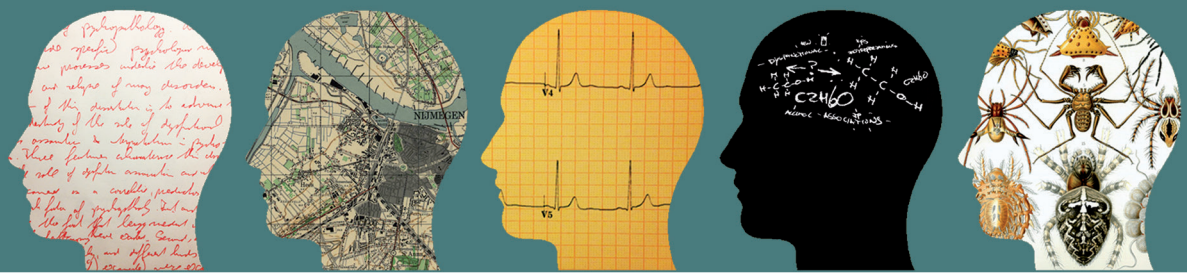
Dysfunctional Automatic Associations and Interpretations in Psychopathology



Marcella L. Woud

Dysfunctional Automatic Associations and Interpretations in Psychopathology

Marcella L. Woud

Marcella L. Woud
ISBN 978-90-6464-771-0
Cover illustration: Floris P. van den Berg
Graphic design: J Ontwerp, Nijmegen
Printed by: GVO drukkers, Ede

Dysfunctional Automatic Associations and Interpretations in Psychopathology

Proefschrift

ter verkrijging van de graad van doctor

aan de Radboud Universiteit Nijmegen

op gezag van de rector magnificus prof. mr. S.C.J.J. Kortmann,

volgens besluit van het college van decanen

in het openbaar te verdedigen op woensdag 7 mei 2014

om 14.30 uur precies

door

Marcella Lydia Woud

geboren op 19 maart 1980

te Wesel, Duitsland

Promotor: Prof. dr. E.S. Becker

Copromotor: Dr. M. Rinck

Manuscriptcommissie:
Prof. dr. A. Dijksterhuis
Prof. dr. K. Roelofs
Prof. dr. P.J. de Jong (Rijksuniversiteit Groningen)

Für Mama 

TABLE OF CONTENTS

1

Introduction

Dysfunctional automatic associations and interpretations are core features of psychopathology. According to various (disorder specific) psychological models, these cognitive processes underlie the development, maintenance, and relapse of many disorders. The general aim of this dissertation is to advance the present understanding of the role of dysfunctional automatic associations and interpretations in psychopathology. Three features characterize this dissertation. First, the role of dysfunctional automatic associations and interpretations was examined as a correlate, predictor and causal risk factor of psychopathology. Such a structured investigation is crucial when aiming to disentangle the specific contribution of dysfunctional automatic associations and interpretations to the development, course, and modification of psychopathology. Second, different types of psychopathology, and different kinds of samples (risk and clinical samples), were examined. This is important because dysfunctional automatic associations and interpretations could be considered as a cognitive vulnerability that many types of psychopathology share. As such, examining different types of psychological disorders, and at different stages, might provide valuable information regarding the presence as well as the specificity of dysfunctional automatic associations and interpretations. Third, a variety of paradigms were used to assess dysfunctional automatic associations and interpretations, ranging from more direct to indirect approaches. This was motivated by current discussion about whether or not direct and indirect approaches should be regarded as complementary, and as such measure different types of processes.

In the following pages, two dual process models will be described, providing the theoretical framework for the conducted studies. After that, a newly developed dual process model of abnormal behavior will be presented. Via this dual process model of psychopathology, I will explain how such a model could lead to a better understanding of dysfunctional automatic associations and interpretations in psychopathology. Next, I will describe how dysfunctional automatic associations and interpretations can be assessed and modified, followed by a step-wise procedure of how to investigate them in a structured way. After that, an overview will be given of what is known and, most importantly, what is needed in order to truly advance the present understanding of dysfunctional automatic associations and interpretations in psychopathology. The introduction ends with the outline of my dissertation, including a presentation of the research questions that served as the motivation for conducting the studies included. Finally, a note regarding the term dysfunctional automatic associations and interpretations which will be used throughout this dissertation. 'Automatic' only relates to the term associations as the assessed interpretations are considered as a rather explicit construct. 'Dysfunctional', however, relates to both associations and interpretations.

A BRIEF INTRODUCTION

Evaluating and assigning meaning are fundamental parts of our everyday human life. We try to explain things. We appraise and define. We try to make sense of what we encounter. The creation of an idiosyncratic reality is the result of this mental activity. At the root of the act of evaluating and interpreting lies memory. That is, past experiences can affect our interpretations in the here and now.

Let me illustrate this with a very recent personal example. During a dinner with colleagues, we were updating each other on how thing were going. I was telling them about my latest study on alcohol-related interpretation biases. I also talked about my attempts to describe my type of research to my family. One of my colleagues suggested that 'Mars' might be a very accessible and straight forward example to explain what ambiguous stimuli were and what kind of processes I was examining. I was confused: 'But why, Mars is not an ambi…'. Looking at the faces of my colleagues, I decided not to finish my sentence. Yes, Mars is a chocolate bar but also a planet and the god of war during the ancient Roman culture. However, these alternatives did not come to my mind. So, what went wrong, and so quickly and so automatically?

The answer lies in my past. My chocolate-related past. When encountering the ambiguous stimulus 'Mars' many positive associations became active, ranging from 'sweet – soft – smooth' to 'makes me happy – this is what I need right now – this will never disappoint me'. Given the activation of this chocolate-related memory schemata, I was doomed and had no other choice than interpreting the ambiguous stimulus 'Mars' in a chocolate-related manner.

An important element of this example is the automaticity with which I processed the ambiguous stimulus. Most of the time such efficiency is beneficial. In addition, we often manage to control the corresponding behavioral responses. However, automatic associations and interpretations as well as the elicited behavioral responses can become very dysfunctional. This clearly affects an individual's quality of life and, in the worst case, might contribute to the development of a psychological disorder. Hence, investigating dysfunctional automatic associations and interpretations will always be an important research target in clinical science, and therefore is the general topic of the present dissertation. In the following pages, two dual process models will be presented that help us to understand automatic associations and interpretations, once for normal and once for abnormal behavior.

DUAL PROCESS MODELS

Normal behavior

Many dual process models of normal behavior (e.g., Gawronski & Bodenhausen, 2006; Smith & DeCoster, 2000; Strack & Deutsch, 2004) consists of three main elements. First, they explain how information is processed through a fast and effortless processing style (i.e., associative processing). Second, they explain how information is processed when an individual has the motivation and/or cognitive resources to engage in a more effortful and reflective processing style (i.e., propositional processing). Third, they explain when which processing style is likely to occur and what kind of behavior is then produced.

Following the rationale of dual process models, overt human behavior should be regarded as the output of the interplay between associative and propositional processing. What does this mean exactly? The following explanations base on the dual process model of Strack and Deutsch (2004, see Figure 1), however, many other models share these assumptions.

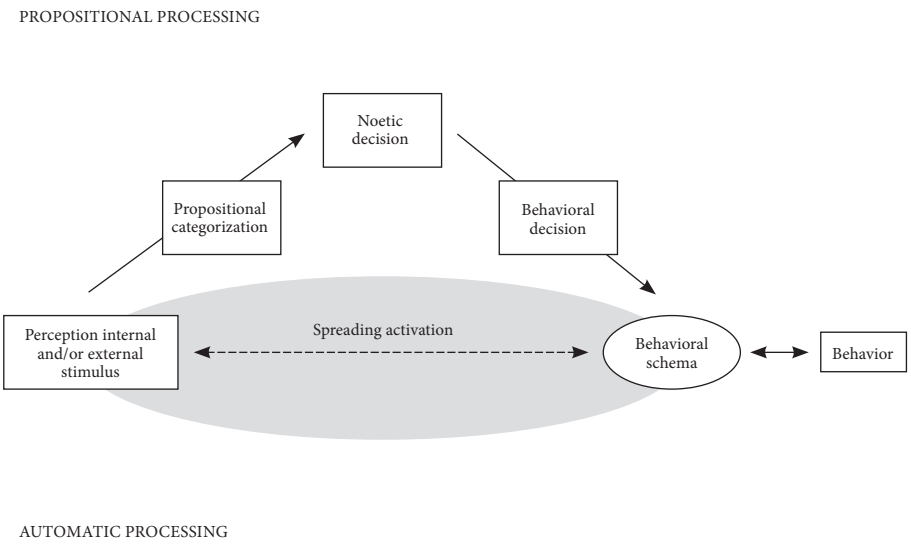


Figure 1. Summary of the dual process model of normal behavior (based on Strack & Deutsch, 2004)

Associative processing is responsible for fast, effortless, and automatic processing of an internal or external stimulus. In addition, it does not require any cognitive resources. The foundation for associative processing is memory, which is thought to operate as an associative network: Associations are activated automatically and their activation spreads out to other parts of the associative network. This also involves the activation of behavioral schemata, which in turn activate a behavioral response. This occurs unintentionally and outside an individual's control or awareness. In contrast, propositional processing is responsible for a slow, effortful and reflective processing of an internal or external stimulus. However, such processing only occurs if an individual is motivated and/or has the cognitive resources as well as the time to do so. In addition, propositional processing can be easily disturbed, for example, if the individual is aroused or in a bad mood. Propositional processing involves reasoning and is a rule-based. The information needed for this type of processing is intentionally accessed. A 'noetic decision', i.e., a decision generated by using the human intellect, is the explicit output of this processing style. The noetic decision is followed by an explicit behavioral decision. For this purpose, behavioral schemata become active, which in turn activate a behavioral response. Propositional processing also makes use of the output generated by associative processing, i.e., it evaluates this information based on logical inferences. As such, propositional processing is generally concerned with validating information. During associative processing, however, the activated associations are not evaluated.

According to many dual process models, associative processing is the default mode. However, in fact the interplay of both propositional and associative processing is considered to be responsible for behavior as the input of propositional processing is mainly provided by associative processing. Important to note here is that propositional and associative processing can be conflicting. For example, automatically activated associations can be rejected during propositional processing. On the other hand, automatically associations can overrule propositional processing. These operational properties do not lead to major negative consequences for our daily human life. When thinking back to the Mars example, the most dysfunctional behavioral response would have been that I would have been unable to resist the chocolate dessert standing in front me (and maybe that of my neighbor), despite my clear knowledge about its calories. However, there are examples during which the operational features of associative and propositional processing do have major negative consequences, namely in the context of psychopathology.

Abnormal behavior

To elucidate the specific contribution of cognitive factors such as dysfunctional automatic associations and interpretations to the development, maintenance, and relapse of psychopathology, clinical psychology has relied heavily on information processing theories put forward by cognitive psychology. Examples of particular historical importance, ranging from general to disorder specific models, are: attribution theory (Heider, 1958; Kelley, 1972; Weiner, 1986); appraisal theory (Lazarus, 1991); associative network theories (Anderson, 1983; Anderson & Bower, 1973; Collins & Quillian, 1969; Collins & Loftus, 1975); Bower's mood and memory associative network model (Bower, 1981); the integrative model of cognition and emotion proposed by Williams, Watts, MacLeod, and Mathews (1997); Beck's schema theory (for depression: Beck, Rush, Shaw, & Emery, 1979; for anxiety: Beck, Emery, & Greenberg, 1985); or the cognitive model of panic disorder (Clark, 1986).

During recent years, dual process models of normal behavior (e.g., Gawronski & Bodenhausen, 2006; Smith & DeCoster, 2000; Strack & Deutsch, 2004), which have their origin in social and personality psychology, have started to receive increasing attention from clinical psychology. Researchers from various psychological backgrounds have used the underlying principles of dual process models to understand the cognitive vulnerability to engage in and maintain abnormal behavior. To the best of my knowledge, there are four currently published disorder specific dual process models, namely in Post Traumatic Stress Disorder (Brewin, Dalgleish, & Joseph, 1996), depression (Beevers, 2005), addiction (Wiers et al., 2007) and anxiety (Ouimet, Gawronski, & Dozois, 2009). Given the eclectic nature of this thesis, i.e., the role of dysfunctional automatic associations and interpretations *across different types of psychopathology*, however, a general dual process model of psychopathology was needed. Hence, I developed such a model, with the dual process model of anxiety (Ouimet et al., 2009) serving as the main inspiration. However, please note that the dual process model of psychopathology proposes a bi-directional link between associative and propositional processing and behavior (Strack & Deutsch, 2004). In addition, the model has a specific focus on associations and interpretations, and thus other relevant processes such as attention or mood are not discussed in detail. Throughout the description of the dual process model of psychopathology, fear of spiders will be used as an example to illustrate the model's operational properties.

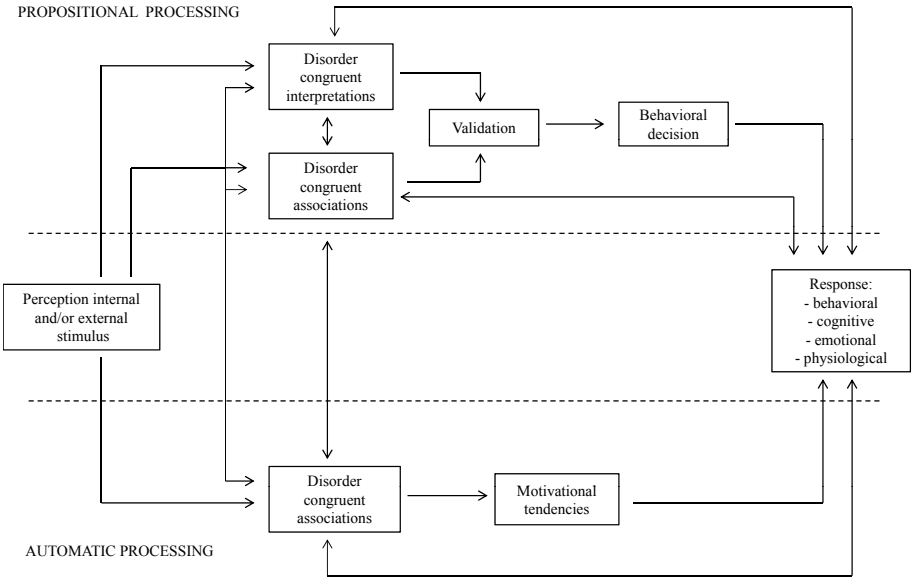


Figure 2. The dual process model of abnormal behavior with a specific focus on dysfunctional automatic associations and interpretations (based on Ouimet et al., 2009, and Strack & Deutsch, 2004)

The dual process model of abnormal behavior (see Figure 2) has the same underlying rationale as dual process models of normal behavior. There are two cognitive processing styles that guide an individual's overt behavior, namely associative processing and propositional processing. Given their operational properties, associative processing can be considered as 'bottom up processing', whereas propositional processing can be considered as 'top down processing'. As stated before, associative processing implies that an internal or external stimulus is processed unintentionally, quickly and automatically, without making use of cognitive resources. In addition, the activation and the course of the activation occurs outside an individual's control or awareness. Associative network theories (Anderson, 1983; Anderson & Bower, 1973; Collins & Quillian, 1969; Collins & Loftus, 1975) offer the theoretical underpinning for the associative processing style. The key element to understand the operational properties of associative networks is memory. In fact, associative networks are memory systems. Within such systems, the world as well as inner states are represented as memory schemata. A memory schema, in turn, consists of associative connections between nodes. A node can be roughly defined as an information unit. On an operational level, the activation of a memory schema proceeds as follows: One or more relevant nodes become(s)

activated, depending on whether the threshold needed for this activation is reached. The activation then spreads to (an) other related node(s), at a rate proportional to the strength of the associative connection between the nodes, and again taking into consideration the required threshold for this diffusion. This is called 'spreading activation' (Collin & Loftus, 1975). The strength between associative connections can change through experiences and learning. The accessibility of a memory schemata increases the more often it has been activated (also called 'Hebb's rule'; Hebb, 1949). As such, activation is a matter of 'associative strength'.

Figure 3 gives an example of this spreading activation: When an individual suffering from fear of spider discovers a black spot on the ceiling, many negative associations are automatically activated, including disorder-congruent associations such as 'fear' or 'uncontrollable', as well as more general negative ones such as 'dusty' or 'dirt'. However, as the disorder-congruent associations are the strongest, i.e., the most accessible ones, these associations 'win' and the corresponding 'spider' memory schemata is in charge. As a consequence, motivational tendencies are activated, which in turn activate a disorder-congruent response. This can be a behavioral, cognitive, emotional, or physiological response. In case of a spider fearful individual, behavioral avoidance, fear, an increased heart beat and sweating are likely consequences (for similar reasoning, see Le Doux, 1995).

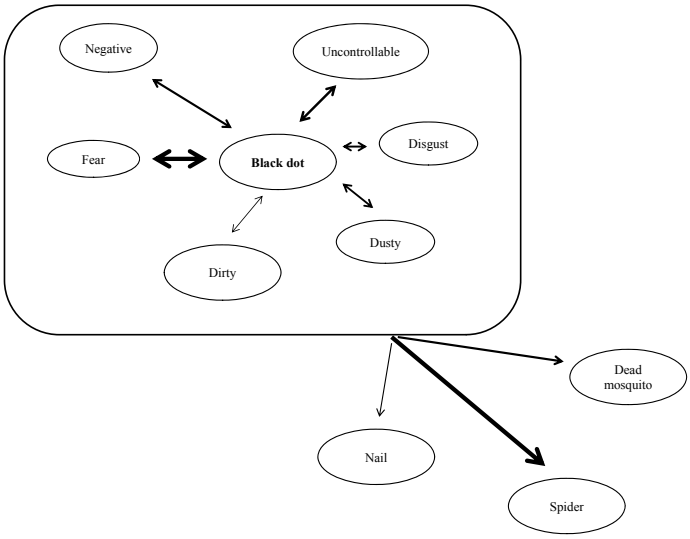


Figure 3. A spider fear network (modeled based on associative network theories, Anderson, 1976; Anderson & Bower, 1973; Collins & Quillian, 1969; Collins & Loftus, 1975)

During propositional processing, an internal or external stimulus is processed in a slow, effortful and reflective manner. Hence, explicit (valenced) associations and/or interpretations of the perceived stimulus are generated. These explicit associations and interpretations can influence each other and are also affected by the output of associative processing. Next, the available explicit information is validated, i.e., the individual examines whether it is true or false. Based on the outcome of this validation, a behavioral decision is made, which in turn activates a response. In the context of fear of spiders, the following could have happened: If a spider fearful individual detects a spider, automatic as well as explicit spider-related associations (e.g., scary, disgusting) are activated, as well as more explicit healthy associations (e.g., small, harmless). Due to the individual's fear of spiders, fear-related associations are regarded as valid and the healthy associations are rejected. Hence, avoidance is the most likely behavioral response.

As already mentioned when integrating the Mars example, automatic processing is not per se harmful. In fact, it can be very adaptive and helpful during our daily human life. However, there are instances where automatic associations and interpretations as well as the elicited behavioral responses are dysfunctional. The previous example illustrated this very nicely and explained how a spider fearful individual can misevaluate a spider: Despite the individual's awareness of the irrational nature of his/her fear, the spider was regarded as something fearsome. However, the presence of the feared object is not always required. A spider fearful individual might automatically misinterpret a black dot as something spider-related and thus dangerous. Due to the subsequent avoidance behaviors, such a misinterpretation cannot be corrected and might even be reinforced. Dysfunctional automatic associations and interpretations may also be positively valenced. For instance, the ambiguous stimulus 'shot' might automatically activate positive associations such as 'relaxing' or 'pleasant' in an individual who consumes alcohol frequently. An alcohol-related interpretation of that cue is the consequence, and ordering a vodka rather than a coke a likely behavioral response. Again, this behavioral response reinforces the misinterpretation, possibly triggering a negative spiral. These assumptions are consistent with many cognitive (disorder specific) psychological models, and they are empirically supported by a range of research in clinical psychology (for review, see e.g., Mathews & MacLeod, 2005; Roefs et al., 2011).

The ease and the rapidity with which dysfunctional associative networks are formed seems a crucial element in the development of a psychological disorder. Moreover, experiencing dysfunctional associations and interpretations occurs automatically, i.e., they are unintentional, very fast and out of the individual's control. Being unable to deactivate and to correct dysfunctional automatic associations and interpretations through explicit cognitions also plays a substantial role. Moreover, dysfunctional automatic associations and interpretations are often affective in nature, and many

forms of psychopathology are characterized by emotion dysregulation. These latter issues might be particularly important for the maintenance of a psychological disorder, and could (partly) explain why psychological disorders can be so persistent. In addition, dysfunctional automatic associations and interpretations could be an explanation of some patient's therapy resistance or relapse: Most interventions target explicit cognitions and this might not necessarily impact dysfunctional automatic associations and interpretations. As such, dysfunctional automatic associations and interpretations remain unchanged and still have a negative influence. Therefore, advancing the understanding of the role of dysfunctional automatic associations and interpretations in psychopathology is important from a theoretical perspective. In addition, it is important from an applied perspective as it could help to improve current interventions which thus could stop the 'psychopathological downward spiral'. However, in order to do so, measures are needed to assess dysfunctional automatic associations and interpretations in a valid and reliable manner. This topic will be addressed next.

MEASURING DYSFUNCTIONAL AUTOMATIC ASSOCIATIONS AND INTERPRETATIONS

Traditionally, questionnaires or ratings scales have been applied very frequently to assess associations and interpretations. Applying such a measurement procedure involves an individual being asked directly about the concept of interest. Unfortunately, however, using such 'direct measures' bears many disadvantages. First, self-report measures may not measure the fundamental processes underlying dysfunctional automatic associations and interpretations such as their uncontrollability. Thus, self-report measures may not be suited to predict abnormal behavioral patterns. Second, self-report measures are sensitive to undesired side effects such as demand and attribution biases (e.g., Nisbett & Wilson, 1977). Third, they depend on what an individual is willing to report. Fourth, the individual may not have an accurate judgment of his/her associations and interpretations.

As a result of these limitations, performance based measures started to receive increasing interest. Such measures can be defined best as 'indirect measures' (De Houwer, 2006). Unlike direct measures, indirect measures are supposed to provide an index of the concept of interest via behavior. That is, the individual's reaction towards the stimulus is used to infer the concept of interest. During the past years, dysfunctional automatic associations and interpretations have been studied intensively by means of indirect measures. Two general classes of tasks have been used to assess associations and interpretations: reaction-time (RT) tasks and open-ended memory tests. A frequently

used RT task is the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998), measuring the relative associative strength between two concepts. Participants are asked to sort words or pictures into four categories by means of two response keys: two categories represent a target concept (e.g., spider vs. butterfly), and two categories represent two poles of an attribute dimension (e.g., fearsome vs. positive). Given this operationalization, clinically observed phenomena and/or the specific prediction of cognitive models thus provide the direct input for the tasks' contents. During an IAT, each target category is paired with both attributes. As such, categorization times are an index of the associative strength between the disorder-relevant target concept and valenced attribute dimensions, respectively. Put differently: The performance during the task is the product of the individual's automatic reaction towards the target stimulus. Word association tasks are also very popular instruments. During such tests, participants are asked to give their first, mostly time-limited, interpretation to a variety of ambiguous cues. Interpretation in this context means that participants are supposed to give their first thought in response to the ambiguous cues. These cues are either disorder-related or unrelated and differ in their complexity. Homographs provide a very good example in this context. A homograph is a word for which the written form has more than one meaning, for example, a disorder-related and disorder-unrelated meaning (e.g., 'shot': an alcoholic drink or a gunshot). Here, it is expected to find disorder-congruent interpretation biases (e.g., alcohol-dependent patients would interpret the homograph 'shot' as being alcohol-related compared to non-dependent control patients) and/or a positive correlation between the number of disorder-congruent interpretations and levels of symptomatology (e.g., individuals who drink a lot generate more alcohol-related interpretations than those who drink less). An overview of frequently used RT tasks and open-ended memory tests can be found in the Appendix, for the assessment of dysfunctional automatic associations as well as interpretations.
Despite their popularity, however, also indirect measures have been criticized. The most important criticism is the low reliability of many tasks (e.g., Bosson, Swann, & Pennebaker, 2000; Reinecke, Becker, & Rinck, 2010). Second, whether indirect measures indeed measure automatic cognitions is still not entirely clear and also depend on the understanding of the processes which are assumed to cause the outcome of indirect measures (De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009). To conclude, there is (and probably will always be) a debate about the validity, reliability, generalization, and interpretation of direct as well as indirect measures. However, they can nevertheless provide important insights regarding the role of dysfunctional automatic associations and interpretations in psychopathology. As De Houwer et al. (2009) state: The most important thing is to select the best paradigm given the specific research question.

CHANGING DYSFUNTIONAL AUTOMATIC ASSOCIATIONS AND INTERPRETATIONS

In parallel to developing measures to assess dysfunctional automatic associations and interpretations, researchers started to investigate whether it is possible to modify such processes. According to many (disorder-specific) cognitive models, there is a bi-directional link between the vulnerability to develop a psychological disorder and dysfunctional automatic associations and interpretations. As such, dysfunctional automatic associations and interpretations should change in step with levels of psychopathology, and vice versa (see also Figure 2 for this bi-directionality). In order to examine this causal link, paradigms that had initially been used to assess dysfunctional automatic associations and interpretations were transformed into 'training paradigms'. That is, participants are exposed to an experimentally established contingency between a disorder-relevant target and a response, with the aim of modifying the participants' information-processing style via learning of the trained contingency (Koster, Fox, & MacLeod, 2009).

Conditioning paradigms offer fruitful approaches for the modification of dysfunctional automatic associations. By means of an evaluative conditioning (EC; cf. De Houwer, Thomas, & Baeyens, 2001) paradigm, Houben, Schoenmakers, and Wiers (2010), for example, aimed to modify alcohol-related associations and drinking behavior. EC can be defined best as an affective learning paradigm. It implies that the evaluation of a stimulus (conditioned stimulus; CS) changes after it has been paired with a positively or negatively valenced stimulus (unconditioned stimulus; US+ or US-), and that this change in evaluation of the CS is in accordance with the valence of the US it had been paired with. In the EC paradigm as used by Houben et al. (2010), participants were instructed to look for irrelevant target pictures that were presented among many other pictures. In the experimental condition, beer-related pictures (CSs) were always paired with negative words and pictures (USs). The control condition, however, did not include these pairings. Subsequently, beer-related associations and craving for beer were assessed (in a pretended second study). In addition, actual drinking behavior was assessed, namely during a bogus taste test at the lab and during the week following the study. Results demonstrated that participants in the experimental condition, compared to participants in the control condition, showed stronger negative associations towards beer. Moreover, they reported less craving and consumed less beer during the taste test as well as during the week following the conditioning. Such an EC paradigm has also been used in the domain of anxiety. Here, Clerkin and Teachmann (2010) tested whether automatic rejection associations could be modified into more functional ones, and whether this had a beneficial effect on levels of anxiety.

Results showed no direct conditioning effect on levels of state nor anticipation anxiety (participants had to do a public speaking task). However, those whose rejection associations were trained into more functional ones were more likely to finish a public speaking task.

As of yet, there are only few studies targeting the direct modification of dysfunctional automatic associations (for more examples, see e.g., Sportel, de Hullu, de Jong, & Nauta, 2013; Kerkhof, Vansteenwegen, Baeyens, & Hermans, 2011). However, the opposite is true with regard to studies aiming to modify dysfunctional interpretations. Here, Mathews and Mackintosh (2000) conducted pioneering work in the area of Cognitive Bias Modification – Interpretation (CBM-I) in the context of social anxiety. Their CBM-I comprised socially ambiguous scenarios that ended with a to-be-completed word fragment, such that the meaning of the scenario remained ambiguous until the final word fragment was resolved. Participants' task was to finish each scenario by completing the word fragment, and these words produced an outcome consistent with either a functional or dysfunctional interpretation, depending on the training condition (CBM-I positive or CBM-I negative). Results showed that the training was successful: Participants in the positive CBM-I responded faster to positive word fragments whereas participants in the negative CBM-I responded faster to negative word fragments. To test whether such a training-congruent interpretation style would also generalize, participants completed a recognition test. During this test, participants were presented with novel socially ambiguous scenarios, each followed by a set of 4 related sentences. Participants had to rate how close in meaning each sentence seemed to the original sentence. Results indeed showed a generalization effect: Participants in the positive CBM-I gave higher similarity ratings for positive than for negative sentences, and vice versa for participants in the negative CBM-I condition. Most noteworthy, self-reported anxiety was affected in a training-congruent manner, providing first evidence for the causal link between emotions and dysfunctional interpretations. Many follow-up and replication studies followed after these encouraging findings, initially, mainly in the area of social anxiety but later also in other anxiety disorders as well as depression (cf. Koster et al., 2009; and for a meta analysis and reviews, see e.g., Hallion & Ruscio, 2011; Hertel & Mathews, 2011; MacLeod & Mathews, 2012).

To conclude, important insights regarding the development of psychopathology can be gained not only from the assessment of dysfunctional automatic associations and interpretations, but also from studies that aim to modify them. Such computerized training procedures not only have potential theoretical use, but also potential clinical applications. They offer promising new treatments opportunities. Most importantly, however, such training paradigms have the potential to modify processes which are not per se targeted by explicit interventions such as Cognitive Therapy (CT), namely

dysfunctional automatic associations and interpretations. However, also CBM-I techniques are not without critique and there are still many questions to be addressed. For example, it has to be shown that changes in symptomatology are indeed mediated by a change in bias and that other biases are also affected by CBM-I. Furthermore, effects of prolonged CBM-I training across different contexts have to be investigated (for more information, see e.g., MacLeod, Koster, & Fox, 2009). Nevertheless, research has clearly shown that dysfunctional automatic associations and interpretations can causally influence levels of psychopathology, and there is accumulating evidence of the therapeutic effects of CBM-I.

DYSFUNCTIONAL AUTOMATIC ASSOCIATIONS AND INTERPRETATIONS: CORRELATE, PREDICTOR OR CAUSAL RISK FACTOR

In part one of this Introduction, the dual process model of abnormal behavior with a specific focus on dysfunctional automatic associations and interpretations was introduced as a general model of psychopathology. In part two, an overview was provided of how to asses and to modify dysfunctional automatic associations and interpretations, including a brief critical discussion. Although these previous elaborations cover important 'ingredients' when aiming to advance the understanding of the role of automatic cognitive processes in psychopathology, something is clearly missing: A procedure of how to investigate the specific contribution of dysfunctional automatic associations and interpretations regarding the development and modification of psychopathology in a structured way.

Kraemer et al. (1997) provides such a procedure, i.e., a stepwise approach to examine the psychopathologic typology of a risk factor. According to Kraemer et al., 'A risk factor is a measurable characterization of each subject in a specified population that precedes the outcome of interest and which can be used to divide the population into 2 groups (the high-risk and the low-risk groups that comprise the total population)' (p. 338). Moreover, Kraemer et al. (1997) put forward five requirements to evaluate a risk: 1. A clear and complete definition of the outcome whereby the outcome is measured in a reliable and valid manner; 2. A definition of the population including an appropriate sampling of the population; 3. A definition of the risk factor whereby the risk factor defines a characteristic preceding the outcome, measured in a reliable and valid manner; 4. The application of analytic approaches to identify the high- and low risk group and the demonstration of a statistically significant difference in risk between the two groups; 5. The application of analytic approaches to demonstrate the existence of

clinically significant or policy significant differences in risk between the two groups. In case these requirements are fulfilled, the process of defining the psychopathologic typology of a factor can start. Figure 4 offers a schematic representation of the necessary steps for this endeavor. To provide concrete research examples within each step, the potential causal role of dysfunctional interpretations in social anxiety will be used as an illustration (partly modeled based on Mathews & Mackintosh, 2000).

