versagensgefühle
- **0** Ich fühle mich nicht als Versager.
- **1** Ich habe häufiger Versagensgefühle.
- **2** Wenn ich zurückblicke, sehe ich eine Menge Fehlschläge.
- **3** Ich habe das Gefühl, als Mensch ein völliger Versager zu sein.

4.) Verlust von Freude
- **0** Ich kann die Dinge genauso gut genießen wie früher.
- **1** Ich kann die Dinge nicht mehr so genießen wie früher.
- **2** Dinge, die mir früher Freude gemacht haben, kann ich kaum mehr genießen.
- **3** Dinge, die mir früher Freude gemacht haben, kann ich überhaupt nicht mehr genießen.

5.) Schuldgefühle
- **0** Ich habe keine besonderen Schuldgefühle.
- **1** Ich habe oft Schuldgefühle wegen Dingen, die ich getan habe oder hätte tun sollen.
- **2** Ich habe die meiste Zeit Schuldgefühle.
- **3** Ich habe ständig Schuldgefühle.

6.) Bestrafungsgefühle
- **0** Ich habe nicht das Gefühl, für etwas bestraft zu sein.
- **1** Ich habe das Gefühl, vielleicht bestraft zu werden.
- **2** Ich erwarte, bestraft zu werden.
- **3** Ich habe das Gefühl, bestraft zu sein.

7.) Selbstablehnung
- **0** Ich halte von mir genauso viel wie immer.
- **1** Ich habe Vertrauen in mich verloren.
- **2** Ich bin von mir enttäuscht.
- **3** Ich lehne mich völlig ab.

8.) Selbstvorwürfe
- **0** Ich kritisiere oder tadle mich nicht mehr als sonst.
- **1** Ich bin mir gegenüber kritischer als sonst.
- **2** Ich kritisiere mich für all meine Mängel.
- **3** Ich gebe mir die Schuld für alles Schlimme, was passiert.

9.) Selbstmordgedanken
- **0** Ich denke nicht daran, mir etwas anzutun.
- **1** Ich denke manchmal an Selbstmord, aber ich würde es nicht tun.
- **2** Ich möchte mich am liebsten umbringen.
- **3** Ich würde mich umbringen, wenn ich die Gelegenheit dazu hätte.

10.) Weinen
- **0** Ich weine nicht öfter als früher.
- **1** Ich weine jetzt mehr als früher.
- **2** Ich weine beim geringsten Anlass.
- **3** Ich möchte gern weinen, aber ich kann nicht.

PEARSON PsychCorp

Summe Seite 1:

Bitte wenden

11.) Unruhe

0 Ich bin nicht unruhiger als sonst.
1 Ich bin unruhiger als sonst.
2 Ich bin so unruhig, dass es mir schwerfällt, still zu sitzen.
3 Ich bin so unruhig, dass ich mich ständig bewegen oder etwas tun muss.

12.) Interessenverlust

0 Ich habe das Interesse an anderen Menschen oder an Tätigkeiten nicht verloren.
1 Ich habe weniger Interesse an anderen Menschen oder an Dingen als sonst.
2 Ich habe das Interesse an anderen Menschen oder Dingen zum größten Teil verloren.
3 Es fällt mir schwer, mich überhaupt für irgend etwas zu interessieren.

13.) Entschlussunfähigkeit

0 Ich bin so entschlussfreudig wie immer.
1 Es fällt mir schwerer als sonst, Entscheidungen zu treffen.
2 Es fällt mir sehr viel schwerer als sonst, Entscheidungen zu treffen.
3 Ich habe Mühe, überhaupt Entscheidungen zu treffen.

14.) Wertlosigkeit

0 Ich fühle mich nicht wertlos.
1 Ich halte mich für weniger wertvoll und nützlich als sonst.
2 Verglichen mit anderen Menschen fühle ich mich viel weniger wert.
3 Ich fühle mich völlig wertlos.

