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Effects of a Dot-Probe Training for Patients suffering from Major Depressive Disorder – A Randomized Controlled Trial

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Abstract

Aim. Major depressive disorder is one of the foremost mental disorders, with a high prevalence of relapse. Individuals suffering from major depressive disorder show maintained attention to negative information and less attention to positive information. This attentional bias is considered to influence the maintenance and relapse of depressive disorder. This study examined the effects of a dot-probe training to reduce the attentional bias in patients suffering from major depressive disorder.

Method. The design of the study was a randomized controlled trial. A sample of 29 patients in clinical or day clinical stay and with DSM-IV diagnosis of major depressive disorder participated in the experiment. They were randomly assigned to an experimental (n = 14) or a placebo control condition (n = 15) of a dot-probe training. This dot-probe training consisted of four training sessions using neutral and positive stimuli. Reaction times were measured to analyze the direction and severity of attentional bias. The severity of depression was measured with the Beck Depression Inventory-II, Hamilton Rating Scale and State Trait Anxiety Inventory-Form X.

Results. Prior to the training, the scores implicated an attentional bias on neutral stimuli in the experimental group but not in the control group. This indicated a baseline difference between the two groups. Although no interactional effects were found between the attentional bias at the beginning and after the training, a main effect of condition on the attentional bias was conducted. After following the training, the attentional bias of the experimental group did not significantly change but shifted in a positive direction. In the control condition participants paid more attention to neutral stimuli instead of positive stimuli and a significant increase in the attentional bias was found after the training. No significant learning effect was examined over four sessions of the training but stabilization and shift in a positive direction was found after the second session. The improvement of the attentional bias was not related to the reduction of depressive symptoms.

Discussion. The results indicate that the training had no significant positive effect to decrease the attentional bias. The comparison between the experimental and control condition showed, however, that not following the training had a negative impact on the attentional bias. The effects should therefore be seen from a different point of view. The focus should lay on the prevention of not worsen the attentional bias in the first place. This could be further analyzed with the focus on comparing the relapse prevalence of participants following a training compared to participants following placebo training. On some points the dot-probe training can be improved and further research to investigate the effects of the training is necessary. Suggestions for future research are provided.

Samenvatting

Doel. Een ernstige depressieve stoornis is een van de meest voorkomende mentale ziekten, met een hoge prevalentie van terugval. Individuen die lijden aan een ernstige depressieve stoornis richten meer aandacht op negatieve informatie en minder aandacht op positieve informatie. Deze attentional bias heeft invloed op het blijven bestaan van de ziekte en de hoge prevalentie van terugval van depressieve stoornissen. Deze studie onderzoekt de effecten van een dot-probe training om de attentional bias bij patiënten, die lijden aan een ernstige depressieve stoornis te reduceren.

Methode. Het design van de studie was een randomized controlled trial. Een steekproef van 29 patiënten in een klinische of dagdeel behandeling, die een ernstig depressieve stoornis op basis van DSM-IV hadden, namen deel aan de studie. Deelnemers werden gerandomiseerd toegewezen aan een experimentele (n = 14) of controle conditie (n = 15) van de dot-probe training. De training bostond uit vier training sessies en maakte gebruik van neutrale en positieve stimuli. Reactietijden werden gemeten om de richting en ernst van de attentional bias te analyseren. De ernst van de depressie werd gemeten met behulp van de Beck Depression Inventory-II, Hamilton Rating Scale en State Trait Anxiety Inventory-Form X.

Resultaten. Aan het begin van de training lieten de scores een attentional bias op neutrale stimuli zien in de experimentele groep, maar niet in de controle groep. Hieruit bleek een baseline verschil tussen de twee groepen. Hoewel er geen interactie effect gevonden werd tussen de attentional bias aan het begin van de training en de attentional bias na afloop van de training, werd er wel een hoofdeffect van de condities op de attentional bias gevonden. Na de training veranderde de attentional bias van de experimentele groep in positieve richting, echter was deze verandering niet significant. In de controle conditie veranderde de attentional bias in een niet gewenste richting. Deelnemers hadden een significant verhoogd attentional bias na de training. Er werd geen significant leer effect over de vier training sessies gemeten. Er werd echter wel een stabilisatie en verschuiving in een positieve richting gevonden na de tweede training. Een verbetering van de attentional bias was niet gerelateerd aan de afname van de depressieve symptomen.

Discussie. Op basis van de resultaten kan geconcludeerd worden, dat de dot probe training geen significant effect had voor het verminderen van de attentional bias bij ernstig depressieve patiënten. Het vergelijken van de experimentele en controle conditie liet zien dat het niet volgen van de training een negatieve invloed had op de attentional bias. De effecten van de training zouden daarom van een andere kant bekeken moeten worden. De focus zou op de preventie moeten liggen, zodat de attentional bias niet versterkt wordt. Op sommige punten

kan de dot-probe training verbeterd worden en verder onderzoek naar de effecten van het training is gewenst. Aanbevelingen voor toekomstig onderzoek worden beschreven.

Contents

1. Introduction

One of the foremost mental disorders in the world is major depressive disorder (MDD). In general, MDD can be treated with several different treatment approaches and is characterized by abnormalities of mood, cognitions, such as immoderate feelings of guilt or worthlessness, psychomotor activity, such as retardation or agitation in movement or speech, and neurovegetative functions, such as sleep disturbance or loss or increase of appetite, (Fava & Kendler, 2000). According to a meta-analysis of 116 studies the global point prevalence of MDD is 4.7 % (Ferrari et al., 2013). The disability-adjusted life years (DALY) describes the sum of years lived with a disability (YLD) and the years of life lost because of premature mortality (YLL). In 2000, MDD accounted for 4.3% of DALYs and ranked depression worldwide as the third leading medical condition with the greatest disease burden (Üstün et al., 2004). Further, MDD accounted for 8.3% of YLD by men and 13.4% by women, and was thereby the leading cause of disability worldwide (Üstün et al., 2004). This shows the high impact of MDD compared to other psychological and physical disorders.

Despite approved pharmacological and psychological interventions, half of the patients who suffer a first depressive episode will relapse within two years after recovery. This indicates that current treatments for MDD are not satisfactory. The risk of relapse increases further with each new episode (Boland & Keller, 2009). The high relapse prevalence leads to chronicity, functional impairments and therefore high societal costs (Murray & Lopez, 1997; Kessler & Wang, 2009). Therapies focus on conscious information processing of the patients. Unconscious information processing is not treated in therapy, what partly maintains depressions (Gotlieb, 2007). The relapse prevalence indicates that the vulnerability factors are stable and not changed through therapy which leads thereto that certain individuals have an increased risk for suffering from depressions repeatedly.

Cognitive theories of depression started to investigate vulnerability factors of depression, for example dysfunctional attitudes or dysfunctional coping strategies (Hallion & Ruscio, 2011). Another important cognitive vulnerability factor is that cognitions are distorted in patients suffering from depression, called cognitive bias. Especially Beck (1967; 1987), assumes in his theory that cognitive biases in the processing of emotional information play an important role in the development and maintenance of disorders.

1.1. Cognitive Bias

A well-known quotation states that some people see their glass as being half empty while others see their glass as being half full. This means that people react differently on the same events and vary in the interpretation of ambivalent events. Research shows that these variables are caused by one's susceptibility to emotional distress (Hertel & Mathews, 2011). The information processing of depressed individuals is congruent with the mood more negative. This means that depressed individuals have a negative information processing. Cognitive bias is distributed in three biases; attentional bias, interpretation bias and memory bias. Those experiencing depression give emotionally negative cues more attention (*attentional bias*), see ambivalent events in a more negative way (*interpretation bias*) and selectively remember negative events (*memory bias*) (Mathews & MacLeod, 2005; Peckham, McHugh & Otto, 2010). According to cognitive theories (Beck, 1987), cognitive biases are seen as the main cognitive factor for causing and maintaining depression. Techniques to measure the cognitive biases are therefore developed to get a better insight in the different cognitive biases. *Attentional biases* are assessed by experiments in which task- irrelevant but affectively meaningful pictures or words have impact on the reaction time to an intended target. People with depression give more attention to stimuli that are related to depression, e.g., a sad face. Non-depressed individuals give more attention to positive stimuli. In contrast to positive stimuli, negative stimuli draw more attention. This is specially the case when these stimuli refer to individual emotional concerns (Hertel & Mathews, 2011). In contrast to individuals suffering from depression, individuals without depression have a tendency to give positive stimuli more attention. Tasks to investigate attentional biases are for example the emotional Stroop task. In this task patients name the color in which words are printed. The reaction time tends to be slower when the word is emotionally negative (Williams, Matthews & MacLeod, 1996). *Interpretation biases* are tested in depressed individuals through spelling tasks in which spoken homophones, e.g. war/ wore, have to be interpreted and spelled. Depressed individuals choose more often the negative interpretation than non-depressed individuals. Although interpretation biases are found in depressed people, research shows that this form of bias is less consistent in depressive disorders (Hertel & Mathews, 2011). In contrast to interpretation biases, *memory biases* are well detected in depressed people. These individuals remember negative pictures and words rather than positive pictures and words (Mathews & MacLeod, 2005). A form of training that changes these cognitive biases that stand in relation with disorders and undesirable emotional reactions is called *cognitive bias modification* (CBM).