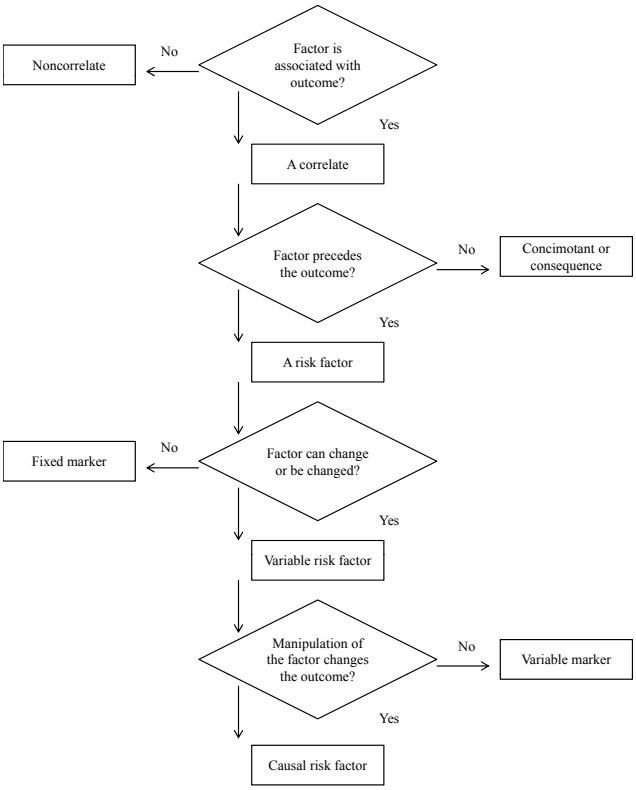


Figure 4. The process of a structured investigation of a risk factor (adapted model from Kraemer et al., 1997)

The first step is to show that the factor is associated with the outcome. Put differently, it should be established that the factor is a correlate. For example, in research a high-risk group/a group suffering from a type of psychopathology may be compared to a low-risk group/a group not suffering from psychopathology. The typical expectation would be to find disorder-congruent interpretations in the former group. However, these should be weaker or even absent in the latter group. Hence, when a group of

highly socially anxious individuals and a group of low socially anxious individuals would be presented with ambiguous open-ended scenarios, one would expect the former group to generate more threat-related interpretations than the latter group.
The second step is to demonstrate that the factor precedes the outcome. In Kraemer et al.'s model (1997), one then talks about a risk factor. An equivalent would be 'predictor'. As such, an incremental and predictive validity study would be needed, showing that dysfunctional interpretations are predictive of psychopathological behavior/psychopathology. In addition: dysfunctional interpretations should predict psychopathological behavior/psychopathology beyond already established risk factors. A longitudinal epidemiologic study including two assessment time points would provide insight into this matter. At time point one, a large (community) sample would be asked to complete a test battery including an assessment of dysfunctional interpretations relevant in social anxiety. In addition, at time point one and two, a diagnostic interview should be conducted. What one would expect is that the dysfunctional interpretations assessed at time point one are predictive for developing social anxiety disorder at time point two. Moreover, dysfunctional interpretations should retain their predictive significance, even after controlling for well established risk factors such as gender, trait anxiety, or psychopathology at time point one.
During step 3, the malleability of the factor is targeted. That is, it has to be clarified whether the factor can change or whether it can be changed. If both types of changes are impossible, the factor should be regarded as a fixed marker. Prototypical fixed markers are gender or ethnicity. However, in case change is possible, the factor should be regarded as a variable risk factor. For the purpose of research, one could take a sample of individuals scoring medium to high on social anxiety. By means of a Cognitive Bias Modification – Interpretation (CBM-I) training, half of the group would train to interpret ambiguous social situations in a positive way (positive group), the other half would train to interpret ambiguous social situations in a negative way (negative group). Before and after the training, participants' interpretations towards ambiguous social scenarios are assessed. One would expect to find a pre-training interpretation bias in both groups, i.e., both groups should interpret the ambiguous scenarios as rather negatively. However, this bias would be supposed to change congruently after the CBM-I, implying that the positive group should show a reduction in bias, whereas the negative group should show an increase in bias.
Step 4 describes how to continue examining the variable risk factor. This involves the manipulation of the variable risk factor, followed by examining whether this then has an effect on the outcome. Here, two expectations are possible: The manipulation of the variable risk factor can result in an increase or decrease in psychopathological behavior/psychopathology. If the manipulation of the risk factor is indeed followed by a

change in psychopathological behavior/psychopathology, the variable risk factor should be regarded as a causal risk factor. The previous CBM-I example forms an adequate base to illustrate this step. However, what is now needed is an assessment of psychopathological behavior/psychopathology, in this case, an assessment of levels of social anxiety. A frequently used option here is to put participants in a highly stressful situation after CBM-I, e.g., a performance task such as giving a speech about a topic participants are not familiar with but which will be judged later. Participants' level of social anxiety would be assessed after the CBM-I training (i.e., before the speech) and after the speech. In this study, one would expect training-congruent changes in interpretation bias to occur post training. In addition, one would expect the positive group to show less anxiety after the training than the negative group. Finally, the positive group should also show less anxiety after the stress task than the negative group, i.e., they should recover more easily. Ideally, the variation in anxiety on the stress task should be mediated by the change in bias which has been manipulated by means of CBM-I. However, even without mediation, these findings would show that the induced interpretation bias leads to bias-congruent changes in anxiety (i.e., psychopathological behavior), and as such would provide evidence that the bias could be regarded as a causal risk factor.

Another option to obtain insight in the potential causal nature of a risk factor is to conduct a clinical study whereby the treatment's effect on dysfunctional interpretations is investigated. In this example, the treatment should be regarded as the manipulation. In the context of social anxiety example, one would need a study which assesses dysfunctional interpretation before and after Cognitive Behavioral Therapy (CBT). First, one would expect to find a reduction in symptoms of social anxiety and dysfunctional interpretations after CBT. Second, and most optimally, one would expect to find that the reduction in levels of social anxiety was mediated by the change in interpretation bias. Given the quasi-experimental nature of this design, however, causality could not necessarily be claimed.

If the manipulation of the variable risk factor has no effect on the outcome, it should be called a variable marker. This means that the variable risk factor should be regarded as a correlate, which might have the potential of being a causal risk factor. In case of the CBM-I example, this would mean that the training changed the interpretation bias accordingly. However, the groups would not have differed in their level of social anxiety following the training, nor would there be a mediation effect of the change in bias in levels of social anxiety.

To conclude, this stepwise approach provides a very thorough and clearly defined procedure to study the role of dysfunctional automatic associations and interpretations in psychopathology. Of note, it can not only be used to identify risk factors for

developing psychopathology, it can be used also to identify risk factor involved in remission, recovery, and relapse. As such, strategies for prevention, treatment, and maintenance can benefit from this procedure.

AIMS AND OBJECTIVES OF THE PRESENT THESIS

The assessment and also the modification of dysfunctional automatic associations and interpretations is a field that has been increasingly recognized during the past few years. On the one hand, studies have demonstrated that it is possible to examine these processes using a variety of assessment instruments that each provide unique insights into psychopathology and the factors maintaining it. On the other hand, the finding that dysfunctional automatic associations and interpretation may be directly modified and that this has a beneficial effect on levels of psychopathology is exciting for both theory and treatment development

However, there are still many issues that need to be resolved. These include general issues as well as issues that are specific of a certain type of psychopathology and/or the way dysfunctional automatic associations and interpretation have been examined within a type of psychopathology. First, research in some domains is still dominated by the application of self report measures. However, as noted earlier, this confers many disadvantages. Hence, the application of indirect measures might be beneficial here. Second, testing the sensitivity of variations of well-established indirect measures is crucial in order to substantiate and extend previous findings. In line with this, it would be also important to find out whether such newly developed indirect measures are unique predictors of dysfunctional behavioral patterns. Third, extension and replication studies are needed to robustly demonstrate the existence of dysfunctional automatic associations and interpretations across different measures. Fourth, variables related to dysfunctional automatic associations and interpretations need to be tested, for example by means of correlational or moderation analyses. Fifth, there are many studies assessing the role of dysfunctional automatic associations and interpretations in risk samples. However, as findings obtained in risk samples do not always match those obtained in clinical samples, more research including patients is needed. Sixth, once it has been found that dysfunctional automatic associations and interpretations are a correlate of (levels of) psychopathology, prospective studies should follow to examine whether they are also predictive of (levels of) psychopathology (Kraemer et al., 1997). Seventh, many cognitive models postulate that dysfunctional automatic associations and interpretations contribute to the development of psychopathology. However, only experimental investigations can provide evidence for such a causal

link by manipulating dysfunctional automatic associations and interpretations. There are promising first findings in social anxiety, depression and addiction, but much more research is needed to substantiate the models' assumptions.
These open questions raise a number of issues for further research. In the next section, I will give a brief outlook of the contribution of my dissertation to each of these issues.

FOCUS AND OUTLINE OF THE PRESENT THESIS

The general aim of the present thesis is to further advance the understanding of the role of dysfunctional automatic associations and interpretations in psychopathology. Therefore, I will present 9 studies which: 1. Assessed dysfunctional automatic associations and interpretations to investigate their roles as correlates (Chapters 2-7), predictor (Chapter 8) and causal risk factors (Chapters 9 and 10) of psychopathology; 2. Were conducted with different types of psychopathology (eating pathology, Chapter 2; anxiety, Chapter 3, 8, 9 and 10; alcohol misuse and dependency, Chapter 4, 5, 6, and 7), and including at risk (Chapters 4 and 5) as well as clinical samples (Chapters 3, 6 and 7); 3. Made use of various paradigms ranging from more direct to indirect approaches. Given these features, the present dissertation will provide an in-depth examination of psychopathological associations and interpretations across different levels of different types of psychopathology, making use of state-of-the-art research paradigms.
Chapters 2-7 focus on the role of dysfunctional automatic associations and interpretations as a correlate of (levels of) psychopathology. The study in Chapter 2 reports the first attempt to assess dysfunctional automatic associations in the context of the 'thin ideal internalization' indirectly. A stimulus response compatibility task (SRC; Mogg, Bradley, Field, & De Houwer, 2003) was applied whereby undergraduate female students were asked to categorize pictures of models as either thin or chubby by moving a manikin figure either towards or away from the pictures. Here, the reaction time needed to execute the manikin's movement served as index of the associative strength between movement and picture type, respectively.
Chapter 3 describes two studies whereby automatic associations towards spiders were investigated. The central aim of these studies was to test the sensitivity of a newly developed variation of the Single Target Implicit Association Test (STIAT; Wigboldus, Holland, & van Knippenberg, 2004), namely a STIAT including a task irrelevant instruction. Furthermore, the study examined whether the performance on this adapted STIAT version was a better predictor of fear responses than self-report. In Study 1, spider-fearful individuals versus non-fearful controls were tested, and Study 2 compared spider enthusiasts to non-fearful controls.

The studies of Chapter 4-7 were conducted in the area of alcohol misuse and abuse. Chapter 4 and 5 involve risk populations, namely drinking students. The main aim of these studies was to obtain more insight in the role of alcohol-related interpretations by providing a more ecologically valid and holistic assessment compared to previous studies. Hence, both studies employed a scenario based approach. In the study of Chapter 4, heavy and light drinking male student were asked to complete open-ended ambiguous scenarios, which were either alcohol-related or neutral in context. The continuations participants generated were used as a bias index. The study in Chapter 5 also used a scenario based approach. However, this was operationalized as an encoding recognition task, i.e., participants were presented with ambiguous scenarios and were asked to rate possible interpretations of these scenarios in a second phase. Unlike the previous study, this study included a balanced distribution of scenarios related to positive and negative reinforcement drinking. In addition, female drinking students were also tested and measures of levels of executive control and prospective drinking were included.

The studies of Chapter 6 and 7 were conducted with clinical samples of alcohol–dependent and control patients, and also investigated alcohol-related associations and interpretation. Hence, these studies generally aimed to replicate the previous findings obtained in risk samples. The study in Chapter 6 was an extension of the study in Chapter 4 to a clinical sample. Therefore, we employed a scenario task and tested whether alcohol-dependent patients, compared to a patient control group, would show an alcohol-related interpretation bias. The study in Chapter 7 employed a priming task and focused on the assessment of dysfunctional automatic alcohol-related associations. Positive and negative affective words served as primes and alcohol and soda words as targets, respectively. It was investigated in how far particularly negative affective primes impact the categorization of alcohol targets. In addition, the moderating role of depressive symptoms and executive control was investigated.

Chapter 8 addresses the role of dysfunctional interpretations as a predictor of psychopathology. Hence, it includes a prospective study in the context of panic disorder. This study tested whether a panic-related interpretation bias at time point one would be predictive of panic onset at time point 2.

Finally, Chapter 9 and 10 describe studies aiming to investigate the causal role of (dys)functional interpretations. Therefore, two analogue experimental studies in the context of Post Traumatic Stress Disorder (PTSD) were conducted, testing the effect of positive versus negative reappraisal training (CBM-App training). The study in Chapter 9 tested the effect of such CBM-App training after participants had been exposed to highly distressing film clips. The study in Chapter 10 tested the reversed

order, i.e., first CBM-App and then exposure to highly distressing film clips. Both studies included three distinct outcome measures, namely: (a) post-training appraisals of novel ambiguous scenarios, (b) differences in trauma-related cognition, and (c) intrusive memories.

In summary, by investigating dysfunctional automatic associations and interpretations across different types and levels of psychopathology and by using various kinds of tasks, this dissertation aims to provide an in-depth examination of their role in psychopathology.

REFERENCES

Anderson, J. R. (1983). *The architecture of cognition*. Cambridge, MA: Harvard University Press.

Anderson, J. R, & Bower, G. H. (1973). *Human associative memory*. Washington: V.H. Winston.

Beevers, C. (2005). Cognitive vulnerability to depression: A dual process model. *Clinical Psychological Review*, *25*, 975–1002.

Beck, A. T., Emery, G., & Greenberg, R.L. (1985). *Anxiety disorders and phobias: A cognitive perspective*. New York: Basic Books.

Beck, A. T., Rush, A. J., Shaw, B. F., & Emery, G. (1979). *Cognitive therapy of depression*. New York: Guildford Press.

Bower, G. H. (1981). Mood and memory. *American Psychologist*, *36*, 129-148.

Brewin, C. R., Dalgleish, T., & Joseph, S. (1996). A dual representation theory of posttraumatic stress disorder. *Psychological Review*, *103*, 670–686.

Bosson, J. K., Swann, W. B., & Pennebaker, J. W. (2000). Stalking the perfect measure of implicit self-esteem: The blind men and the elephant revisited? *Journal of Personality and Social Psychology*, *79*, 631–643.

Clark, D. M. (1986). A cognitive approach to panic. *Behaviour Research and Therapy*, *24*, 461-470.

Clerkin, E. M., & Teachman, B. A. (2009). Automatic and strategic measures as predictors of mirror gazing among individuals with body dysmorphic disorder symptoms. *Journal of Nervous and Mental Disease*, *197,* 589–598.

Collins, A. M., & Loftus, E. F. (1975). A spreading activation theory of semantic processing. *Psychological Review*, *82*, 407-428.

Collin, A. M., & Qullian, M. R. (1969). Retrieval time from semantic memory. *Journal of Verbal Learning and Verbal Behavior*, *8*, 240-247.

De Houwer, J. (2006). What are implicit measures and why are we using them. In R.W. Wiers & A.W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp. 11–28). Thousand Oaks: Sage Publishers.

De Houwer, J., Teige-Mocigemba, S., Spruyt, A., & Moors, A. (2009). Implicit measures: A normative analysis and review. *Psychological Bulletin*, *135*, 347–368.

De Houwer, J., Thomas, S., & Baeyens, F. (2001). Associative learning of likes and dislikes: A review of 25 years of research on human evaluative conditioning. *Psychological Bulletin*, *127*, 853-869.

Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin*, *132*, 692-731.

Greenwald, A. G., McGhee, D. E., & Schwartz, L. K. (1998). Measuring individual differences in implicit cognitions: The Implicit Association Test. *Journal of Personality and Social Psychology*, *74*, 1464-1480.

Hallion, L. S., & Ruscio, A. M. (2011). A meta-analysis of the effect of Cognitive Bias Modification on anxiety and depression. *Psychological Bulletin*, *137*, 940-958.

Hebb, D. O. (1949). *The organization of behavior*. New York: Wiley & Sons.

Heider, F. (1985). *The psychology of interpersonal relations*. New York: Wiley.

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

Houben, K., Schoenmakers, T., & Wiers, R. W. (2010). I didn't feel like drinking but I don't know why: The effects of evaluative conditioning on alcohol-related attitudes, craving and behavior. *Addictive Behaviors*, *35*, 1161-1163.

Kelley, H. H. (1972). *Causal schemata and the attribution process*. Morristown: General Learning Press.

Koster, E. H. W., MacLeod, C., & Fox, E. (2009). Introduction to the special section on cognitive bias modification in emotional disorders. *Journal of Abnormal Psychology*, *118*, 1-4.

Kraemer, H. C., Kazdin, A. E., Offord, D. R., Kessler, R. C., Jensen, P. S., & Kupfer, D. J. (1997). Coming to terms with terms of risk. *Archives General Psychiatry*, *54*, 337-343.

Lazarus, R. S. (1991). *Emotion and adaptation*. Oxford: Oxford University Press.

Le Doux, J. E. (1995). Emotions: Cues from the brain. *Annual Review of Psychology*, *46*, 209-235.

MacLeod, C., Koster, E. H. W., & Fox, E. (2009). Whither cognitive bias modification research? Commentary on the special section articles. *Journal of Abnormal Psychology*, *118*, 89–99.

MacLeod, C., & Mathews, A. (2012). Cognitive bias modification approaches to anxiety. *Annual Review of Clinical Psychology*, *8*, 189–217.

Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety. *Journal of Abnormal Psychology*, *109*, 602-615

Mathews, A., & MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annual Review of Clinical Psychology*, *1*, 167–195.

Mogg, K., Bradley, B. P., Field, M., & De Houwer, J. (2003). Eye movements to smoking-related pictures in smokers: Relationship between attentional biases and implicit and explicit measures of stimulus valence. *Addiction*, *98*, 825–836.

Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review*, *84*, 231–259.

Ouimet, A. J, Gawronski, B., & Dozois, D. J. A. (2009). Cognitive vulnerability to anxiety: A review and an integrative model. *Clinical Psychology Review*, *29*, 459–470.

Reinecke, A., Becker, E. S., & Rinck, M. (2010). Three indirect tasks assessing implicit threat associations and behavioral response tendencies test-retest reliability and validity. *Zeitschrift für Psychologie/Journal of Psychology*, *218*, 4-11.

Roefs, A., Huijding, J., Smulders, F., MacLeod, C. M., de Jong, P. J. , Wiers, R. W., & Jansen, A. T. (2011). Implicit measures of association in psychopathology research. *Psychological Bulletin*, *137*, 149–193.

Smith, E. R., & DeCoster, J. (2000). Dual-process models in social and cognitive psychology: Conceptual integration and links to underlying memory systems. *Personality and Social Psychology Review*, *4*, 108–131.

Sportel, E. B., de Hullu, E., de Jong, P. J., & Nauta, M. H. (2013). Cognitive bias modification versus CBT in reducing adolescent social anxiety: A randomized controlled trial. PLoS ONE, *8*, e64355.

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, *8*, 220-247.

Wiers, R. W., Bartholow, B. D., Van den Wildenberg, E., Thush, C., Engels, R. C. M. E., Sher, K. J., Grenard, J., Ames, S. L., & Stacy, A. W. (2007). Automatic and controlled processes and the development of addictive behaviors in adolescents: A review and a model. *Pharmacology, Biochemistry and Behavior*, *86*, 263-283.

Wigboldus, D. H. J., Holland, R. W., & van Knippenberg, A. (2004). *Single target implicit associations*. Unpublished manuscript.

Williams, J. M., Watts, F. N., MacLeod, C., & Mathews, A. (1997). *Cognitive psychology and emotional disorders* (2nd ed.). Chichester: Wiley.

Weiner, B. (1986). *An attributional theory of motivation and emotion*. New York: Springer.

2

Measuring thinspiration and fear of fat indirectly: A matter of approach and avoidance

ABSTRACT

The concepts 'thinspiration' and 'fear of fat' are crucial regarding the development and maintenance of body image disturbances and eating pathology. This study aimed to advance our current understanding of these two motivational concepts. Unlike previous studies that have primarily relied on self report measures to investigate thinspiration and fear of fat, we applied an indirect measure, namely a Stimulus Response Compatibility (SRC) task. During our SRC task, undergraduate female students were instructed to symbolically approach and avoid pictures of thin and chubby models. Hence, the participants' reaction times during the SRC task provided an index of the automatic affective and motivational valence of the models. Results showed that participants were faster to approach than to avoid thin models, however, there was no difference in approach-avoidance responses regarding chubby models. Analyses revealed that the approach-avoidance responses were related to important eating-related, cognitive schemata, e.g., the participants' level of drive for thinness, thin-ideal internalization, body dissatisfaction and their weight control behaviors. These findings clearly support the application of an indirect measure such as the SRC task in order to examine the concepts thinspiration and fear of fat, and highlight the need for further research that validates and extends current results.

This chapter is based on:
Woud, M. L., Anschutz, D. J., Van Strien, T., & Becker, E. S. (2011). Measuring thinspiration and fear of fat indirectly: A matter of approach and avoidance. *Appetite*, *56*, 451-455.

INTRODUCTION

People tend to argue that physical attractiveness is a matter of personal preferences, however, the Western media has produced and consistently perpetuates a stereotypical image of femininity that is dominated by thin ideal representations. This media prototype of the ideal female has created a high societal pressure to be thin which can contribute to the development of body image disturbances and eating pathology among young women (e.g., Grabe, Ward, & Hyde, 2008). According to Stice, Schupak-Neuberg, Shaw, and Stein (1994), the relationship between eating pathology and media exposure is mediated by the internalization of these thin beauty ideals. Thin ideal internalization is a psychological process that emerges when women assimilate the thin-ideal and its associated standards into their worldview, and execute particular behaviors to approximate towards these ideals (Thompson & Stice, 2001). According to Bordo (1993), the impact, or better pressure of this process shapes females bodies and minds more and more.

The concepts *thinspiration* and *fear of fat* are important in this context. The former implies that women are eager to approach an idealized thin identity, whereas the latter implies that women are eager to avoid the acquisition of a stigmatized over-fat identity (Dalley & Buunk, 2009). As such, both concepts are compatible with the two motivational orientations described by the regulatory-focus theory (Higgins, 1997), which postulates that individuals are either motivated to approach a desired end-state (i.e., *promotion focused*) or are motivated to avoid shortfalls (i.e., *prevention focused*). Both, thinspiration and fear of fat, are diagnostic criteria for eating disorders such as bulimia or anorexia (American Psychological Association, 2000). Therefore, we have seen a surge of research efforts towards a better understanding of how these motivational concepts contribute to the development and maintenance of dysfunctional dieting behaviors and eating-related attitudes. Findings from Thompson and Stice (2001), for example, suggest that dieting behavior might be driven by the desire to approach a thin beauty ideal. However, there is emerging evidence indicating that dieting behavior is rather driven by the desire to avoid the stigmatized over-fat identity (e.g., Ackard, Croll, & Kearney-Cooke, 2002; Dalley & Buunk, 2009; Mussap, 2007). Dalley and Buunk (2009), for example, required participants to complete questionnaires measuring the participants' perceived similarity with thin and over-fat prototypes. Results showed that those who reported an increased perception of similarity to over-fat prototypes perceived these prototypes as more unfavorable, and were more likely to be involved in frequent dieting behaviors. Similar findings have been reported by Ackard et al. (2002), who have proposed an association between an avoidance motivation and dysfunctional behaviors and eating attitudes.

Research into thinspiration and fear of fat has generally relied on self-report measures, and although e.g., questionnaires have well-established predictive validity and are important research instruments, they contain several limitations. Self-report or *direct measures* are assumed to be prone to biases initiated by social desirability, demand characteristics, or self-presenting strategies (see De Houwer, 2006). Given these limitations, it is important to complement self-report measures when studying cognitive schemata associated with thinspiration and fear of fat. Hence, *indirect measures* might provide an important tool to supplement direct measures. Unlike direct measures, indirect measures do not directly ask individuals to reveal their thoughts or attitudes. Instead, most of these tasks are performance measures, and cognitions or attitudes are inferred from systematic differences in reaction times (RTs). This provides specific advantages, for example, it offers the possibility of studying cognitions and attitudes over which people cannot easily exert cognitive control and which are less accessible via self-report, but that nevertheless influence human behavior.

Regarding the research related to eating pathology, body image disturbances or thin-ideal internalization, a variety of indirect measures have been used. To illustrate, Ahern, Bennett, and Hetherington (2008) employed an Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) to study automatic attitudes to the ultra-thin ideal in a non-clinical sample. The IAT is a categorization task which provides a method for indirectly assessing the relative strength of associations between concepts (see Greenwald et al., 1998, for a detailed description). By means of the IAT, Ahern and colleagues (2008) investigated whether young women who hold more positive automatic associations towards underweight models do also report higher levels of eating disorder symptoms. Results showed that women who automatically associated underweight with positivity scored higher on drive for thinness. Moreover, this relationship was stronger for those women who indicated that the media is an important outlet for them regarding the societal standards of the thin ideal. Besides the IAT, other indirect measures like the dot probe paradigm (e.g., Rieger et al., 1998; Shafran, Lee, Cooper, Palmer, & Fairburn, 2007), the Stroop task (for a review, see Dobson & Dozois, 2004; Lee & Shafran, 2004), the affective priming paradigm (e.g., Roefs et al., 2005) or the visual search task (e.g., Smeets, Roefs, Van Furth, & Jansen, 2008) have been applied very successfully, as they provided unique information that could not have been gathered by self-report measures. As such, indirect measures are very attractive, additional research instruments that can help to increase our understanding of the functional relationship between cognitive processes and the etiology and maintenance of eating pathology.

The present study sought to expand self-report procedures in order to test the suitability of an indirect measure in the context of thinspiration and fear of fat. Therefore,

we applied a modified version of a Stimulus Response Compatibility (SRC) task, introduced by Mogg, Bradley, Field, and De Houwer (2003). Findings from a long line of research have demonstrated that affective stimuli automatically trigger compatible, behavioral dispositions: A negative stimulus activates avoidance tendencies, whereas a positive stimulus activates approach tendencies (e.g., Chen & Bargh, 1999; Neumann & Strack, 2000). Similar findings were obtained by De Houwer, Crombez, Baeyens, and Hermans (2001). They instructed participants to execute symbolic approach and avoidance movements towards positive and negative words by moving a manikin figure either towards or away from the word stimuli. Results showed the expected compatibility effects: Response times to categorize positive words were faster if the required response was a symbolic approach movement rather than a symbolic avoidance movement, and the opposite was true for negative words. In the area of addiction research, the SRC task has been applied very successfully in studies on nicotine dependence. For instance, Mogg et al. (2003) demonstrated that smokers are faster than non-smokers to make an approach response to smoking-related pictures than to make an avoidance response (see also e.g., Bradley, Field, Mogg, & De Houwer, 2004; Field, Mogg, & Bradley, 2005). Hence, the SRC task can be described as an indirect measure of the affective and motivational valence of stimuli.

In our version of the SRC task, undergraduate female students were asked to categorize pictures of models as either thin or chubby by moving the manikin figure either towards or away from the pictures. As such, our SRC task provides an indirect measure of the models' favorability as the response time participants need to initiate an approach or avoidance movement can be regarded as an index of the affective and motivational valence of the models. For this reason, we think that this is an ecologically valid operationalization of the concepts thinspiration and fear of fat: An approach bias towards thin models (i.e, approach responses are faster initiated than avoidance responses) represents the first concept, whereas an avoidance bias towards chubby models (i.e., avoidance responses are faster initiated than approach responses) represents the latter concept. Making use of pictorial stimuli when applying an indirect measure has been very successful in this area of research (e.g., Ahern et al., 2008; Shafran et al., 2007; Smeets et al., 2008), further validating our method. As recent evidence suggests that particularly avoidance oriented processes are related to eating pathology (e.g., Ackard et al., 2002; Dalley & Buunk, 2009; Mussap, 2007), we expect an avoidance bias towards chubby models to occur. In order to gain more insight between the approach-avoidance responses and their relation to eating-related, cognitive schemata, we assessed participants' level of drive for thinness, thin-ideal internalization, body dissatisfaction and their weight control behaviors. Finally, we also investigated the relation between these valenced responses and participants' BMI.

METHOD

Participants

A total of 108 female students of the Radboud University of Nijmegen participated in this study.[1] The mean age of the participants was 20.1 years (*SD* = 1.95) and their average body mass index (BMI = weight/height^2) was 22.56 (*SD* = 3.1).

Materials & Procedure

Stimulus Response Compatibility (SRC) task

The SRC task was administered first. Pictures of 10 models served as experimental stimuli. These original 10 model pictures were used for the category *thin*. Pictures for the category *chubby* were a manipulation of the thin pictures, they were stretched 20% so that the models looked plump. This resulted in a total set of 20 experimental stimuli. In each trial of the SRC task, a picture of either a thin or a chubby model appeared in the centre of the screen. In addition, a manikin figure was displayed either below or above the picture. Participants were instructed to move the manikin figure either towards or away from the picture by making use of the keys '2' (manikin moved downwards) and '8' (manikin moved upwards) on the numeric part of the keyboard. The SRC task consisted of two blocks with two different stimulus-response assignments: One block required participants to move the manikin towards chubby models (positive approach movement) and to move the manikin away from thin models (negative avoidance movement), whereas the other block required participants to move the manikin away from chubby models (negative avoidance movement) and towards thin models (positive approach movement). The latency between picture onset and the participant's response served as the dependent variable. All participants completed both blocks, however, the order of blocks was counterbalanced across participants. Within each block, the manikin appeared below the picture on 50% of the trials, and above it on the other 50%. When the manikin appeared below the picture, 50% of the trials required a down response, whereas the other 50% required an up response, and the same was true when the manikin appeared above the picture. The manikin position and picture type varied randomly over trials. Each block was preceded by 8 practice trials. During the test trials, each experimental picture was presented twice, implying that each block contained 40 test trials. The whole SRC task contained 96 trials.

[1] Some participants of this sample also participated in the study of Anschutz, Engels, Becker, and Van Strien (2009).

Questionnaires

Following the SRC task, the Eating Disorder Inventory-II (EDI-II; Garner, 1991), the Sociocultural Attitudes Towards Appearance Questionnaire (SATAQ; Thompson, Van den Berg, Roehrig, Guarda, & Heinberg, 2004), and the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien, Frijters, Bergens, & Defares, 1986) were administered. Regarding the EDI, we used the *drive for thinness* and *body dissatisfaction* subscales in order to assess cognitions related to preoccupation with weight and satisfaction with various weight-related parts of the body. The drive for thinness subscale comprises 7 statements (e.g., 'I am preoccupied with the desire to be thinner.'). Participants respond to them on a 6-point Likert Scale anchored at the extremes with 1 ('never') and 6 ('always'). Cronbach's α for this sample was .87 (M = 2.5, SD = .91). The body dissatisfaction subscale includes 9 items (e.g., 'I think that my thighs are too large.'), and participants rate how often they agree with each statement according to a 6-point Likert scale ranging from 'always' to 'never'. In this sample Cronbach's α was .88 (M = 3.1, SD = .99). The *thin-ideal internalization* subscale of the SATAQ was administered to examine the level of internalization of societal sanctioned standards of appearance. This subscale comprises 9 statements (e.g., 'I would like my body to look like the people who are in the movies.'), and the response options range from 1 ('totally disagree') to 5 ('totally agree'). Cronbach's α for this sample was .92 (M = 2.6, SD = .85). Finally, the *restraint* subscale of the DEBQ was applied to measure the tendency to eat less than desired. This subscale includes 10 items (e.g., 'Do you deliberately eat less in order not to become heavier?'), with response categories ranging from 1 ('never') to 5 ('very often'). In this sample Cronbach's α was .93 (M = 2.6, SD = .84). Following the questionnaires, participants' weight and height were measured. Finally, all participants were debriefed and thanked for their time.

RESULTS

Stimulus Response Compatibility (SRC) task

To correct for the potential effects of outlier reaction times (RTs), the means reported below are means of medians (see also Figure 1). The RT data from incorrect trials were discarded (7.1% of the data). Two participants had to be excluded as 25% of their responses were incorrect, leaving a final sample of 106 participants.

The 2 (Movement: Approach, Avoidance) x 2 (Model Type: Thin, Chubby) Repeated Measure ANOVA revealed a main effect of Model Type: $F(1,105) = 44.05$, $p < .001$, $\eta^2 = .3$, and a main effect of Movement: $F(1,105) = 59.52$, $p < .001$, $\eta^2 = .36$. More

importantly, the Movement x Model Type interaction was significant: $F(1,105) = 9.52$, $p < .01$, $\eta^2 = .08$. Post-hoc comparison (paired sample t-tests) indicated that participants showed an approach bias towards thin models, i.e., their approach responses were faster than their avoidance responses (approach: $M = 929.93$, $SD = 185.61$ vs. avoidance: $M = 1067.75$, $SD = 265$), $t(105) = 6.85$, $p < .001$. However, no significant differences were found regarding the approach-avoidance responses towards chubby models: $t(105) = 1.05$, $p = .135$.

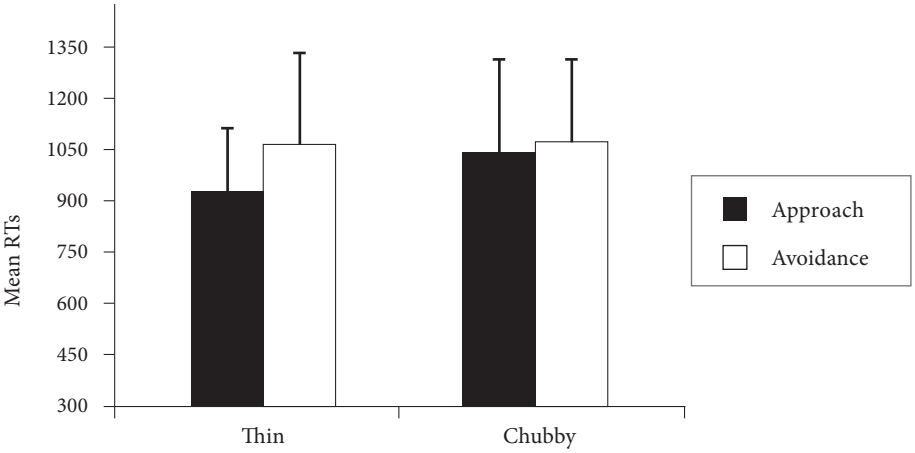


Figure 1. Mean RTs of Stimulus Response Compatibility (SRC) task

Correlations

For the correlational analysis, we calculated two difference scores, one for approach-avoidance responses towards thin models (thin avoidance – thin approach), and one for approach-avoidance responses towards chubby models (chubby avoidance – chubby approach). As such, a positive difference score for thin models means that approach responses towards thin models were faster than avoidance responses, whereas a negative difference score for chubby models means that avoidance responses away from chubby models were faster than approach responses. The rational to calculate difference scores between approach and avoidance per picture type is that this is the most meaningful variable, not approach- or avoidance-time per se (cf. Nosek & Sriram, 2007).
Table 1 illustrates the correlation of these difference scores with the questionnaire subscales and BMI. First of all, it shows that a faster approach of thin models is associated

with a faster avoidance of chubby models. Besides, a faster approach of thin models is marginally significant related to a higher score on thin ideal internalization. However, there is no relationship between the difference score for thin models and the other subscales (i.e., drive for thinness, body dissatisfaction, restraint eating) or BMI. Regarding the avoidance of chubby models, results show that faster avoidance is associated with a higher score on drive for thinness. Moreover, the avoidance of chubby models is related to higher scores on restraint eating, thin ideal internalization, body dissatisfaction and BMI. Finally, we also examined if these correlations differ significantly from each other. Results showed that drive for thinness, restraint eating, thin ideal internalization and body dissatisfaction correlated significantly higher with the avoidance of chubby models than with the approach of thin models ($p < .01$ for the first three comparisons, and $p < .05$ for body dissatisfaction). However, no significant difference was found for BMI ($p > .05$).