15.) Energieverlust

0 Ich habe so viel Energie wie immer.
1 Ich habe weniger Energie als sonst.
2 Ich habe so wenig Energie, dass ich kaum noch etwas schaffe.
3 Ich habe keine Energie mehr, um überhaupt noch etwas zu tun.

16.) Veränderungen der Schlafgewohnheiten

0 Meine Schlafgewohnheiten haben sich nicht verändert.
1a Ich schlafe etwas mehr als sonst
1b Ich schlafe etwas weniger als sonst.
2a Ich schlafe viel mehr als sonst.
2b Ich schlafe viel weniger als sonst.
3a Ich schlafe fast den ganzen Tag.
3b Ich wache 1-2 Stunden früher auf als gewöhnlich und kann dann nicht mehr einschlafen.

17.) Reizbarkeit

0 Ich bin nicht reizbarer als sonst.
1 Ich bin reizbarer als sonst.
2 Ich bin viel reizbarer als sonst.
3 Ich fühle mich dauernd gereizt.

18.) Veränderungen des Appetits

0 Mein Appetit hat sich nicht verändert.
1a Mein Appetit ist etwas schlechter als sonst.
1b Mein Appetit ist etwas größer als sonst.
2a Mein Appetit ist viel schlechter als sonst.
2b Mein Appetit ist viel größer als sonst.
3a Ich habe überhaupt keinen Appetit.
3b Ich habe ständig Heißhunger.

19.) Konzentrationsschwierigkeiten

0 Ich kann mich so gut konzentrieren wie immer.
1 Ich kann mich nicht mehr so gut konzentrieren wie sonst.
2 Es fällt mir schwer, mich längere Zeit auf irgend etwas zu konzentrieren.
3 Ich kann mich überhaupt nicht mehr konzentrieren.

20.) Ermüdung oder Erschöpfung

0 Ich fühle mich nicht müder oder erschöpfter als sonst.
1 Ich werde schneller müde oder erschöpft als sonst.
2 Für viele Dinge, die ich üblicherweise tue, bin ich zu müde oder erschöpft.
3 Ich bin so müde oder erschöpft, dass ich fast nichts mehr tun kann.

21.) Verlust an sexuellem Interesse

0 Mein Interesse an Sexualität hat sich in letzter Zeit nicht verändert.
1 Ich interessiere mich weniger für Sexualität als früher.
2 Ich interessiere mich jetzt viel weniger für Sexualität.
3 Ich habe das Interesse an Sexualität völlig verloren.

Summe Seite 2:	
Übertrag Seite 1:	Gesamt Seite 1+2:

Appendix F Response-Styles Questionnaire-D (RSQ-D)

RSQ-Response-Styles Questionaire (Deutsche Fassung von Kühner, Huffziger und Nolen-Hoeksema, 2007)

Menschen denken und verhalten sich ganz unterschiedlich, wenn sie sich traurig oder niedergeschlagen fühlen. Bitte kreuzen Sie bei allen nachfolgenden Aussagen an, ob Sie diese „fast nie“, „manchmal“, „oft“ oder „fast immer“ denken oder tun, wenn Sie sich traurig, niedergeschlagen oder deprimiert fühlen. Bitte geben Sie jeweils an, was Sie *üblicherweise* tun, wenn Sie sich traurig oder niedergeschlagen fühlen, *nicht* was Sie Ihrer Meinung nach tun sollten.