1.2. Cognitive Bias Modification

Cognitive bias modification is an experimental paradigm that changes cognitive biases. The goal of CBM is to change and understand the interactions between cognition and emotion (Hertel & Mathews, 2011). Cognitive studies about the interaction between emotions and cognitions have been applied historically. Researches, however, focused their attention on how mood impacts consecutive cognitions, e.g. if mood, manipulated by music, determines cognitions. CBM investigates the reversed direction. It analyzes whether changes in cognition have an impact on emotions. It may examine if a higher attention on mostly negative events effects emotions negatively.

Research has shown that cognitive biases can be altered through CBM experiments and therefore also can lead to a reduction of disorder symptoms (Hertel & Mathews, 2011). Many cognitive theories assume a causal relationship between cognitions and emotions (MacLeod, Campbell, Rutherford & Wilson, 2004, Wells & Bevers, 2010) that is also assumed in this research.

That depression is associated with cognitive biases is shown in previous research (Philips, Hine & Thorsteinsson, 2010; Peckham et al., 2010). According to a meta-analysis (Hallion & Ruscio, 2011) of 45 studies with 2,591 participants, CBM has a medium effect on cognitive bias and a small effect on depression. However, the study explores different techniques for cognitive bias modification, based on changing attentional, interpretational and memory bias. It is important to focus on the different forms of cognitive biases individually to reduce the biases effectively. This research focuses only on attentional biases in patients suffering from MDD. There are several techniques used for the detection and reduction of attentional biases. One commonly used task is the visual probe detection task (MacLeod et al., 1986).

1.3. Dot-Probe Task and Dot-Probe Training

The visual probe detection task is developed by Posner, Sydney and Davidson (1980) and is commonly referred to as the dot-probe task (DP task). The DP task is a test of attention bias. In the DP task two stimuli at the same time are shown on a computer screen. One of the stimuli is negative, for example an angry face. The other stimulus is positive, for example a friendly or neutral face. After disappearing of the images from the screen, a probe (e.g. an arrow) appears in the location of one of the pictures, pointing to the left or to the right side. The participants' task is to identify the probe and push a corresponding button on a keyboard as fast as possible, for the left or the right side. The participants' reaction time is recorded. A faster reaction time by negative stimuli indicates an attentional bias.

Focused on depressive disorders, two factors play an important role for the difficulty to perform the DP task. The first factor is the severity to withdraw the focus from mood congruent stimuli, such as sadness. The second factor is the avoidance to attend to mood incongruent stimuli, such as pleasure (Mathews & MacLeod, 2005). Nowadays, the DP training is commonly used to better understand and test hypothesis about differences in selective-attentional processing. This leads to an improved understanding of depression and anxiety (Frewen et al., 2008). Further, it can be used to reduce the attentional bias.

Whereas the DP task is used to detect the attentional bias, the dot-probe training (DP training) is used to possibly shift the attentional bias away from negative stimuli towards positive stimuli. The DP training consists of several sessions that can differ in quantity and duration. The difference between the DP task and DP training concerns the dot probes location after a mood-congruent or mood-incongruent picture. In the DP training the probe appears consistently after a positive stimulus to shift the attention away from negative or neutral stimuli to positive stimuli and therefore reduce the attentional bias. Because in this study participants are patients in a clinical context, negative stimuli are replaced with neutral stimuli. This is done because of ethical concerns. Negative stimuli could have a negative impact on the depression and treatment of the patients.

Numerous experiments about anxiety show that participants with high level anxiety detect probes which replace negative stimuli faster than participants with a low level of anxiety (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van IJzendoorn, 2007; Fox, Mathews, Calder & Yiend, 2007). This means that they have an attentional bias on negative stimuli. Studies referencing the effect of the DP training in patients suffering from social anxiety found that training significantly reduced symptoms of social anxiety (Beard, Weisberg & Amir, 2011). For individuals with depression the evidence is less clear. Some studies indicate that the DP training leads to a reduction of the attentional bias towards negative stimuli and a reduction of the depressive symptoms. For example, Wells and Beevers (2010) investigated 34 college students with mild to moderate depression. Their research shows that manipulating the attentional bias by using the DP task is possible. The students who participated in a DP training in four sessions had significantly decreased depressive symptoms from baseline to follow-up four weeks after the baseline session compared to a control group. Another study tested the hypothesis that attention retraining at an early stage could reduce depressive symptoms (Tsumura, Shimada, Normura, Sugaya, Suzuki, 2012). In this study, modification of attentional bias is effective for reducing depressive mood responses and cortisol responses. Results of other studies (Baert, DeRaedt, Schact & Koster, 2010; Johnson, Joorman & Gotlieb, 2007) indicated a reduction of depressive symptoms through CBM training with the spatial cueing task without a reduction of attentional biases on negative stimuli. Baert et al. (2010) examined the effects on attentional bias modification training on mood and depressive symptoms on dysphoric and depressed students. In dysphoric students a mild improvement of depressive symptoms without a significant reduction of attentional bias was found. However, this was not the case for students with more severe depressions. In students with more severe depression the symptoms increased after the training and no reduction on the attentional bias was noted. They concluded that the effect of attentional bias modification depends on the severity of the depression. Johnson, Joormann and Gotlieb (2007) investigated 63 patients diagnosed with MDD that completed information processing task to change their attentional and memory bias. The authors found a decrease of the depressive symptoms. But also in their study the improvement of the depressive symptoms was not predicted by an improvement of the attentional bias modification. They concluded that depression is more related to memory biases than to attentional biases. More specific research with patients diagnosed with MDD is necessary to analyze the effectiveness of the DP training on depressive symptomatic and the reduction of cognitive biases. Participants of similar research are mostly non-clinical participants, e.g. students, which tend to have less severe symptoms than clinical patients. Because the evidence for the effectiveness of the DP task on depression is less examined, further research is necessary.

1.4. Aim of the Study

Given the influence of cognitive biases on the preservation and treatment of depression, it is important to consider options to reduce the cognitive biases. Attentional bias modification could be another way to reduce depressive symptoms. It could lead, alongside approved therapy, to lower vulnerability, relapse prevalence and a more effective treatment of depressive symptoms. This could lead to lower chronicity and socio-economic consequences. If the DP intervention shows a positive effect in patients, the technique can easily be implemented in the treatment of the patients. Furthermore it is a cost-effective treatment. After implementing of the training only low costs occur. It is therefore important to study the effects of the DP training to change the attentional bias of patients.

Although research is conducted on DP training, participants were mostly non-clinical patients who have less severe symptoms than clinical patients and also less attentional biases. The main focus of this thesis is the exploration of the effectiveness of the DP training with patients suffering from MDD. This leads to the following research question:

How effective is the dot-probe training in the modification of attentional biases for patients suffering from major depressive disorder?

Subsequent to the research question several hypothesis are established:

1. Before the training, participants will demonstrate an attentional bias on neutral images which means that participants show a faster reaction to the probe which replaces neutral stimuli compared to positive stimuli.
2. After the training, it is hypothesized that the attentional bias of the participants in the training condition is reduced. This is tested by a faster reaction time on positive stimuli compared to neutral stimuli.
3. Participants in the training condition develop a faster reaction time to positive pictures after each session. The reaction time over the course of four sessions is compared.
4. The improvement of the attentional bias in the training condition is related to the severity of depressive symptoms. This is tested by the correlation of the degree of attentional bias with the severity of symptoms.