Table 1. Correlation of difference scores with EDI-II, SATAQ, DEBQ scales & BMI.

	Chubby models	Drive for thinness	Body dissatisfaction	Restraint eating	Thin ideal internalization	BMI
Thin models	-.42**	.11	.08	.16	*.17*	.0
Chubby models	-	-.27**	-.23*	-.25*	-.22*	-.24*

Note: * p < .05, ** p < .01, italics: marginal significance

When repeating the correlational analysis and controlling for BMI the result pattern generally remains the same. A faster approach of thin models is associated with a faster avoidance of chubby models ($r = -.44$, $p < .001$). The drive for thinness subscale is not significantly correlated with the RTs of approaching thin models ($r = .12$, $p > .05$), however, it is related to a faster avoidance of chubby models ($r = -.2$, $p < .05$). Besides, both difference scores are marginally associated with restraint eating (thin models: $r = .17$, $p = .08$; chubby models: $r = -.18$, $p = .08$). The thin ideal internalization subscale is marginally related to approaching thin models faster ($r = .17$, $p = .08$), and significantly related to avoiding chubby models faster ($r = -.22$, $p < .04$). Finally, both difference scores are not associated with body dissatisfaction (thin models: $r = .1$, $p > .05$; chubby models: $r = -.14$, $p > .05$).

DISCUSSION

The current study examined the two concepts *thinspiration* and *fear of fat* by employing a unique version of a stimulus response compatibility (SRC) task. Participants symbolically approached and avoided models that were depicted with either a thin or a chubby body image. Based on previous findings supporting the notion that avoidance oriented processes are related to eating pathology, we expected an avoidance bias towards chubby models to occur. However, results showed that participants had an approach bias towards thin models. Correlational analyzes demonstrated that the approach-avoidance responses were related to important eating-related, cognitive schemata such as drive for thinness, restraint eating, thin ideal internalization, body dissatisfaction and to the participants' BMI.

Unexpectedly, the findings on the SRC task seem to indicate that the concept thinspiration was more manifested in our sample than the concept fear of fat. Results showed that the participants' approach responses towards thin models were faster than their avoidance responses, whereas the RTs of their approach-avoidance responses towards and away from chubby models were not significantly different. This suggests that a thin model represented a positive stimulus, which might have resulted in an automatic activation of a valence congruent motivation, i.e., approach.

Interestingly, we found that the SRC performance was associated with eating-related, cognitive schemata assessed via several self-report measures (i.e., the EDI-II, the SATAQ and the DEBQ) and the participants' BMI. A fast avoidance response away from chubby models was related to a high preoccupation with weight-related concerns (i.e., drive for thinness) and with a high level of internalized, societal sanctioned standards of appearance (i.e., thin ideal internalization). Moreover, these RTs were positively related to the participants' level of unhappiness with their body shape (i.e., body dissatisfaction), and also to the tendency to eat less (i.e., restraint eating) and to the participants' BMI. The approach responses towards thin models, however, were unrelated to any of the questionnaire subscales with the exception of marginal significance with the thin ideal internalization scale. Finally, a faster approach of thin models was accompanied by a faster avoidance of chubby models. Summarizing these findings, it appears that thinspiration and fear of fat are closely correlated, although they do seem to represent two distinct concepts (see Levitt, 2003), and that specifically the avoidance of chubby models is related to dysfunctional, eating-related cognitions and BMI.

There are two principal phenomena to be considered from the current study. The results of the SRC task demonstrated that the majority of participants exhibited an approach bias towards thin models. Thus, thin models were perceived as positive and desirable. This supports the notion put forward by Thompson and Stice (2001), who

postulate that the desire to approach the extreme thinness is the dominant motivational concept when it comes to the engagement in and execution of dysfunctional eating-related cognitions and behaviors. This is partly corroborated by our correlational data, as favoring thin models is marginally associated with a high score on thin ideal internalization. However, finding that the avoidance of chubby models is correlated with dysfunctional, eating-related, cognitive schemata and BMI leads to a more cautious interpretation of these former conclusions. In fact, our results also confirm findings of, for example, Dalley and Buunk (2009), who argue that dieting is driven by a motivation to avoid an unfavorable fat identity rather than by a desire to approach a thin ideal. This claim is predominately supported by our finding that avoiding chubby models faster corresponds to a higher score on restraint eating. Similarly, conclusions of Ackard et al. (2002) seem to be supported as well. Likewise, their sample consisted of young, normal weight women and also their results showed that problematic eating behavior and negative, eating-related attitudes were associated with avoidance strategies (but see also e.g., Bellew, Gilbert, Mills, McEwan, & Gale, 2006; Mussap, 2007).

Although our results are encouraging, our conclusions should be treated with some reservations. There are at least two limitations that should be addressed. First, we did not pilot the pictures, implying that we do not know if participants clearly evaluated the models as either thin or chubby, respectively. Second, showing images of chubby women might not be regarded as an adequate representation of the concept fear of fat, so pictures of obese women might have been more valid. Therefore, we cannot rule out that these pictures were actually evaluated as neutral, which seems plausible when taking into account that the body shape of our female students is more likely to be closer to the chubby picture type than the thin picture type. Consequently, not finding a difference with respect to the approach-avoidance responses towards chubby models could be explained by the fact that this manipulation was not potent enough to arouse avoidance.

The present research provides new and valuable insights into the thinspiration versus fear of fat discussion. The application of an indirect measure was successful, as the SRC task was sensitive enough to detect differences in the participants' motivational disposition towards the model pictures. Besides, these differences were associated with dysfunctional, eating-related cognitive schemata. The fact that this was found among a group of young, normal-weight women further strengthens the importance of these findings. However, more research should be conducted to validate our results, to improve instruments to identify women at risk, and to extend our current knowledge of what motivates women to develop and to maintain eating disturbances. Our method might provide a very innovative starting point, so research in this field should be premised on the motivational orientation of 'approach' rather than 'avoidance'.

REFERENCES

Ackard, D. M., Croll, J. K., & Kearney-Cooke, A. (2002). Dieting frequency among college females: Association with disordered eating, body image, and related psychological problems. *Journal of Psychosomatic Research*, *52*, 129–136.

Ahern, A. L., Bennett, K. M., & Hetherington, M. M. (2008). Internalization of the ultra-thin ideal: Positive implicit associations with underweight models are associated with drive for thinness in young women. *Eating Disorders*, *16*, 294-307.

American Psychological Association (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

Anschutz, D. J., Engels, R. C. M. E., Becker, E. S., & Van Strien, T. (2009). The effects of tv commercials using less thin models on young women's mood, body image and actual food intake. *Body Image*, *6*, 270-276.

Bellew, R., Gilbert, P., Mills, A., McEwan, K., & Gale, C. (2006). Eating attitudes and striving to avoid inferiority. *Eating Disorders*, *14*, 313–322.

Bordo, S. (1993). *Unbearable weight: Feminism western culture and the body*. Berkeley, CA: University of California Press.

Bradley, B. P., Field, M., Mogg, K., & De Houwer, J. (2004). Attentional and evaluative biases for smoking cues in nicotine dependence: Component processes of biases in visual orienting. *Behavior Pharmacology*, *15*, 29-36.

Chen, M., & Bargh, J. A. (1999). Consequences of automatic evaluation: Immediate behavioral predispositions to approach or to avoid the stimulus. P*ersonality and Social Psychology Bulletin*, *25*, 215-224.

Dalley, S. E., & Buunk, A. P. (2009). "Thinspiration" vs. "fear of fat". Using prototypes to predict frequent weight-loss dieting in females. *Appetite*, *52*, 217-221.

De Houwer, J. (2006). What are implicit measures and why are we using them? In R. W. Wiers, & A. Stacy (Eds.). *Handbook of implicit cognition and addiction* (pp. 11-28). Thousands Oaks, CA: Sage Publishers.

De Houwer, J., Crombez, G., Baeyens, F., & Hermans, D. (2001). On the generality of the affective Simon effect. *Cognition & Emotion*, *15*, 189-206.

Dobson, K. S., & Dozois, D. J. A. (2004). Attentional bias in eating disorders: A meta-analytic review of Stroop performances. *Clinical Psychology Review*, *23*, 1001-1022.

Field, M., Mogg, K., & Bradley, B. P. (2005). Alcohol increases cognitive biases for smoking cues in smokers. *Psychopharmacology*, *180*, 63-72.

Garner, D. M. (1991). *Eating Disorder Inventory-2: Professional Manual*. Odessa, FL: Psychological Assessment Resources.

Grabe, S., Ward, M. L., & Hyde, J. S. (2008). The role of the media in body image concerns among women: A meta-analysis of experimental and correlational studies. *Psychological Bulletin*, *134*, 460-476.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, *74*, 1464-1480.

Higgins, E. T. (1997). Beyond pleasure and pain. *American Psychologist*, *52*, 1280–1300.

Lee, M., & Shafran, R. (2004). Information processing biases in eating disorders. *Clinical Psychological Review*, *24*, 215-238.

Levitt, D. H. (2003). Drive for thinness and fear of fat: Separate yet related constructs? *Eating Disorders*, *11*, 221-234.

Mogg, K., Bradley, B. P., Field, M., & De Houwer, J. (2003). Biases in eye movements to smoking-related cues in smokers: Relationship to affective and motivational valence. *Addiction*, *98*, 825-836.

Mussap, A. J. (2007). Motivational processes associated with unhealthy body change attitudes and behaviours. *Eating Behaviours*, *8*, 423-428.

Neumann, R., & Strack, F. (2000). Approach and avoidance: The influence of proprioceptive and exteroceptive cues on encoding of affective information. *Journal of Personality and Social Psychology*, *79*, 39-48.

Nosek, B. A., & Sriram, N. (2007). Faulty assumptions: A comment on Blanton, Jaccard, Gonzales, and Christie (2006). *Journal of Experimental Social Psychology*, *43*, 393-398.

Rieger, E., Schotte, D. E., Touyz, S. W., Beumont, P. J. V., Griffiths, R., & Russel, J. (1998). Attentional biases in eating disorders: A visual probe detection procedure. *International Journal of Eating Disorders*, *23*, 199-205.

Roefs, A., Stapert, D., Isabella, L. A. S., Wolters, G., Wojciechowski, F., & Jansen, A. (2005). Early associations with food in anorexia nervosa patients and obese people assessed in the affective priming paradigm. *Eating Behaviors*, *6*, 151–163.

Shafran, R., Lee, M., Cooper, Z., Palmer, R. L., & Fairburn, C. G. (2007). Attentional bias in eating disorders. *International Journal of Eating Disorders*, *40*, 369-380.

Smeets, E., Roefs, A., Van Furth, E., & Jansen, A. (2008). Attentional bias for body and food in eating disorders: Increased distraction, speeded detection, or both? *Behaviour Research and Therapy*, *46*, 229-238.

Stice, E., Schupak-Neuberg, E., Shaw, H. E., & Stein, R. L. (1994). Relation of media exposure to eating disorder symptomatology: An examination of mediating mechanisms. *Journal of Abnormal Psychology*, *103*, 836-840.

Thompson, J. K., Van den Berg, P., Roehrig, M., Guarda, A. S., & Heinberg, L. J. (2004). The Sociocultural Attitudes Towards Appearance Scale-3 (SATAQ-3): Development and validation. *International Journal of Eating Disorders*, *35*, 293-304.

Thompson, J. K., & Stice, E. (2001). Thin-ideal internalization: Mounting evidence for a new risk factor for body-image disturbance and eating pathology. *Current Directions in Psychological Science*, *10*, 181-183.

Van Strien, T. J., Frijters, E. R., Bergers, A. P. A., & Defares, P. B. (1986). Dutch Eating Behaviour Questionnaire for assessment of restraint, emotional and external eating. *International Journal of Eating Disorders*, *5*, 295-315.

3

Task-irrelevant spider associations affect categorization performance

ABSTRACT

In two studies, the Single Target Implicit Association Test (STIAT) was used to investigate automatic associations towards spiders. In both experiments, we measured the strength of associations between pictures of spiders and either threat-related words or pleasant words. Unlike previous studies, we administered a STIAT version in which stimulus contents was task-irrelevant: The target spider pictures were categorized according to the label 'picture', irrespective of what they showed. In Study 1, spider-fearful individuals versus non-fearful controls were tested, Study 2 compared spider enthusiasts to non-fearful controls. Results revealed that the novel STIAT version was sensitive to group differences in automatic associations towards spiders. In Study 1, it successfully distinguished between spider-fearful individuals and non-fearful controls. Moreover, STIAT scores predicted automatic fear responses best, whereas controlled avoidance behavior was best predicted by the FAS (German translation of the Fear of Spiders Questionnaire). The results of Study 2 demonstrated that the novel STIAT version was also able to differentiate between spider enthusiasts and non-fearful controls.

This chapter is based on:
Woud, M. L., Ellwart, T., Langner, O., Rinck, M., & Becker, E. S. (2011). Task-irrelevant spider associations affect categorization performance. *Journal of Behavior Therapy and Experimental Psychiatry*, *42*, 309 – 316.

INTRODUCTION

Cognitive models of anxiety disorders (e.g., Barlow, 1988; Beck, Emery, & Greenberg, 1985; Eysenck, 1992; Foa & Kozak, 1986) assert that cognitive processes play an important role in the maintenance and etiology of anxiety. A particularly important and central characteristic of anxiety disorders is a bias in interpreting stimuli as harmful (e.g., Mathews & MacLeod, 2005). As a result, harmless stimuli are experienced as dangerous and are associated with irrational beliefs. An anxiety disorder that is characterized by such strong irrational beliefs affecting behavior is spider anxiety. Typically, the patient's underlying dysfunctional associations are difficult to control and occur unintentionally, something often referred to as implicit effects. However, as an exact definition of the term implicit is currently under debate (see e.g., De Houwer, 2006; De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009; Moors & De Houwer, 2006), we refer to these effects as automatic, stressing the unintentionality and lack of control as central operational features.

For spider phobia and spider anxiety, a variety of indirect, performance-based tasks have been applied to study (dysfunctional) automatic spider associations. The first measure to be used to assess automatic spider associations was the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). Teachmann, Gregg, and Woody (2001), for example, demonstrated that individuals with spider or snake phobia reacted faster to pictorial stimuli of their feared animal in combination with negative words than with positive words, respectively. Similar findings with the IAT were obtained by Ellwart, Rinck, and Becker (2006), who measured associations towards spiders among spider-fearful individuals, non-fearful participants, and spider enthusiasts. Noteworthy, besides distinguishing between the three groups, automatic spider associations measured with the IAT predicted avoidance behavior better than self-reports (for more studies applying the IAT, see de Jong, van den Hout, Rietbroek, & Huijding, 2003; Huijding & de Jong, 2007; Teachman & Woody, 2003). Although the application of the IAT offered new and valuable insights regarding the role of automatic spider associations in spider phobia and anxiety, there are two limitations regarding these results. First, due to its double-relative nature the IAT assesses the relative strength of associations between two targets and two attributes (De Houwer, 2003a). Hence, one cannot conclude which target – attribute combination is responsible for the observed IAT effects. Second, the IAT requires the presentation of two immanently meaningful opposite target categories, something that is hard to define for spiders.

As an alternative indirect measure circumventing some of the problems of the IAT, the Extrinsic Affective Simon Task (EAST; De Houwer, 2003b) has been applied to study automatic spider associations. Like the IAT, the EAST measures the strength

of associations between particular target stimuli and specific, valenced attributes. However, due to its task properties, the EAST allows for less relative conclusions about the associations between target stimuli and a valence dimension. Assessing automatic spider associations, Huijding and de Jong (2005) demonstrated that the EAST successfully distinguished between groups of low and high spider-fearful individuals (see also Ellwart, Rinck, & Becker, 2005). Moreover, the EAST was the best predictor for automatic fear related behavior, outperforming self-reports (see also Huijding & de Jong, 2006). Despite being promising, these findings should also be treated with caution. In a series of studies, De Houwer and De Bruycker (2007) found that measurements taken with the EAST tended to be unreliable. Further, Reinecke, Becker, and Rinck (2010) found rather low validity scores for the EAST.

Here, we report two studies that further explore the role of automatic[1] spider associations, by applying an alternative indirect measure not used so far, the Single Target Implicit Association Test (STIAT; Wigboldus, Holland, & van Knippenberg, 2004).[2] In a typical STIAT, two classes of stimuli are presented: Attribute *stimuli* and target stimuli (e.g., pictures of spiders). Mostly, attribute stimuli have to be classified according to their emotional valence, e.g., fear-related versus pleasant. In addition, participants have to respond to all target stimuli with one of the buttons already used for the attribute stimulus classification. This creates two conditions: One condition in which threatening target stimuli require the same response as fear-related attributes (compatible condition), and one condition in which threatening target stimuli require the same response key as pleasant attributes (incompatible condition).[3] Using this task, participants frequently exhibit faster responses to targets for compatible trials than for incompatible ones, something assumed to indicate the individual degree of association between the target and the two attributes. By using a single target category, the STIAT does not have the interpretation problems of the double-relative IAT logic. Similar to the EAST, the STIAT is assumed to express the relative associative strength of the used target with the two attribute categories (but see Rothermund & Wentura, 2004, for an alternative interpretation). However, compared to the EAST, the STIAT seems to exhibit better psychometric properties (Bluemke & Friese, 2008). The task used in this study was a variation of the STIAT. In common STIAT versions, the

[1] The authors are aware of the fact that automatic processes embrace a variety of properties. Thus, when arguing that a process is automatic, one should specify the particular properties the automatic process is supposed to posses (e.g., effortless, goal-independent, involuntary). As it is not clear yet which properties are central to the concept of automaticity (Moors & De Houwer, 2006), and because this study did not aim to investigate the concept of 'automaticity' itself, we decided to keep the more general phrase of automatic associations.

[2] This task is conceptually identical to the Single Category Implicit Association Test (SCIAT; Karpinski & Steinmann, 2006).

[3] Please note that for convenience, we use the terms *compatible* (spider-fear) and *incompatible* (spider-pleasant) for all participant groups, although strictly speaking, they only apply to spider-fearful participants, and might even be reversed for spider enthusiasts.

contents of the target category is made task-relevant: In this case, participants would be required to categorize the targets (e.g., pictures of spiders) according to the label spider. This study, however, applied an alternative approach. We made picture contents task-irrelevant by requiring participants to categorize the targets according to the label 'picture'.

Two aims were central in the first study. First, we sought to test if, analog to the IAT and the EAST, this novel STIAT version can successfully distinguish between spider-fearful individuals and non-fearful controls.[4] We expected spider-fearful individuals to show larger differences between the compatible and incompatible STIAT blocks than non-fearful controls. Our second aim was to assess the ability of our STIAT version to predict (specific) fear-related behavior, thereby adding additional evidence to earlier promising results showing that indirect measures have good predictive power for automatic, spider fear related behaviors (e.g., Ellwart et al., 2006; Huijding et al., 2006). Results of studies in other areas of psychology support this aim. Spalding and Hardin (1999), for example, demonstrated that self-related anxiety during an interview was best predicted by a direct measure of self-esteem, whereas non-verbal, experimenter-rated anxious behavior was best predicted by an indirect measure of self-esteem (see also Asendorpf, Banse, & Mücke, 2002; Egloff & Schmuckle, 2002).

In the second study, we compared spider enthusiasts to non-fearful controls to further corroborate the application of our STIAT version. Spider enthusiasts keep spiders as domestic animals, making it plausible to assume that they have positive rather than neutral or negative associations towards spiders. We expected our STIAT version to be sensitive to these group differences, and to reflect the differential automatic associations towards spiders.

Additionally, both studies together provide an interesting perspective on two concurring frameworks, making rather different predictions about automatic associations towards spiders. In the first, Karpinski and Hilton (2001; see also Fazio & Olson, 2003; Olson & Fazio, 2004) argue that automatic associations (as measured with the IAT) reflect cultural stereotypes or extrapersonal associations rather than individual ones. The second framework is the *preparedness principle* often used to explain the onset of anxiety disorders from an evolutionary point of view (Cook & Mineka, 1990; Mineka & Öhman, 2002; Öhman & Mineka, 2003; Seligman, 1971). According to this principle, all humans have innate, negative associations towards spiders or do learn such associations quickly. A consequence of both theories is that spider-fearful individuals, spider enthusiasts, and non-fearful controls should exhibit the same negative

[4] The authors are aware of the fact that our task comprises elements of a STIAT as well as elements of an EAST. Our decision to describe it as a variation of a STIAT is based on the fact that it makes use of a blocked presentation, which is a typical feature of a STIAT.

associations towards spiders. However, if our predictions are correct, it would provide empirical support for the position of Greenwald and colleagues who describe the IAT as a measure that is sensitive to automatic expressions of individual associations (e.g., Greenwald et al., 1998, 2002).

STUDY 1

METHOD

Participants

About 800 undergraduate students of Dresden University of Technology completed a short screening questionnaire (Spider Anxiety Screening, SAS; Rinck et al., 2002) to assess fear and avoidance of spiders as well as possible distress. Students with extreme scores on the SAS were invited for a diagnostic interview. To diagnose spider fear and possible other disorders, a trained clinical psychologist interviewed participants using the 'Mini-DIPS' (Margraf, 1994), a German adaptation of the 'American Anxiety Disorders Interview Schedule-Revised' (ADIS-R; DiNardo, Brown, & Barlow, 1994). The 'Mini-DIPS' allows for the diagnosis of anxiety disorders, affective disorders, substance-related disorders, somatoform disorders, and eating disorders, and a screening of psychotic disorders. Finally, 58 students were selected and participated in this study. This sample included 29 individuals with no fear of spiders (non-fearful controls) and 29 spider-fearful individuals. The control group consisted of 26 women and 3 men with a mean age of 21.8 years (SD = 2.0). The distribution of women and men was the same for the spider-fearful individuals, and their mean age was 21.7 years (SD = 1.9). The degree of spider fear was assessed with the Spider Fear Questionnaire (FAS; Rinck et al., 2002). This is the German version of the 'Fear of Spiders Questionnaire' (FSQ; Szymanski & O'Donohue, 1995). In addition, all spider-fearful participants fulfilled criterion A to D of the DSM-IV criteria (American Psychiatric Association, 1994) for specific phobia, and some of them also fulfilled criterion E (i.e., spider phobia interferes significantly with person's daily routine, occupational functioning, or social life, or the person is markedly distressed about having the phobia). All participants received course credit or were paid a modest fee for their participation in the study.

Single Target Implicit Association Test (STIAT; Wigboldus et al., 2004)

Fear-related words and pleasant words served as attributes during the STIAT. We used fear-related words rather than general negative words as we were particularly interested in fear-specific associations. The attribute words consisted of 10 clearly anxiety-related words (e.g., panic, shock, fear) and 10 pleasant words (e.g., happy, exaltation, pleasure). These 20 German words had been shown to be unambiguously classifiable ('pleasant' vs. 'fear-related') in pre-tests and previous experiments (Ellwart et al., 2006). In German, the two word types did not differ with regard to word frequency or word length. Ten pictures of spiders were used as target stimuli, also taken from Ellwart et al (2006). They were standardized to a16 bit color/5x4 cm format.

As proposed by Wigboldus et al. (2004), the STIAT consisted of a complete sequence of five blocks: (a) attribute discrimination, (b) target categorization practice, (c) first combined block, (d) reversed target categorization practice, and (e) reversed combined block. Each block started with instructions describing the discrimination category and the assignment of the response keys (left vs. right). The procedure started with (a) the attribute discrimination block, in which participants had to categorize single words according to their emotional valence (fear-related vs. pleasant words). Participants were asked to press one key (the letter 'Y', located in the lower left corner of the German keyboard) in response to fear-related words, and the other key (the '-' key located in the lower right corner) in response to pleasant words. The stimuli in this block consisted of the 10 fear-related attribute words and the 10 pleasant attribute words which were presented one after another in a fixed random order. In the second block (b), pictures were introduced to practice responses to targets. Half of the participants were told to press the left key ('Y' key) in response to all pictures, and the other half was told to press the right key ('-' key) in response to all pictures. In this practice block, 5 pictures consisting of unidentifiable colored fragments of spiders were presented. It is important to note that participants were not told to categorize targets according to their contents (spider), but simply to decide whether something was presented.

The following first combined block (c) was a combination of target and attribute discrimination in which target pictures and attribute words appeared in a mixed random order. Figure 1 shows a sample trial from this block: A spider picture is shown in the center of the screen, and the correct response is to press the left key. The labels at the top of the screen indicate that the same response is correct for fear-related words, whereas pleasant words require pressing the right key. In this block, 160 items were presented: Each of the 10 pictures appeared 4 times, the 10 words which required the same response were also shown 4 times each, and the 10 words which required the opposite response were presented 8 times each. Because pictures are assigned to only

one key during combined blocks, there are fewer responses on the opposite key. To balance this mismatch of responses by the left and right key, attributes assigned to the opposite side of the pictures were presented twice as often, resulting in an equal number of left and right responses in each of the combined blocks.
During the following reversed target discrimination block (d), participants were introduced to a reversal of the response assignment for pictures. Participants who had pressed the fear-related key in response to spiders now had to respond with the pleasant key, the other half of the participants vice versa. This block consisted of 10 fragment pictures. The final reversed combined block (e) combined the unchanged attribute discrimination with the reversed target discrimination. This is illustrated in the second part of Figure 1: Again, a spider picture was shown in the center of the screen, and now the correct response was to press the right key. The same was true for pleasant words, whereas fear-related words required pressing the left key. Analogous to the first combined block (c), 160 items were presented.

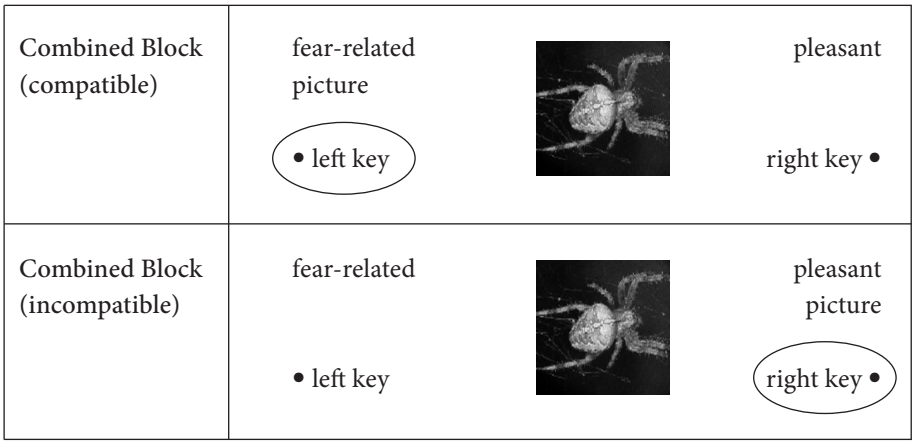


Figure 1. Depiction of sample trials in the combined blocks (compatible and incompatible) of the STIAT.

To control for the sequence of the combined blocks, half of the participants started with the compatible block followed by the incompatible block, and the other half vice versa. Each of the presented stimuli remained on the computer screen until participants pressed one of the two possible response keys. All stimuli (black lettered words and colored pictures) were presented vertically and horizontally centered against a light grey background. During each trial, reminder labels (appropriate category names positioned in the top left and top right corner of the screen) remained visible. Within

each block, stimuli appeared in the same fixed random order for each participant. Each stimulus was preceded by a fixation cross presented for 500 ms and was shown until a response was made. After incorrect responses, a black 'X' appeared in the center of the screen for one second. The experiment was programmed in RSVP (Williams & Tarr, no date) and implemented on a Macintosh Performa 5100. In total, it took participants about 15 minutes to complete the STIAT.

Behavioral Assessment Test (BAT)

After the STIAT, all participants were asked to take a Behavioral Assessment Test (BAT) in which they had to approach a living spider. The test consisted of 4 phases, and the average heart rate during each phase was measured using a mobile pulse meter, operated by a trained experimenter. During the first baseline phase, heart rate was assessed while participants where standing in the laboratory completing an unrelated questionnaire for about 3 minutes. During the following anticipation phase, they where informed that they had to go into the neighboring room where a spider was located. During this phase, participants were standing as well. Before actually approaching the spider, they where asked to look at a picture of the spider, anticipating the upcoming confrontation. During the following confrontation phase, they were asked to actually open the door of the neighboring room and approach the spider as quickly and closely as possible. The spider was a 7 cm long tarantula positioned about 5 meters away from the door in a closed terrarium. When participants indicated that they wanted to stop the approach, the remaining distance between the participant and the spider as well as the duration of the approach attempt was registered. Because participants could avoid the spider either by approaching it slowly (affecting time) or by stopping far away from the spider (affecting distance), approach speed was calculated, taking both time and distance into account. To this end, we divided the distance covered during approach by time. Then, the final cool down phase followed. Participants were asked to leave the room and were invited to take a rest in the laboratory for 3 minutes.

Procedure

Participants were tested individually. The study started with the diagnostic interview (Mini-DIPS) to select participants, followed by the FAS. Afterwards, all participants completed the STIAT. The session closed with the BAT, after which participants were thanked and debriefed.

RESULTS

Fear Questionnaire

As expected, spider-fearful individuals and non-fearful controls differed greatly in their FAS scores (spider-fearful individuals: $M = 71.9$, $SD = 11.7$; controls: $M = 2.7$, $SD = 3.5$; $t(56) = 30.61$, $p < .001$). Please note that this difference is inflated because participants were selected according to their SAS questionnaire scores, which have been found to correlate as highly as $r = .90$ with FAS scores (Rinck et al., 2002).

Single Target Implicit Association Test (STIAT)

Only data of the two combined blocks were used and only RTs of correct responses were analyzed. Reaction times below 300 ms or above 3000 ms were recoded to 300 ms and 3000 ms, respectively. Regarding the incompatible block, 2.2% of the data was below 300 ms and one RT was above 3000 ms. Regarding the compatible block, 4% of the data was below 300 ms, and none above 3000 ms. We used log-transformed latencies in our analyzes. From them, we calculated mean RTs for spider pictures in the compatible block (spiders requiring the same response as fear-related words) and in the incompatible block (spiders requiring the same response as pleasant words) for each participant. Non-transformed means and their standard deviations are presented in the left part of Table 1.

The STIAT RTs were analyzed with a 2 x 2 x 2 ANOVA including the between-subjects factors Group (spider-fearful vs. non-fearful) and Block Sequence (compatible block before incompatible vs. vice versa), and the within-subjects factor STIAT Block (compatible vs. incompatible block). There was a significant main effect of Block, showing that the incompatible block yielded longer RTs than the compatible one, $F(1,54) = 9.67$, $p < .01$, $\eta^2 = .15$. Moreover, the interaction of Block and Group, $F(1,54) = 8.65$, $p < .01$, $\eta^2 = .14$, indicated that the difference between blocks was larger for spider-fearful individuals than non-fearful controls (80 ms vs. 8 ms). Neither the main effect of Block sequence nor any interaction with this factor approached significance, all $F(1,54) < 1$, indicating that the order of the combined blocks had no influence on performance.

A STIAT score was calculated for each participant as the average latency for spider pictures in the compatible block minus the average latency in the incompatible block. Thus, negative STIAT scores signal negative associations towards spiders and positive

scores signal positive associations, respectively. These STIAT scores are reported in the lower left part of Table 1. STIAT scores significantly differed between spider-fearful individuals and non-fearful controls, as shown by the interaction mentioned above. Moreover, the spider-fearful individuals' STIAT score of -80 ms differed significantly from zero ($t(28) = 3.36$, $p < .01$), while the controls' score of -8 ms did not ($t(28) = .57$, $p = .57$).

Table 1. Mean RTs (in ms) for compatible and incompatible blocks and STIAT effects.

	Experiment 1					Experiment 2				
	Spider fearfuls		Non-fearful controls			Spider enthusiasts		Non-fearful controls		
Block and effect	*M*	*SD*	*M*	*SD*	*d*	*M*	*SD*	*M*	*SD*	*d*
Compatible	502	56	585	79		581	108	595	85	
Incompatible	582	121	593	100		566	99	629	115	
STIAT effect	-80	128	-8	70	.80	15	62	-34	59	.88

BAT: Approach speed and heart rate

As expected, the two groups' speed when approaching the spider differed significantly. Compared to non-fearful controls, spider-fearful individuals avoided the spider by approaching it more slowly (spider-fearful individuals: $M = 46.8$ cm/sec, $SD = 21.4$; non-fearful controls: $M = 82.5$ cm/sec, $SD = 14.4$; $t(56) = 7.46$, $p < .001$). Because heart rate measures are prone to measurement errors when taken during walking, we only included heart rate data measured during baseline and anticipation in the analysis. For practical reasons, however, participants kept wearing the mobile pulse meter throughout the BAT. We computed a difference score between heart rate during anticipation and baseline (anticipation minus baseline), reflecting the heart rate change caused by anticipating the confrontation. Due to technical problems, the data of 3 participants were missing, so the following analyses are based on 54 participants. Heart rates of spider-fearful individuals increased by an average of 4.6 beats ($SD = 5.0$), and those of non-fearful controls increased by 5.3 beats ($SD = 4.2$). Both increases were significantly larger than zero (spider-fearful individuals: $t(27) = 4.4$, $p < .001$; non-fearful controls: $t(26) = 6.49$, $p < .001$), but the two groups did not differ from each other in the size of the increase ($t(53) < 1$).