Wenn ich mich traurig oder niedergeschlagen fühle		Fast nie	Manch-mal	Oft	Fast immer
1.	denke ich daran, wie allein ich mich fühle	1	2	3	4
2.	denke ich, „ich werde nicht fähig sein, meine Arbeit zu machen, weil ich mich so schlecht fühle"	1	2	3	4
3.	denke ich daran, wie erschöpft ich mich fühle	1	2	3	4
4.	denke ich, wie schwer es ist, mich zu konzentrieren	1	2	3	4
5.	versuche ich, etwas Positives an der Situation zu finden oder etwas was ich dabei gelernt habe	1	2	3	4
6.	denke ich, „ich werde jetzt etwas tun, um mich besser zu fühlen“	1	2	3	4
7.	Helfe ich jemand anderem bei irgend etwas, um mich abzulenken	1	2	3	4
8.	Denke ich daran, wie passiv und unmotiviert ich bin	1	2	3	4
9.	Sage ich mir, daß diese Gefühle nicht anhalten werden	1	2	3	4
10.	Denke ich über vorausgegangene Ereignisse nach, um zu verstehen, weshalb ich depressiv bin	1	2	3	4
11.	Denke ich daran, daß ich überhaupt nichts mehr zu fühlen scheine	1	2	3	4
12.	Denke ich, „warum komme ich nicht in Schwung“	1	2	3	4
13.	Denke ich, „warum reagiere ich immer so“	1	2	3	4
14.	Gehe ich an meinen Lieblingsort, um mich von meinen Gefühlen abzulenken	1	2	3	4
15	Denke ich darüber nach, weshalb ich mich so fühle	1	2	3	4
16.	Denke ich, „ich konzentriere mich jetzt auf etwas anderes als darauf, wie ich mich fühle“	1	2	3	4
17.	Schreibe ich auf, über was ich nachdenke und versuche es zu analysieren	1	2	3	4
18.	Tue ich etwas, das mich in der Vergangenheit hat besser fühlen lassen	1	2	3	4

19.	Denke ich über eine zurückliegende Situation nach und wünsche, daß diese besser gelaufen wäre	1	2	3	4
20.	Denke ich, „ich werde jetzt ausgehen und etwas Spaß haben“	1	2	3	4
21.	Konzentriere ich mich auf meine Arbeit	1	2	3	4
22.	Denke ich darüber nach, wie traurig ich mich fühle	1	2	3	4
23.	Denke ich an all meine Unzulänglichkeiten, Schwächen und Fehler	1	2	3	4
24.	Tue ich etwas, das mir Freude macht	1	2	3	4
25.	Denke ich daran, daß ich mich nicht stark genug fühle, um irgend etwas zu tun	1	2	3	4
26.	Denke ich über meine Persönlichkeit nach und versuche zu verstehen weshalb ich depressiv bin	1	2	3	4
27.	Unternehme ich mit Freunden etwas, was mit Spaß macht	1	2	3	4
28.	Gehe ich irgendwo hin, wo ich alleine bin, um über meine Gefühle nachzudenken	1	2	3	4
29.	Denke ich, wie ärgerlich ich über mich selbst bin	1	2	3	4
30.	Höre ich traurige Musik	1	2	3	4
31.	Ziehe ich mich zurück und denke über die Gründe nach, weshalb ich mich so traurig fühle	1	2	3	4
32.	Versuche ich, mich selbst zu verstehen, indem ich mich auf meine depressiven Gefühle konzentriere	1	2	3	4

Appendix G Momentary Ruminative Self-Focus Inventory (MRSI)

Teilnehmernummer:
Datum:

Lesen Sie sich bitte jede der unten stehenden Aussagen durch und geben Sie an, inwieweit Sie damit übereinstimmen. Es geht darum, was Sie in **genau diesem Moment** denken.

	Trifft überhaupt nicht zu	Trifft nicht zu	Trifft wenig zu	Neutral	Trifft ein wenig zu	Trifft zu	Trifft immer zu
1. In diesem Moment bin ich mir meiner Gefühle bewusst.	❑	❑	❑	❑	❑	❑	❑
2. In diesem Augenblick denke ich über mein Leben nach.	❑	❑	❑	❑	❑	❑	❑
3. In diesem Moment bin ich mir meiner tiefsten Gedanken bewusst.	❑	❑	❑	❑	❑	❑	❑
4. Gerade denke ich darüber nach, wie glücklich oder traurig ich mich fühle.	❑	❑	❑	❑	❑	❑	❑
5. Gerade frage ich mich, warum ich reagiere, wie ich es tue?	❑	❑	❑	❑	❑	❑	❑
6. In diesem Moment denke ich über die Bedeutung meiner Gefühle nach.	❑	❑	❑	❑	❑	❑	❑