2. Method

2.1. Design

The design of the study is a randomized controlled trial (RCT). Patients were randomly assigned to either the experimental group or the control group. The experimental group took part in the attentional bias modification training. The control group took part in the placebo training of the attentional bias modification training. In the placebo training the probe appeared equally often behind a neutral and positive stimuli. The research protocol was approved by the ethical committee of the University of Twente and the LVR-Hospital in Essen, a hospital of the University of Duisburg-Essen.

2.2. Participants

A convenience sample of 45 participants was recruited for this study. In this study, data of completers only were analyzed. Data of participants who did not finish the training was removed. This resulted in 29 participants who took part in the complete training. Participants were patients diagnosed with MDD and received treatment in the LVR-Hospital in Essen, hospital of the University of Duisburg-Essen. The patients were either in a clinical stay or in a day clinic treatment. The selection process is shown in figure 1. Between February 2, 2015, and May 28, 2015, 156 patients were treated. Based on computer records, all participants with a MDD diagnosis and a lifespan between 18 and 60 years were invited to take part in the study (n = 48). Patients who had major acute psychiatric disorder rather than a current episode of depressive or mood disorders, e.g. substance misuse or dependency or psychosis, were excluded (n = 108). From the 48 patients, 45 patients wanted to participate in the study. Selections were based on pre-screening with the SCID-I, to ensure that the participants met the inclusion criteria of a MDD. Seven participants had to be excluded of the DP training because they did not meet the inclusion criteria after pre-screening. Participants were then randomly assigned into the experimental (n = 19) or control no-training condition (n = 19) and started with the DP training. Five participants did not finish the study till the last training session, because they had to be discharged earlier (n = 2) or because disciplinary reasons (n = 3), resulting in 16 participants in the experimental group and 17 participants in the control group. One patient showed, in the first session before the training started too many missing data (> 15%) and had to be excluded. Data of three participants had to be excluded because the wrong training variant was offered (see Flow Chart 1). The data of one participant were incomplete because this person did not come to the training and therefore missed the second session. However, the data of the other sessions of this participant were included in the analysis. Therefore, baseline data of 14 participants in the experimental group and 15 participants in the control group was analyzed.

The descriptive data of the participants is shown in table 1. Participants had a mean age of 34.97 (SD = 10.56), ranging from 19 to 55. 72.4% of the participants were women and 27.4 % were men. Most of the participants had a recurrent MDD (51.7%) or MDD and anxiety (24.1%). From the participants, 31% had a primary or lower secondary education and 37.9% followed specific three year career training. Most of the participants had a recurrent MDD (51.7%) and MDD with an anxiety disorder (24.1%). Except one participant, all participants took antidepressants (79.3%), antidepressants together with neuroleptics (10.3%) or together with antiepileptics (6.9%). All data was obtained between February, 2, 2015 and May,28, 2015.

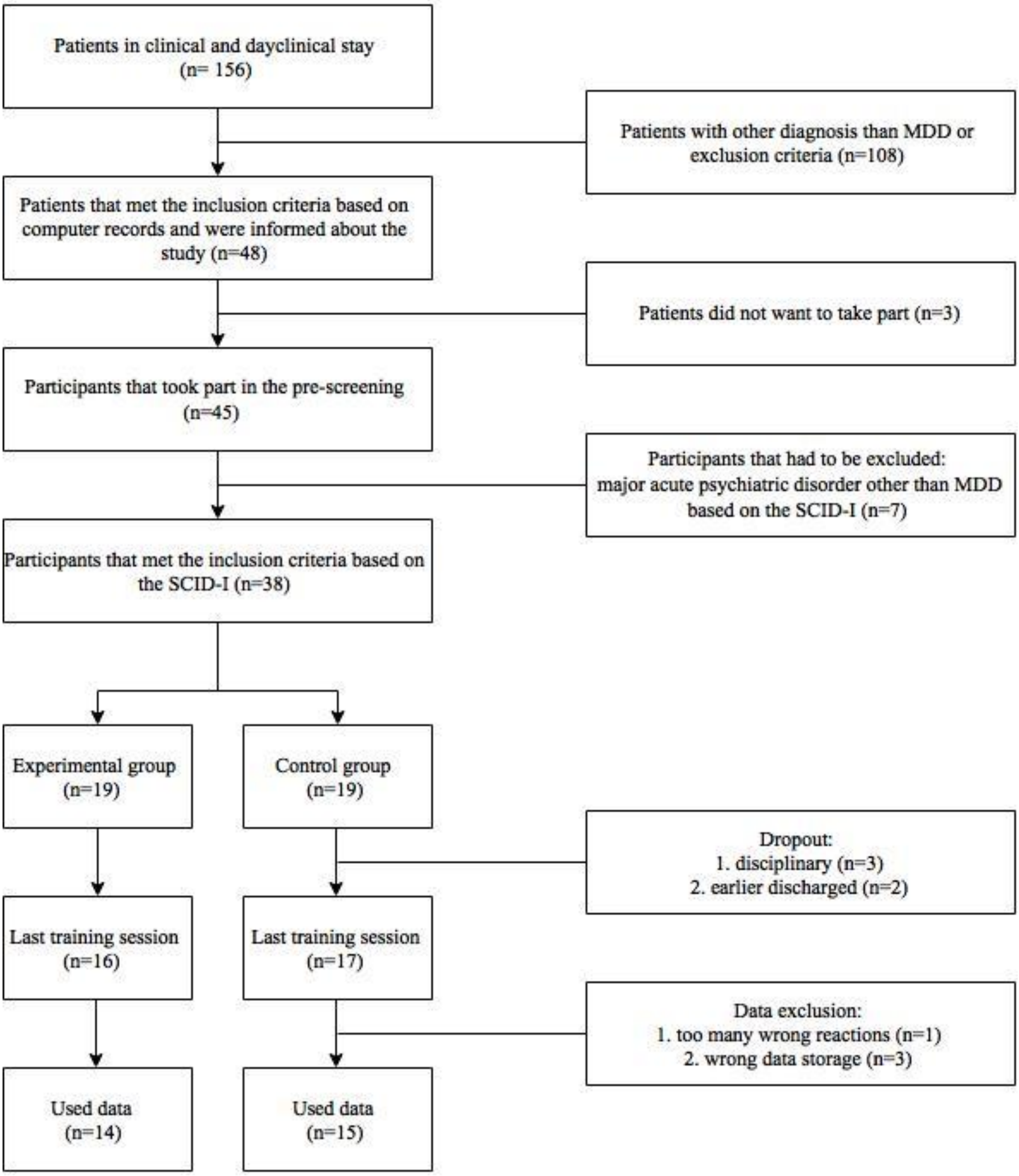

Figure 1
Flow Diagram

2.3. Materials

2.3.1. Depression Assessment Instruments

This study used a number of validated questionnaires and interviews. To assess the severity of depression and changes in mood, the Beck Depression Inventory Second Edition (BDI-II), the Hamilton Rating Scale for Depression (HRSD) and the State-Trait Anxiety Inventory Form X (STAI-X) were used.

The *BDI-II* is a revision of the self-report measure the Beck Depression Inventory (Beck, Steer & Brown, 1996). It assesses the presence and intensity of depression in patients and consists of 21 items which correspondently assess 21 symptoms and attitudes related to depression (sadness, pessimism, past failure, loss of pleasure, guilt feelings, punishment feelings, self-dislike, self-criticalness, suicidal thoughts or wishes, crying, agitation, loss of interest, indecisiveness, worthlessness, loss of energy, changes in sleeping pattern, irritability, changes in appetite, concentration difficulty, tiredness or fatigue and loss of interest in sex). Participants are asked to indicate how frequently they had suffered from the named symptoms in the last two weeks. All items are scored on a 4-point Likert scale that ranges from not present (0) to severe (3). The scores of all items are summed up, leading to a range from 0 to 63. A higher score indicates a more severe depression. Research shows that the BDI-II has a high reliability ($\alpha = .92$) and a good convergent validity (Beck, Steer & Brown, 1996, Osman et al., 1997, Steer et al., 1999).

The *HRSD* is a clinical interview measuring the severity of depression. It is an observer-reported measure; the items are scored based on the clinical interview with the patient through a clinician and are not scored by the patient. The interview consists of 21 items. Depending on the symptom, items are scored on a 3-point and 5-point Likert scale. A higher score indicates a more severe depression. The advantage of the HRSD is the sensitivity to change (Miller, Bishop, Norman & Maddever, 1984). Research about interraterreliability is not consistent. The interraterreliability of the total score is according to Endicott et al. (1981) acceptable and according to Hamilton (1960) high. Further research shows that the reliability is acceptable till very good ($\alpha = .73$ to .91) (Baumann, 1976).