Relations between FAS, STIAT and behavior

Table 2 displays relations between FAS, STIAT scores, and behavioral fear measures. We found significant correlations of the STIAT scores with self report (FAS), with controlled behavior (approach speed), and with automatic behavior (heart rate increase from baseline to anticipation). The directions of the correlations are fully in line with our predictions: Having more negative automatic spider associations in the STIAT was associated with more self-reported fear of spiders on the FAS, with slower approach of spiders, and with a larger heart rate increase during anticipation. Interestingly, the latter did not correlate with self-reported anxiety.

Table 2. Correlations between STIAT scores, FAS, BAT speed and heart rate change in Experiment 1.

	FAS	BAT speed	Heart rate change
STIAT Score	-.41**	.45***	-.30*
FAS	-	-.72***	-.10
BAT speed		-	.00

Note: All correlations were calculated with log-transformed STIAT scores.
*p < .05; **p < .01; ***p < .001

To test whether STIAT scores can explain additional variance in automatic behavior (heart rate change) and controlled behavior (BAT approach speed) beyond that explained by questionnaires, we calculated separate hierarchical regressions for the two behavioral measures (Tabachnick & Fidell, 2006). In both analyses, we first included only FAS as predictor, and added STIAT scores and FAS x STIAT interaction scores in the second step. All predictors were centered before inclusion.

For approach speed, the model containing only the FAS explained 52% of the variance, $F(1,56) = 61.43$, $p < .01$. Adding the STIAT and FAS x STIAT interaction significantly improved the explained variance to 58%, $p < .05$, with regression coefficients of -0.49 ($p < .01$), 6.0 ($p = .75$), and 0.90 ($p = .05$) for the FAS, STIAT, and interaction term, respectively, $F(3,54) = 24.94$, $p < .01$. Importantly, the significant interaction means that the predictive value of the STIAT in the model depended on the actual FAS score. Consequently, we tested the simple slopes of the STIAT for different FAS levels (Aiken & West, 1991), namely FAS scores one SD above (73.4) and one SD below (1.6) the average. This showed that the STIAT predicted approach speed beyond FAS when FAS scores were high, $b = 6.33$, $p < .02$, but not when FAS scores were low, $b = -4.34$, $p = .41$. Participants approached the spider particularly slowly when they showed

both high self-reported fear of spiders on the FAS and stronger negative associations with spiders in the STIAT.

For heart rate change, the FAS-only model explained merely 1% of variance and was non-significant, $F(1,53) = .55$, $p = .46$. Adding the STIAT and the interaction term led to a significant increase in explained variance by 15%, $p < .01$, and an overall significant model, $F(3,51) = 3.03$, $p < .04$. However, different from controlled behavior, heart rate change as an indicator of automatic behavior was significantly predicted only by the STIAT, $b = -11.91$, $p < .03$. There was no significant FAS x STIAT interaction, $b = 0.02$, $p = .86$, and only a marginal effect of the FAS, $b = -0.03$, $p < .07$. This is most noteworthy because variance in FAS scores, but not in STIAT scores, was artificially inflated by pre-selecting participants.

DISCUSSION

The results of Study 1 show that the novel STIAT version is able to assess automatic fear associations towards spiders. It successfully detected group differences between spider-fearful individuals and non-fearful controls, as only spider-fearful individuals showed longer RTs on the incompatible block than the compatible one. As expected, spider-fearful individuals scored significantly higher than non-fearful controls on the FAS, and STIAT and FAS scores correlated significantly. Investigating their role as possible predictors of relevant behavior, i.e., controlled avoidance behavior (speed in approaching a spider) and automatic, physiological arousal (heart rate increase during anticipation of the approach test), the results demonstrated that both measures have differential predictive power: STIAT scores were the better predictor of anticipatory heart rate increase, whereas FAS scores were the best predictor of approach speed. The finding that our novel STIAT version has predictive power for automatic fear responses further corroborates its application. Moreover, this result is in line with results reported by Huijding and de Jong (2005, 2006), who found that another indirect measure, the EAST, best predicted automatic fear responses. Thus, our results support the assertion that indirect measures maybe particularly useful for predicting automatic aspects of behavior (see also Asendorpf et al., 2002), as these tasks leave little room for deliberative reflection about a response and directly tap into involuntary aspects of behavior.

STUDY 2

Study 2 was conducted to provide further evidence for the usefulness of our novel STIAT version. Second, we aimed to investigate if spiders are generally evaluated in a negative way. Therefore, we compared spider enthusiasts to non-fearful controls, assuming that they should differ in their STIAT performance. We expected that spider enthusiasts will show faster RTs than non-fearful controls on incompatible blocks (when spiders require the same response as pleasant words), reflecting positive automatic associations towards spiders (see Footnote 2). The reason for this hypothesis is the fact that spider enthusiasts keep spiders as domestic animals, implying that they might have positive associations towards spiders rather than negative ones. Empirical evidence for this hypothesis comes from findings by Ellwart et al. (2006), who demonstrated differences in a standard IAT between spider enthusiasts and non-fearful controls.

METHOD

Participants

Spider enthusiasts and non-fearful controls participated in this study. Both groups were recruited through newspaper and internet advertisements. All of them were screened by means of the SAS to assess fear and avoidance of spiders as well as possible distress. Those who scored < 4 were invited to take part in the study. For spider enthusiasts, an extra criterion was applied: They should keep at least one spider as a domestic animal. As an additional measure of fear of spiders, the FAS was administered to all participants. They were also screened for mental disorders (e.g., depression or anxiety disorders) and for alcohol or drug consumption during the last 24 hours. After this screening procedure, a final sample of 14 spider enthusiastic individuals and 14 non-fearful controls remained. The spider enthusiastic sample included 4 women and 10 men with a mean age of 31.0 (SD = 11.8), the control sample included 5 women and 9 men with a mean age of 30.9 (SD = 10.6).

Materials and Procedure

The procedure of Study 2 differed slightly from Study 1, because we did not include any behavioral measures. However, with regard to the materials and procedure of the remaining tasks, Study 2 mirrored Study 1.

RESULTS

Fear Questionnaire

As expected, spider enthusiasts and non-fearful controls did not differ from each other on the FAS (spider enthusiasts: $M = 5.4$, $SD = 4.3$; non-fearful controls: $M = 3.9$, $SD = 4.3$; $t(26) = .92$, $p = .37$).

Single Target Implicit Association Test (STIAT)

Response latencies, error rates and STIAT effects were computed and analyzed as before. The means and standard deviations of these RTs are presented in the right part of Table 1.

A 2 x 2 x 2 ANOVA was used to analyze the STIAT RTs, including the between-subjects factors Group (spider enthusiast vs. non-fearful) and Block Sequence (compatible block before incompatible vs. vice versa), and the within-subjects factor STIAT Block (compatible vs. incompatible block). Results revealed a significant interaction of Block and Group, $F(1,24) = 4.62$, $p < .05$, $\eta^2 = .16$, implying that the difference between blocks was more positive for spider enthusiasts than for non-fearful controls. There was no effect of Block Sequence, $F(1,24) < 1$. The spider enthusiast's STIAT score was slightly positive (15 ms), but did not differ significantly from zero, $t(13) = .92$, $p = .37$. The non-fearfuls' STIAT score was significantly negative (-34 ms), $t(13) = 2.2$, $p = .05$. These STIAT scores are reported in the lower right part of Table 1.

DISCUSSION

The results of Study 2 support the application of this novel STIAT version to assess group differences in automatic associations towards spiders. We found significant differences between spider enthusiasts and non-fearful controls, implying that the two groups differed in their performance between the two STIAT blocks. These results suggest that this STIAT was sensitive to individual rather than extrapersonal associations. When examining the two groups more closely, we found that the STIAT scores of non-fearful controls differed significantly from zero, indicating negative automatic association towards spiders. STIAT scores of spider enthusiasts were slightly positive, but did not differ significantly from zero. An adequate explanation for this finding might be a lack of statistical power, as both samples contained only 14 participants

each. This seems plausible, as we did find a significant interaction between group and block. Regarding the direct measure of fear of spiders, the two groups did not differ on their FAS scores. As we compared spider enthusiasts to non-fearful controls, this is a finding we expected.

GENERAL DISCUSSION

The present study was designed to advance our understanding of automatic spider associations. It involved testing spider-fearful individuals, non-fearful controls, and spider enthusiasts. In order to investigate automatic, spider-related associations, we used a Single Target Implicit Association Test (STIAT; Wigboldus et al., 2004). Unlike previous STIATs, however, we made picture contents task-irrelevant instead of letting participants react to the dimension of interest (i.e., spider). Two aims were central in the current study: First, we wanted to test if this novel STIAT version would be sensitive to differences in individual, automatic spider-related associations. Second, we wanted to investigate if the novel STIAT version had specific power in predicting controlled and automatic aspects of fear-related behavior.

With regard to the first research aim, the results of Study 1 and 2 provide empirical support for the useful application of the current STIAT version, as it successfully detected differences in spider associations between spider-fearful individuals and non-fearful controls (Study 1) and between spider enthusiasts and non-fearful controls (Study 2), respectively. Comparing these findings with previous studies that used target-attribute categorization tasks to assess automatic associations towards spiders (e.g., the IAT), our findings mirror previous results (Ellwart et al., 2006; Huijding & de Jong, 2007; Teachman et al., 2001; Teachman & Woody, 2003). However, the interpretation of our findings is more straightforward. First, the STIAT measures the strengths of (valenced) associations with a single target category, implying that less relative conclusions can be drawn than from an IAT. This advantage is inherent to an EAST as well, however, the STIAT seems to have better psychometric properties than the EAST (Bluemke & Friese, 2008). Thus, although the relativity problem remains when making use of a STIAT due to the fact that two attribute dimensions are used, the extent to which spiders are associated with fearful versus pleasant words can be measured, independently of the associations of another target category. Theoretically, this comes quite close to the procedure underlying the Brief Implicit Association Test (Brief IAT) that has been introduced recently by Sriram and Greenwald (2009). Like the IAT, the Brief IAT comprises two blocks with four categories and the corresponding stimulus-response mappings. However, the Brief IAT has substantially fewer trials.

Moreover, participants are instructed to focus on only two of the category-response mappings instead of four. Thus, it tries to manage the participants' strategy by manipulating their "associative focus that allows the subjects' performance to be determined primarily by a single association" (Sriram & Greenwald, p. 293). As such, the Brief IAT resembles the STIAT at a theoretical level (i.e., measuring single associations) and might also be an interesting paradigm in this context. A second advantage of applying a STIAT when aiming to measure automatic spider associations is the fact that it is independent of whether the particular target category has a natural opposite or not.

The second research aim was to investigate if the STIAT version used here has specific predictive value regarding automatic, fear-related behavior. In a recent review, Friese, Hofmann, and Schmitt (2009) concluded that indirect measures are particularly successful when it comes to the prediction of behavior that is associated with automatic processes (for similar conclusions, see Asendorpf et al., 2002; Egloff & Schmuckle, 2002; Gschwender, Hofmann, & Schmitt, 2008; Olson & Fazio, 2003). This notion is supported by our findings. We found the STIAT to be a better predictor of heart rate increase during the BAT than the used self-report measure (i.e., the FAS), providing additional evidence that indirect measures may be especially useful in predicting (fear-related) behavior. These findings are also in line with earlier results by Huijding and de Jong (2005, 2006) and Ellwart et al. (2006), who reported that indirect measures predicted automatic, fear-related behavior best. Hence, this strengthens the view that what is measured by automatic association measures like the STIAT in fact corresponds to those initial associations that are supposed to underlie automatic fear reactions.

Our results also provide further insight regarding the question what the associations measured by indirect tasks do reflect. Here, we observed reliable group differences between spider fearful individuals, non-fearful individuals, and spider enthusiasts. This is neither compatible with an interpretation of automatic association as cultural stereotypes (Karpinski & Hilton, 2001), nor with the *preparedness principle* (Cook & Mineka, 1990; Mineka & Öhmann, 2002; Öhman & Mineka, 2003; Seligman, 1971), according to which every human being has automatic, negative associations towards spiders. Hence, our results further support Greenwald and colleagues' assumption that (ST)IAT effects reflect automatic expressions of individual associations.

To summarize, our novel STIAT version revealed an interesting set of results which are in line with earlier findings, but also lead to new empirical questions. To illustrate, one question could be which specific (ST)IAT element activates the spider anxiety schemata. The core idea of such categorization tasks is that pairings of targets and attributes that are strongly associated are categorized faster because they refer to concepts that are strongly accessible within the same schema. Hence, spider-fearful individuals are faster during compatible blocks (e.g., spider pictures combined with

fear-related words) than during incompatible ones (e.g., spider pictures combined with pleasant words). However, apparently this is not unconditional: While Teachman and Woody (2003) found differences between high and low spider-fearful individuals in a picture-word IAT, the word IAT of de Jong et al. (2003) yielded no group differences. A possible explanation for these contradictive findings is that pictures may be more powerful than words (see also Ellwart et al., 2005). This seems even more plausible in light of our results. They revealed the expected RT patterns in performance, even though the task instructions made it unnecessary to activate the fear schema. Taken together, it seems that not only the stimulus material itself is important, but also its combination with the task instructions.

The outcome of our second research question (i.e., the predictive value of the STIAT) highlights another topic that needs further research. Our results and those of others clearly demonstrate that indirect measures are very useful when it comes to the prediction of specific (fear-related) behavior. This is particularly relevant in a clinical context. For instance, indirect measures may be helpful when trying to predict treatment success and its maintenance after treatment. Moreover, indirect measures may offer insights into the mechanisms of change during treatment. As of yet, few studies have been conducted to address this topic, and there is a continued need to investigate this issue more thoroughly (for a recent overview, see Roefs et al., 2011).

Although the current study provides promising findings, at least two limitations should be addressed. First, we did not include a neutral baseline condition (e.g., showing neutral pictures) or a comparison condition (e.g., showing normative positive and negative pictures) in the STIAT. Therefore, the variance in individual scores might not only represent differences in reactions to pictures of spiders but also differences of general positive-negative response asynchronies. Possibly, spider-fearful participants react more quickly to negative stimuli in general. To control for such effects and in order to improve interpretability, future studies should include these two additional conditions, and should also include other spider-specific associations such as disgust. Second, it cannot be ruled out that participants recoded our instructions in the STIAT. Instead of categorizing the targets as pictures they might have categorized them as spiders. In the current task version, this was neither necessary nor helpful, but certainly possible. As a consequence, the target contents would not have been task-irrelevant anymore, implying that the current task actually generated less automatic effects. To control for this, future research should use different types of pictures. A follow-up study that would also include pictures comprising a strong positive association would make recoding of the pictures impossible.

Despite these limitations, we believe that the present results clearly extend our current knowledge of the role of automatic processes in spider phobia. First, the current

STIAT version was capable of detecting specific group differences. According to its methodological and psychometric properties, it seems to be a better alternative to earlier tests like the IAT or EAST, respectively. Second, the STIAT was predictive of automatic, fear-related behavior, further emphasizing the predictive validity of indirect measures. Hence, we hope that our findings may be valuable and inspiring for further research.

REFERENCES

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.

American Psychiatric Association (1994). *Diagnostic and statistical manual of mental disorders*. Washington, DC: APA.

Asendorpf, J. B., Banse, R., & Mücke, D. (2002). Double dissociation between implicit and explicit personality self-concept: The case of shy behavior. *Journal of Personality and Social Psychology*, *83*, 380-393.

Barlow, D. H. (1988). *Anxiety and its disorder. The nature and treatment of anxiety and panic*. New York: Erlbaum.

Beck, A. T., Emery, G., & Greenberg, R. L. (1985). *Anxiety disorders and phobias*. New York: Basic Books.

Bluemke, M., & Friese, M. (2008). Reliability and validity of the Single-Target IAT (ST-IAT): Assessing automatic affect towards multiple attitude objects. *European Journal of Social Psychology*, *38*, 977-997.

Cook, M., & Mineka, S. (1990). Selective association in the observational conditioning of fear in rhesus monkeys. *Journal of Personality and Social Psychology*, *81*, 800-814.

De Houwer, J. (2003a). A structural analysis of indirect measures of attitudes. In J. Musch, & K. C. Klauer (Eds.), *The psychology of evaluation* (pp. 219-244). Mahwah, NJ: Erlbaum.

De Houwer, J. (2003b). The Extrinsic Affective Simon Task. *Experimental Psychology*, *50*, 77-85.

De Houwer, J. (2006). *What are implicit measures and why are we using them*. In R. W. Wiers & A. W. Stacy (Eds.), Handbook of implicit cognition and addiction (pp. 11–28). Thousand Oaks, CA: Sage.

De Houwer, J., & De Bruycker, E. (2007). The Identification-EAST as a valid measure of implicit attitudes toward alcohol-related stimuli. *Journal of Behavior Therapy and Experimental Psychiatry*, *38*, 133-143.

De Houwer, J., Teige-Mocigemba, S., Spruyt, A., & Moors, A. (2009). Implicit measures: A normative analysis and review. *Psychological Bulletin*, *135*, 347-368.

de Jong, P. J., van den Hout, M. A., Rietbroek, H., & Huijding, J. (2003). Dissociations between implicit and explicit attitudes toward phobic stimuli. *Cognition and Emotion*, *17*, 521-545.

DiNardo, P. A., Brown, T. A., & Barlow, D. H. (1994). *Anxiety disorders interview schedule for DSM-IV: Lifetime Version (ADIS-IV-L)*. Albany, NY: Graywind Publications.

Egloff, B., & Schmuckle, S. C. (2002). Predictive validity of an implicit association test for assessing anxiety. *Journal of Personality and Social Psychology*, *83*, 1441-1455.

Ellwart, T., Becker, E. S., & Rinck, M. (2005). Activation and measurement of threat associations in fear of spiders: An application of the Extrinsic Affective Simon Task. *Journal of Behavior Therapy and Experimental Psychiatry*, *36*, 281-299.

Ellwart, T., Rinck, M., & Becker, E. S. (2006). From fear to love: Individual differences in implicit spider associations. *Emotion*, *6*, 18-27.

Eysenck, M. W. (1992). *Anxiety: The cognitive perspective*. Mahwah, NJ: Erlbaum.

Fazio, R. H., & Olson, M. A. (2003). Implicit measures in social cognition research: Their meaning and use. *Annual Review of Psychology*, *54*, 297-327.

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to correcting information. *Psychological Bulletin*, *99*, 20-35.

Friese, M., Hofmann, W., & Schmitt, M. (2009). When and why do implicit measures predict behaviour? Empirical evidence for the moderating role of opportunity, motivation, and process reliance. *European Review of Social Psychology*, *19*, 285–338.

Gschwendner, T., Hofmann, W., & Schmitt, M. (2008). Convergent and predictive validity of implicit and explicit anxiety measures as a function of specificity similarity and content similarity. *European Journal of Psychological Assessment*, *24*, 254–262.

Greenwald, A. G., Banaji, M. R., Rudman, L. A., Farnham, S. D., Nosek, B. A., & Mellott, D. S. (2002). A unified theory of implicit attitudes, stereotypes, self-esteem, and self-concept. *Psychological Review*, *109*, 3-25.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, *74*, 1464-1480.

Huijding, J., & de Jong, P. J. (2005). A pictorial version of the Extrinsic Affective Simon Task sensitivity to generally affective and phobia-relevant stimuli in high and low spider fearful individuals. *Experimental Psychology*, *52*, 289-295.

Huijding, J., & de Jong, P. J. (2006). Specific predictive power of automatic spider-related affective associations for controllable and uncontrollable fear responses toward spiders. *Behaviour Research and Therapy*, *44*, 161-176.

Huijding. J., & de Jong, P. J. (2007). Beyond fear and disgust: The role of (automatic) contamination-related associations in spider phobia. *Journal of Behavior Therapy and Experimental Psychology*, *38*, 200-211.

Karpinksi, A., & Hilton, J. L. (2001). Attitudes and the Implicit Association Test. *Journal of Personality and Social Psychology*, *81*, 774-778.

Karpinski, A., & Steinman, R. B. (2006). The Single Category Implicit Association Test as a measure of implicit social cognition. *Journal of Personality and Social Psychology*, *91*, 16-32.

Mathews, A., & MacLeod, C. (2005). Cognitive vulnerabilities to emotional disorders. *Annual Review of Clinical Psychology*, *1*, 167-195.

Margraf, J. (1994). *Diagnostic interview for mental disorders: Short version handbook* [Mini-Dips: Diagnostisches Kurzinterview bei psychischen Störungen]. Berlin: Springer.

Moors, A., & De Houwer, J. (2006). Automaticity: A conceptual and theoretical analysis. *Psychological Bulletin*, *132*, 297-326.

Mineka, S., & Öhmann, A. (2002). Born to fear: Non-associative vs associative factors in the etiology of phobias. *Behaviour Research and Therapy*, *40*, 173-184.

Öhmann, A., & Mineka, S. (2003). The malicious serpent: Snakes as a prototypical stimulus for an evolved module of fear. *Current Directions in Psychological Sciences*, *12*, 5-9.

Olson, M. A., & Fazio, R. H. (2004). Relations between implicit measures of prejudice: What are we measuring? *Psychological Science*, *14*, 636-639.

Reinecke, A., Becker, E. S., & Rinck, M. (2010). Three indirect tasks assessing implicit threat associations and behavioral response tendencies test-retest reliability and validity. *Zeitschrift für Psychologie/Journal of Psychology*, *218*, 4-11.

Rinck, M., Bundschuh, S., Engler, S., Müller, A., Wissmann, J., Ellwart, T., & Becker, E. S. (2002). Reliability and validity of German versions of three instruments measuring fear of spiders. *Diagnostica*, *48*, 141-149.

Roefs, A., Huijding, J., Smulders, F. T. Y., MacLeod, C. M., de Jong, P.J., Wiers, R.W., & Jansen, A. (2011). The use of indirect measures in psychopathology research: A review. *Psychological Bulletin*, *137*, 149-193

Rothermund, K., & Wentura, D. (2004). Underlying processes in the Implicit Association Test (IAT): Dissociating salience from associations. *Journal of Experimental Psychology: General*, *133*, 139-165.

Seligman, M. E. P. (1971). Phobias and preparedness. *Behaviour Therapy*, *2*, 307-320.

Sriram, N., & Greenwald, A. G. (2009). The brief implicit association test. *Experimental Psychology*, *56*, 283-294.

Spalding, L. R., & Hardin, C. D. (1999). Unconscious unease and self-handicapping: Behavioral consequences of individual differences in implicit and explicit self-esteem. *Psychological Science*, *10*, 535-539.

Szymanski, J., & O'Donohue, W. (1995). Fear of Spiders Questionnaire. *Journal of Behavior Therapy and Experimental Psychiatry*, *26*, 31-34.

Tabachnick, B. G., & Fidell, L. S. (2006). *Using multivariate statistics*. New York: Harper Collins.

Teachman, B. A., Gregg, A. P., & Woody, S. R. (2001). Implicit associations for fear-relevant stimuli among individuals with snake and spider fears. *Journal of Abnormal Psychology*, *110*, 226-235.

Teachman, B. A., & Woody, S. R. (2003). Automatic processing in spider phobia: implicit fear associations over the course of treatment. *Journal of Abnormal Psychology, 112*, 100-109.

Wigboldus, D. H. J., Holland, R. W., & van Knippenberg, A. (2004). *Single target implicit associations*. Unpublished manuscript.

Williams, P., & Tarr, M. J. (No date). *RSVP: Experimental control software for MacOS* [Online]. Available: http://www.tarrlab.org/rsvp/ [1998, March 25].

4

‘Getting into the spirit’: Alcohol-related interpretation bias in heavy drinking students

ABSTRACT

Alcohol misuse is characterized by patterns of selective information processing. The present study investigated whether heavy-, compared to light-drinking students, show evidence of an alcohol-related interpretation bias to ambiguous, alcohol-related cues. Towards this aim, participants were asked to create continuations for ambiguous, open-ended scenarios that provided either an alcohol-related or neutral context. Results showed that heavy-drinking students generated more alcohol continuations for ambiguous alcohol-related scenarios than light-drinking students. This result was independent of the coding method employed, with an interpretation bias found when continuations were coded by either participants themselves or by two independent raters.

This chapter is based on:
Woud, M. L., Fitzgerald, D. A., Wiers, R. W., Rinck, M., & Becker, E. S. (2012). ‘Getting into the spirit’: Alcohol-related interpretation bias in heavy drinking students. *Psychology of Addictive Behaviors*, *26*, 627–632.

INTRODUCTION

Research on implicit, cognitive processes related to alcohol misuse and abuse has repeatedly demonstrated patterns of selective information processing (e.g., Wiers et al., 2007). These processes can be divided roughly into three categories: attentional processes, automatically activated approach tendencies, and alcohol-related implicit memory associations (Stacy & Wiers, 2010). Implicit memory associations are typically assessed by means of two sorts of tasks: reaction time paradigms and open-ended memory association tasks. The Implicit Association Test (IAT, Greenwald, McGhee, & Schwartz, 1998) is a prominent example of a reaction time task (for an overview, see Houben, Nosek, & Wiers, 2010). Various measures have been developed to probe open-ended memory associations (e.g., Ames, Franken, & Coronges, 2006). The present study aims to advance our understanding of cognitive processes similar to those captured by memory association tasks, thus we describe them in more detail.

According to Stacy and colleagues (e.g., Ames & Stacy, 1998; Stacy, Ames, & Grenard, 2006; Stacy, 1995, 1997), open-ended memory association tasks can be used as a measure of implicit memory associations without directly mentioning the targeted behavior (Stacy et al., 2006).[1] Participants are asked to give their first, mostly time-limited, association to a variety of ambiguous cues that are either alcohol-related or unrelated. Single ambiguous word cues (e.g., 'draft') as well as simple ambiguous situations (e.g. 'Friday night') or ambiguous phrases containing affective components (e.g., 'feeling good') have been used. Cues have also been combined (e.g., 'Friday night-feeling good'). Generally, the number of alcohol-related memory associations generated in response to ambiguous cues is positively related to actual alcohol use. Most noteworthy, this relationship is independent of potential correlates with these variables (e.g., friends' alcohol use). Additionally, it has been shown that word association tasks are better predictors of future alcohol use after controlling for previous use, relative to other more explicit measures (e.g., Stacy, 1997, Kelly, Masterman, & Marlatt, 2005; Thush et al., 2007). Regarding the underlying mechanism of these tasks, it is thought that ambiguous alcohol-related cues implicitly activate alcohol-related memory schemata that are established and strengthened during repeated alcohol use. Closely related associations become more accessible which then "easily bias one's train of thought, interpretations, and decisions" (Stacy, 1997, p. 70). Word association tasks are the most widely used approach in basic memory research (Stacy et al., 2006). The aim of the present study was to more firmly establish biased interpretational

[1] Please note that the term 'implicit' in this context refers to conceptualizations such as 'spontaneous' and 'automatic' rather than 'unconscious' (see e.g., Moors & De Houwer, 2006)

processes. Unlike previous studies we compared two extreme groups: heavy-drinking versus light-drinking students. We only included male students as findings suggest that heavy and/or problematic alcohol use is more prominent among male university students (Ham & Hope, 2003). We applied a paradigm that has, to the best of our knowledge, not been used in alcohol research so far: Instead of making use of single cues or phrases, we used more complex cues, namely open ended, ambiguous scenarios. These scenarios were either alcohol-related or neutral in context. In order to tap into emotional, cognitive, and social themes that are associated with (excessive) alcohol consumption, the Inventory of Drinking Situation (IDS; Annis, 1982) questionnaire served as a basis for the contents of the alcohol-related scenarios. As such, the significance of this scenario-based approach is first that it comprises a high ecological validity. Second, it offers a better understanding of idiosyncratic dispositions in sensitivity to the activation of alcohol-related associations, as the scenarios themselves (i.e., the context) represent an important cue which does or does not activate an alcohol-related memory association (Krank & Wall, 2006).

In the present study, participants were asked to interpret open-ended scenarios and generate continuations based on their own interpretation of the ambiguous situation. Studies investigating the role of interpretation biases in anxiety disorders (Hertel, Brozovich, Joormann, & Gotlib, 2008) and eating pathology (Cooper, 1997) support the general validity of this method in psychopathology research. To illustrate, Hertel et al. (2008) used open ended, ambiguous scenarios to investigate interpretation biases in generalized social phobia. In line with cognitive models of social phobia, socially-phobic individuals generated less positive interpretations than non-anxious controls. Based on previous findings in the alcohol literature, we expected that heavy-drinking students, compared to light-drinking students, would exhibit an alcohol-related interpretation bias. Therefore, we predicted that heavy drinkers would produce more alcohol-related continuations for ambiguous, alcohol-related scenarios than light drinkers. The presence of an alcohol-related interpretation bias was tested by means of two different rating methods: Participants rated their own responses and two independent raters coded the continuations. The former approach was inspired by the work of Frigon and Krank (2009), suggesting that self-coding may be a beneficial tool in reducing ambiguity during coding due to the more accurate nature of this method. The validity of this approach is supported by their findings that self-coded scores were highly correlated with and predictive for future alcohol use, respectively. Finally, it is a very efficient approach as it less time consuming than external coding.

METHOD

Recruitment

The initial sample included 67 male students of the Radboud University who were recruited via flyers and posters. An initial screening questionnaire was sent out via e-mail (inclusion criteria: male, university student, age 18-28 years). Heavy-drinking students were selected to drink 20 or more standard alcoholic drinks per week (a standard drink contains approximately 15 ml of pure ethanol in the Netherlands), and to have had at least five or more standard glasses of alcohol at one sitting during the past 2 weeks (binge). Light-drinking students were required to drink 8 or less but at least 1 standard alcoholic drink per week without a binge in the past two weeks (for similar criteria, see Wiers, Rinck, Dictus, & van den Wildenberg, 2009). If inclusion criteria were met, participants were invited to take part in the study.

Measures and Materials

Time-Line-Follow-Back questionnaire (TLFB; Sobell & Sobell, 1992)
Alcohol use was measured with an adapted version of the TLFB questionnaire (Wiers, Hoogeveen, Sergeant, & Gunning, 1997). Participants were required to sum up for every day of the past week, how many and what kind of standard alcoholic drinks they had consumed, and how many drinks they would typically drink on an average day (assessed for all 7 days). In addition, they indicated the number of occasions on which they had drunk five or more standard glasses of alcohol during the previous 2 weeks.

Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, De la Fuente, & Grant, 1993)
The AUDIT is a self-report questionnaire that measures alcohol use, symptoms of alcohol dependence and alcohol-related problems. It comprises a multiple-choice answering format and consists of 10 questions (first three related to alcohol use, remaining seven with alcohol-related problems).

Rutger Alcohol Problem Index (RAPI; White & Labouvie, 1989)
The RAPI is a 23-item self-report instrument assessing problems and problematic situations involving alcohol for adolescents and young adults (e.g., not being able to study for an exam because of a hangover). Participants indicated on a 5-point Likert

scale how often they had experienced each problem (0 = *never* up to 4 = *more than 10 times*).

Scenarios

All scenarios were piloted to ensure that they allowed for different interpretations. Each scenario described a typical student life situation (e.g., at the university, being with friends, joining a party). Regarding the alcohol-related scenarios, the following risk factors of the IDS (Annis, 1982) served as themes for their specific contents: *urge and temptation*, *negative emotions*, *social pressure*, *pleasant times with others*, *conflict*, *physical discomfort*, and *pleasant emotions*. For example, the factor pleasant times with others was used to create the following scenario: "At the festival. You and your friends are attending a festival. You want to have a big night out. So you and your friends are quickly going to the …". Neutral scenarios included situations like this: "New class. You changed to another class at university. Everyone already knows each other, so you introduce yourself. Your new classmates will probably find you very …".[2] A booklet contained 14 ambiguous, alcohol-related scenarios (2 per risk factor), and 10 ambiguous, neutral scenarios. Each scenario started with a title and contained three lines. The final line ended abruptly and was followed by an empty line on which participants were instructed to write down a continuation. Each scenario was printed on a single page. In order to control for carry-over effects, six different booklets with a different scenario order were created. The order of booklets was counterbalanced across participants.

Self coding task

Participants were asked to code whether their continuation belonged to particular categories. There were four main categories (i.e., drugs, activity, emotion, people), and each main category had several subcategories. However, of interest was only the main category drugs, including the subcategories alcohol, nicotine, marihuana and not applicable

Procedure

Following informed consent, participants received a booklet containing the open-ended scenarios. They were asked to read each scenario carefully and to write down their first, spontaneous continuation. They were instructed not to continue to the next scenario until completing each continuation. After the last scenario, a funneled

[2] A full overview of all scenarios can be received on request via e-mail by contacting the first author.

debriefing followed in which participants were asked whether they recognized particular topics in the scenarios and whether they had an idea about the task's aim. Subsequently, the categorization task was administered in which participants had to go back to the first scenario of their booklet and code each continuation by means of the four categories. Then, the TLFB, AUDIT and RAPI were administered. Finally, participants were debriefed and thanked for their participation.

Independent rating of scenario continuations

Two trained research assistants blind to participant group coded the continuations in two different ways: 1. Conservative approach with only unambiguous alcohol-related continuations coded (e.g., contained a mention of beer, wine), 2. Liberal approach including more ambiguous, alcohol-related continuations that were suggestive of an alcohol-related interpretation (e.g., mentions going to a bar). The two raters first coded all scenarios individually, then discussed their interpretations and agreed on a consensus in case of a mismatch. Finally, a mean conservative and a mean liberal consensus score of alcohol-related continuations was obtained for each participant. Both inter-rater reliabilities were high: $r = .96$ ($p < .001$) for the conservative coding, and $r = .99$ ($p < .001$) for the liberal coding. Regarding the neutral scenarios, the independent raters did not report any alcohol-related continuations, implying that they had a 100% agreement.