4

Appendix H Stimulus Material

Cue word	Valence	Target word
Person	pos	zusammen
essen	pos	Lust
vorbereiten	pos	Party
Wissenschaft	pos	grandios
Begegnung	pos	umarmen
Stängel	pos	Blume
Flügel	pos	Engel
Organ	pos	gesund
klingen	pos	bejubeln
Bühne	pos	Talent
Gebäude	pos	schön
Ernennung	pos	Romantik
finden	pos	Belohnung
Lotto	pos	Freude
Aktivität	pos	Höhepunkt
erwarten	pos	Hoffnung
Affekt	pos	Liebe
Lampe	pos	gemütlich
Fahrrad	pos	Freiheit
unternehmen	pos	Vergnügen
Kerze	pos	verliebt
Jahreszeit	pos	Sommer
Unterwäsche	pos	Erotik
Büro	pos	Freundschaft
Geschichte	pos	Humor
Statue	pos	Held
Bewerber	pos	super
Gekicher	pos	lebendig
Gebiss	pos	strahlend
Koffer	pos	Urlaub
Sand	pos	Oase
Rücken	pos	Massage
Mund	pos	küssen
Turnschuh	pos	topfit
Rede	pos	lachen
Ort	pos	Paradies
Klavier	pos	Begabung
Tier	pos	loyal
Buch	pos	wertvoll
Anfänger	pos	Erfolg
Fasching	pos	kreativ

Cue word	Valence	Target word
Haltung	pos	Optimist
Brettspiel	pos	Sieg
Wette	pos	Gewinn
baden	pos	Warm
Zustand	pos	Frieden
Flughafen	pos	Ferien
Tonfall	pos	Harmonie

Cue word	Valence	Target word
Kleidung	neu	gefaltet
Lebensmittel	neu	Mahlzeit
Zeichenbrett	neu	Richtung
Ring	neu	tragen
Partner	neu	Unternehmen
Fußboden	neu	Stein
Brille	neu	Fassung
Bürste	neu	Zahn
Tropfen	neu	Wasserhahn
Fernseher	neu	Programm
Horizont	neu	Schiff
Leim	neu	Sohle
Bank	neu	Automat
Schuh	neu	Schnürsenkel
Kalender	neu	Termin
Zeitung	neu	Artikel
erbeten	neu	Mitleid
Geruch	neu	Nase
Hose	neu	Knopf
gelb	neu	Stoff
drehen	neu	Runde
trinken	neu	Saft
Luft	neu	Atmosphäre
Spülmachine	neu	Tafelgeschirr
Niederlassung	neu	Blätter
Holz	neu	Brett
Computer	neu	Bildschirm
Bein	neu	laufen
Küche	neu	Pfanne
Museum	neu	Ausstellung
Farbe	neu	Pinsel
Aussage	neu	Tatsache
Fußball	neu	Stadion
Vase	neu	Töpferei
Erziehung	neu	Schule
Karton	neu	heben
Fabrik	neu	Mitarbeiter
greifen	neu	manuell
Merkmal	neu	Locken
Treppe	neu	Keller
Lesesaal	neu	Lupe
Route	neu	Wege
Wolke	neu	weiß

Cue word	Valence	Target word
Schrank	neu	Kerzenhalter
Adressat	neu	Absender
Kasse	neu	Geschäft
Box	neu	Stift
Acker	neu	Getreide