The *Structured Clinical Interview for DSM –IV Axis I Disorders* (SCID-I) is a semi-structured interview which explores symptoms, syndromes and diagnoses of the DSM- IV. It assesses mood disorders, substance use disorders, anxiety disorders, psychotic disorders, obsessive-compulsive disorders, eating disorders, sleep disorders, somatic disorders, and trauma-and stressor-related disorders. The SCID-I is published in a clinical and a clinical trial version. The difference between both is that the clinical trial version is used for research. In this study, the research model is used, as it includes more DSM-IV disorders, their subtypes and their degrees and their development. The research version of the SCID-I is mostly used to elect patients with a specific diagnosis, as it is the case in this study. The SCID-I is used to explore if all participants met the inclusion criteria of a MDD. Further, it is used to explore if the participants do not have other diagnoses that were under the exclusion criteria, referenced above. The psychometric qualities of the SCID-I are acceptable (Williams et al., 1992).

To investigate the anxiety of participants, the *State –Trait Anxiety Inventory (STAI-X)* was incorporated (Spielberger, Gorusch & Lushene, 1970). The STAI-X measures anxiety as a state (feelings of anxiety), as well as a trait (feelings of depression), with respectively 20 items for each scale. This study measures only anxiety as a trait (T-Anxiety scale), because it refers to individual differences in the tendency to have anxiety reactions. Questions are answered on a 4-point Likert scale and focus on areas including the level of nervousness, tension, worry and apprehension. The higher the score the more severe was the anxiety. It has a high test-retest reliability (α = .86) and a good construct validity of .80 for the Taylor Manifest Anxiety Scale (Spielberger, Gorusch & Lushene, 1970).

2.3.2. Dot-Probe Training

The DP training was accomplished via a computer program. Two pairs of emotional pictures were presented at the same time. In this DP training the pairs consisted of one positive and one neutral picture. Neutral pictures were used instead of negative pictures, because of ethical concerns. Participants should not be confronted with negative stimuli during their therapy in the clinic. The confrontation with negative stimuli could worsen the depressive symptoms and could therefore have a negative impact on the therapy. The stimuli of each pair were presented above each other. The pairs of stimuli consisted of 100 neutral and 100 positive pictures and represented different categories (e. g. human beings, animals or objects). The pictures were chosen from the International Affective Pictures System (IAPS) and the emotional intensity of the neutral and positive pictures of one pair was equal (Lang, Bradley & Cuthbert, 2005). This means that the neutral and positive picture that appeared together had the same emotional intensity. Participants were seated roughly 50 cm away from the computer monitor in a quiet room to perform the training. They were instructed to observe the pictures. After 500 milliseconds the pictures disappeared and a probe appeared behind one of the pictures, showing either to the left or to the right side. The task was to react as quickly and as accurate as possible to the direction of the probe by pressing a button. The probe was shown a maximum of 5 seconds. If the response was correct a new pair of stimuli appeared on the screen, otherwise an error message was shown prior to start a new trial. Thus, participants could not react a second time on the same trial. The following trial appeared 1000 ms after the reaction. Pictures were presented at random in the top or bottom of the screen (depicted in figure 1). A faster reaction time for mood-congruent stimuli (e.g. a neutral picture) than for mood-incongruent stimuli (e.g. a positive picture) indicated an attentional bias.

Participants took part in four sessions. Each session consisted of several different trials with no prior knowledge of the participants. First, eight practice trials appeared, followed by

40 test trials, 200 training trials and again 40 test trials. The training trials differed for the experimental and control groups. In the experimental group the probe appeared consistently after positive pictures. In the control group the probe appeared equally often behind a positive and neutral stimuli. The practice and test trials were the same for each group. They were used to test the attentional bias before and after the training.

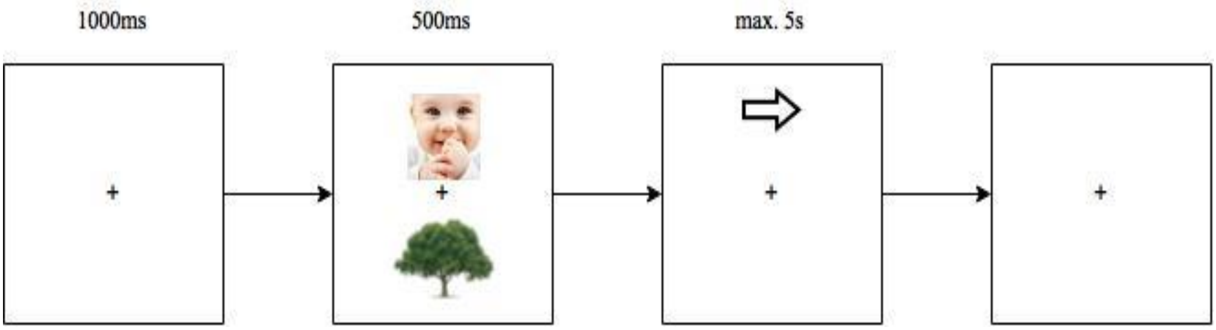

Figure 2
Setting of the DP training

2.4. Procedure

The participation in the study began one week after the intake of the patients. Individuals were informed via descriptive patient information. The descriptive patient information was given to them by a hand out in the clinical stay by the research assistant. Once agreeing to take part in the study and confirming to have read the descriptive patient information, participants obtained written informed consent that had to be signed. Participants were then selected based on prescreening with the structured clinical interview for DSM-IV (SCID-I). If participants met the inclusion criteria they filled in the questionnaires BDI-II, HRSD and STAI-X and participated in the DP training. Participants did not have to reach a cut-off score on the questionnaires.

The DP training consisted of four sessions of 15 minutes behind a computer in the hospital. Participants were instructed that a pair of pictures would appear on the monitor for a short amount of time and to identify the direction (left or right) of the probe behind the picture. They were instructed to react as fast and accurate as possible to the direction of the probe by pressing a right or left keyboard button. Participants took part in the study over a two week period, with two DP trainings per week. The participants were tested individually. At post testing all questionnaires were re-administered, to explore possible changes in the severity of depressive symptoms.

After accomplishing the fourth training session and questionnaires, participants were verbally debriefed about the purpose of the study. They were informed as to which group they were assigned. Participants of the control group had opportunity to take part in the experimental training condition.

2.5. Statistical Analyses

To provide an answer to the research question, the data was analyzed in a controlled way. At first, false responses, e.g., a false identification of the direction of the probe or no reaction, were excluded from the data. Based on previous research, 1% of the slowest and 1% of the fastest reaction times of all participants taken together were excluded, to clear data of extreme scores. Very fast reactions suggest that a button was pressed precociously or was held down from the previous stimulus. On the other hand, too slow reactions could show a lack of attention (Mogg, Mathews & Eysenck, 1992). The data was not corrected for reaction times differing more than three standard deviations from the median because of the kurtosis of reaction times. The data of participants from which more than 15% of the reaction times had to be removed because of false reactions were also excluded from the analysis (Maas, Kejsers, Rinck, Tanis & Becker, 2014). Based on the Kolmogorov-Smirnov test the normal distribution was analyzed. Level of significance was measured and histograms were analyzed.

Based on the Kolmogorov-Smirnov test the sum scores of the experimental and the control group taken together were normally distributed. To analyze if the scores were also normally distributed between the experimental group and control group separately, a Kolmogorov-Smirnov test was conducted for both groups, individually. In the experimental and control group almost all sum scores of the BDI-II, HRSD and STAI-X prior to starting the training and following the training were normally distributed. Only the data of the BDI-II in the control group after the placebo training, $D(15) = .27$, $p < .05$, was significantly non-normal. However, based on the Kolmogorov-Smirnov test the data is not normally distributed, the skewness of the data (2.27) is considered acceptable to prove normal distribution (George & Mallery, 2010). Therefore the correlation was determined with a parametrical parameter, Pearson’s r.

The median reaction time of each participant was calculated. Medians were analyzed instead of means to correct outlier reaction times. Medians were used to examine the extent and direction of attentional bias on the DP training. In the following text the mean of median RTs will be described as mean RT. The RTs in trials in which the probe replaced a positive picture was subtracted from the RTs in trials in which the probe replaced a neutral picture. A negative score of the mean RT indicated that more attention was drawn to the neutral pictures.

It therefore indicated an attentional bias to neutral stimuli. A positive score indicated that more attention was drawn to the positive pictures.