RESULTS

Data cleaning and participant characteristics

Based on the TLFB, 16 participants were removed from further analysis as they did not meet inclusion criteria during testing: Three potential heavy and 13 potential light drinkers were excluded, leaving a final group of N = 25 heavy drinkers (M_{age} = 22.12, SD = 2.03) and N = 26 light drinkers (M_{age} = 21.62, SD = 2.12). The TLFB results of the remaining sample showed that heavy drinkers had a significantly higher weekly alcohol consumption than light drinkers, $t(49) = 13.36$, $p < .001$ (heavy drinkers: M = 33.9, SD = 11.44, range 21-61.25; light drinkers: M = 3.61, SD = 1.66, range 1-7.5). Furthermore, heavy drinkers reported a mean of 4.88 (SD = 1.2) binges during the previous weeks whereas light drinkers reported no binges. Finally, heavy-drinking students scored significantly higher than light-drinking students on both the AUDIT and the RAPI: AUDIT: $t(49) = 9.31$, $p < .001$ (heavy drinkers: M = 16.28, SD = 4.41, range 9-23; light drinkers: M = 6.42, SD = 3.05, range 1-13), RAPI: $t(49) = 5.64$, $p < .001$

(heavy drinkers: $M = 17.28$, $SD = 5.54$, range 7-28; light drinkers: $M = 7.46$, $SD = 6.81$, range 0-26).

Scenario task

In order to test whether both groups received an equal number of booklet versions we executed a chi-square test. The analysis revealed that this was the case: $\chi^2(5) = 4.88$, $p = .431$.

Self coding

For alcohol-related scenarios, heavy-drinking students more often classified their continuations as belonging to the subcategory alcohol than light-drinking students, $t(49) = 5.46$, $p < .001$, $d = 1.52$ (heavy drinkers: $M = .31$, $SD = .11$; light drinkers: $M = .15$, $SD = .1$). Regarding the outcome of the neutral scenarios, heavy-drinking students more often classified their continuations as belonging to the subcategory alcohol than light-drinking students, $t(49) = 3.57$, $p = .001$, $d = 1$ (heavy drinkers: $M = .23$, $SD = .13$; light drinkers: $M = .11$, $SD = .11$) (see Figure 1).

Independent ratings

As the independent raters did not report any alcohol-related continuations for neutral scenarios, the analyses were only conducted for the alcohol-related scenarios. The scores of the independent raters showed the same pattern as the participant self coding: The conservative consensus score revealed that heavy-drinking students generated more alcohol continuations for alcohol scenarios than light-drinking students, $t(49) = 5.03$, $p < .001$, $d = 1.44$ (heavy drinkers: $M = .34$, $SD = .13$; light drinkers: $M = .16$, $SD = .12$), and the same was true for results of the liberal consensus score, $t(49) = 4.83$, $p < .001$, $d = 1.31$ (heavy drinkers: $M = .41$, $SD = .15$; light drinkers: $M = .22$, $SD = .14$) (see Figure 1).[3]

[3] These analyses were repeated including the group of participants that was initially excluded on the basis of their classification as light or heavy drinker at the time of testing. On all dependent measures, heavy-drinking students generated more alcohol continuations than light-drinking students: (1) Self ratings for alcohol scenarios: $t(65) = 4.66$, $p < .001$, $d = 1.24$ (heavy drinkers: $M = .3$, $SD = .11$; light drinkers: $M = .17$, $SD = .1$); (2) Self ratings for neutral scenarios: $t(65) = 3.2$, $p = .002$, $d = .8$ (heavy drinkers: $M = .22$, $SD = .13$; light drinkers: $M = .12$, $SD = .12$); (3) Conservative consensus score for alcohol scenarios: $t(65) = 4.88$, $p < .001$, $d = 1.17$ (heavy drinkers: $M = .33$, $SD = .12$; light drinkers: $M = .19$, $SD = .12$); and (4) Liberal consensus score for alcohol scenarios: $t(65) = 4.32$, $p < .001$, $d = 1.03$ (heavy drinkers: $M = .4$, $SD = .15$; light drinkers: $M = .25$, $SD = .14$).

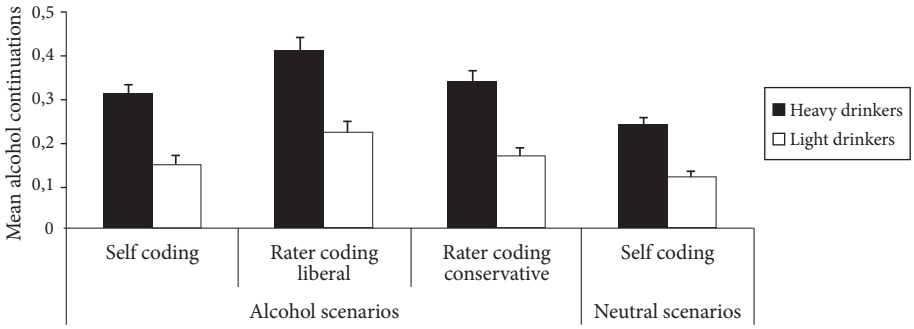


Figure 1. Mean alcohol continuations per scenario type and coding method. Error bars represent standard errors. Please note that independent raters did not report any alcohol-related continuations for neutral scenarios.

Correlational analysis

Table 1 shows the correlations between interpretation bias per scenario type and coding method employed (i.e., self-coding, external conservative and liberal coding), alcohol use, symptoms of alcohol dependence and alcohol-related problems (i.e., TLFB, AUDIT and RAPI). Analyses revealed positive correlations between all variables (except for self-coding neutral scenarios and RAPI), implying that the more alcohol continuations were generated, the higher the level of alcohol consumption, symptoms of alcohol dependence and alcohol-related problems. Correlation coefficients can be interpreted as moderate until high.

Table 1. Correlations of interpretation bias per scenario type and coding method with TLFB, AUDIT and RAPI scores. Please note that independent raters did not report any alcohol-related continuations for neutral scenarios.

Interpretation bias	TLFB	AUDIT	RAPI
1. Self coding alcohol scenarios	.59**	.56**	.38**
2. Self coding neutral scenarios	.57**	.4**	.15
3. Rater liberal coding alcohol scenarios	.60**	.54**	.4**
4. Rater conservative coding alcohol scenarios	.56**	.51**	.33*

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

Awareness check

Twenty students were aware of the goal of the task and 13 students reported having a vague idea about the goal. However, there was no significant correlation between being *aware* ('2'), *having a vague idea* ('1') and *not aware* ('0') and the participants' self coding of alcohol scenario continuations, $r = .07$, $p = .623$, and neutral scenarios, $r = .1$, $p = .497$, or the independent raters' conservative consensus score of the alcohol scenarios, $r = .04$, $p = .759$, and their liberal consensus score, $r = .09$, $p = .536$.

DISCUSSION

The present study investigated whether heavy-drinking students show evidence of an alcohol-related interpretation bias. We used ambiguous alcohol-related versus neutral scenarios and asked heavy and light-drinking students to generate a continuation for each scenario. Continuations were coded by two independent raters and by the participants themselves in order to improve the codings' accuracy (Frigon & Krank, 2009). Results showed that heavy-drinking students generated more alcohol-related continuations to the former type of scenario than light drinking students, i.e., they interpreted ambiguous alcohol-related scenarios more often in an alcohol-related manner. This was true across all three coding methods. However, self-coded scores were lower than both the raters' conservative and liberal scores. This finding contrasts with previous findings using similar methods (see Frigon & Krank, 2009; Krank, Schoenfeld, & Frigon, 2010). An explanation that could account for this result is that participants themselves have the most unique access to the meaning of their continuations. Interestingly, participants also coded some of their continuations on neutral scenarios as alcohol-related whereas the independent raters did not. There are at least two explanations here: One may be that this simply points to a lack of task compliance from the participants. A second one may be that participants took the entire context into consideration while coding: As all scenarios described typical student life situations, alcohol or its consumption could have somehow played a role. Speculatively, heavy drinkers may have had a general tendency to endorse an alcohol-related interpretation when confronted with these potential, alcohol-related contexts, implying that a response bias could account for this result. Finally, correlational analyses revealed that all types of bias indices were associated positively with the level of alcohol consumption, symptoms of alcohol dependence and alcohol-related problems. Hence, a stronger bias

is related to a higher level of alcohol use and alcohol-related problems. These results suggest that our scenarios tap into similar, alcohol-related concepts as assessed via the used self-report measures, and therefore could be regarded as additional support for the application of our scenario task.

To summarize, our findings mirror those obtained with memory association tasks (e.g., Ames & Stacy, 1998; Stacy, 1995, 1997). Our results can be explained with the same rationale as those of memory association tasks. During the processing of ambiguous alcohol-related scenarios, alcohol-related memory schemata which were established and strengthened during previous experiences with alcohol became active. As a result, alcohol-related associations became more accessible, implying that conceptually similar responses were elicited (i.e., alcohol-related interpretations). It is likely that the ambiguous alcohol-related scenarios in our study activated alcohol-related memory schemata in both heavy- and light-drinking students. However, results suggest that alcohol-related associations were stronger in heavy-drinking students due to their higher level of alcohol consumption. Hence, heavy-drinking students interpreted the ambiguous alcohol-related scenarios more often in an alcohol-related manner compared to light-drinking students.

Although the present study shows promising findings, some limitations should be considered when interpreting these results. First, approximately 40% of the participants became aware of the task's goal (which can also happen during an RT-based association task, see De Houwer, 2006). Hence, they could have chosen to censor their first associations and to respond with different associations. This rather high awareness score could be due to the high number of alcohol-related scenarios employed in the task that were not matched in quantity with neutral situations. In contrast, during memory associations task, a few ambiguous, alcohol-related cues are presented amongst many different, non-alcohol related ambiguous cues. However, the awareness score did not correlate with the bias index making it highly unlikely that our findings are simply the results of demand effects. Second, the outcome of the correlational analyses of bias indices and alcohol-related self-report measures should be treated with caution: Due to the fact that the TLFB scores which we used to define our extreme groups are highly correlated with AUDIT and RAPI, it is very likely that the reported correlations are inflated. Third, our sample size was rather small. Moreover, we only included male participants, reducing the generalizability of our results. Therefore, follow-up studies are needed that replicate the present findings with a larger sample. In addition, such a sample should include both (heavy drinking) male and female participants to further validate the paradigm. Finally, we cannot rule out that we measured the *tendency* to interpret scenarios in an alcohol-related way rather than an actual interpretation bias, so future research may consider using reaction time based approaches to overcome this

limitation.[4] For example, participants could be instructed to make speeded, lexical decisions about the final word of a scenario (alcohol/not alcohol). In that case, reaction times would serve as an index of the interpretation bias as they directly reflect the associative strength of the assessed association. Another promising line of future research would be to investigate whether an alcohol-related interpretation bias is associated with an alcohol-related memory bias, for example, by asking participants to recall their continuations (e.g., Hertel et al., 2008). Results of Franken, Rosso, and van Honk (2003) demonstrated that abstinent alcoholics exhibited an alcohol-related memory bias to alcohol cues, and that this bias was positively related with a craving for alcohol. Linking this research to interpretation biases in active drinkers may be fruitful in furthering our knowledge in this field.

To conclude, we found that heavy-drinking students, compared to light-drinking students, exhibit an alcohol-related interpretation bias. Due to the novelty of this scenario-based approach in the context of alcohol research our results might provide an inspiring starting point for further investigations. From a clinical perspective, this paradigm could provide useful in the diagnosis of alcohol-related problems and in the identification of potential risk situation after treatment, including the advantage of applying a rather indirect method which is less prone to biased self report. Finally, this task may also serve as a base for developing a 'cognitive bias modification' method (cf. Koster, Fox, & MacLeod, 2009) in order to *re-train* the alcohol-related interpretation bias.

REFERENCES

Ames, S. L., Franken, I .H. A., & Coronges, K. (2006). Implicit cognition and drugs of abuse. In R. W. Wiers, & A. W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp. 363–378). Thousand Oaks, CA: Sage Publishers.

Ames, S .L., & Stacy, A. W. (1998). Implicit cognition in the prediction of substance use among drug offenders. *Psychology of Addictive Behaviors*, *12*, 272-281.

Annis, H. M. (1982). *Inventory of drinking situations*. Toronto: Addiction Research Foundation of Ontario.

Cooper, M. (1997). Bias in interpretation of ambiguous scenarios in eating disorders. *Behaviour Research and Therapy*, *35*, 619-626.

[4] Research on interpretation biases in e.g., depression or social phobia that used such reaction time (RT) approaches refer to them as 'on-line' measurements, assuming that the measured interpretations are elicited when encountering the ambiguous material (see e.g., Hirsch, Clark, & Matthews, 2006). Our present scenario-based approach, however, should be rather defined as 'off-line' measurement, as participants had the time to reflect on their interpretations.

De Houwer, J. (2006). What are implicit measures and why are we using them. In R.W. Wiers & A.W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp. 11–28). Thousand Oaks, CA: Sage Publishers.

Franken, H. A., Rosso, M., & Van Honk, J. (2003). Selective memory for alcohol cues in alcoholics and its relation to craving. *Cognitive Therapy and Research*, *27*, 481-488.

Frigon, A. P., & Krank, M. D. (2009). Self-coded indirect memory associations in a brief school-based intervention for substance use suspensions. *Psychology of Addictive Behaviours*, *23*, 736-742.

Greenwald, A. G., McGhee, D. E., & Schwartz, L. K. (1998). Measuring individual differences in implicit cognitions: The Implicit Association Test. *Journal of Personality and Social Psychology*, *74*, 1464-1480.

Ham, L. S., & Hope, D. A. (2003). College students and problematic drinking: A review of the literature. *Clinical Psychology Review*, *23*, 719–759.

Hertel, P. T., Brozovich, F., Joormann, J., & Gotlib, I. H. (2008). Biases in interpretation and memory in generalized social phobia. *Journal of Abnormal Psychology*, *117*, 278-288.

Hirsch, C., Clark, D. M., & Matthews, A. (2006). Imagery and interpretation in social phobia: Support for the combined cognitive biases hypotheses. *Behavior Therapy*, *37*, 223-236.

Houben, K., Nosek, B. A., & Wiers, R. W. (2010). Seeing the forest through the trees: A comparison of different IAT variants measuring implicit alcohol associations. *Drug and Alcohol Dependence*, *106*, 204-211.

Kelly, A. B., Masterman, P. W., & Marlatt, G.A. (2005). Alcohol-related associative strength and drinking behaviours: Concurrent and prospective relationships. *Drug and Alcohol Review*, *24*, 489-498.

Koster, E. H. W., MacLeod, C., & Fox, E. (2009). Introduction to the special section on cognitive bias modification in emotional disorders. *Journal of Abnormal Psychology*, *118*, 1-4.

Krank, M. D., & Wall, A. M. (2006). Context and retrieval effects on implicit cognition for substance abuse. In R.W. Wiers & A.W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp.281-292). Thousand Oaks, CA: Sage Publishers.

Krank, M. D., Schoenfeld, T., & Frigon, A. P. (2010). Self-coded indirect memory associations and alcohol and marijuana use in college students. *Behavior Research Methods*, *42*, 733-738.

Moors, A., & De Houwer, J. (2006). Automaticity: A theoretical and conceptual analysis. *Psychological Bulletin*, *132*, 297–326.

Saunders, J. B., Aasland, O. G., Babor, T. F., De La Fuente, J. R., & Grant, M. (1993).

Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction*, *88*, 791-804.

Sobell, L. C., & Sobell, M. B. (1992). Timeline follow-back: A technique for assessing self-reported alcohol consumption. In R.Z. Litten & J.P. Allen (Eds.), *Measuring alcohol consumption: Psychosocial and biochemical methods* (pp. 41-72). Totowa, NJ: Humana Press.

Stacy, A. W. (1995). Memory associations and ambiguous cues in models of alcohol and marijuana use. *Experimental and Clinical Psychopharmacology*, *3*, 183-194.

Stacy, A. W. (1997). Memory activation and expectancy as prospective predictors of alcohol and marijuana use. *Journal of Abnormal Psychology*, *106*, 61-73.

Stacy, A. W., Ames, S. L., & Grenard, J. L. (2006). Word association tests of associative-memory and implicit processes: Theoretical and assessment issues. In R.W. Wiers & A.W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp.75-90). Thousand Oaks, CA: Sage Publishers.

Stacy, A. W., & Wiers, R. W. (2010). Implicit cognition and addiction: A tool for explaining paradoxical behavior. *Annual Review of Clinical Psychology*, *6*, 551-575.

Thush, C., Wiers, R. W., Ames, S. L., Grenard, J. L., Sussman, S., & Stacy, A. W. (2007). Apples and oranges? Comparing indirect measures of alcohol-related cognition predicting alcohol use in at-risk adolescents. *Psychology of Addictive Behaviors*, *21*, 587-591.

White, H. R., & Labouvie, E. W. (1989). Towards the assessment of adolescent problem drinking. *Journal of Studies on Alcohol*, *50*, 30-37.

Wiers, R. W., Bartholow, B. D., Van den Wildenberg, E., Thush, C., Engels, R. C. M. E., Sher, K. J., Grenard, J., Ames, S. L. & Stacy, A. W. (2007). Automatic and controlled processes and the development of addictive behaviors in adolescents: A review and a model. *Pharmacology, Biochemistry and Behavior*, *86*, 263-283.

Wiers, R. W., Hoogeveen, K. J., Sergeant, J. A., & Gunning, W. B. (1997). High and lowdose expectancies and the differential associations with drinking in male and female adolescents and young adults. *Addiction*, *92*, 871-888.

Wiers, R. W., Rinck, M., Dictus, M., & Van den Wildenberg, E. (2009). Relatively strong automatic appetitive action-tendencies in male carriers of the OPRM1 G-allele. *Genes Brain and Behavior*, *8*, 101–106.

5

Valence-congruent relations between alcohol-related interpretation biases and drinking motives

ABSTRACT

The aim of the present study was to examine whether negative and positive alcohol-related interpretation biases were specifically related to coping and enhancement drinking motives, respectively. Furthermore, it was examined whether such interpretation biases predict future drinking, especially in individuals with low levels of executive control. This was motivated by the scarce and sometimes conflicting empirical evidence on the functional relationship between implicit alcohol-related cognitions and drinking motives. In the present study, an adapted version of the Encoding Recognition Task (ERT) was applied to measure alcohol-related interpretation biases in male and female students. Participants were asked to read ambiguous alcohol-related scenarios. During a subsequent recognition phase, participants then had to interpret these scenarios. Coping motives were a unique predictor of the tendency to interpret negatively valenced, ambiguous alcohol-relevant situations in an alcohol-related manner. Similarly, enhancement motives were a unique predictor of the tendency to interpret positive ambiguous alcohol-relevant situations in an alcohol-related manner. However, executive control did not moderate the prediction of prospective drinking by the two types of alcohol-related biases. We conclude that the latter result is most likely due to features of the ERT. The current findings further advance our understanding of the functional relation between alcohol-related interpretation biases and drinking motives.

This chapter is based on:
Woud, M. L., Becker, E. S., Rinck, M., & Salemink, E. (2014). *Valence-congruent relations between alcohol-related interpretation biases and drinking motives*. Manuscript submitted for publication.

INTRODUCTION

According to models of addictive behavior (e.g., Wiers et al., 2007), implicit alcohol-related memory associations play an important role in alcohol abuse and misuse (Stacy & Wiers, 2010). A well-validated paradigm to assess alcohol-related memory associations are word association tasks. During these tasks, participants are asked to give their first association to a variety of ambiguous cues. For example, single ambiguous words ('draft') have been used, as well as ambiguous phrases containing affective components ('feeling good') and open-ended ambiguous scenarios (Ames & Stacy, 1998; Stacy, 1997, 1995; Stacy, Ames, & Grenard, 2006; Woud, Fitzgerald, Wiers, Rinck, & Becker, 2012). With these tasks, it was repeatedly found that individuals who tended to interpret ambiguous information in an alcohol-related manner consumed more alcohol. Besides such implicit alcohol-related cognitions, explicit ones have also been studied. According to Cox and Klinger (1988), two types of affective states are involved in alcohol consumption: People either drink to decrease negative affective states (negative reinforcement) or to increase positive affective states (positive reinforcement). A questionnaire suitable for detecting individual differences in these drinking motives is the Drinking Motives Questionnaire (DMQ; Cooper, 1994). It includes four factors, two of which address negative and positive reinforcement drinking, namely coping and enhancement drinking motives.

Recently, the functional relationship between implicit alcohol-related memory associations and drinking motives has been studied. To illustrate, Salemink and Wiers (2013) applied a Word-Sentence Association Paradigm (WSAP; Beard & Amir, 2009) and investigated whether negative and positive alcohol-related memory associations are specifically related to coping and enhancement drinking motives, respectively. During the WSAP, alcohol-related or alcohol-unrelated words were presented, followed by an ambiguous sentence involving a negative or a positive affect situation, or a neutral control situation. Participants had to indicate whether word and sentence were related. Here, coping motives (but not enhancement motives) predicted the tendency to associate alcohol-related words with negative affect situations, while enhancement motives (and not coping motives) predicted the tendency to associate alcohol-related words with positive affect situations. Similarly, Stewart, Hall, Wilkie, and Birch (2002) used an affective priming task to show that coping drinkers demonstrated an increased activation of alcohol-related concepts when primed negatively, whereas enhancement drinkers demonstrated an increased activation of alcohol-related concepts when primed positively. Unexpectedly, however, positive primes also activated alcohol-related concepts in coping drinkers, and neutral primes also activated alcohol-related concepts in enhancement drinkers.

There are a few other studies on, for example, the relation between alcohol use and general implicit outcome expectancies (e.g., Palfai & Wood, 2001; Stacy, 1997), the relation between drinking motives, mood, and alcohol-approach tendencies (Ralston, Palfai, & Rinck, 2013) or the role of arousal-related implicit alcohol cognitions in heavy versus light drinking (Wiers, van Woerden, Smulders, & de Jong, 2002). However, to the best of our knowledge, the studies by Salemink and Wiers (2013) and Stewart et al. (2002) are the only ones that explicitly investigated the functional relationship between implicit alcohol-related associations and drinking motives. This scarcity of evidence in combination with the partly inconsistent findings by Stewart et al. (2012) motivated the present study. Specifically, we investigated the relationship between alcohol-related interpretation biases and drinking motives. The Encoding Recognition Task (ERT) was adapted to assess alcohol-related interpretation biases (for a validation study in the field of anxiety, see Salemink & van den Hout, 2010).

The present alcohol-ERT contained ambiguous alcohol-relevant scenarios which were inspired by items of the DMQ-R. Half of the scenarios described negative situations and the other half described positive ones. First, it was expected that DMQ-R coping motives would specifically predict the tendency to interpret negative ambiguous situations in an alcohol-related manner, while DMQ-R enhancement motives would specifically predict the tendency to interpret positive ambiguous situations in an alcohol-related manner. Second, it was expected that alcohol-related interpretation biases (IBs) in negative and positive affect situations would be predictive of prospective drinking, and that their predictive power would further depend on individual differences in executive control (EC). More specifically, alcohol-related IBs should predict prospective drinking, particularly in individuals with low rather than high levels of EC. This latter prediction is in line with recent theorizing that deficits in executive control may be a risk factor for, and a consequence of, alcohol abuse and misuse (Koob & Volkow, 2010; Verdejo-Garcia et al., 2008; de Wit, 2009). Moreover, Salemink and Wiers (2013) showed that implicit alcohol associations in positive affect situations were predictive of prospective alcohol use and number of binges, depending on the individuals' level of working memory capacity.

METHOD

Participants

In total, 119 students of Radboud University Nijmegen participated (inclusion criteria: having consumed alcohol in the past week, university student, age 18-28 years). Eleven

participants were excluded from all further analyses: Eight did not consume alcohol and 3 were tested despite not meeting the age requirement. The final sample (n = 108) consisted of 57 females and 51 males with a mean age of 21.2 years (SD = 2.8).

Self-report measures

Time-Line-Follow-Back questionnaire (TLFB; Sobell & Sobell, 1992)
During the lab session, alcohol use was measured with an adapted version of the TLFB questionnaire (Wiers, Hoogeveen, Sergeant, & Gunning, 1997). Participants were asked to sum up for every day of the past week, how many and what kind of standard alcoholic drinks they had consumed, and how many drinks they would typically drink on an average day (assessed for all 7 days). In addition, they indicated the number of occasions on which they had drunk five or more standard glasses of alcohol during the previous 2 weeks. Alcohol use in the week following the lab session was measured with a shorter version, the TLFB online version. Here, participants were asked to indicate how many glasses of alcoholic beverages they had consumed during each day of the week.

Drinking Motives Questionnaire - Revised (DMQ-R; Cooper, 1994)
The DMQ-R was used to assess participants' drinking motives. The DMQ-R is a 20-item self-report questionnaire assessing the relative frequency of drinking for each of the four drinking motives, including a scale ranging from 1 ('almost never/never') to 5 ('almost always/always'). Of main interest here were the drinking motives 'enhancement' and 'coping'.

Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993)
The AUDIT is a self-report questionnaire measuring alcohol use and levels of hazardous drinking. It comprises a multiple-choice answering format and consists of 10 questions (3 related to alcohol use, 7 to alcohol-related problems).

Stroop task (Stroop, 1935)

The classical color-interference Stroop task (card version) was used to measure executive control. Participants categorized stimuli according to their print color (yellow, green, red, blue and white). On the compatible card, the words 'yellow', 'green', 'red', 'blue'

and 'white' were shown, and the word's meaning matched its print color. The same words were shown on the incompatible card, however, here the word's meaning did not match its print color (e.g., the word 'red' was printed in green). Finally, there was a card that showed meaningless colored strings of XXX. Each card contained 40 stimuli, i.e., 8 stimuli distributed across 5 columns. Each card appeared on the screen after a mouse click initiated by the experimenter. As soon as the participant had named the last word's print color, the experimenter clicked again and the card disappeared. Reaction times were saved by the computer. Participants' errors were recorded by the experimenter who was blind to the type of card that was presented.

Encoding Recognition Task (ERT)

To assess the alcohol-related interpretation bias, participants completed the ERT. The ERT consisted of two parts. In part one, 24 ambiguous alcohol-related scenarios were presented on the computer screen. There were 12 negative and 12 positive scenarios. Their contents was modeled on items of the coping and enhancement scales of the DMQ-R (Cooper, 1994). Each scenario started with a title and had 3 lines. In the final line, a word was missing, and this missing word appeared as soon as the space bar was pressed. However, the missing word was presented as a word fragment which participants were asked to complete. Specifically, participants were instructed to press the space bar again as soon as they knew the complete word. Then, they were supposed to type in the first missing letter of the word fragment. If correct, the complete word appeared on the screen. This procedure was supposed to ensure that participants processed the scenario thoroughly (see Table 1 for examples). Every scenario was followed by a comprehension question which participants had to answer with 'yes' or 'no'. Finally, participants were asked to indicate on a seven-point Likert scale ranging from 1 ('not at all') to 7 ('completely') how well they had been able to imagine themselves in the presented scenario.

In part two, the original 24 titles from part one were presented randomly, each followed by a set of 4 sentences. For each sentence, participants had to indicate how close in meaning the sentence was to the original meaning of the scenario, using a four-point Likert scale (1 = 'not at all' to 4 = 'very much'). Of the four sentences, one represented a possible alcohol-related interpretation of the original ambiguous scenario (i.e., alcohol-related target sentence), and one represented a possible alcohol-unrelated interpretation (i.e., alcohol-unrelated target sentence / control sentence). In addition, two more sentences were presented. Their contents was broadly similar to the original scenario but did not represent a resolution of the ambiguity (i.e., foil sentences). See Table 1 for examples.

Table 1. Example of a negative and positive scenario during the Encoding Recognition Task (ERT).

Scenario Type	Title	"Wanting to forget your problems"
Negative	Encoding sentence	"You are agitatedly walking up and down your room. You are very dissatisfied with your present situation. Your study loan piles up, you failed an exam and now you lost your wallet. You just want to forget all your … *(pro_lems / problems)*
	Recognition sentences:	
	Alcohol-related target	"You want to forget all your problems and decide to have a few extra drinks tonight."
	Alcohol-unrelated target	"You want to forget all your problems and decide to go for a long run."
	Foil 1	"You want to forget all your problems and grab your jacket."
	Foil 2	"You want to forget all your problems and go outside."
Scenario Type	Title	"Celebrating your housemate's birthday."
Positive	Encoding sentence	"Your housemate is celebrating his birthday and invited many people. The party gets going quickly and the atmosphere is great. You want to get in the … even more. (*m_od / mood*)."
	Recognition sentences:	
	Alcohol-related target	"You want to get in the mood even more, so you get a bottle of beer."
	Alcohol-unrelated target	"You want to get in the mood even more, so you turn up the music."
	Foil 1	"You want to get in the mood even more, so you stand up from the table."
	Foil 2	"You want to get in the mood even more, so you turn towards the person sitting next to you."

Procedure

Upon arrival, participants gave informed consent and answered demographic questions. This was followed by the Stroop and the ERT. Finally, the three self-report measures were administered, i.e., TLFB, DMQ-R, and AUDIT. One week later, participants received an email containing a link to complete the online version of the TLFB questionnaire.

RESULTS

Alcohol-related interpretation bias in positive and negative affect situations

Correlations between alcohol-related interpretation biases and self-report measures

We computed correlations between the negative and positive alcohol-related IBs (scores on alcohol-related target sentences) with coping and enhancement drinking motives (DMQ-R scores), alcohol consumption during the past seven days (TLFB lab version), level of hazardous drinking (AUDIT scores), alcohol consumption during the seven days following the lab session (TLFB online version), executive control (Stroop index) and gender (see Table 2). To determine the specificity of these correlations, scores on alcohol-unrelated targets (control sentences) and foil sentences for both negative and positive affect situations were also included. Regarding correlations with the TLFB lab version, one participant was excluded due to an extreme value on this measure (> 3 SDs above the group's mean).

We found that the alcohol-related IB in negative affect situations correlated significantly with coping and enhancement drinking motives, levels of alcohol consumption during the past seven days, levels of hazardous drinking, and prospective drinking. That is, individuals who had a stronger tendency to interpret negative affect situations as alcohol-related more often drank in response to negative as well as positive emotions, had consumed more alcohol during the past 7 days, showed higher levels of hazardous drinking and drank more during the seven days following the lab session. As expected, scores on control sentences (i.e., alcohol-unrelated target sentences) in negative affect situations did not significantly correlate with any of the self-report measures. The alcohol-related IB in positive affect situations correlated significantly with enhancement drinking motives, levels of alcohol consumption during the past 7 days, levels of hazardous drinking, and prospective drinking. That is, individuals who had a stronger tendency to interpret positive affect situations as alcohol-related more often drank in response to positive emotions, had consumed more alcohol during the past 7 days, showed higher levels of hazardous drinking and drank more during the seven days following the lab session. In addition, there was a marginally significant correlation between alcohol-related IB in positive affect situations and coping drinking motives. Moreover, as for negative-affect situations, scores on positive-affect control sentences (alcohol-unrelated target sentences) did not significantly correlate with any of the self-report measures. Finally, there was a significant positive correlation between negative and positive alcohol-related IBs, implying that individuals who had a stronger tendency to interpret negative affect situations as alcohol-related also interpreted positive affect situations as such.

Table 2. Correlations between alcohol-related interpretation bias in positive and negative affect situations, drinking motives, alcohol use (TLFB lab version), alcohol-related problems (AUDIT scores), prospective drinking (TLFB online version), executive control (Stroop Index) and gender.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. ART Negative Affect	-												
2. ART Positive Affect	.70**	-											
3. AUT Negative Affect	.20*	.27**	-										
4. AUT Positive Affect	.29**	.54**	.64**	-									
5. FS Negative Affect	.04	.13	.50**	.44**	-								
6. FS Positive Affect	.07	.14	.46**	.34**	.73**	-							
7. DMQ-R Coping	.27**	.16†	.16	.05	.04	.06	-						
8. DMQ-R Enhancement	.25**	.25*	.05	-.09	.04	-.01	.27*	-					
9. TLFB I a	.31**	.27**	-.08	-.08	-.08	-.04	.10	.37**	-				
10. AUDIT	.25**	.21*	-.08	-.13	-.09	.00	.25*	.45**	.66**	-			
11. TLFB IIb	.34*	.22*	.03	-.02	-.10	-.10	.16	.43**	.72**	.67**	-		
12. Stroop Index	.14	-.03	-.13	-.10	-.17†	-.06	-.01	.02	-.04	-.09	-.04	-	
13. Gender	.16	.09	-.19†	-.13	-.10	-.07	-.05	.04	.26*	.11	.13	.27*	-
M	2.12	2.72	2.77	3.00	2.73	2.80	8.69	13.55	12.86	9.99	1.83	10.77	57♀
SD	.55	.58	.48	.50	.44	.41	2.91	3.89	8.72	4.18	1.74	5.59	51♂

Note: n = 108 but [a]n = 107 for TLFB I due to one outlier and [b]n = 92 for prospective drinking. Significances: †$p < .1$, * $p < .05$, ** $p < .001$. ART Negative Affect: Alcohol-Related Target Negative Affect Situations; ART Positive Affect: Alcohol-Related Target Positive Affect Situations; AUT Negative Affect: Alcohol-Unrelated Target Negative Affect Situations; AUT Positive Affect: Alcohol-Unrelated Target Positive Affect Situation; FS Negative Affect: Foil Sentences Negative Affect; FS Positive Affect: Foil Sentences Positive Affect; DMQ-R Coping: Coping subscale Drinking Motives Questionnaire Revised; DMQ-R Enhancement: Enhancement subscale Drinking Motives Questionnaire Revised; TLFB I: Time Line Follow Back lab version; AUDIT: Alcohol Use Disorders Identification Test; TLFB II: Time Line Follow Back online version (i.e., one week follow-up); Stroop Index: RT incompatible – RT compatible; Gender: 0 = female and 1 = male.