Cue word	Valence	Target word
Notar	neg	Scheidung
Autobahn	neg	Unfall
Lunge	neg	Atemnot
Kasino	neg	Verlust
Eigentum	neg	Sklave
schlafen	neg	Alptraum
Wetter	neg	Unheil
Scheune	neg	verwesen
arbeiten	neg	Stress
Kette	neg	berauben
Zug	neg	Verzögerung
Fakten	neg	lieblos
Haus	neg	Krank
Leuten	neg	einsam
Seil	neg	Geisel
Körperteil	neg	Lepra
Zeugin	neg	Verbrechen
Unterhaltung	neg	Unfriede
Chemie	neg	Giftgas
Pelz	neg	grausam
Beziehung	neg	Untreue
Hemd	neg	eiskalt
fühlen	neg	schuldig
Taucher	neg	Unterkühlung
Gehirn	neg	Tumor
atmen	neg	Angstanfall
neutral	neg	negativ
Kopf	neg	Verletzung
Geschichte	neg	Krieg
Hörner	neg	Satan
Öffentlichkeit	neg	Verrat
Ozean	neg	ertrinken
Darlehen	neg	Schuld
Schwester	neg	tot
Keller	neg	Sadismus
Ereignis	neg	traurig
Heute	neg	freudlos
Zeigefinger	neg	Drohen
Stabheuschrecke	neg	leblos
Konto	neg	wertlos
Arzt	neg	Krankheit
Meer	neg	Überschwemmung
Kontakt	neg	zerstören
Shampoo	neg	Haarausfall
rot	neg	Bluttat
Fenster	neg	Selbstmord
Rucksack	neg	Bombe
Abend	neg	Raubüberfall

Appendix I Onscreen Instructions of Training (5th Day, 4th Training Day)

Anleitung:

- Dieses Experiment hat das Ziel, psychologische Methoden zu entwickeln, um Menschen zu helfen. Ihre ernsthafte und verlässliche Mitarbeit ist sehr wichtig, um die Ergebnisse gut interpretieren zu können, sodass wir in Zukunft Menschen helfen können, die diese Hilfe brauchen.
- Vielen Dank für Ihre Mitarbeit.
- Für alle Instruktionen während dieses Experiments gilt, dass Sie die Leertaste drücken können, um weiterzugehen. Lesen Sie die Instruktionen konzentriert und gut durch, da es nicht die Möglichkeit gibt, zum vorigen Schirm zurückzugehen.
- Drücken Sie die Leertaste, um weiterzugehen.

- Sie nehmen an einer Untersuchung teil, bei der es um das Behalten von Wörtern geht.
- In diesem Experiment werden wir Ihr Gedächtnis testen.
- Drücken Sie die Leertaste, um weiterzugehen.

- Die Aufgaben sind einander ähnlich, aber es ist sehr wichtig, dass Sie die Instruktionen immer gut lesen. Wenn Sie Fragen haben oder etwas undeutlich ist, kann der Testleiter Ihnen helfen.
- Drücken Sie die Leertaste, um weiterzugehen.

Study Phase:

- Bei dieser Aufgabe werden wir Sie bitten sich Wortpaare zu merken.
- Die Wortpaare werden einzeln auf dem Bildschirm erscheinen. Jedes Wortpaar wird einige Sekunden auf dem Schirm zu sehen sein. Nutzen Sie also diese Zeit, um sich das Paar zu merken.
- Die Wortpaare, die Sie sich merken sollen, werden jetzt nacheinander auf dem Bildschirm erscheinen. Wenn Sie glauben sich das Wortpaar gut gemerkt zu haben, können Sie auf die Leertaste drücken, um zum nächsten Wortpaar zu gehen.
- Wenn Sie das letzte Wort gesehen haben, werden wir Sie bitten, Rechenaufgaben zu lösen.
- Drücken Sie die Leertaste, um weiterzugehen.

Distraction (Calculations):

- Jetzt werden einige Rechenaufgaben folgen. Geben Sie jeweils das Ergebnis der Aufgabe ein und drücken Sie danach auf ENTER. Probieren Sie die richtige Antwort zu geben. Es ist nicht schlimm, wenn Sie etwas Zeit benötigen, um zu rechnen.
- Nachdem Sie einige Zeit an diesen Aufgaben gearbeitet haben, werden wir Sie bitten, jeweils das zweite Wort der Wortpaare zu erinnern und einzutippen.
- Drücken Sie die Leertaste, um weiterzugehen.