To analyze the direction and extent of attentional bias, deviation scores of the first and last session were compared. A univariate analysis of variance was conducted. To analyze if variables of age, gender and education predicted the attentional bias, a multivariate Analysis of Covariance (ANCOVA) was conducted. The difference scores of the first session prior to the training and the last session after all trainings were compared as within-subject factor, the group (experimental or control) as between-subject factor, age as covariates and education and gender as random factors. Therefore, the difference of the reaction time for neutral pictures and positive pictures was analyzed. This was done to analyze if the baseline data at the beginning of the training was different between the experimental and control condition, and if participants had an attentional bias at the beginning of the training. Additionally, Levene's test was conducted to indicate that group variances were equal and that the assumption of homogeneity has not been violated

A paired sample t-test was utilized to measure the extent and direction of the attentional bias. The RTs of correct responses were the dependent variables. To measure the effectiveness of the DP training, the mean RT of each participant from the first session was compared to the last session. A change in the attentional bias with a more positive score indicated the effectiveness of the DP training. The same analysis was conducted for the control and experimental groups.

In analyzing the fourth hypotheses, the correlation was computed between the attentional bias and the severity of depressive symptoms measured with the BDI-II and HRSD, and the severity of anxious symptoms measured with the STAI-X. Correlations are measured to analyze if the attentional bias and the severity of symptoms stay in relation with each other. The sum scores of the BDI-II, HRSD and STAI-X were calculated. The data of the questionnaires BDI-II, HRSD and STAI-X was ordinal. The items 21, 26, 27, 30, 33, 36 and 39 of the STAI-X had to be inverted.

Depending on the normal distribution of the data, correlations were determined with a parametrical parameter, Pearson's *r*. Because a directional hypothesis was assumed, the test was one-tailed. First a correlation between the questionnaires was conducted. The attentional bias that was measured in the first session of the DP training was correlated with the questionnaires of the first measurement. Also, correlations between the attentional bias measured in the fourth session and the questionnaires of the last session were measured. Finally, the relation between the improvements of reducing the attentional bias and the reduction of symptoms was analyzed. This was done through the difference score of the attentional bias prior and after the training and the difference score of the questionnaires.

In this analysis, Cronbach's alpha above .70 are seen as acceptable, above .80 are seen as high and above .90 are seen as very high (Cohen, Manion & Morrison, 2011). Correlations of .10, .30 and .50 are respectively seen as low, middle and high (Cohen, 1988). In this analysis *p* values below .05 are seen as significant. Effect sizes above .80, .50 and .20 are respectively considered as large, moderate and small (Cohen, 1988). All data was analyzed with SPSS version 21.00.

3. Results

3.1. Data Preparation and Sample Descriptive

Prior to analyzing the data, all error rates, which included pressing the right button when the probe showed to the left or pressing the left button when the probe showed to the right, were removed. False reactions were due to the ease of the task low, resulting in an exclusion of 1.9% of all RTs. To minimize the influence of outlying data, 1% of the fastest and 1% of the slowest reaction times of all participants taken together were excluded. This resulted in the exclusion of RTs faster than 382ms and RTs slower than 1480ms.

Means and standard deviations were calculated separately for gender, age, education, diagnosis and medication for the experimental and control group (see Table 1). The results of chi-square tests and *t*-tests for independent samples showed a baseline difference of the sum score of the STAI-X between the groups. The experimental and control group differed at baseline in their anxiety level. Participants in the experimental group were more anxious (M = 63.79, SD = 5.41), compared to participants in the experimental group (M = 59.33, SD = 4.79). There were no further significant differences between both groups regarding age, age category, years and category of education, number of days in clinic, attentional bias before starting with the training, BDI-II and HRSD score on the first day (see Table 1).

Table 1

Descriptive Data divided in Experimental and Control Group and Comparison of Baseline Characteristics of Participants

	Experimental group (n=14)	Control group (n=15)	Total (n=29)	*t*	χ^2	*p*
	n %	n %	n %			
Gender					1.06	*ns*
Male	2 (14.3%)	6 (40%)	8 (27.6%)			
Female	12 (85.7%)	9 (60%)	21 (72.4%)			
Age Category					.47	*ns*
18-40 years	8 (57.1%)	12 (80%)	20 (69%)			
41-60 years	6 (42.9%)	3(20%)	9 (31%)			
Education					.98	*ns*
Primary & lower secondary	6 (42.9%)	3 (20%)	9 (31%)			
Apprenticeship (career training)	5 (35.7)	6 (40%)	11 (37.9%)			
Upper Secondary	2 (14.3%)	5 (33.3%)	7 (24.1%)			
Tertiary	1 (7.1%)	1 (6.7)	2 (6.9%)			
	M (SD)	M (SD)	M (SD)			
Age	36.36 (11.43)	33.67 (9.9)	34.97 (10.56)	.24		*ns*
Years of education	12.21 (2.94)	13.47 (3.36)	12.84 (3.15)	-.33		*ns*
Number of days in clinic	17.64 (8.96)	12.40 (9.54)	15.02 (9.09)	1.82		*ns*
BDI-II	30.93 (9.41)	30.2 (9.5)		.21		*ns*
HRSD	25.79 (6.34)	29.67 (6.02)		-1.69		*ns*
STAI-X	63.79 (5.41)	59.33 (4.79)		2.35		.03
Attentional Bias before the training	-3.46 (46.14)	26.07 (51.3)		-1.63		*ns*

3.2. Attentional Bias

In order to analyze the direction and extent of attentional bias, deviation scores of the attentional bias before starting with the first training session and the attentional bias after completion of the last training session were compared. A univariate analysis of variance was conducted. No significant interaction effect was found between the pre and post measurement of the attentional bias. This means that the attentional bias prior to the training had no impact on the level of the attentional bias after completing the training. The analysis further revealed the presence of a significant main effect of the conditions following the experimental or control training, $F_{(1,29)} = 5.12$, $p < .05$, $\eta_{partial}^2 = .18$. The attentional bias after the training was influenced by the condition (experimental or control) that was followed. In which direction the attentional bias was influenced was further analyzed separately for the experimental and control group.

In the experimental group the attentional bias on the first session was negative (*M* = -3.46, *SE* = 12.33), implicating that more attention was drawn to neutral pictures than to positive pictures. In comparing sessions, there was no significant decrease of the attentional bias occurred after following four DP training sessions, (*M* = 32.36, *SE* = 16.43), $t(13) = 1.72$, $p = .11$, $r = -.03$. However, at the end of the training the attentional bias shifted in a positive direction. Because the difference between the first and last training was not significant, it cannot be spoken about a change in attentional bias.

The attentional bias of the control group was differently than in the experimental group. In the control group, subjects reacted faster to positive pictures rather than to neutral pictures at baseline (*M* = 26.07, *SE* = 13.25). They had no attentional bias at baseline on neutral stimuli. Compared both sessions a significant change in attention bias took place during the last four sessions, $t(14) = -2.48$, $p < .05$, $r = -.17$. Results showed that attentional bias was negative, implicating that more attention was drawn to neutral pictures after four placebo training sessions (*M* = -16.57, *SE* = 8.9). The attentional bias changed after the placebo training in the opposite direction. In the hypotheses it was suspected that the attention of the control condition does not change significantly neither in a positive nor neutral direction because in the placebo training the probe appeared equally often behind a neutral and positive stimuli. When comparing the experimental and control condition, the direction of the attentional bias is comparable, with the difference that the scores are not significant in the experimental but in the control group.

Furthermore, it was analyzed if covariates of age, education and gender had influence on the outcome. Because the treatment groups (experimental and control) did not differ at baseline in relation at the covariates (age, education and gender), a multivariate Analysis of Covariance (ANCOVA) could be conducted (Lord, 1969). The bias difference scores were compared as within-subject factor, the group (experimental or control) as between-subject factor, age as covariates and education and gender as random factors. Results indicated no significant effect of age, education and gender. The significant main effect of the conditions on the attentional bias was not influenced by age, gender or education of the participants.