Prediction of negative and positive alcohol-related interpretation biases

To examine whether negative and positive alcohol-related IBs were specifically predicted by coping and enhancement drinking motives, respectively, two regression analyses were conducted. All variables were first z-standardized (Aiken & West, 1991). The negative and positive alcohol-related IBs were used as outcomes in the regressions (the scores on alcohol-related target sentences). In each regression, DMQ-R enhancement and coping motives, scores on the AUDIT and TLFB lab version, and gender were entered as predictors. For the negative alcohol-related IB, three multivariate outliers were excluded, and four multivariate outliers for the positive alcohol-related IB (based on studentized deleted residuals and Mahalanobis distance). See Table 3 for a summary of the regression analyses.

Regarding the prediction of the negative alcohol-related IB, the overall model was significant, $R^2 = .17$ (adjusted $R^2 = .13$), $F(5, 99) = 4.08$, $p < .02$. The DMQ-R coping motive was a significant predictor, $B = .25$, $SE = .1$, $p < .02$, indicating that individuals who had a stronger tendency to interpret negative affect situations as alcohol-related more often drank in response to negative emotions. None of the other predictors were significant.

Regarding the prediction of the positive alcohol-related IB, the overall model was also significant, $R^2 = .15$ (adjusted $R^2 = .11$), $F(5, 98) = 3.45$, $p < .02$. Here, the DMQ-R enhancement motive was a significant predictor, $B = .21$, $SE = .11$, $p < .05$, indicating that individuals who had a stronger tendency to interpret positive affect situations as alcohol-related more often drank in response to positive emotions. The other predictors were not significant.[10]

Table 3. Summary of regression analyses for prediction of alcohol-related interpretation biases (IBs) in negative and positive affect situations.

	Alcohol-related IB	
	Negative	Positive
Model (R2)	.17*	.15*
Variable (B)		
DMQ-R Coping	.25*	.07
DMQ-R Enhancement	.08	.21*
AUDIT	.01	-.01
TLFB lab version	.24†	.23
Gender	.22	.11

Note: DMQ-R Coping: Coping subscale Drinking Motives Questionnaire Revised; DMQ-R Enhancement: Enhancement subscale Drinking Motives Questionnaire Revised; AUDIT: Alcohol Use Disorders Identification Test. TLFB lab version: Time Line Follow Back lab version. For the gender variable: 0 = female and 1 = male. †p = / <.10 *$p < .05$; **$p < .001$.

[1] We also conducted two regression analyses with the same predictors and alcohol-unrelated target sentences as the outcome. Here, the model was not significant, neither for negative affect situations ($R^2 = .05$, $F(5,98) = 1.07$, $p = .382$, nor for positive affect situations ($R^2 = .04$, $F(4,99) = .88$, $p = .499$).

Prediction of prospective drinking by means of alcohol-related interpretation biases, moderated by levels of executive control

Manipulation check Stroop task

To test whether participants showed the expected Stroop interference effect, RTs of compatible cards were subtracted from RTs of incompatible cards. A positive difference score indicates interference by incompatibility of word meaning and print color. The average difference score was indeed significantly positive, $t(107) = 20.04$, $p < .001$ ($M = 10.77$, $SD = 5.59$).

Prediction of prospective drinking

To examine whether alcohol-related IBs predicted future drinking especially in individuals with low executive control (EC), a multiple moderated regression analysis was performed including z-standardized variables (Aiken & West, 1991). The quantity of alcohol consumed during the week following the lab session (TLFB online version) was used as outcome. As predictors, we entered gender and level of hazardous drinking (AUDIT scores) (Step 1), DMQ-R coping and enhancement motives (Step 2), negative and positive alcohol-related IBs, executive control (Stroop interference score) (Step 3), and the Stroop x negative IB and Stroop x positive IB interactions (Step 4). In total, 92 individuals completed the online TLFB version. Eight participants were identified as multivariate outliers (based on studentized deleted residuals and Mahalanobis distance) and were excluded.

As Table 4 shows, all 4 models were significant. However, adding the predictors to the model in Step 2, 3, and 4 did not significantly add to the prediction of future drinking. In addition, no predictor of primary interest was significant: IB_negative x Stroop, $B = -.12$, $SE = .17$, $p = .47$, and IB_positive x Stroop, $B = -.06$, $SE = .2$, $p = .76$. Only the alcohol-related IB in negative affect situations was a marginally significant predictor, $B = .25$, $SE = .14$, $p = .08$.

Table 4. Summary of hierarchical regression analysis for variables predicting alcohol use at one week follow-up.

	Prospective drinking			
Variable	Significance model	R^2/adjusted R^2	R^2 change	B
Step 1	$F(2,83) = 34.33$, $p < .001$	.45/.44		
AUDIT				.67**
Gender				.04
Step 2	$F(4,81) = 17.81$, $p < .001$	.47/.44	.015	
AUDIT				.61**
Gender				.04
DMQ-R Coping				-.04
DMQ-R Enhancement				.15
Step 3	$F(7,78) = 10.64$, $p < .001$	.49/.44	.02	
AUDIT				.59**
Gender				.06
DMQ-R Coping				-.07
DMQ-R Enhancement				.15
ART Negative Affect				.18
ART Positive Affect				-.07
Stroop Index				-.11
Step 4	$F(9.76) = 8.54$, $p < .001$	.5/.44	.015	
AUDIT				.58**
Gender				.06
DMQ-R Coping				-.08
DMQ-R Enhancement				.13
ART Negative Affect				.25†
ART Positive Affect				-.11
Stroop Index				-.1
Stroop x ART Negative Affect				-.12
Stroop x ART Positive Affect				-.06

Note: $n = 85$. ART Negative Affect: Alcohol-Related Target Negative Affect Situations; ART Positive Affect: Alcohol-Related Target Positive Affect Situations; DMQ-R Coping: Coping subscale Drinking Motives Questionnaire Revised; DMQ-R Enhancement: Enhancement subscale Drinking Motives Questionnaire Revised; Gender: 0 = female and 1 = male; AUDIT: Alcohol Use Disorders Identification Test; Stroop Index: RT incompatible – RT compatible. †$p < .10$; *$p < .05$; **$p < .001$. Deviations in adjusted R^2 are due to rounding.

DISCUSSION

The present study aimed to identify functional relationships between alcohol-related IBs and drinking motives by employing a new alcohol Encoding Recognition Task. Correlations revealed that individuals who more often interpreted negative affect situations as alcohol-related, drank more often in response to negative and positive emotions, had consumed more alcohol during the past week, showed higher levels of hazardous drinking, and drank more during the week following the lab session. Similarly, individuals who more often interpreted positive affect situations as alcohol-related, more often drank in response to positive emotions, had consumed more alcohol during the past week, showed higher levels of hazardous drinking, and drank more during the week following the lab session. Importantly, scores on control sentences in both negative and positive affect situations did not correlate with any of the alcohol-related self-report measures. Results of the regression analyses further specified this pattern: As predicted, DMQ-R coping motives were a unique predictor of the tendency to interpret negative ambiguous alcohol-relevant situations in an alcohol-related manner, while DMQ-R enhancement motives were a unique predictor of the tendency to interpret positive ambiguous alcohol-relevant situations in this manner. Finally, the alcohol-related IB in negative affect situations was a trend-level significant predictor for prospective drinking. The alcohol-related IB in positive affect situations did not predict prospective drinking, and individual levels of executive control (EC) did not moderate the predictions.

To summarize, we found a valence-congruent association between alcohol-related IBs and drinking motives. This is in line with findings by Salemink and Wiers (2013) and Stewart et al. (2002). Hence, the present results replicate and extend previous findings. Moreover, we found that individuals who had a stronger tendency to interpret negative affect situations as alcohol-related also drank more often in response to positive emotions. Stewart et al. (2002) also reported non-specific effects, as coping drinkers were primed by both positive and negative stimuli, and therefore suggested that both types of stimuli can activate implicit alcohol-related cognitions. Moreover, previous research has shown that situations involving pleasant times with others as well as unpleasant emotions predicted DMQ coping scores in students (Carrigan, Barton, Samoluk, & Stewart, 1998). Hence, both positive and negative alcohol-related cognitions may be activated in individuals who mainly drink alcohol to ameliorate affective states.

The negative alcohol-related IB was also a marginally significant predictor of prospective drinking when the interaction terms were included in the regression. However, the positive alcohol-related IB did not predict prospective drinking, and individual

differences in executive control did not moderate this relation. This is not in line with our expectations, and there are at least two potential explanations. First, the alcohol-ERT might not be adequate for assessing *implicit* alcohol-related associations, i.e., spontaneous, unintentional and automatic associations (Moors & De Houwer, 2006). Participants read the ambiguous scenarios and interpreted them later. This 'off-line' measurement does not assess participants' interpretations immediately, unlike 'on-line' measurements such as the alcohol-WSAP (Salemink & Wiers, 2013). Hence, the latter might be more sensitive to individual differences in executive control. Dual process models of addictive behaviors support such an assumption (Wiers et al., 2007), postulating that low levels of executive control are associated with stronger automatic alcohol-related associations (Grenard, et al., 2008; Thush et al., 2008). A second explanation for not finding a moderating role of executive functioning is the fairly homogeneous sample we tested. Since they were all university students, the variance in Stroop scores was probably reduced.

Of course, the present study is not without limitations. First, we cannot draw causal conclusions regarding the relationship between alcohol-related IBs and drinking motives, due to the correlational design of the study. Second, our sample involved only students. Therefore, we need follow-up studies that involve mixed-gender samples or more clinical samples. Moreover, the causal relationship between alcohol-related IBs and alcohol consumption is worth investigating. Therefore, experimental studies are needed that induce an alcohol-related IB and then test its effect on alcohol consumption. Second, mood induction studies may further advance our understanding of alcohol-related IBs. To illustrate, Grant, Stewart, and Birch (2007) showed mood-congruent effects on implicit alcohol-related concepts after a mood manipulation (see also Ralston et al., 2013), and such a relation can also be expected in the present context. Finally, investigating whether alcohol-related IBs are associated with other cognitive biases (e.g., alcohol-related attention biases) could be very informative.

To conclude, we found unique and valence-specific relations between alcohol-related IBs and drinking motives. However, alcohol-related IBs did not predict prospective drinking and we did not find moderation by levels of EC. Our data show that it is important to disentangle the functional relationship between valenced alcohol-related IBs and drinking motives, and future research is needed to further examine this issue.

REFERENCES

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Thousand Oaks, CA: Sage.

Ames, S. L., & Stacy, A. W. (1998). Implicit cognition in the prediction of substance use among drug offenders. *Psychology of Addictive Behaviors*, *12*, 272-281.

Beard, C., & Amir, N. (2009). Interpretation in social anxiety: When meaning precedes ambiguity. *Cognitive Therapy and Research*, *33*(4), 406-415.

Carrigan, G., Barton Samoluk, S., & Stewart, S. H. (1998). Examination of the short form of the inventory of drinking situations (IDS-42) in a young adult university student sample. *Behaviour Research and Therapy*, *36*(7-8), 789-807.

Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment*, *6*, 117-128.

Cox, W. M., & Klinger, E. (1988). A motivational model of alcohol use. *Journal of Abnormal Psychology*, *97*(2), 168-180.

De Wit, H. (2009). Impulsivity as a determinant and consequence of drug use: a review of underlying processes. *Addictive Biology*, *14*, 22–31.

Grant, V. V., Stewart, S. H., & Birch, C. D. (2007). Impact of positive and anxious mood on implicit alcohol-related cognitions in internally motivated undergraduate drinkers. *Addictive Behaviors*, *32*, 2226-2237.

Grenard, J. L., Ames, S. L., Wiers, R. W., Thush, C., Sussman, S., & Stacy, A. W. (2008). Working memory capacity moderates the predictive effects of drug-related associations on substance use. *Psychology of Addictive Behaviors*, *22*, 426-432.

Koob, G. F., & Volkow, N. D. (2010). Neurocircuitry of Addiction. *Neuropsychopharmacology Reviews*, *35*, 217–238.

Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety. *Journal of Abnormal Psychology*, *109*, 602-615.

Moors, A., & De Houwer, J. (2006). Automaticity: A theoretical and conceptual analysis. *Psychological Bulletin*, *132*, 297-326.

Palfai, T., & Wood, M. D. (2001). Positive alcohol expectancies and drinking behavior: The influence of expectancy strength and memory accessibility. *Psychology of Addictive Behaviors*, *15*, 60-67.

Ralston, T. E., Palfai, T. P., & Rinck, M. (2013). The influence of depressed mood on action tendencies towards alcohol: The moderational role of drinking motives. *Addictive Behaviors*, *38*, 2810-2816.

Salemink, E., & van den Hout, M. (2010). Validation of the "recognition task" used in the training of interpretation biases. *Journal of Behavior Therapy and Experimental Psychiatry*, *41*, 140-144.

Salemink, E., & Wiers, R. W. (in press). Alcohol-related memory associations in positive and negative affect situations: Drinking motives, working memory capacity, and prospective drinking. *Psychology of Addictive Behaviors*.

Saunders, J. B., Aasland, O. G., Babor, T. F., De La Fuente, J. R., & Grant, M. (1993). Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction*, *88*, 791-804.

Sobell, L. C., & Sobell, M. B. (1992). Timeline follow-back: A technique for assessing self-reported alcohol consumption. In R.Z. Litten & J.P. Allen (Eds.), *Measuring alcohol consumption: Psychosocial and biochemical methods* (pp. 41-72). Totowa, NJ: Humana Press.

Stacy, A. W. (1995). Memory association and ambiguous cues in models of alcohol and marijuana use. *Experimental and Clinical Psychopharmacology*, *3*, 183-194.

Stacy, A. W. (1997). Memory activation and expectancy as prospective predictors of alcohol and marijuana use. *Journal of Abnormal Psychology*, *106*, 61-73.

Stacy, A. W., Ames, S. L., & Grenard, J. L. (2006). Word association tests of associative memory and implicit processes: Theoretical and assessment issues. In R.W. Wiers & A.W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp.75-90). Thousand Oaks, CA: Sage Publishers.

Stacy, A. W., & Wiers, R. W. (2010). Implicit cognition and addiction: A tool for explaining paradoxical behavior. *Annual Review of Clinical Psychology*, *6*, 551-575.

Stewart, S. H., Hall, E., Wilkie, H., & Birch, C. (2002). Affective priming of alcohol schema in coping and enhancement motivated drinkers. *Cognitive Behaviour Therapy*, *31*, 68-80.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, *18*, 643–661.

Thush, C., Wiers, R. W., Ames, S. L., Grenard, J. L., Sussman, S., & Stacy, A. W. (2008). Interactions between implicit and explicit cognition and working memory capacity in the prediction of alcohol use in at-risk adolescents. *Drug and Alcohol Dependence*, *94*, 116-124.

Verdejo-García, A., Lawrence, A. J., & Clark, L. (2008). Impulsivity as a vulnerability marker for substance-use disorders: Review of findings from high-risk research, problem gamblers and genetic association studies. *Neuroscience Biobehavioral Review*, *32*, 777-810.

Wiers, R. W., Bartholow, B. D., Van den Wildenberg, E., Thush, C., Engels, R. C. M. E., Sher, K. J., Grenard, J., Ames, S. L. & Stacy, A. W. (2007). Automatic and controlled processes and the development of addictive behaviors in adolescents: A review and a model. *Pharmacology, Biochemistry and Behavior*, *86*, 263-283.

Wiers, R. W., van Woerden, N., Smulders, F. T. Y., & de Jong, P. J. (2002). Implicit and explicit alcohol-related cognitions in heavy and light drinkers. *Journal of Abnormal Psychology*, *111*, 648-658.

Woud, M. L., Fitzgerald, D. A., Wiers, R. W., Rinck, M., & Becker, E. (2012). Getting into the spirit: Alcohol-related interpretation bias in heavy drinking students. *Psychology of Addictive Behaviors*, *26*, 627-632.

6

Alcohol-related interpretation bias in alcohol-dependent patients

ABSTRACT

Models of addictive behaviors postulate that implicit alcohol-related memory associations and biased interpretation processes contribute to the development and maintenance of alcohol misuse and abuse. The present study examined whether alcohol-dependent patients show an alcohol-related interpretation bias. Second, the relationship between the interpretation bias and levels of harmful drinking was investigated. The sample included 125 clinically diagnosed alcohol-dependent patients, and 69 clinically diagnosed control patients who had either a mood or an anxiety disorder. Participants completed a booklet containing 12 open-ended ambiguous scenarios. Seven scenarios were alcohol-relevant, and 5 were emotionally relevant, i.e., panic- or depression-relevant. Participants were asked to read each scenario and to generate a continuation. In addition, the Alcohol Use Disorder Identification Test (AUDIT) and Beck Depression Inventory (BDI) were administered. Logistic multivariate multilevel analyses revealed that alcohol dependent patients' probability of generating an alcohol-related continuation on all three scenario types was higher than that of control patients. Moreover, alcohol-related interpretation biases were positively associated with levels of harmful drinking (i.e., AUDIT scores). These findings are the first to show that alcohol-dependent patients show an alcohol-related interpretation bias which generalizes to other ambiguous emotionally relevant contexts, and therefore advance our understanding of the role of implicit biased alcohol-related memory associations and interpretation processes.

This chapter is based on:
Woud, M. L., Pawelczak, S., Rinck, M., Lindenmeyer, J., Souren, P., Wiers, R. W., & Becker, E. S. (2014). Alcohol-related interpretation bias in alcohol-dependent patients. *Alcoholism: Clinical and Experimental Research*. doi: 10.1111/acer.12334.

INTRODUCTION

When reading the word 'draft', many readers may start experiencing some discomfort because this reminds them of the manuscript which should have been finished weeks ago. A problem drinker, however, may interpret this differently, as the word 'draft' may automatically activate alcohol- related concepts, for example, a 'draft beer'. According to dual-process models of addictive behaviors (e.g., Wiers et al., 2007) such implicit biased alcohol-related memory associations are crucial in the development and maintenance of an alcohol dependency. The present study aims to advance our understanding of this matter. Therefore, we investigated the role of alcohol-related interpretation biases in a clinical sample of alcohol-dependent patients by employing a newly developed scenario task.

Alcohol-related cognitive processes can be roughly divided into two categories. First, there are explicit alcohol-related cognitive processes on which pioneering work has been conducted by Goldman and colleagues in the area of alcohol expectancies (Brown, Goldman, & Anderson, 1980; Goldman, Del Boca, & Darkes, 1999), and by Cooper and colleagues in the area of drinking motives (Cooper, 1994; Cooper, Frone, Russell, & Mudar, 1995). Second, there are implicit alcohol-related cognitive processes, involving processes that are rather 'spontaneous' and 'automatic' (e.g., Stacy & Wiers, 2010). According to dual-process models of addiction (e.g., Wiers et al., 2007), both explicit and implicit processes play important roles in addiction (for recent meta-analyses, see Reich, Below, & Goldman, 2010; Rooke, Hine, & Thorsteinsson, 2008).

Regarding implicit cognitive processes, much research has been focused on the role of alcohol-related memory associations. Two general classes of tasks have been used to assess these associations: reaction-time tests and open-ended memory tests (for a review, see Stacy & Wiers, 2010). We focus here on the well-validated open-ended memory paradigms to assess implicit alcohol-related memory associations (e.g., Ames & Stacy, 1998; Ames, Sussman, Dent, & Stacy, 2005; Krank, Schoenfeld, & Frigon, 2010; Stacy, 1995; 1997; and for overviews, see Stacy, Ames, & Grenard, 2006; Stacy & Wiers, 2010). During these tasks, participants give their first spontaneous association to ambiguous cues that are either alcohol-related or unrelated. A variety of cues have been used so far, for example single word cues (e.g., 'draft', 'shot'), ambiguous situations (e.g. 'Friday night') or open-ended phrases (e.g. 'When I feel confident and relaxed I...'). In addition, phrases including affective components (e.g. 'Feeling good'), as well as compound cues using a combination of ambiguous situations and affective components (e.g. 'Friday night – Feeling good') have been applied as well. Results have repeatedly demonstrated that individuals with high levels of alcohol consumption generate more alcohol-related interpretations. Moreover, word association tasks have been shown to be better predictors of future alcohol use than explicit measures, even when adjusting

for earlier alcohol use (e.g., Kelly et al., 2005; Stacy, 1997; Thush et al., 2007). According to associative network accounts (Anderson, 1983; Bower, 1981; Collins & Loftus, 1975), results of open-ended association tasks can be explained as follows: During the processing of ambiguous alcohol-related cues, alcohol-related memory schemata that are established during previous alcohol experiences become active. These schemata elicit alcohol-related memory associations, and they are particularly strong (i.e., easily accessible) in individuals who consume high amounts of alcohol. Hence, heavier drinking individuals generate more alcohol-related interpretations when being confronted with ambiguous alcohol-related cues.

More recently, the word association task approach has been extended to test whether open-ended ambiguous *scenarios* are also able to detect biases in alcohol-related memory associations (Woud, Fitzgerald, Wiers, Rinck, & Becker, 2012). This approach is a well-established method to assess interpretation biases in mood and anxiety disorders (cf. Mathews & MacLeod, 2005). Testing the effectiveness of such a scenario-based approach in research on alcoholism was motivated by findings that alcohol use and misuse depend highly on contextual features such as cognitive, social and affective states. These states determine how alcohol-related experiences are encoded, and, in turn, influence the accessibility of alcohol-related memory associations during later retrieval (Krank & Wall, 2006; Krank, Wall, Stewart, Wiers, & Goldmann, 2005). Word association tasks can also involve such contextual features, e.g., when compound cues are used. However, the scenario-based approach provides a more nuanced context, and therefore offers more insight into individual differences in sensitivity to context effects. As such, it is a more holistic and ecologically valid approach. This is also true when comparing the scenario-based approach with reaction time (RT) tasks used to assess alcohol-related memory associations as such RT tasks mostly involve single word cues. Furthermore, two studies directly comparing RT and open-ended measures found that the latter predicted more variance in addictive behaviors (Ames et al., 2007; Thush et al., 2007), a finding also confirmed by a meta-analysis (Rooke et al., 2008). Results of Woud et al. (2012) showed that the scenario-based approach is indeed a sensitive paradigm to detect variations in alcohol-related interpretation biases. Heavy- and light-drinking male students were asked to complete open-ended ambiguous scenarios by writing down their spontaneous continuation (i.e., interpretation) of the scenario. Results demonstrated that heavy drinkers exhibited an alcohol-related interpretation bias: They generated more alcohol-related continuations on ambiguous alcohol-related scenarios than light drinkers. In addition, the bias index was positively related to harmful drinking patterns and alcohol-related problems.

Given these promising findings, a next step was to investigate alcohol-related interpretation biases in a clinical population. Would patients suffering from a clinically diagnosed alcohol dependency show such a bias? This is possible, but not necessary:

Research has shown that observations in risk populations do not always match observations in clinical populations. For example, heavy drinkers show an attentional bias towards alcohol (e.g., Field, Mogg, Zetteler, & Bradley, 2004), however, abstaining alcohol-dependent patients show an attentional bias away from alcohol (e.g., Noël et al., 2006) and patients with a longer duration of the problem show a smaller bias (e.g., Loeber et al., 2010). Therefore, the present study aimed to contribute to a better understanding of the role of alcohol-related interpretation biases in alcohol dependency, and examined whether a sample of alcohol-dependent patients indeed suffer from such a bias. To this aim, a newly developed scenario task was used during which participants were asked to complete open-ended ambiguous scenarios that were either alcohol-, panic-, or depression-relevant. Specifically, they were asked to interpret the scenarios and to generate a continuation for each scenario. Participants were alcohol-dependent patients and control patients.

Our first hypothesis was that alcohol-dependent patients would have a greater probability of generating alcohol-related continuations on ambiguous alcohol-relevant scenarios than control patients. Second, we expected the alcohol-related interpretation bias to be correlated with levels of harmful drinking (i.e., AUDIT scores): The higher the alcohol-related bias, the higher the AUDIT scores. Regarding the continuations on ambiguous emotionally relevant contexts (i.e., panic- and depression-relevant scenarios), our hypothesis was exploratory. As these scenarios involve cognitions, affective states and bodily symptoms that may be associated with alcohol consumption, one could expect that these contextual features serve as primes, and therefore activate alcohol-related memory associations (Krank & Wall, 2006; Krank et al., 2005). Hence, we expected that alcohol-dependent patients would also have a greater probability to generate alcohol-related continuations on ambiguous emotionally relevant contexts, i.e., that the bias would generalize to ambiguous panic- and depression-relevant scenarios.

METHOD

Participants

Participants were 194 patients from the Salus Clinic Lindow, Germany. The sample's mean age was 46.4 years (SD = 8.6), including 103 male and 91 female participants. The inclusion criterion for alcohol-dependent patients was a primary diagnosis of alcohol dependence. The control patient group consisted of patients with a mood or anxiety disorder as a primary diagnosis who did not have a history of alcohol dependence or comorbid alcohol dependency. The present sample included 125 alcohol-dependent

patients (AP) and 69 control patients (CP). Within the CP group, 45 participants had a mood and 24 participants had an anxiety disorder as primary diagnosis.[1]

Self report measures

Alcohol Use Disorder Identification Test (AUDIT; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993).
The AUDIT is a screening tool for hazardous drinking behavior. It consists of 10 questions. The first 3 are related to alcohol use and the remaining 7 assess alcohol-related problems. Scores for the first 8 questions range from 0 to 4 (0 = 'never', 1 = 'less than monthly', 2 = 'monthly', 3 = 'weekly', 4 = 'daily or almost daily'. For questions 9 and 10 the scoring is 0, 2 and 4 (0 = 'no', 2 = 'yes, but not in the past year', 4 = 'yes, during the past year').

Beck Depression Inventory (BDI; Hautzinger, Bailer, Worall, & Keller, 1994).
The BDI assesses levels of depressive symptoms. It consists of 21 questions tapping into depression-related symptoms. Each question is followed by four statements reflecting increasing levels of intensity of a depressive symptom. Statements are scored from 0 to 3 and are summed to determine the depression's severity: 0–9 minimal; 10–18: mild; 19–29: moderate; 30–63: severe.

Scenario task

Four different booklets were used. Each booklet included seven ambiguous alcohol-relevant scenarios and five panic- or depression-relevant scenarios (booklet 1 and 2 included two panic- and three depression-relevant scenarios, and vice versa for booklet 3 and 4). Each booklet contained a unique set of scenarios, so that each scenario was used only once. The order of scenarios within each booklet was randomized.
Each scenario started with a title and contained four lines. The final line ended abruptly and was followed by an empty line on which participants were asked to write down a continuation. The alcohol-relevant scenarios were a modified version of previously used scenarios (Woud et al., 2012). They were adapted to be relevant for male

[1] In order to avoid mis-categorization of participants, the present sample includes only alcohol-dependent patients whose AUDIT score was 8 or higher, and control patients whose score was lower than 8 (see Saunders et al., 1993). Regarding the BDI, only participants with a score of 1 or higher (across both groups) were included.

and female adults. The following risk factors of the Inventory of Drinking Situations (IDS; Annis, 1982) served as themes for the scenarios: *urge and temptation*, *negative emotions*, *social pressure*, *pleasant times with others*, *conflict*, *physical discomfort*, and *pleasant emotions* (for an open-ended phrase task which also based on items of the IDS, see Ames et al., 2005). For example, the factor pleasant times with others was used to create the following ambiguous alcohol-relevant scenario: "In the park. Your friends organized a picnic in the park. You are lying on a large blanket and you are having a jolly and cheerful time. You hear a fizzling noise, someone opens a can. You think: 'That's what I want, too', so you grab … ". The contents of the ambiguous panic- and depression-relevant scenarios tapped into cognitions, emotional responses and bodily responses that are specific for those disorders (Panic-relevant example: "Cup of coffee. You are sitting in a café, enjoying a cup of coffee. Your eyes meet those of the person sitting at the table next to you. You feel that your heart starts pounding. This means that… "; Depression-relevant example: "At the shop. You are at a shop. You want to buy something and you are thinking back and forth. The shop assistant becomes impatient and rolls her eyes. You start feeling very insecure because…").
For participants, the scenario task was introduced as a questionnaire consisting of 12 little scenarios. These scenarios were described as situations out of everyone's daily life, including for example pleasant situations with others as well as situations during which one feels unpleasant. It was then explained that these scenarios do not have an ending yet, and that it is the participant's task to generate an ending for each scenario. It was pointed out that two things are crucial here: Participants were supposed to 1. Imagine themselves in the situation even if it did not match perfectly with their own daily life, 2. Write down the first ending that crossed their mind. Finally, it was explained that these spontaneous answers are important to get to know the patient: The clinical environment will be very different compared to their own and familiar home environment. Hence, the patients' answers might provide valuable information regarding their habits and spontaneous reactions.

Scoring scenario task

Two trained clinical psychology master students blind to participants' group coded the continuations. The two raters coded all scenarios individually and in a conservative way. That is, only unambiguous continuations were coded as being alcohol-related, implying that the continuations had to include words such as 'beer', 'wine' or 'alcohol'. The continuations were coded as binary variables, i.e., an alcohol-related continuation was coded with '1' (i.e., present), and an alcohol-unrelated continuation was coded with '0' (i.e., absent).[2]

Procedure

According to the procedures of the German rehabilitation system, patients who apply for patient treatment are extensively diagnosed by either a specialized practitioner or an addiction counsellor. All applicants are then checked for their diagnosis and treatment needs by the medical department of the German Pension Fund to be eligible for patient treatment. The treatment is entirely voluntary. All patients included in the present sample underwent this procedure. In addition, all alcohol-dependent patients underwent an alcohol detoxification procedure. The study was conducted two to three weeks before the patients started their behavioral cognitive treatment at the rehabilitation clinic, i.e., the time period during which participants were waiting for their admission approval and the date for their actual admission. During this period, the scenario task was sent home to them via mail, introduced as a questionnaire participants are supposed to complete prior to their stay at the clinic. Participants were informed about the study and that doing the scenario task was completely voluntary without any consequences for their treatment. Participants were asked to return the booklet via mail, together with the questionnaires.
Within the first week after arrival, a participant's diagnosis was re-checked by his/her therapist. This was based on criteria as formulated in the International Statistical Classification of Diseases (ICD-10; WHO, 1992), and also included the administration of the AUDIT (Saunders et al., 1993) and BDI (Hautzinger et al., 1994). In addition, some participants completed the computerized version of the Composite International Diagnostic Interview (CIDI; Robins et al., 1988). The study had the necessary institutional review board approvals.

RESULTS

Participant characteristics

The two patients groups differed significantly on the AUDIT and BDI. Regarding the AUDIT, alcohol patients (AP) scored significantly higher than control patients (CP), $t(192) = 24.59$, $p < .001$. However, regarding the BDI, AP scored significantly lower than CP, $t(192) = 3.22$, $p = .001$ (see Table 1 for means and standard deviations).

[2] Raters also coded whether continuations on the three scenarios types (i.e., alcohol-, panic-, and depression-relevant) were panic- or depression-related. A continuation was coded as panic-related if it included exaggerated expressions of catastrophic thinking and / or worsening of bodily symptoms, whereas a continuation was coded as depression-related if it included expressions of worthlessness, of not being good enough, being unable to succeed, self criticism, passivity or guilt. However, due to our main interest in alcohol-related continuations involving the corresponding logistic multilevel analysis, these data are not reported nor analyzed.

Table 1. Demographic data and AUDIT and BDI scores for the two patient groups.

	N	Gender (m/f)	Age	AUDIT	BDI
Patient group			*M* / *SD*	*M* / *SD*	*M* / *SD*
Alcohol	125	86/39	46.4 (8.6)	25.9 (8)	15 (11.6)
Control	69	17/52	46.3 (8.7)	1.9 (1.9)	20.1 (8.6)
p		$p < .001$	$p = .891$	$p < .001$	$p = .001$

Scenario task

Pre analysis check

Before analyzing the scenarios, several aspects of the data were checked. First, we inspected missing values by calculating a sum score of missing values for each participant. Analyses showed that the two groups did not differ significantly on this score, $t(192) = .33$, $p = .742$ (AP: $M = .22$, $SD = .53$; AP: $M = .19$, $SD = .60$). Next, we checked the randomization between groups and booklet version, which was successful, $\chi^2(3) = 1.31$, $p = .726$. Finally, we checked group differences regarding age and gender. Analyses revealed no significant group difference regarding age, $t(192) = .14$, $p = .891$. However, the two groups differed significantly regarding gender, $\chi^2(1) = 34.82$, $p < .001$ (see Table 1 for an overview and means and standard deviations).

Inter-rater agreement

Before analyzing the outcome of the scenario task, we examined the inter-rater agreement by means of Cohen's Kappa. This index was high: $\kappa = .89$ ($p < .001$).

Analysis alcohol-related continuations

To examine the probability of generating an alcohol-related interpretation on the three scenario types (i.e., alcohol-, panic-, and depression-relevant), a logistic multivariate multilevel analysis was conducted. The alcohol-related versus alcohol-unrelated continuation of both raters served as the dependent variable ('1': alcohol-related continuation present, '0': alcohol-related continuation absent). Binary-coded dummy variables were created for the variables of interest, namely Group (AP, CP), Scenario Type (alcohol-, panic-, depression-relevant), Booklet Nr (1, 2, 3, 4) and Gender (male, female). The reference categories for the equation were as follows: Group: AP, Scenario Type: alcohol-relevant, Booklet Nr: 1, and Gender: male.