Practice Phase:

- Sie haben vorhin eine Abfolge von Wortpaaren gelernt. Sie werden jetzt jeweils das erste der Worte aus den Paaren einzeln nacheinander zu sehen kriegen. Setzen Sie jeweils das

dazugehörige zweite Wort ein. Probieren Sie so viele von den vorhin gelernten Worten zu erinnern und einzutippen.

- Wenn Sie Ihre Antwort eingegeben haben, drücken Sie die Lehrtaste, um zum nächsten Wort zu gehen.
- Drücken Sie die Lehrtaste, um weiterzugehen.

Distraction (Raven Progressive Matrices):

- Jetzt beginnt ein neuer Teil der Untersuchung.
- Nehmen Sie sich bitte das Buch mit den Puzzles (Raven Progressive Matrices), das neben dem Computer liegt.
- Probieren Sie bei jedem Puzzle das fehlende Stück zu finden, welches das Muster des Puzzles komplettiert. Sie können die Lösung umkreisen.
- Wenn Sie ein Puzzle einmal nicht lösen können, können Sie einfach zum nächsten weitergehen. Sie brauchen nicht alle Puzzles zu lösen. Es ist nur wichtig, dass Sie in Ruhe hieran arbeiten.
- Sobald Sie eine Klingel hören können Sie das Puzzlebuch schließen und mit den Computeraufgaben fortfahren.
- Drücken Sie die Leertaste, wenn Sie für die Puzzle-Aufgaben bereit sind.

- Sie können das Puzzlebuch jetzt weglegen.
- Drücken Sie die Leertaste, um zum nächsten und letzten Teil der Untersuchung zu gehen.

Test Phase:

- Jetzt folgt der letzte Test des Experimentes über die Wortpaare.
- Das erste Wort der Wortpaare wird jeweils erneut einzeln auf dem Bildschirm erscheinen. Ihre Aufgabe ist es, so viele von den zuvor gelernten, dazugehörigen Worten zu erinnern und einzutippen.
- Für das Einsetzen der Wörter haben Sie 8 Sekunden Zeit. Nach Ablauf der 8 Sekunden wird automatisch zum nächsten Wort übergegangen.
- Drücken Sie die Leertaste, um weiterzugehen.

Measure of Real-Life Emotional Memory Performance:

- Wir bitten Sie nun an ein wichtiges Erlebnis in Ihrem Leben zu denken und dieses kurz zu beschreiben. Es kann etwas sein, was erst kürzlich passiert ist, aber auch etwas von früher.
- Beschreiben Sie auf der nächsten Seite kurz, was bei dem Erlebnis passiert ist und wie Sie sich gefühlt haben.
- Drücken Sie nun die Leertaste, um zur nächsten Seite zu gehen.
- Beschreiben Sie hierunter kurz das Erlebnis und wie Sie sich dabei gefühlt haben.
  Mit der ENTER-Taste können Sie in die nächste Zeile springen, um weiterzuschreiben.
  Wenn Ihre Beschreibung fertig ist, können Sie die Control-Taste (Ctrl) unten links drücken, um weiterzugehen.

- Sie haben seit Beginn dieser Untersuchung 144 Wortpaare gelernt. Nächste Woche werden Sie getestet werden, an wie viele dieser Wörter Sie sich noch erinnern können.

- Sie sind nun am Ende von diesem Teil der Untersuchung.
- Sie können dem Testleiter nun Bescheid geben, dass Sie fertig sind. Sie wird Ihnen erklären wie die Folgeuntersuchung in einer Woche ablaufen wird.

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Curriculum Vitae

Der Lebenslauf ist in der Online-Version aus Gründen des Datenschutzes nicht enthalten.