3.3. Training Effects on Attentional Bias

To test the third hypothesis, the study revealed whether training had an impact on the results. This means that participants developed a faster reaction time to positive pictures after each session. A repeated measures analysis was conducted and was adjusted by Bonferroni. This analysis was conducted with data of 13 participants in the experimental group and of 15 participants in the control group, because one participant in the experimental group missed one training session. Therefore the data of this person was not complete. The within-subject factors were the sessions of each day (day one to four) which were respectively separated into test trials prior the training (pre) and test trials after the training (post), resulting in eight different measurements (Table 2). Mauchly's test statistics was non-significant, χ^2 (27) = 33.91, p = .17. Therefore, it was concluded that the variances of differences between the conditions were not significantly different and that the assumption of sphericity has not been violated. The mean reaction time was not significantly affected by the number of sessions, $F_{(7, 128)} = 1.63$, p = .12, $\eta_{partial}^2 = .06$. This indicates that no training effect took place of the four sessions.

Table 2

Median Scores and Standard Deviations of the Reaction Times before and after each Training Session

Session	Measure	DP Training Median Scores (SD) (n=13)	DP no Training Median Scores (SD) (n=15)
1	pre	-3.73 (13.82)	26.07 (12.86)
	post	28.23 (17.02)	-4.27 (15.84)
2	pre	4.54 (10.95)	-16.63 (10.19)
	post	-3.85 (16.48)	-5.57 (15.35)
3	pre	-2.89 (12.85)	7.8 (11.96)
	post	1.00 (12.11)	-7.37 (11.27)
4	pre	11.35 (15.82)	13.4 (14.73)
	post	32.96 (13.94)	-16.57 (12.98)

Figure 3 shows the attentional bias of participants over all eight measuring points. They are divided into sessions (1, 2, 3, 4) and measure moment (before the training (pre) and after the training (post)). In the experimental condition the attentional bias fluctuated in the first two training sessions. After the first training session, the attentional bias improved and more attention was drawn to positive stimuli. In the second session the attentional bias declined, and after the training more attention was drawn to neutral stimuli compared to prior to the training. After the second session the attentional bias was stable and shifted in a positive direction. An exponential tendency to decrease the attentional bias was recognized. In the control condition the attentional bias fluctuated after each session. This was expected because in the placebo training the probe appeared equally often behind neutral and positive stimuli. Neither a tendency for a linear nor exponential learning effect was recognizable.

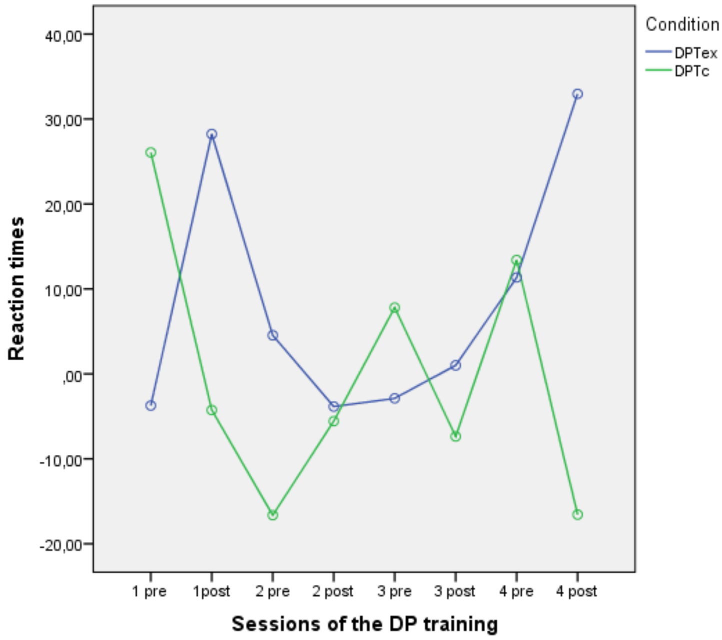

Figure 3
Change of Attentional Bias over Four Sessions for the Experimental and Control Group, separated into Pre- and Post Measurement

3.4. Relation between the Severity of Depression, Anxiety and Attentional Bias

As analyzed in the method, the data was normally distributed. Therefore parametrical correlations are measured to analyze whether the attentional bias and the severity of symptoms stay in relation with each other. In table 3, the relationships of pre and post measurements of the BDI-II, HRSD and STAI-X are shown. As expected, the pre measurement of the BDI-II correlated moderately with the pre measurements of the HRSD (.40) and STAI-X (.48). The pre and post measurements of the STAI-X only correlated significantly with the BDI-II scores and not with the HRSD scores. Further, the relation between the attentional bias and the severity of symptoms was analyzed, to analyze if the attentional bias and the severity of depression stay in relation with each other. In the experimental group, the severity of depression prior to and at the end of the training was not significantly correlated with the attentional bias before and after the training.

In the control condition, the severity of depression prior to the training did also not significantly correlate with the attentional bias. After the training, the severity of depression correlated significantly with the attentional bias (BDI-II: *r* =.68, HRSD: *r* = .65). Because this relation appeared at the end of the training in the control condition it can be concluded that the attentional bias and the severity of depression stayed not in relation with each other. Finally, it was analyzed if the change (improvement or decline) of the attentional bias correlated with more reduction of the depressive symptoms. This was analyzed by the difference score of the attentional bias and the difference scores of the severity of symptoms. No significant relations were examined between the improvements of the attentional bias in the experimental condition. However, a significant correlation was documented between the increase of the attentional bias in the control condition and the increase of depressive symptoms measured with the HRSD ($r = .61$, $p < .05$) and STAI-X ($r = .46$, $p < .05$) and implied that the increase on the attentional bias was related to the increase of depressive and anxious symptoms.

Table 3
Correlation matrix

	1.	2.	3.	4.	5.	6.
1. BDI-II pre	-					
2. HRSD pre	.40*	-				
3. STAI-X pre	.48**	.19	-			
4.BDI-II post	.53**	.17	.29	-		
5.HRSD post	.33*	.72**	.06	.38*	-	
6.STAI-X post	.31	.07	.41*	.79**	.28	-
Experimental group						
Attentional bias pre	-.00	-.10	.11	-	-	-
Attentional bias post	-	-	-	-.02	.15	.12
Control group						
Attentional bias pre	.19	.21	.32	-	-	-
Attentional bias post	-	-	-	.68**	.65**	.40

Note: $p < .05$*, p < .01**, (1-tailed)

4. Discussion

The purpose of this study was to examine the effects of the dot probe training in the modification of attentional biases for patients suffering from major depressive disorder. This was done in a randomized controlled trial. Participants were randomly assigned to either a training condition or a placebo control condition. The aim of the DP training was to significantly decrease the attentional bias on neutral stimuli of participants. In the following, the hypotheses from the beginning of the study are answered.

First it was hypothesized that before the training, participants will demonstrate an attentional bias on neutral images which means that participants show a faster reaction to the probe which replaces neutral stimuli compared to positive stimuli. Prior to starting the training, participants in the experimental group showed an attentional bias towards neutral stimuli. Interestingly, participants in the control group had no attentional bias towards neutral stimuli, before starting with the training. The control group already drew more attention on positive stimuli instead on neutral stimuli. The difference in the attentional bias occurred even though participants were randomly assigned to the experimental and control condition and the two groups did not differ in relation to descriptive data or the severity of depression. This result shows that not by all participants in the study an attentional bias was measured. Although most studies found an attentional bias at baseline this was not the case in other research. The baseline difference is in line with prior research about attentional bias in depressed participants. MacLeod et al. (1986) and Hill and Dutton (1989) also did not find an attentional bias towards emotional words in depressed participants. Another possible explanation for the baseline difference can be that the difference between neutral and positive pictures was not big enough and that participants of did not see a difference between the two picture groups. This can be influential on measuring the attentional bias. As noted, in this study the DP training consisted of neutral and positive stimuli because of ethical reasons. Most studies that investigate the DP training in depressive disorders use stimuli pairs consisting of neutral and negative stimuli (MacLeod et al., 2002). Participants with a current depressive disorder can be more attended to negative images than to neutral ones. Using positive images compared to neutral images also shows the different attention between the stimuli. But neutral stimuli do not represent the depressed mood of the participants who took part in the study.

Secondly it was hypothesized that after the training the attentional bias of the participants in the training condition is reduced. From the results it can be concluded that the dot probe training had no significant effect on changing the attentional bias on neutral stimuli in the training condition after four sessions. Further, no interactional effect in the DP training was found in the experimental group. This means that the attentional bias prior to the training did not influence the attentional bias after completing the training. However, when comparing the training and placebo condition a significant main effect between the experimental and control condition on the attentional bias after the final training sessions was found with a small effect size. Even though participants in the experimental group did not significantly pay more attention on positive stimuli, participants who took part in the placebo training paid significantly more attention on neutral stimuli after the training. In the placebo training the probe appeared equally behind neutral and positive stimuli. To the best of my knowledge, this effect was not found in other recent studies yet. One can conclude that even though the training had no significant positive effect, the absence of the training had a negative effect on the attentional bias. This means that without training too much attention was drawn on neutral stimuli and that with the DP training the attentional bias could be minimized. The result shows the importance of further research and on what it should concentrate on. Not only the effects of the training are important to analyze but also about the effects when no training occurs. The effects should therefore be seen from a different point of view. The focus should lay on the prevention of not worsen the attentional bias in the first place. This could be further analyzed with the focus on comparing the relapse prevalence of participants following a training compared to participants following placebo training. The importance of also focusing on the attentional bias when no training occurs are also seen in the following results of the third hypothesis.