Table 2 gives an overview of the model estimates of the null and full model, respectively. The null model is the model without predictors, the full model is the model with all

predictors relevant for the present research question. Both models include the responses of rater 1 and rater 2. The covariance, i.e., the between rater variance, provides an indication of the reliability of the data. Regarding the null model, the random intercept estimate is 1.164 for rater 1, and 1.323 for rater 2, and the covariance is 1.24. Regarding the full model, the random intercept estimate is .839 for rater 1 and .864 for rater 2, and the covariance is .897. The correlation between the raters is r = 1 for both the null and full model, respectively.

Table 2. Overview model estimates logistic multivariate multilevel analysis on scenario task.

	Null model			
	Rater 1 (SE)		Rater 2 (SE)	
Fixed effects intercept	-1.449 (.094)		-1.504 (.099)	
Random effects:				
Intercept (rater level)	1.164		1.323	
Covariance/Correlation (R1,R2)				1.24/1
	Full model			
Fixed effects intercept	-1.145		-1.250	
	Parameter estimates (SE)	p	Parameter estimates (SE)	P
Patient Group: CP	-1.547 (0.222)	< .0001	-1.883 (0.237)	< .0001
Panic Scenario	-1.624 (0.193)	< .0001	-1.751 (0.205)	< .0001
Depression Scenario	-1.149 (0.165)	< .0001	-1.212 (0.172)	< .0001
Booklet Nr 2	0.431 (0.247)	= .08	0.431 (0.247)	= .08
Booklet Nr 3	0.813 (0.267)	< .0001	0.918 (0.275)	< .0001
Booklet Nr 4	0.570 (0.272)	= .04	0.743 (0.279)	< .0001
Gender: Female	0.177 (0.200)	= .38	0.154 (0.203)	= .44
Random effects:				
Intercept (rater level)	.839		.864	
Covariance/Correlation (R1,R2)				.897/1

Note: The reference categories: Group: AP, Scenario Type: alcohol-relevant, Booklet Nr: 1, Gender: male.

Table 3 gives an overview of the probabilities of generating an alcohol-related continuation, taking into consideration the possible combinations of the variables of interest and their corresponding levels (e.g., the probability to generate an alcohol-related continuation for female alcohol-dependent participants for alcohol-relevant scenarios included in booklet 3). Results showed that the probability of generating an alcohol-related continuation on the three scenario types (i.e., alcohol-, panic-, depression-relevant) was always higher for AP than for CP. This pattern was consistent across rater 1 and rater 2.

Table 3. Probability of generating an alcohol-related continuation based on the codings of rater 1 and 2.

	Group	Scenario Type	Booklet Nr	Probabilities rater 1 male/female	Probabilities rater 2 male/female
1	AP	Alcohol	1	.24/.28	.22/.25
2	AP	Alcohol	2	.33/.37	.34/.38
3	AP	Alcohol	3	.42/.46	.42/.46
4	AP	Alcohol	4	.36/.40	.38/.41
5	CP	Alcohol	1	.06/.07	.04/.05
6	CP	Alcohol	2	.09/.11	.07/.08
7	CP	Alcohol	3	.13/.15	.1/.11
8	CP	Alcohol	4	.11/.13	.08/.1
9	AP	Panic	1	.06/.07	.05/.05
10	AP	Panic	2	.09/.10	.08/.1
11	AP	Panic	3	.12/.14	.11/.13
12	AP	Panic	4	.10/.12	.09/.11
13	CP	Panic	1	.01/.02	.01/.01
14	CP	Panic	2	.02/.02	.01/.02
15	CP	Panic	3	.03/.03	.02/.02
16	CP	Panic	4	.02/.03	.02/.02
17	AP	Depression	1	.09/.11	.08/.09
18	AP	Depression	2	.13/.16	.13/.15
19	AP	Depression	3	.19/.21	.18/.2
20	AP	Depression	4	.15/.18	.15/.17
21	CP	Depression	1	.02/.02	.01/.01
22	CP	Depression	2	.03/.04	.02/.03
23	CP	Depression	3	.05/.05	.03/.04
24	CP	Depression	4	.03/.04	.03/.03

Relation between alcohol-related continuations and AUDIT

Regression analyses were performed to evaluate the relationship between alcohol-related continuations and AUDIT scores.[3] Per rater, a sum score of alcohol-related continuations was computed for each scenario type (i.e., alcohol-, panic-, depression-relevant), and this served as the dependent variable for the particular regression. Booklet Nr and Gender were included as control variables. Given the non-normally distributed residuals, a Bootstrapping procedure was applied (Sampling Method: Simple; Number of Samples: 1000), and the corresponding outcomes are reported (i.e., unstandardized coefficients, bias score, p value and confidence interval) (Efron & Tibshyrani, 1993).[4]

Table 4 summarizes the outcome of these analyses, once for rater 1 and once for rater 2. When considering the entire sample, alcohol-related continuations for all three scenario types were positively significantly related with AUDIT scores, and this was true across both raters. These results suggest that the more alcohol-related continuations were generated, the higher the level of harmful drinking. Regarding the analyses including alcohol dependent patients only, the outcomes differ per rater. Regarding rater 1, results showed that alcohol-related continuations on alcohol- and depression-relevant scenarios were positively significantly related with AUDIT scores. However, alcohol-related continuations on panic-relevant scenarios did not correlate significantly with AUDIT scores. Regarding rater 2, results showed that alcohol-related continuations on depression-relevant scenarios were positively significantly related with AUDIT scores. In addition, alcohol-related continuations on alcohol- and panic-relevant scenarios were marginally significantly related with AUDIT scores.

[3] Our variables were non-normally distributed so we conducted a regression analysis instead of simply calculating correlations.
[4] For the sake of brevity, we only report the outcomes of main interest here.

Table 4. Regression analyses including bootstrapping procedure for total group and alcohol-dependent patients only (AP) between alcohol-related continuations of rater 1 and rater 2 on alcohol-. panic- and depression-relevant scenarios and AUDIT scores.

			Rater	Model summary	B	Bias	P	BCa 95% CI
Measures	Group	Scenario type						
AUDIT	Total: *F*(6/188)							
		Alcohol	Rater 1	R^2 = .61 p < .001	.07	0	< .01	.048 - .086
			Rater 2	R^2 = .6 p < .001	.07	-0	< .01	.051 - .084
		Panic	Rater 1	R^2 = .16 p < .001	.01	0	< .02	.002 - .010
			Rater 2	R^2 = .2 p < .001	.01	0	< .01	.005 - .012
		Depression	Rater 1	R^2 = .27 p < .001	.01	0	< .01	.008 - .019
			Rater 2	R^2 = .29 p < .001	.01	0	< .01	.009 - .019
	AP: (6/119)	Alcohol	Rater 1	R^2 = .62 p < .001	.04	0	= .04	.000 - .081
			Rater 2	R^2 = .62 p < .001	.04	-0	= .06	.003 - .072
		Panic	Rater 1	R^2 = .19 p < .001	.01	0	= .22	-.004 - -.016
			Rater 2	R^2 = .21 p < .001	.01	0	= .08	-.001 -.015
		Depression	Rater 1	R^2 = .29 p < .001	.01	0	< .02	.002 - .026
			Rater 2	R^2 = .31 p < .001	.01	0	= .03	.003 - .024

Note: Group: Total: n = 194. AP: n = 125. Gender and Booklet Number were entered as control variables. Values that are zero but negative are due to rounding. AUDIT: Alcohol Use Disorder Identification Test; R^2: Adjusted R^2; B: Unstandardized Coefficient; Bias: level of disagreement bootstrap vs. sample distribution; p: p-value; BCa 95% CI: Bias-corrected and accelerated 95% Confidence Interval.

DISCUSSION

The present study investigated whether alcohol-dependent patients exhibited an alcohol-related interpretation bias, using a newly developed scenario task. The scenarios

included open-ended ambiguous alcohol-, depression-, and panic-relevant scenarios, and participants were asked to interpret and to generate a continuation for each scenario, respectively. Results demonstrated that alcohol-dependent patients showed an alcohol-related interpretation bias. Compared to control patients, alcohol-dependent patients had a higher probability of generating alcohol-related continuations on ambiguous alcohol-relevant scenarios. This was true for scores derived from both raters. Moreover, alcohol-related continuations of all three scenario types were positively related to levels of harmful drinking (i.e., AUDIT scores) in the entire patient group. Regarding alcohol-dependent patients, alcohol-related continuations on alcohol- and depression-relevant scenarios were significantly related with AUDIT scores when using scores of rater 1 for the regression. When using scores of rater 2 in the regression, results showed that alcohol-related continuations on depression-relevant scenarios were positively significantly related with AUDIT scores, and alcohol-related continuations on alcohol- and panic-relevant scenarios were marginally significantly related with AUDIT scores.

We also had an exploratory hypothesis concerning the generalization of the alcohol-related interpretation bias to other ambiguous emotionally relevant contexts (i.e., depression-, and panic-relevant scenarios). We indeed found such a generalization effect: Compared to control patients, alcohol-dependent patients had a higher probability of generating an alcohol-related continuation on depression-, and panic-relevant scenarios. Again, this pattern was consistent across rater 1 and rater 2.

Regarding the first result, i.e., an alcohol-related interpretation bias on alcohol-relevant scenarios, our finding is in accordance with what has been found in risk groups and community samples (e.g., Ames & Stacy, 1998; Ames et al., 2005; Krank et al., 2010; Stacy, 1995, 1997). In particular, the present finding is in accordance with the scenario-based approach employed by Woud et al. (2012), demonstrating that male heavy-drinking students, compared to male light-drinking students, showed an alcohol-related interpretation bias regarding ambiguous alcohol-relevant scenarios. The present study extends these findings. First, our results show that alcohol-related interpretation biases also exist in a clinical sample of alcohol-dependent patients. Second, regression analyses revealed a positive association between interpretation bias and symptoms of harmful drinking (i.e., AUDIT scores) within the group of alcohol-dependent patients. Particularly the latter is noteworthy when taking into consideration that the AUDIT was administered approximately 3-4 weeks after participants had completed the scenario task.

Regarding our exploratory hypothesis, results showed that alcohol-dependent patients also had a higher probability of generating alcohol-related continuations on panic- and depression-relevant scenarios. Finding such a generalization effect is also in line with

Woud et al. (2012). An explanation that could account for the present finding is that the scenarios contained contextual features that are highly associated with alcohol and its consumption (e.g., negative affective states), and therefore may have activated alcohol-related memory associations (Krank & Wall, 2006; Krank et al., 2005). Put differently, the affective states and bodily symptoms described in these scenarios served as alcohol-relevant primes. Associative network accounts provide theoretical fundament for this finding (e.g., Anderson, 1983; Bower, 1981; Collins & Loftus, 1975), postulating that mood-memory-congruent cues (e.g., negative affective states) can indeed activate mood-congruent materials (e.g., alcohol-related concepts). Clinical observations demonstrating that relapse after successful treatment is frequently attributed to negative affective states such as stress or anger are in line with our findings (Marlatt, 1996). From an empirical perspective, studies investigating the activation of alcohol-related concepts and drinking motives are also supportive. For example, a stress induction can lead to an alcohol-related attentional bias in social drinkers scoring high on coping- drinking motives (Field & Powell, 2007). However, there are also findings that are less consistent regarding such mood-congruency effects. To illustrate, results of Stewart, Hall, Wilkie, and Birch (2002) showed that coping drinkers showed an increased activation of alcohol-related concepts when primed negatively, whereas enhancement drinkers showed increased activation of alcohol-related concepts when primed positively. Unexpectedly, positive primes also activated alcohol-related concepts in coping drinkers, and neutral primes also activated alcohol-related concepts in enhancement drinkers.

Despite these promising findings, the present study is not without limitations. First, completing the scenario task at home has the disadvantage that it was beyond our control in which context, emotional and physical state participants completed it. For example, it is possible that participants were not sober while completing the scenarios. However, participants performing the task at home meant that the task was performed in a natural setting. One could argue that this is likely to enhance the ecological validity of the task. Second, we cannot rule out demand effects, implying that the alcohol-dependent patients' scores on the scenario task could be either an understatement or an overstatement of the actual alcohol-related interpretation bias. On the one hand, participants may have censured their first association because they became aware of the task's goal (which can also happen during an RT-based association tasks, see De Houwer, 2006) or because they were about to be admitted to the clinic and thus considered alcohol a sort of taboo. On the other hand, however, participants may also have generated more alcohol-related answers due to their upcoming admission and treatment. In line with this: We do not know whether scores derived from the generated continuations can be considered as 'implicit' measures. Despite these limitations,

however, alcohol-dependent patients still generated more alcohol-related continuations than control patients across all three scenario types. Furthermore, earlier findings showed no correlation between the interpretation bias and task awareness (Woud et al., 2012). Finally, clinically diagnosed alcohol-dependent patients were compared to a clinically diagnosed patient control group. On the one hand, this is an adequate control group. On the other hand, however, a design which also included a non-diagnosed sample including adult high-risk drinkers and problem drinkers would have been a more balanced approach.

Despite these limitations, however, the present findings suggest interesting routes for future research. A next intriguing question is whether the interpretation bias is a cause and / or a consequence of alcohol misuse (Kraemer et al., 1997). On the one hand, longitudinal research is needed to investigate whether the bias precedes the dependency (i.e., whether it is a predictor for developing an alcohol dependency). On the other hand, experimental research could target the question whether inducing an interpretation bias increases levels of alcohol consumption. Research in the domain of Cognitive Bias Modification (CBM) techniques could prove useful concerning the latter idea (cf. Koster, MacLeod, & Fox, 2009). In studies on social anxiety, for example, socially-relevant interpretation biases were experimentally induced which indeed increased levels of state anxiety (e.g., Mathews & Mackintsoh, 2000; Salemink, van den Hout, & Kindt, 2007). Furthermore, it would be worthwhile to investigate potential moderators like working memory. For example, Thush et al. (2008) showed that implicit alcohol-related memory associations were more strongly related to alcohol use for individuals with low than with high levels of working memory (for similar findings, see e.g., Grenard et al., 2008; Houben & Wiers, 2009). In contrast, explicit alcohol-related cognitions were more strongly related to alcohol use for individuals with high than for individuals with low levels of working memory. As such, working memory may be an important construct when examining alcohol-related concepts, particularly when also examining its differential effects regarding implicit and explicit alcohol-related concepts. Finally, findings of Krank et al. (2010) showed that self-coding is beneficial in reducing ambiguity during coding and reveals larger effects sizes than external coding. Hence, to obtain a more accurate score of alcohol-related interpretation biases follow-up research should include self-coding.

To conclude, the present study showed that alcohol-dependent patients show an alcohol-related interpretation bias which generalized to other ambiguous emotionally relevant contexts. Furthermore, the alcohol-related interpretation bias was positively related to levels of harmful drinking. To the best of our knowledge, this is the first demonstration of such biased interpretation processes in a clinical sample. Moreover, the fact that a risk group (Woud et al., 2012) as well as a clinical sample of alcohol-dependent

patients have such biases further stresses the significance of these processes. However, the present study should be considered as 'proof of principle', i.e., a first step towards a better understanding of the role of alcohol-related interpretation biases in alcohol dependency. Hence, follow-up studies are needed that replicate and validate the present findings. Nevertheless, the present findings suggest the possibility of some potential clinical applications. For example, the scenario task could be administered before treatment to identify those patients suffering from an interpretation bias, and who thus may benefit from a more intensive treatment, including possibly a variety of CBM techniques, directly aiming to retrain these interpretations, as has been used successfully in anxiety (for an overview, see e.g., Mathews & MacLeod, 2005). Moreover, the treatment could specifically target contexts that triggered the interpretation bias and as such lead to a more individualized approach.

REFERENCES

Ames, S. L., Grenard, J. L., Thush, C., Sussman, S., Wiers, R. W., & Stacy, A. W. (2007). Comparison of indirect assessments of association as predictors of marijuana use among at-risk adolescents. *Experimental Clinical Psychopharmocology*, *15*, 204-218.

Ames, S. L., & Stacy, A. W. (1998). Implicit cognition in the prediction of substance use among drug offenders. *Psychology of Addictive Behaviors*, *12*, 272-281.

Ames, S. L., Sussman, S., Dent, C. W., & Stacy, A. W. (2005). Implicit cognition and dissociative experiences as predictors of adolescent substance use. *American Journal of Drug and Alcohol Abuse*, *31*, 129-162.

Anderson, J. R. (1983). *The architecture of cognition*. Cambridge, MA: Harvard, University Press.

Annis, H. M. (1982). *Inventory of drinking situations*. Toronto: Addiction Research Foundation of Ontario.

Bower, G. H. (1981). Mood and memory. *American Psychologist*, *36*, 129-148.

Brown, S. A., Goldman, M. S., Inn, A., & Anderson, L. R. (1980). Expectations of reinforcement from alcohol: Their domain and relation to drinking patterns. *Journal of Consulting and Clinical Psychology*, *48*, 419–426.

Collins, A. M., & Loftus, E. (1975). A spreading activation theory of semantic processing. *Psychological Review*, *82*, 407-428.

Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment*, *6*, 117–28.

Cooper, M. L., Frone, M. R., Russell, M., & Mudar, P. (1995). Drinking to regulate positive and negative emotions: A motivational model of alcohol use. *Journal of Personality and Social Psychology*, *69*, 990–1005.

De Houwer, J. (2006). What are implicit measures and why are we using them. In R.W. Wiers & A.W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp. 11–28). Thousand Oaks, CA: Sage Publishers.

Efron, B., & Tibshyran, R. J. (1993). *An introduction to the bootstrap*. New York: Chapman and Hall.

Field, M., Mogg., K., Zetteler, J., & Bradley, B. P. (2004). Attentional bias for alcohol cues in heavy and light social drinkers: The role of initial orienting and maintaining attention. *Psychopharmacology*, *176*, 88-93.

Field, M., & Powell, H. (2007). Stress increases attentional bias for alcohol cues in social drinkers who drink to cope. *Alcohol*, *42*, 560-566.

Goldman, M. S., Del Boca, F. K., & Darkes, J. (1999). Alcohol expectancy theory: the application of cognitive neuroscience. In: K. E. Leonard, & H. T. Blane, (Eds.), *Psychological theories of drinking and alcoholism* (pp.203-246) 2nd ed. New York: Guilford

Greenwald, A. G., McGhee, D. E., & Schwartz, L. K. (1998). Measuring individual differences in implicit cognitions: The Implicit Association Test. *Journal of Personality and Social Psychology*, *74*, 1464-1480.

Grenard, J. L., Ames, S. L., Wiers, R. W, Thush. C., Sussman. S., & Stacy, A. W. (2008). Working memory capacity moderates the predictive effects of drug-related associations on substance use. *Psychology of Addictive Behaviors*, *22*, 423-423.

Hautzinger, M., Bailer M., Worall, H., & Keller, F. (1994). *Beck – Depression – Inventory* (*BDI*). Bern: Huber.

Houben, K., & Wiers, R. W. (2009). Response inhibition moderates the relationship between implicit associations and drinking behavior. *Alcoholism: Clinical and Experimental Research*, *33*, 626-633.

Kelly, A. B., Masterman, P. W., & Marlatt, G. A. (2005). Alcohol-related associative strength and drinking behaviours: Concurrent and prospective relationships. *Drug and Alcohol Review*, *24*, 489-498.

Kraemer, H. C., Kazdin, A. E., Offord, D. R, Kessler, R. C., Jensen, P. S., & Kupfer, D. J. (1997). Coming to terms with terms of risk. *Archives of General Psychiatry*, *54*, 337-343.

Krank, M. D., Schoenfeld. T., & Frigon, A. P. (2010). Self-coded indirect memory associations and alcohol and marijuana use in college students. *Behavior Research Methods*, *42*, 733-738.

Krank. M, D., & Wall, A.M. (2006). Context and retrieval effects on implicit cognition for substance abuse. In R. W. Wiers & A.W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp.281-292). Thousand Oaks, CA: Sage Publishers.

Krank, M., Wall, A. M., Stewart, S. H., Wiers, R. W., & Goldmann, M. S. (2005). Context effects on alcohol cognitions. *Alcoholism: Clinical and Experimental Research*, *29*, 196-206.

Koster, E. H. W., MacLeod, C., & Fox, E. (2009). Introduction to the special section on cognitive bias modification in emotional disorders. *Journal of Abnormal Psychology*, *118*, 1-4.

Loeber, S., Vollstadt-Klein, S., von der Goltz, C., Flor, H., Mann, K., & Kiefer, F. (2009). Attentional bias in alcohol-dependent patients: The role of chronicity and executive functioning. *Addictive Biology*, *14*, 194-203.

Marlatt, G. A. (1996). Taxonomy of high-risk situations for alcohol relapse: Evolution and development of a cognitive-behavioral model. *Addiction*, *91*, 37-49.

Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety. *Journal of Abnormal Psychology*, *109*, 602-615.

Mathews, A. & MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annual Review of Clinical Psychology*, *1*, 167-195.

Noël, X., Colmant, M., Van Der Linden, M., Bechara, A., Bullens, Q., Hanak, C., & Verbanck, P. (2006). Time course of attention for alcohol cues in abstinent alcohol patients: The role of initial orienting. *Alcoholism: Clinical and Experimental Research*, *30*, 1871-1877.

Reich, R. R., Below, M. C., & Goldman, M. S. (2010). Explicit and implicit measures of expectancy and related alcohol cognitions: A meta-analytic comparison. *Psychology of Addictive Behaviors*, *24*, 13–25.

Robins, L. N., Wing, J., Wittchen, H. U., Helzer, J. E., Babor, T. F., Burke, J.,… Towle, L. H. (1988). The Composite 454 International Diagnostic Interview: an epidemiologic instrument suitable for use in conjunction with different 455 diagnostic systems and in different cultures. *Archives of General Psychiatry*, *45*, 1069-1077.

Rooke, S. E., Hine, D. W., & Thorsteinsson, E. B. (2008). Implicit cognition and substance use: A meta-analysis. *Addictive Behaviors*, *33*, 1314-1328.

Salemink, E., van den Hout, M., & Kindt, M. (2007). Trained interpretive bias: Validity and effects on anxiety. *Journal of Behavior Therapy and Experimental Psychiatry*, *38*, 212-224.

Saunders, J. B., Aasland, O. G., Babor, T. F., De La Fuente, J. R., & Grant, M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction*, *88*, 791-804.

Stacy, A. W. (1995). Memory associations and ambiguous cues in models of alcohol and marijuana use. *Experimental and Clinical Psychopharmacology*, *3*, 183-194.

Stacy, A. W. (1997). Memory activation and expectancy as prospective predictors of alcohol and marijuana use. *Journal of Abnormal Psychology*, *106*, 61-73.

Stacy, A .W., Ames, S. L., & Grenard, J. L. (2006). Word association tests of associative memory and implicit processes: Theoretical and assessment issues. In R. W. Wiers & A. W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp.75-90). Thousand Oaks, CA: Sage Publishers.

Stacy, A. W., & Wiers, R. W. (2010). Implicit cognition and addiction: A tool for explaining paradoxical behavior. *Annual Review of Clinical Psychology*, *6*, 551-575.

Stewart, S. H., Hall, E., Wilkie, H., & Birch, C. D. (2002). Affective priming of alcohol schema in coping and enhancement motivated drinkers. *Cognitive Behaviour Therapy*, *31*, 68-80.

Thush, C., Wiers, R. W., Ames, S. L., Grenard, J. L., Sussman, S., & Stacy, A. W. (2007). Apples and oranges? Comparing indirect measures of alcohol-related cognition predicting alcohol use in at-risk adolescents. *Psychology of Addictive Behaviors*, *21*, 587–591.

Thush, C., Wiers, R. W., Ames, S. L., Grenard, J. L., Sussman, S., & Stacy, A. W. (2008). Interactions between implicit and explicit cognition and working memory capacity in the prediction of alcohol use in at-risk adolescents. *Drug and Alcohol Dependence*, *94*, 116-124.

Wiers, R. W., Bartholow, B. D., van den Wildenberg, E., Thush, C., Engels, R. C., Sher, K. J., Grenard, J., Ames, S. L., & Stacy, A. W. (2007). Automatic and controlled processes and the development of addictive behaviors in adolescents: A review and a model. *Pharmacology Biochemistry & Behavior*, *86*, 263-283.

World Health Organization (1992) *ICD-10 Classifications of Mental and Behavioural Disorder: Clinical Descriptions and Diagnostic Guidelines*. Geneva: World Health Organization.

Woud, M. L., Fitzgerald, D. A., Wiers, R. W., Rinck, M., & Becker, E. S. (2012). 'Getting into the spirit': Interpretation bias in heavy drinking students. *Psychology of Addictive Behaviors*, *26*, 627-632.

7

Does negative affect prime alcohol in alcohol-dependent inpatients? A large-scale clinical investigation of the moderating role of depression and executive control

ABSTRACT

The present study tested to what extent alcohol-related concepts are automatically activated by negative affective words. Participants were alcohol-dependent inpatients (n=847) and an inpatient control group (n=130). An affective priming task was used to assess the automatic activation of alcohol-related memory associations. Executive control was assessed with an adapted Stroop task. We expected alcohol-dependent inpatients to show enhanced alcohol activation after negative primes. In addition, we predicted that this enhanced negative priming effect would be further qualified by participants' levels of depressive symptoms. Finally, we expected the interaction between executive control and priming effect as well as the interaction between executive control, priming effect and depressive symptoms to be predictive for group membership. Results showed that alcohol-dependent inpatients did not show a priming effect by negative words, and this effect was not moderated by levels of depressive symptoms. Moreover, group membership was not predicted by the interaction between priming effect and executive control, nor by the interaction between priming effect, executive control and depressive symptoms. We conclude that these results are most likely due to the particular population we studied (i.e., inpatients instead of at-risk populations) and to features of the priming task (i.e., low reliability, part of a test battery).

This chapter is based on:
Woud, M. L., Wiers, R. W., Pawelczak, S., Becker, E. S., Lindenmeyer, J., & Rinck, M. (2013). Does negative affect prime alcohol in alcohol-dependent inpatients? A large-scale clinical investigation of the moderating role of depression and executive control. *Journal of Experimental Psychopathology*, *4*, 279-290.

INTRODUCTION

Different affective states may trigger alcohol consumption, for example, people drink in response to exciting, positive life events as well as in response to sad, negative life events. Drinking in response to negative affective states is particularly linked to problem drinking and/or psychopathological states of alcohol use (e.g., Carey & Correia, 1997; Cooper, 1994; Cunningham, Sobell, Sobell, Gavin, & Annis, 1995; Holahan, Moos, Holahan, Cronkite, & Randall, 2001). This is in line with negative reinforcement theories of addiction (e.g., Baker, Piper, McCarthy, Majeske, & Fiore, 2004; Koob & Le Moal, 2001), postulating that a reduction of negative affect is the major drinking motive in alcohol dependency. Other factors than heavy drinking and related problems may also contribute to the cue-eliciting power of negative affective cues, for example levels of psychiatric distress (Zack, Toneatto, & MacLeod, 1999). In the present study, we investigated the priming effect of negative affective stimuli on alcohol-related memory associations as well as potential moderators of this priming effect (i.e., levels of depressive symptoms and executive control). Previous studies mainly investigated risk populations, whereas the present study involved a large inpatient sample of alcohol-dependent inpatients and a control inpatient group.

Various paradigms have been used to assess alcohol-related memory associations, among them the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998), word association tasks (see Stacy, Ames, & Grenard, 2006), scenario-based approaches (Woud, Fitzgerald, Wiers, Rinck, & Becker, 2012), and sequential priming paradigms (e.g., semantic and affective priming tasks). Priming tasks involve the brief presentation of a prime stimulus (e.g., a word), followed by the presentation of a target stimulus requiring a response (e.g., categorization). The reaction time (RT) needed to respond to the target serves as an index of the 'associative match' between prime and target, i.e., the prime can either facilitate or slow down response latencies. To illustrate: If a problem drinker consistently consumes alcohol in response to negative affective states, an association between negative affect and alcohol is established. This association becomes stronger the more often this drinking pattern is repeated. Transferring this rationale to a priming task, a problem drinker should be faster to categorize alcohol-related targets when they are preceded by negative instead of positive affective primes. Negative reinforcement theories of addiction (e.g., Baker et al., 2004, Koob & Le Moal, 2001) support such a prediction, postulating that the reduction of negative affective states is the key drinking motive when it comes to addictive levels of alcohol consumption. Empirical support for this is provided by research on cue exposure, showing for example that a negative mood induction can increase a problem drinker's desire to consume alcohol (Litt, Cooney, Kadden, & Gaupp, 1990).

Several studies investigated negative affect priming effects as well as potential moderators of these effects, expecting a stronger reactivity to negative cues in individuals experiencing negative affective states on top of their alcohol abuse/misuse. Associative network accounts (e.g., Anderson, 1983; Bower, 1981; Collins & Loftus, 1975) provide the theoretical support for such an assumption. Like negative reinforcement theories, associative network accounts postulate that alcohol-related concepts can be automatically activated by negative cues. Moreover, these accounts postulate that mood-congruent cues can strengthen this activation. According to such a mood-memory-congruency perspective, negative affective states should thus lead to an even stronger negative priming effect. Empirical support for this assumption is provided by studies investigating the relation between personality traits and levels of alcohol use, for example, demonstrating that young drinkers scoring high on anxiety sensitivity, compared to those scoring low on anxiety sensitivity, tend to have higher levels of alcohol use when experiencing negative affective states (Samoluk & Stewart, 1998; Stewart, Carp, Pihl, & Peterson, 1997). Moreover, young drinkers with high levels of anxiety sensitivity also experience more alcohol-related problems (Samoluk & Stewart, 1998). Finally, results obtained in clinical samples show that alcohol abuse during negative affective states is more likely in dependent patients with a negative temperament (Cannon, Leeka, Patterson, & Baker, 1990).

Following the abovementioned predictions, the study by Zack, Poulos, Fragopoulos, and MacLeod (2003) used a verbal priming task to assess whether positive and/or negative word cues would automatically activate the concept 'alcohol' in young problem drinkers who scored either high or low on anxiety sensitivity. Results showed that primes related to negative but not positive mood states primed alcohol-related concepts. Furthermore, the negative priming effect did not vary as a function of anxiety sensitivity. However, the magnitude of the priming effect was related to the severity of alcohol-related problems (for related results, see Zack, Poulos, Fragopoulos, Woodford, & MacLeod, 2006). A similar study was executed in outpatient problem drinkers scoring high versus low on psychiatric distress (Zack et al., 1999). Here, alcohol-related concepts were primed by negative affective primes in problem drinkers with high but not low psychiatric distress.

In sum, these finding demonstrate that alcohol misuse/abuse is characterized by an enhanced activation of alcohol-related concepts when encountering negative affective primes. However, the magnitude of this priming effect seems to be conditional, i.e., can depend on a moderating variable (e.g., levels of psychiatric distress) and on the included sample (e.g., young problem drinkers vs. a sample of outpatient problem drinkers). As such, more research is needed to further disentangle the specific conditions of these priming effects. This is also important when considered from a clinical and

therapeutic perspective as there are observations demonstrating that relapse after successful treatment is frequently attributed to negative affective states (Marlatt, 1996), and that such negative states particularly precede severe and not mild relapses (Hodgins, el-Guebaly, & Armstrong, 1995).

Therefore, the first aim of the present study was to test whether alcohol-dependent inpatients show a negative priming effect. The second aim was to replicate findings by Zack et al. (1999). However, the present study tested whether participants' levels of depressive symptoms moderate the negative priming effect (measured via a translated version of the Beck Depression Inventory; BDI; Hautzinger, Bailer, Worall, & Keller, 1994). Moreover, unlike Zack et al. (1999), our study involved a very large sample of alcohol-dependent inpatients, plus a large inpatient control group. Finally, an Affective Priming Task (APT; Fazio, Sanbonmatsu, Powell, & Kardes, 1986) was used to assess alcohol-related memory associations because this task is a very adequate operationalization to test the automatic activation of memory associations. Alcohol and soft drinks words were used as targets, and words related to negative and positive affective states served as primes. In order to prevent participants from adopting conscious response strategies, and to enhance automatic processing of the primes, primes were presented for 300ms only (Neely, 1977; Posner & Snyder, 1975). We predicted that alcohol-dependent inpatients would show a negative priming effect, that is, faster categorization of alcohol targets when primed with negative affective cues. Second, we expected that alcohol-dependent inpatients scoring high on depressive symptoms would show a greater negative priming effect. Finally, in order to test the reliability of our findings, we also examined the internal validity of our priming task. According to Bosson, Swann, and Pennebaker (2000), priming effects can be unreliable and might produce small effects.

Our third aim was to investigate the moderating role of executive control (EC) in this context. This is motivated by recent theorizing postulating that deficits in EC over impulsive behaviors may be a risk and, most important in this context, also a consequence of an addiction (Koob & Volkow, 2010; Verdejo-Garcia et al., 2008; Winstanley, Olausson, Taylor, & Jentsch, 2010; de Wit, 2009). Findings obtained in risk samples support this view. Thush et al. (2008), for example, showed that automatic positive arousal associations were predictive of alcohol use 1 month later in participants with low levels of working memory capacity, but not in participants with high levels of working memory. Similar findings were reported by Houben and Wiers (2009), demonstrating that the relationship between automatic alcohol associations and alcohol use depended on participants' response inhibition abilities. While all of these studies involved non-clinical groups, their findings suggest that EC should also play an important role in alcohol misuse, and probably also in alcohol abuse. Therefore,

our third aim was to investigate whether group membership could be predicted by the interaction between EC (measured via an adapted version of the classical Stroop task; Stroop, 1935) and scores on the priming task. We expected those with a low level of EC and a strong negative priming effect to be in the group of alcohol dependent inpatients. Furthermore, we investigated the role of depression in this context, expecting that those with a low level of EC, a strong negative priming effect, and a high level of BDI to be in the group of alcohol-dependent inpatients.