The third hypothesis was that participants in the training condition would develop a learning effect, indicated through a faster reaction time to positive pictures after each session. The repeated measure analysis showed that no significant learning effect over the four DP training sessions was found in the experimental group. When comparing the attentional bias of the experimental and control condition over the four sessions differences between the two groups are visualized. In the first two sessions the attentional bias fluctuated in the control as well as in the experimental condition. Interestingly, this changed after the second session in the experimental condition and a difference between the experimental and control condition was therefore recognizable. After the second session the attentional bias was stable and improved in a positive direction. An exponential tendency to decrease the attentional bias was recognized. Because this training only consisted of four training sessions no further development of the training could be analyzed. Therefore, it would be interesting to investigate in further research if the exponential learning effect continues after four sessions. Possibly the attentional bias would decrease further which could lead to significant changes when analyzing the effect of the training. The number of training sessions varies in different research, from one to twelve sessions. This shows that there is no advisable number of how many training sessions of DP training are effective to change attentional bias. Research of Eberl, Wiers, Pawelczack, Rinck, Becker, Lindenmeyer (2014) however analyzed the optimal amount of training sessions to maximize change in bias in a different task for cognitive bias modification. The study addressed the optimal number of training sessions of the approach avoidance task in alcohol dependent patients. They concluded that six training sessions were the mean optimum. Further, they addressed that also many participants improved their approach bias even after six training sessions. It would be therefore from interest to focus in further research on the effect of six DP training sessions on the attentional bias.

Finally, it was hypothesized that participants who show a higher reduction of attentional bias show a greater reduction in depressive symptoms. The reduction of the attentional bias was not related to the reduction of depressive symptoms in the experimental group. Interestingly, in the control condition the increase of the attentional bias was related to the increase of the severity of symptoms measured with the HRSD and symptoms of anxiety measure with the STAI-X after completing the placebo training. It is from interest why the relations between the groups to the severity of the symptoms are different. One possible explanation could be that only the attentional bias in the control group significantly changed after the training, as analyzed above. However, it would be interesting to analyze the relation of attentional bias and the severity of symptoms to get more insight in the reasons. The results of other studies show that the attentional bias as well as depressive symptoms reduce after a DP training (Beard, Weisberg & Amir, 2011; Wells & Beevers, 2010) or that depressive symptoms reduce without a reduction of the attentional bias (Johnson, Joorman & Gotlieb, 2007). One possible factor that may have influenced the result is that the participants had mood swings over the day. This is a symptom of depressive disorder, but also can be induced by the clinical setting in which the study took place. Participants were in clinical or day clinical stay and had different psychological treatments for their disorders. This could also result in the variety of the moods that influenced the results.

A general possible factor that could have influence on the results of the study can be medication of the participants. It is determined in previous studies that, emotional information processing can be influenced by medication, because of changes in the serotonin level (Merens, van der Does & Spinhoven, 2007). Attentional bias is one aspect of the emotional information processing. It is approved that serotonin has effect on mood as well as on cognition. In their meta-analysis of 25 studies researchers found that the serotonin level affects not only facial emotion recognition, dysfunctional attitude, decision making, emotional memory but also attentional bias positively. The study concludes that amongst other informational biases, especially the attentional bias should be investigated further. In this study, all participants but one did take antidepressants. This may have an influence on the outcome of this study. It could also explain the outcome of other research that attentional biases are found in non-clinical participants who perhaps did not took antidepressants. Similar results are also discussed in the study by Baert et al. (2010) analyzing the attentional bias in clinical depressed patients, that did not find effects on the attentional bias using a spatial cueing task training in depressed patients who followed the training in addition to therapy and medication.

4.1. Limitations

Even though this study gives insight into the effects of the DP training and has several strengths, a number of limitations have to be recognized. First, the sample size with 29 participants was small. It is necessary that more respondents take part in the study. This will be tested in the research of Fischer (n. d.) where this study is part of and where data of more participants in the experimental and control group are analyzed. A further point, that may have had influence on the outcome of the study, is the short duration of representation of the stimuli in the training. In this DP training the stimuli were represented over a duration time of 500ms, which is the typical exposure duration used in dot-probe tasks. Research examined if stimuli should be exposed for a longer duration. According to Gotlieb et al. (2004) stimuli have to be presented for a longer duration of more than 1 second to demonstrate an attentional bias. The reason is that the longer duration time allows participants a sustained processing of the content of the stimuli. Other research (Siegle, Granholm, Ingram & Matt, 2001) also showed that the sustained processing plays an important role in the maintenance of depression. Most of the participants who took part in the study also reported that they could not see the content of the stimuli, because of the short duration and also because two stimuli were represented at the same time on the screen. Some participants also reported that they did not note that the stimuli were the same in each session. A third point that is important to mention is that the research assistant was not blind to the conditions of participants and to pre and post measure. This could have influence on the observer’s reported measure of HRSD. The HRSD was filled out by the research assistant and could be unconsciously completed to agree with the hypotheses that the symptoms reduce after the experimental training. The scores of the HRSD correlated moderately with the BDI-II scores, indicating that the scores correspond to each other. However, in further studies, it is advisable to let a second blind research assistant fill in the HRSD.

4.2. Suggestions for further research and clinical settings

In this analysis no effect of the dot-probe training was found. This may be explained by numerous points, for example the uncertainty of the number of sessions, second the duration of the representation of the stimuli and the emotional content of the stimuli and, third the influence of serotonin on the attentional bias. Further research with a randomized controlled trial should give more insight into these aspects and the effects of the dot probe training in patients suffering from major depressive disorder.

Finally open questions remain regarding the effects of the different trainings on changing attentional biases in MDD. It is from interest, which cognitive bias modification tasks have the most effect. Further research should therefore compare the effects of different attentional bias modification trainings. This would give insight about which training has the most effect on reducing the attentional bias. May be different approaches are more effective in reducing attentional biases than the dot probe training. It is further from interest how attentional bias modification training can be best implemented into the clinical setting and how patients would work with the training. Although participants in this study finished the four training sessions they reported that they did not like the task because it was not interesting and took a long time. Research about practical implications of trainings is therefore important to reach the best effect of the trainings.

As mentioned in the beginning of the research, the high relapse prevalence of individuals suffering from MDD shows the urgency of treatments to reduce the frequent relapse. Even though no significant effect of the training was found in the experimental group, not following the training had a negative impact on the attentional bias. It is therefore from interest to get more insight into the effects and implications in clinical settings. A possible implementation of attentional bias modification training into the clinical context would give patients another form of treatment that is not available, even today, in most clinical settings. The research was a further step to get more insight in the effects of DP training. Nonetheless more research about the effects and factors that can be optimized is necessary.

References

Baert, S., DeRaedt, R., Schact, R. & Koster, E. H. W. (2010). Attentional bias training in depression: therapeutic effects depend on depression severity. *Journal of Behavior Therapy and Experimental Psychiatry, 41*(3), 265-274. doi:10.1016/j.jbtep.2010.02.004

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J. & van IJzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin, 133*(1), 1−24. doi:10.1037/0033-2909.133.1.1

Baumann, U. (1976). Methodische Untersuchungen zur Hamilton-Depressions-Skala. *Archiv für Psychiatrie und Nervenkrankheiten, 222*(4), 359-375. doi:10.1007/BF00343243

Beck, A. T. (1967). *Depression: Clinical, Experimental and Theoretical Aspects.* New York: Harper and Row

Beck, A. T. (1987). Cognitive models of depression. *Journal of Cognitive Psychotherapy: An International Quarterly, 1*(1), 5–37.

Beck, A. T. (2002). Cognitive models of depression. *Clinical advances in cognitive psychotherapy: Theory and application, 14*(1), 29-61.

Beck, A. T., Steer, R. A. & Brown, G. K. (1996). *Manual for the Beck Depression Inventory—II.* San Antonio, TX: Psychological Corporation.

Boland, R. J. & Keller, M. B. (2009). Course and outcome of depression. In I. A. Gotlib, & C. L. Hammen (Eds.), *Handbook of depression, Vol. Second.* (pp. 23–43). New York: The Guilford Press.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. 2nd edition. Hillsdale, NJ: Erlbaum.

Cohen, L., Manion, L. & Morrison, K. (2011).*Research Methods in Education*.7th edition. Routledge.

Eberl, C., Wiers, R. W., Pawelczack, S., Rinck, M., Becker, E. S. & Lindenmeyer, J. (2014) Implementation of approach bias re-training in alcoholism - How many sessions are needed? *Alcoholism: Clinical and Experimental Research, 38*(2), 587-594. doi:10.1111/acer.12281

Endicott, J., Cohen, J., Nee, J., Fleiss, J. & Sarantakos, S. (1981). Hamilton Depression Rating Scale. Extracted from regular and change versions of the schedule for affective disorders and schizophrenia. *Archives of General Psychiatry, 38*(1), 98-103. doi:10.1001/archpsyc.1981.01780260100011

Everaert, J., Koster, E. H. W. & Derakshan, N. (2012). The combined cognitive bias hypothesis in depression. *Clinical Psychology Review, 32*(*5*), 413–424. doi:10.1016/j.cpr.2012.04.003

Fava, M. & Kendler, K. S. (2000). Major depressive disorder. Neuron, 28(2), 335-341, doi:10.1016/S0896-6273(00)00112-4

Ferrari, A. J., Somerville, A. J., Baxter, A. J., Norman, R., Patten, S. B., Vos T. & Whiteford, H. A. (2013). Global variation in the prevalence and incidence of major depressive disorder: A systematic review of the epidemiological literature. *Psychological Medicine, 43*(3), 471–481. doi:10.1017/S0033291712001511

Fischer, V. (n.d.). No title yet.

Fox, E., Mathews, A., Calder, A. & Yiend, J. (2007). Anxiety and sensitivity to gaze direction in emotionally expressive faces. *Emotion, 7*(3), 478-486. doi: 10.1037/1528-3542.7.3.478

Frewen, P. A. , Dozois, D. J. A., Joanisse, M. F., Richard W.J. & Neufeld, R. W. J. (2008). Selective attention to threat versus reward: Meta-analysis and neural-network modeling of the dot-probe task. *Clinical Psychology Review, 28*(2), 307–337. doi:10.1016/j.cpr.2007.05.006

George, D., & Mallery, M. (2010). SPSS for Windows Step by Step: A Simple Guide and Reference, 17.0 update (10a ed.). Boston: Pearson.

Gotlieb, I. H., Kasch, K. L., Triall, S., Joormann, J., Arnow, B. A. & Johnson, S. L. (2004). Coherence and specificity of information-processing in depression and social phobia. *Journal of Abnormal Psychology, 113*(3), 396-398. doi:10.1037/0021-843X.113.3.386

Hallion, L. S. & Ruscio, A. M. (2011). A meta-analysis of the effect of cognitive bias modification on anxiety and depression. *Psychological Bulletin, 137*(6), 940–958. doi:10.1037/a0024355

Hamilton, M. (1960). A rating scale for depression. *Journal of Neurological Neurosurgery Psychiatry, 23*(1), 56-62. doi:10.1136/jnnp.23.1.56

Hertel, P. T. & Mathews, A. (2011). Cognitive bias modification: Past perspectives, current findings, and future applications. *Perspectives on Psychological Science, 6*(6) 521–536. doi:10.1177/1745691611421205

Johnson, S. L., Joormann, J. & Gotlieb, H. (2007). Does processing of emotional stimuli predict symptomatic improvement and diagnostic recovery from major depression? *Emotion , 7*(1), 201–206. doi:10.1037/1528-3542.7.1.201

Kessler, R. C. & Wang, P. S. (2009). Epidemiology of depression. In I. A. Gotlib, & C. L. Hammen (Eds.), *Handbook of depression, Vol. Second.* (5–22) New York: The Guilford Press.

Lang, P. J., Bradley, M. M. & Cuthbert, B. N. (1999). *International affective picture system (IAPS): Technical manual and affective ratings.* Gainesville, FL: University of Florida, Center for Research in Psychopathology

Lord, F. M. (1969). Statistical adjustments when comparing preexisting groups. *Psychological Bulletin, 72*(5), 336–337. doi:10.1037/h0028108

Maas, J., Keijsers, G. P., Rinck, M., Tanis, J. & Becker, E. S. (2014). Does a dieting goal affect automatic cognitive processes and their trainability? *Cognitive Therapy and Research*, 1-12. doi:10.1007/s10608-014-9658-0

MacLeod, C., Campbell, E., Rutherford, L. & Wilson, E. (2004). The causal status of anxiety-linked attentional and interpretive bias. In J. Yiend (Ed.), *Cognition, emotion and psychopathology: Theoretical, empirical and clinical directions* (172–189). New York, NY: Cambridge University Press. doi:10.1017/CBO9780511521263.010

MacLeod, C., Mathews, A. & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 95(*1), 15–20. doi:10.1037/0021-843X.95.1.15

Mathews, A. & MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annual Review of Clinical Psychology, 1*(7), 167–195. doi:10.1146/annurev.clinpsy.1.102803.143916

Merens, W., van der Does, A. J. W. & Spinhoven, P. (2007). The effects of serotonin manipulations on emotional information processing and mood. *Journal of Affective Disorders, 103*(1-3), 43-62.

Miller, I. W., Bishop, S., Norman, W. H. & Maddever, H. (1984). The modified Hamilton Rating Scale for depression: Reliability and validity. *Psychiatry Research, 14* (2), 131-142. doi:10.1016/0165-1781(85)90057-5

Osman, A., Downs, W. R., Barrios, F. X., Kopper, B. A., Gutierrez, P. M. & Chiros, C. E. (1997). Factor structure and psychometric characteristics of the Beck Depression Inventory – II. *Journal of Psychopathology and Behavioral Assessment, 19*(4), 359-375. doi:10.1007/BF02229026

Peckham, A. D., McHugh, R. K. & Otto, M. W. (2010). A meta-analysis of the magnitude of biased attention in depression. *Depression and Anxiety*, *27*(12), 1135–1142. doi:10.1002/da.20755

Phillips, W. J., Hine, D. W. & Thorsteinsson, E. B. (2010). Implicit cognition and depression: A meta-analysis. *Clinical Psychological Review, 30*(6), 691-709. doi: 10.1016/j.cpr.2010.05.002

Posner, M. I., Snyder, C. R., & Davidson, B. J. (1980). Attention and the detection of signals. *Journal of Experimental Psychology: General, 109*(2), 160–174. doi:10.1037/0096-3445.109.2.160

Spielberger, C. D., Gorsuch, R.L. & Lushene. R.E. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

Steer, R. A., Ball, R., Ranieri, W. F. & Beck, A. T. (1997). Further evidence for the construct validity of the Beck Depression Inventory-II with psychiatric outpatients. *Psychological Reports, 80*(2), 443-446. doi:10.2466/pr0.1997.80.2.443

Tsumura, H., Shimada, H., Normura, K., Sugaya, N. & Suzuki, K. (2012). The effects of attention retraining on depressive mood and cortisol responses to depression-related stimuli1 *Japanese Psychological Research*, *54*(4), 400–411. doi:10.1111/j.1468-5884.2012.00523.x

Üstün T. B., Ayuso-Mateos, J. L., Chatterji, S., Mathers, C. & Murray, C. J. (2004). Global burden of depressive disorders in the year 2000. *The British Journal of Psychiatry, 184*(5), 386–392. doi:10.1192/bjp.184.5.386

Wells, T. T. & Beevers, C. G. (2010). Biased attention and dysphoria: Manipulating selective attention reduces subsequent depressive symptoms. *Cognition and Emotion, 24*(4), 719-728. doi:10.1080/02699930802652388

Williams, J. B. W., Gibbon, M., First M. B., Spitzer, R. L., Davies, M., Borus, J., Howes, M. J., Kane, J., Pope, H. G., Rounsaville, B. & Wittchen, H. (1992). The Structured Clinical Interview for DSM-III-R (SCID) II. Multisite test- retest reliability. *Archives of General Psychiatry, 49*(8), 630-636. doi:10.1001/archpsyc.1992.01820080038006