METHOD

Participants

Participants were 977 inpatients from the salus clinic in Lindow, Germany. The sample's mean age was 46.1 years (SD = 8.4), including 674 males and 303 females. In the present sample, 847 participants met the criteria for alcohol dependence. The inpatient control group contained 130 patients, including patients with various psychological disorders: 60% were diagnosed with a mood disorder, 17% with an anxiety disorder, 14% with a psychosomatic disorder, and the final 9% included inpatients with, e.g., hypochondria and adaptation disorder. The control group did not include any inpatients who were diagnosed with a comorbid alcohol-related disorder. All inpatients received Cognitive Behavioral Therapy, whereby a few also received additional individualized treatments. The treatment duration for alcohol-dependent inpatients was approximately 3 months, while the control inpatients' treatment duration was about 4-5 weeks.[1]

Alcohol use and levels of hazardous drinking were assessed with the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993). As expected, alcohol-dependent inpatients (ADP) had significantly higher scores than control inpatients (CP), $t(975) = 37.34$, $p < .001$ (ADP: M = 25.6, SD = 7.0, range 8-40; CP: M = 2.7, SD = 1.8, range 1-7). Beck's Depression Inventory (BDI; Hautzinger et al., 1994) was used to assess symptoms related to depression. As expected, ADP had significantly lower scores than CP, $t(975) = 4.17$, $p < .001$ (ADP:

[1] In order to avoid miscategorization of participants, the present sample of n = 977 includes only alcohol-dependent inpatients whose AUDIT score was 8 or higher, and control inpatients whose score was lower than 8 (see Saunders et al., 1993). Regarding the BDI-II, participants were supposed to have a score of 1 or higher (across both groups). This selection criterion was applied after the priming data were merged with the questionnaire data (i.e., AUDIT and BDI). This sample only includes participants with complete data sets for both the priming task and the questionnaires.

M = 13.8, *SD* = 10.6, range 1-58; CP: *M* = 17.9, *SD* = 9.5, range 1-44). ADP were also slightly younger than CP, $t(975) = 2.41$, $p < .02$ (ADP: *M* = 45.9, *SD* = 8.5, range 18-72; CP: *M* = 47.8, *SD* = 7.2, range 26-63). Moreover, the two groups differed significantly regarding the distribution of male and female participants, $\chi^2(1) = 72.06$, $p < .001$ (626 males and 221 females among the ADP vs. 48 males and 82 females among the CP, see also Table 1).

Table 1. Participant characteristics for alcohol-dependent inpatients and control inpatients.

	Patient Group	
	Alcohol-dependent Inpatients (n = 847, 626 males)	Control inpatients (n = 130, 48 males)
Measure	*M (SD)*	*M* (*SD*)
Age	45.9 (8.5)	47.8 (7.2)
AUDIT	25.6 (7.0)	2.7 (1.8)
BDI	13.8 (10.6)	17.9 (9.5)

Note: AUDIT: Alcohol Use Disorders Identification Test, BDI: Beck Depression Inventory

Affective Priming Task (APT; Fazio et al., 1986)

During the APT, participants were asked to categorize target words into whether they denoted alcoholic drinks or soft drinks. Six alcohol targets (beer, wine, liquor, vodka, whiskey, rum) and 6 soft drink targets (Coke, Fanta, orange juice, apple juice, water, Pepsi) were used. Participants were instructed to look at the prime but to only react to target words, respectively. Furthermore, it was explained that targets should be categorized as quickly as possible into the correct category (alcohol or soft drink). For that purpose, two keys were marked on a computer keyboard, representing the two categories. If participants categorized a target word incorrectly or if they did not react at all within 5 seconds, an error message was presented. Immediately before a target word appeared, a prime word was presented for 300 ms. The primes described 6 positive and 6 negative affective states (positive: relaxed, cheerful, jolly, funny, comical, happy; negative: stressed, bored, anxious, insecure, lonely, unhappy), respectively.[2] This yielded four prime-target combinations: alcohol target preceded by positive or negative prime, and soft drink target preceded by positive or negative prime. Each prime preceded

[2] Please note that for convenience, we use the terms 'positive primes' and 'negative primes' from now on.

each target once, resulting in a total of 144 test trials per participant, preceded by 12 practice trials. Here, each target appeared once, preceded by a task-unrelated prime (i.e., man, woman, child, kitchen, bread, beverage).

Stroop task (Stroop, 1935)

An adapted version of the classical color-interference Stroop task (Stroop, 1935) was used to measure executive control. During the Stroop task, participants were asked to categorize stimuli that appeared on the screen according to their print color. Again, participants were instructed to react as quickly and as accurately as possible, and an error message was presented following incorrect categorization. There were 4 print colors regarding the to-be-categorized stimuli, namely yellow, green, red and blue. Each color was represented by a key on the keyboard, and participants gave their answer by pressing the key that represented the stimulus' print color. The Stroop included 2 types of blocks, i.e., neutral blocks and incompatible blocks. During neutral blocks, a meaningless, colored string of XXXX was presented. During incompatible blocks, 4 word stimuli were shown (i.e., 'yellow', 'green', 'red' and 'blue'). However, these were 'color-incongruent words', i.e., the word's meaning never matched its print color (e.g., the word 'yellow' was printed in green, red, or blue color, but never in yellow). All neutral and incompatible blocks comprised 6 trials each. There were 4 neutral and 4 incompatible blocks, respectively, resulting in a total of 4 x 6 = 24 trials per block type. As such, all X strings and all word stimuli appeared equally often in all 4 colors across the Stroop task. Neutral and incompatible blocks were presented in an alternating order, starting with a baseline block. The Stroop also contained 8 so-called 'dummy trials' during which the word stimulus 'color' was shown twice in each print color. Two such dummy trials were shown at the very beginning of the Stroop, and then were presented at the end of each block to precede the switch between block types. In sum, the Stroop task thus included a total of 24 + 24 + 8 = 56 trials.

Procedure

According to the procedures of the German rehabilitation system, patients who apply for inpatient treatment are extensively diagnosed by either a specialized practitioner or an addiction counsellor. All applicants are then checked for their diagnosis and treatment needs by the medical department of the German Pension Fund to be eligible for inpatient treatment. All inpatients included in the present sample underwent this procedure. Within the first week after arrival, a participant's diagnosis was re-checked by

his/her therapist. This was based on criteria as formulated in the International Statistical Classification of Diseases (ICD-10; WHO, 1992) and also included administration of the AUDIT (Saunders et al., 1993). In addition, some participants completed the computerized version of the Composite International Diagnostic Interview (CIDI; Robins et al., 1988). During this first week, participants also completed the Stroop task and the APT. Both were parts of a larger computerized test battery. This test battery was implemented as a standard diagnostic instrument which participants complete before starting their treatment at the clinic. All participants were detoxificated at that moment. The study had the necessary IRB approvals.

RESULTS

Affective Priming Task (APT)

We corrected for the effects of potential outliers by computing the median reaction time (RT) of each participant per prime-target combination (minimum RT to be included in aggregation: 150 ms). Next, we computed a priming score for alcohol pictures (RT negative-alcohol minus RT positive-alcohol). Negative scores indicate that alcohol was primed by negative words more than by positive ones. The same score was computed for soda pictures (RT negative-soda minus RT positive-soda). Again, negative scores indicate that soda was primed by negative words more than by positive ones. Then we computed an overall priming score by subtracting the soda score from the alcohol score. Here, negative values indicate that negative words primed alcohol more strongly than they primed soda. Despite using the median, however, a few participants had extreme outliers among their priming scores. Hence, we excluded 19 participants whose score deviated more than 3 SD from the group's mean score. This sample was then checked for influential data points (Cook's distance), however, no such points were identified. The mean error score of the remaining 958 participants was low, $M = .01$ ($SD = .02$).

To test the predictions that 1) alcohol-dependent inpatients show an enhanced negative priming effect, and 2) that this negative priming effect is qualified by participants' level of depressive symptoms, we performed a hierarchical regression analysis. The priming score served as the dependent variable. As predictors, we entered Group (ADP, CP), BDI, Gender, Age (Step 1), and the interaction of Group x BDI (Step 2). All variables were standardized before inclusion in the analysis, and interaction terms were computed from these standardized scores (Aiken & West, 1991). Step 1 of the hierarchical regression analysis of the priming effect was not significant, $R^2 = .005$,

$F(4, 953) = 1.08$, $p = .36$, and none of the predictors were significant either. Hence, there was no difference in priming effect between alcohol-dependent inpatients and controls. Step 2 of the hierarchical regression analysis was not significant either: $R^2 = .005$, $F(5, 952) = .9$, $p = .48$, and again none of predictors were significant.

Stroop task

Our third aim addressed the question whether group membership could be predicted by the interaction between executive control (EC; i.e., Stroop difference scores) and scores on the priming task, and/or by the interaction between EC, priming task and level of depressive symptoms (i.e., BDI scores).

For the Stroop reaction times, we again calculated median scores per participant (minimum RT to be included in aggregation: 150 ms). Data of 4 participants were missing. Moreover, we excluded 13 participants because their Stroop scores deviated more than 3 SD from the group's mean score. Nine additional participants were excluded due to high error rates (more than 20%). The mean error rate of the remaining 825 participants was $M = .02$ ($SD = .03$). The expected Stroop effect was observed in both groups, i.e., slower RTs for incompatible color words than for neutral XXX strings: alcohol-dependent inpatients: $t(824) = 31.24$, $p < .001$ (incompatible: $M = 1236$, $SD = 289$, neutral: $M = 1018$, $SD = 205$), control inpatients: $t(125) = 14.58$, $p < .001$ (incompatible: $M = 1325$, $SD = 335$, neutral: $M = 1009$, $SD = 210$).

Next, we calculated an index of EC by subtracting RTs of incompatible color words from RTs of neutral strings. As such, a negative Stroop score implies slower RTs on incongruent color words, i.e., weaker EC. As a first step, we examined the relationship between EC, priming, age, level of hazardous drinking (i.e., AUDIT scores) and depressive symptoms (i.e., BDI scores). We analyzed this for the entire inpatient group as well as for the two groups separately. Regarding the outcome of the analysis across the entire group: As Table 2 shows, there was a significant and negative correlation between EC and age, such that higher levels of EC were associated with being older. Furthermore, EC was significantly and positively correlated with AUDIT scores, implying that lower levels of EC were associated with higher levels of hazardous drinking. For alcohol-dependent inpatients alone, we only found a significant correlation between EC and age, and the direction of this correlation was the same as that of the entire group (i.e., higher levels of EC were associated with being older). For control inpatients, EC was significantly and negatively correlated with BDI scores, such that lower levels of EC were associated with higher levels of depressive symptoms.

Table 2. Correlations of Stroop interference score with priming difference score, AUDIT, BDI, and age.

	Stroop Interference		
	Total inpatient group (n = 933)	Alcohol-Dependent inpatients (n = 812)	Control inpatients (n = 121)
Priming difference score	.02	.03	-.07
AUDIT	.10**	-.04	.03
BDI	-.03	.02	-.21*
Age	-.10**	-.10*	-.07

Calculation difference score priming task: (RT negative-soda - RT positive-soda) - (RT negative-alcohol - RT positive-alcohol). Calculation difference score Stroop: (RT XXX string) – (RT incongruent color words). Interpretation significances: * $p < .05$, ** $p < .01$

As a second step, we examined whether group membership (ADP vs. CP) could be predicted by means of the interaction between EC and priming, and/or by the interaction between EC, priming and BDI. Group membership served as the dependent variable. As predictors, we entered Stroop, priming and BDI (Step 1), the interactions of Stroop x priming, Stroop x BDI, and priming x BDI (Step 2), and the interaction of priming x Stroop x BDI (Step 3). Again, all variables were standardized before inclusion in the analysis, and interaction terms were computed from these standardized scores.[3] Regarding the interaction of interest in Step 2, i.e., Stroop x priming, we found that this predictor was not significant (B = -.1, SE = .09, p = .3, $Exp(B)$ = .91). Furthermore, the three-way interaction of Step 3, i.e., Stroop x priming x BDI, was not significant either, (B = -.06, SE = .11, p = .61, $Exp(B)$ = .95).

Internal validity of the Affective Priming Task

In order to examine the internal validity of the priming task, we calculated mean scores for both targets types (i.e., alcohol and soft drink) per prime word, yielding 12 scores per target type (i.e., 6 negative and 6 positive scores for alcohol targets, and 6 negative and 6 positive scores for soft drink targets). Next, we computed 6 difference scores for each target type by subtracting positive scores from negative scores. This yielded 12 difference scores, and these difference score were entered into the analysis of internal validity, which revealed a low value: Cronbach's α = .16.

[3] For the sake of brevity, we only report the outcomes of main interest. In addition, these are the significance values of the predictors in Step 1: Stroop: B = -.43, SE = .09, $p < .001$, $Exp(B)$ = .66; priming: B = -.12, SE = .1, p = .21, $Exp(B)$ = .88; BDI: B = -.36, SE = .09, $p < .001$, $Exp(B)$ = 1.43.

DISCUSSION

The present study was designed to test to what extent negative affective words would automatically activate alcohol-related concepts in (a subgroup of) alcohol-dependent inpatients. Participants were a large sample of alcohol-dependent inpatients and an inpatient control group. An affective priming task (Fazio et al., 1986) was used to measure automatic alcohol activation. Levels of executive control (EC) were assessed by an adapted version of the Stroop task (Stroop, 1935). We expected alcohol-dependent inpatients, compared to control inpatients, to show an enhanced negative priming effect. In addition, we expected this negative priming effect to be strongest for those dependent inpatients who scored high on depressive symptoms. Third, we expected those with low levels of EC and a strong negative priming effect, and in particular those with low levels of EC, a strong negative priming effect and high levels of depressive symptoms, to be in the group of alcohol-dependent inpatients.

Regarding the first hypothesis, we did not find a negative priming effect in alcohol-dependent inpatients, that is, compared to control inpatients, they were not faster to categorize alcohol targets when being primed with negative affective words. This is not in line with negative reinforcement theories of addiction (e.g., Baker et al., 2004; Koob & Le Moal, 2001). These theories put forward that the reduction of negative affective states is the most prominent drinking motive in alcohol dependency, so expecting a negative priming effect to occur in alcohol-dependent inpatients is a plausible deduction. The most parsimonious explanation of our null finding may be the rather low reliability of the priming task. According to Bosson et al. (2000), priming effects can be unreliable and instable. In fact, the present negative finding nicely aligns with a recent call by Kahneman (2012) to critically re-test previous priming results. Second, there is evidence that alcohol-dependent inpatients can hold both negative and positive drinking motives (e.g., Faber, Khavari, & Douglass, 1980; Ooteman, Koeter, Verheul, Schippers, & van den Brink, 2006). Hence, positive as well as negative affective primes could have activated alcohol-related memory associations. As such, the affective priming task may not have been sensitive enough to disentangle these effects.

Second, levels of depressive symptoms did not moderate the expected negative priming effect. According to associative network accounts (e.g., Anderson, 1983; Bower, 1981; Collins & Loftus, 1975), however, one would have expected such a moderation, as levels of depressive symptoms could be regarded as a mood-congruent cue that enhances the negative priming effect. When trying to explain this null result, it might be worthwhile to compare the present study with that of Zack et al. (1999). Zack and colleagues applied a lexical decision task in outpatient problem drinkers scoring high versus low

on psychiatric distress, and they found a negative priming effect in problem drinkers who scored high on psychiatric distress. A difference that may account for our contradictive findings is that Zack et al.'s (1999) sample included outpatient problem drinkers, and not all of them met the criteria for alcohol dependency. Our sample included alcohol-dependent inpatients suffering from a long history of dependency. According to Ooteman et al. (2006), drinking motives can change during the course of an alcohol dependency, so it is likely that individuals have distinctive drinking motives during early stages of their dependency, but then have both positive and negative drinking motives at a later stage. According to this perspective, it may have been the case that Zack et al.'s (1999) sample held mainly negative drinking motives whereas our clinical sample held both positive and negative drinking motives. Another difference between the studies lies in the primes that were used. Zack and colleagues used negative and neutral primes, whereas we used negative and positive primes. In case participants indeed held both negative and positive drinking motives, our setup may have made it impossible to find distinct priming effects. Third, Zack et al.'s (1999) priming task had more trials than ours (320 versus 144), so maybe a task with more trials may have revealed the expected effects. Fourth, Zack et al. (1999) included extra instructions making sure participants processed the primes (i.e., participants were asked to read each prime silently). We only instructed participants to look at the primes, making it possible that our participants did not pay enough attention to them. Finally, Zack et al. (1999) used the Symptom Checklist-90 (SCL-90; Slater & Linn, 1982) to classify participants. In addition, prime stimuli were derived from the SCL-90, including word primes that referred to symptoms ranked highest by problems drinkers scoring high on psychiatric distress (Zack, Toneatto, & Streiner, 1998). We classified our sample based on depressive symptoms (by means of the BDI; Hautzinger et al., 1994) and used primes that referred to rather general negative affective states. Maybe our classification was too specific, and our primes too general, suggesting that a close match between the participant's negative symptoms and the type of prime words is a crucial.

The third prediction concerned the moderating role of executive control (EC). Here, we expected the interaction between EC and priming to be predictive for participants' group membership. In addition, we expected participants' levels of depressive symptoms to further qualify this interaction, i.e., those with low levels of EC, a strong negative priming effect, and high scores on the BDI should belong to the group of alcohol-dependent inpatients. Results demonstrated that none of the two predictions were confirmed. This is in contrast to recent theorizing which postulates that deficits in EC are one of the main consequences of alcohol abuse (e.g., Bechara & Martin, 2004, Koob & Volkow, 2010; Noël et al., 2005; Verdejo-Garcia et al., 2008; Winstanle et al., 2010; de Wit, 2009; and for similar elaborations, see Wiers et al., 2007). Finding a

positive correlation between EC and age in the group of alcohol-dependent inpatients (as well as across the entire group) is an additional contradiction here. An explanation may lie in the adapted version of the classical Stroop task we used during which participants reacted by means of keys that were assigned to the 4 print colors. This version has been successfully used in other studies (e.g., Houben & Wiers, 2009). However, it may have produced an additional load for our inpatients (i.e., keeping in mind the key assignment) which may have affected the assessment of the intended concept (i.e., color-word interference) in a negative manner. Finally, according to Miyake, Friedman, Emerson, Witzki, and Howerter (2000), executive control is not a unitary concept and can be divided into three distinctive abilities (i.e., response inhibition, working memory updating, and mental set shifting). Hence, though highly speculative, finding EC to be a moderator in this context may have required a much more focused approach, e.g., by using the stop-signal task (Logan, 1994) tapping into the concept of response inhibition, or the Self-Ordered Pointing Task (SOPT; Petrides & Milner, 1982) tapping into working memory capacities, a task which has also been successfully used to assess moderation effects in non-dependent participants (Grenard et al., 2008; Thush et al., 2008). Finally, patients suffering from depression and/or anxiety disorders also show deficits in EC (e.g., Austin, Mitchell, & Goodwin, 2001; Beaudreau, & O'Hara, 2008; Kaiser et al., 2003; Micco et al., 2009; Trichard et al., 1995). In our data, this is reflected by the negative correlation between Stroop scores and levels of depressive symptoms. As such, EC may not have been the most differentiating variable.

In sum, our findings do not support our predictions derived from the present empirical and theoretical state of affairs. However, our null findings are clearly not a result of insufficient sample size, as both our dependent and control inpatient samples were unusually large. Moreover, due to our selection criteria on AUDIT and BDI, we defined our groups as clearly as possible. However, a limitation of the present study is that both the priming task and the Stroop task were part of a larger test battery which included other computerized tasks to measure cognitive processes related to alcohol and executive control, implying that carry-over effects may have affected our results in an unfortunate manner. Hence, replicating the present study with both tasks administered in a single session seems worthwhile. The application of a more reliable paradigm to assess priming effects is another recommendation, and implementing a manipulation that guarantees a thorough processing of the affective primes may be crucial, too. In student samples, for example, mood induction procedures have been applied quite successfully when studying cognitive processes related to the automatic activation of alcohol-related concepts (Birch et al., 2008; Grant, Stewart, & Birch, 2007).

To conclude, the present study was designed to identify boundary conditions of the automatic activation of alcohol-related memory associations by affective words in a clinical population of alcohol-dependent inpatients. Results showed that none of our expectations were confirmed. The main reason for this may be found in the particular population we studied: Previous studies mainly involved risk samples, whereas we tested alcohol-dependent inpatients. Second, features of the affective priming task may be responsible for the observed null effects, namely its low reliability and the fact that it was part of a larger test battery. However, the identification of risk factors for developing and maintaining an alcohol dependency is of great clinical and societal importance. Therefore, the general recommendation for future research is to systematically apply optimized methods in different populations to further advance our understanding of the impact of negative affect on the automatic activation of alcohol-related concepts.

REFERENCES

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Thousand Oaks, CA: US.

Anderson, J. R. (1983). *The architecture of cognition*. Cambridge, MA: Harvard University Press.

Austin, M. P., Mitchell, P., & Goodwin, G. M. (2001). Cognitive deficits in depression: possible implications for functional neuropathology. *British Journal of Psychiatry*, *178*, 200-206.

Baker, T. B., Piper, M. E., Fiore, M. C., McCarthy, D. E., & Majeskie, M. R. (2004). Addiction motivation reformulated: An affective processing model of negative reinforcement. *Psychological Review*, *111*, 33-51.

Beaudreau, S. A., & O'Hara, R. (2008). Late-life anxiety and cognitive impairment: A review. *American Journal of Geriatric Psychology*, *16*, 790-803.

Bechara, A., & Martin, E. M. (2004). Impaired decision making related to working-memory deficits in individuals with substance addictions. *Neuropsychology*, *18*, 152-162.

Birch, C. D., Stewart, S. H., Wiers, R. W., Klein, R. M., MacLean, A. D., & Berish, M. J. (2008). The mood-induced activation of implicit alcohol cognition in enhancement and coping motivated drinkers. *Addictive Behaviors*, *33*, 565-81.

Bosson, J. K., Swann, W. B., & Pennebaker, J. W. (2000). Stalking the perfect measure of implicit self-esteem: the blind men and the elephant revisited? *Journal of Personality and Social Psychology*, *79*, 631-643.

Bower, G. H. (1981). Mood and memory. *American Psychologist*, *36*, 129-148.

Cannon, D. S., Leeka, J. K., Patterson, E. T., & Baker, T. B. (1990). Principal components analysis of the Invenory of Drinking Situations: empirical categories of drinking by alcoholics. *Addictive Behaviors*, *15*, 265-269.

Carey, K. B., & Correia, C. J. (1997). Drinking motives predict alcohol-related problems in college students. *Journal of Studies on Alcohol*, *58*, 100-105.

Cooper, M. L. (1994). Motivations for alcohol use among adolescents: development and validation of a four-factor model. *Psychological Assessment*, *6*, 117- 128.

Collins, A. M., & Loftus, E. F. (1975). A spreading activation theory of semantic processing. *Psychological Review*, *82*, 407-428.

Cunningham, J. A., Sobell, M. B., Sobell, L. C., Gavin, D. R., & Annis, H. M. (1995). Heavy drinking and negative affective situations in a general population and a treatment sample: alternative explanations. *Psychology of Addictive Behaviors*, *9*, 123-127.

De Wit, H. (2009). Impulsivity as a determinant and consequence of drug use: a review of underlying processes. *Addictive Biology*, *14*, 22–31.

Farber, P. D., Khavari, K. A., & Douglas, F. M. (1980). A factor analytic study of reasons for drinking: empirical validation of positive and negative reinforcement dimension. *Journal of Consulting and Clinical Psychology*, *48*, 780-781.

Fazio, R. H., Sanbonmatsu, D. M., Powell, M. C., & Kardes, F. R. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology*, *50*, 229 – 238.

Grant, V. V., Stewart, S. H., & Birch, C. D. (2007). Impact of positive and negative mood on implicit alcohol-related cognitions in internally motivated undergraduate students. *Addictive Behaviors*, *32*, 2226-2237.

Greenwald, A. G., McGhee, D. E., & Schwartz, L. K. (1998). Measuring individual differences in implicit cognitions: The Implicit Association Test. *Journal of Personality and Social Psychology*, *74*, 1464-1480.

Grenard, J. L., Ames, S. L., Wiers, R. W., Thush, C., Sussman. S., & Stacy, A. W. (2008) Working memory capacity moderates the predictive effects of drug-related associations on substance use. *Psychology of Addictive Behaviors*, *22*, 423-423.

Hautzinger, M., Bailer, M., Worall, H. & Keller, F. (1994). *Beck-Depressions Inventar (BDI)*. Bern: Huber.

Hodgins, D. C., el-Guebaly, N., & Armstrong, S. (1999). Prospective an retrospective reports of mood states before relapse to substance use. *Journal of Consulting and Clinical Psychology*, *63*, 400-407.

Holahan, C. J., Moss, R. H., Holahan, C. K., Cronkite, R. C., & Randall, P. (2001). Drinking to cope, emotional distress and alcohol use and abuse: a ten-year model. *Journal of Studies on Alcohol*, *62*, 190-198.

Houben, K., & Wiers, R. W. (2009). Response inhibition moderates the relationship between implicit associations and drinking behavior. *Alcoholism: Clinical and Experimental Research*, *33*, 626-633.

Kahneman, D. (2012, September 26). Subject: A proposal to deal with questions about priming effects. Retrieved from http://www.nature.com/polopoly_fs/7.6716.1349271308!/suppinfoFile/Kahneman%20Letter.pdf

Kaiser, S., Unger, J., Kiefer, M., Markelaa, J., Mundta, C., & Weisbroda, M. (2003). Executive control deficit in depression: Event-related potentials in a Go/Nogo task. *Psychiatry Research: Neuroimaging*, *122*, 169-184.

Koob, G. F., & Le Moal, M. (2001). Drug addiction, dysregulation of reward, and allostasis. *Neuropsychopharmacology*, *24*, 97- 129.

Koob, G. F., & Volkow, N. D (2010). Neurocircuitry of Addiction. *Neuropsychopharmacology Reviews*, *35*, 217–238

Litt, M. D., Cooney, N. L., Kadden, R. M., & Gaupp, L. (1990). Reactivity to alcohol cues and induced moods in alcoholics. *Addictive Behaviors*, *15*, 137-146.

Logan, G. D. (1994). On the ability to inhibit thought and action: A user's guide to the stop signal paradigm. In R. W. Dagenbach & T. H. Carr (Eds.), In *Inhibitory Processes in Attention, Memory, and Language* (pp 189–239). San Diego: Academic Press.

Marlatt, G. A. (1996). Taxonomy of high-risk situations for alcohol relapse: Evolution and development of a cognitive-behavioral model. *Addiction*, *91*, 37-49.

Micco, J. A., Henin, A. H., Biederman, J., Rosenbaum, J. F., Petty, C., Rindlaub, L. A., Murphy, M., & Hirshfeld-Becker, D. R. (2009). Executive functioning in offspring at risk for depression and anxiety. *Depression and Anxiety*, *9*, 780-790.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, *41*, 49–100.

Neely, J. H. (1977). Semantic priming and retrieval from lexical memory: Roles of inhibitionless spreading activation and limited-capacity attention. *Journal of Experimental Psychology: General*, *106*, 226-254.

Noël, X., Van der Linden, M., d'Acremont, M., Colmant, M., Hanak, C., Pelc, I., Verbanck, P., & Bechara, A. (2005). Cognitive biases toward alcohol-related words and executive deficits in polysubstance abusers with alcoholism. *Addiction*, *100*, 1302-1309.

Ooteman, W., Koeter, M., Verheul, R., Schippers, G., & van den Brink, W. (2006). Development and validation of the Amsterdam Motives for Drinking scale (AMDS): an attempt to distinguish relief and reward drinkers. *Alcohol & Alcoholism*, *41*, 284-292.

Petrides, M., & Milner, B. (1982). Deficits on subject-ordered tasks after frontal- and temporal-lobe lesions in man. *Neuropsychologia*, *20*, 249–262.

Posner, M. L., & Snyder, C. R. R. (1975). Facilitation and inhibition in the processing of signals. In P. M. A. Rabbitt & S. Dornie (Eds.), *Attention and performance: V* (pp.669-682). New York: Academic Press.

Robins, L. N., Wing, J., Wittchen, H. U., Helzer, J. E., Babor, T. F., Burke, J.,… Towle, L. H. (1988). The Composite International Diagnostic Interview: An epidemiologic instrument suitable for use in conjunction with different diagnostic systems and in different cultures. *Archives of General Psychiatry*, *45*, 1069-1077.

Samoluk, S. B., & Stewart, S. H. (1998). Anxiety sensitivity and situation-specific drinking. *Journal of Anxiety Disorders*, *12*, 407-419.

Saunders, J. B., Aasland, O. G., Babor, T. F., De La Fuente, J. R., & Grant, M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction*, *88*, 791-804.

Slater, E. J., & Linn, M. W. (1982). Predictions of rehospitalization in a male alcoholic population. *American Journal of Drug and Alcohol Abuse*, *9*, 211-220.

Stacy, A. W., Ames, S. L., & Grenard, J. L. (2006). Word association tests of associative memory and implicit processes: theoretical and assessment issues. In R. W. Wiers & A. W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp.75-90). Thousand Oaks, CA: Sage Publishers.

Stewart, S. H., Carp, J., Pihl, R. O., & Peterson, R. A. (1997). Anxiety sensitivity and self-reported reasons for drug use. *Journal of Substance Abuse*, *9*, 223-240.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, *18*, 643–661.

Thush, C., Wiers, R. W., Ames, S. L., Grenard, J. L., Sussman, S., & Stacy, A. W. (2008). Interactions between implicit and explicit cognition and working memory capacity in the prediction of alcohol use in at-risk adolescents. *Drug and Alcohol Dependence*, *94*, 116-124.

Trichard, C., Martinot, J. L., Alagille, M., Masure, M. C., Hardy, P., Ginestet, D., & Feline, A. (1995). Time course of prefrontal lobe dysfunction in severely depressed in-patients: a longitudinal neuropsychological study. *Psychological Medicine*, *25*, 79–85

Verdejo-García, A., Lawrence, A. J., & Clark, L. (2008). Impulsivity as a vulnerability marker for substance-use disorders: Review of findings from high-risk research, problem gamblers and genetic association studies. *Neuroscience Biobehavioral Review*, *32*, 777-810.

World Health Organization (1992). ICD-10 *Classifications of Mental and Behavioural Disorder: Clinical Descriptions and Diagnostic Guidelines*. Geneva: World Health Organization.

Wiers, R. W., Bartholow, B. D., Van den Wildenberg, E., Thush, C., Engels, R. C. M. E., Sher, K. J., Grenard, J., Ames, S. L., & Stacy, A. W. (2007). Automatic and controlled processes and the development of addictive behaviors in adolescents: A review and a model. *Pharmacology, Biochemistry and Behavior*, *86*, 263-283.

Winstanley, C. A., Olausson, P., Taylor, J. R., & Jentsch, J. D. (2010). Insight into the relationship between impulsivity and substance abuse from studies using animal models. Alcoholism: *Clinical and Experimental Research*, *34*, 306–1318.

Woud, M. L., Fitzgerald, D. A., Wiers, R. W., Rinck, M., & Becker, E. S. (2012). 'Getting into the spirit': Interpretation bias in heavy drinking students. *Psychology of Addictive Behaviors*, *26*, 627-632.

Zack, M., Poulos, C. X., Fragopoulos, F., & MacLeod, C. M. (2003). Effects of negative and positive mood phrases on priming of alcohol words in young drinkers with high and low anxiety sensitivity. *Experimental and Clinical Psychopharmacology*, *11*, 176-185.

Zack, M., Poulos, C. X., Fragopoulos, F., Woodford, T. M., & MacLeod, C. M. (2006). Negative affect words prime beer consumption in young drinkers. *Addictive Behaviors*, *31*, 169- 173.

Zack, M., Toneatto, T., & MacLeod, C. M. (1999). Implicit activation of alcohol concepts by negative affective cues distinguishes between problem drinkers with high and low psychiatric distress. *Journal of Abnormal Psychology*, *108*, 518- 531.

Zack, M., Toneatto, T., & Streiner, D. L. (1998). The SCL-90 factor structure in comorbid substance abusers. *Journal of Substance Abuse*, *10*, 85-101.

8

Don't panic: Interpretation bias is predictive of new onsets of panic disorder

ABSTRACT

Psychological models of panic disorder postulate that interpretation of ambiguous material as threatening is an important maintaining factor for the disorder. However, demonstrations of whether such a bias predicts onset of panic disorder are missing. In the present study, we used data from the Dresden Prediction Study, in which an epidemiologic sample of young German women was tested at two time points approximately 17 months apart, allowing the study of biased interpretation as a potential risk factor. At time point one, participants completed an Interpretation Questionnaire including two types of ambiguous scenarios: panic-related and general threat-related. Analyses revealed that a panic-related interpretation bias predicted onset of panic disorder, even after controlling for two established risk factors: anxiety sensitivity and fear of bodily sensations. This is the first prospective study demonstrating the incremental validity of interpretation bias as a predictor of panic disorder onset.

This chapter is based on:
Woud, M. L., Zhang, X. C., Becker, E. S., McNally, R. J., & Margraf, J. (2014). Don't panic: Interpretation bias is predictive of new onsets of panic disorder. *Journal of Anxiety Disorders*, *28*, 83-87.

INTRODUCTION

A pounding heart, hot flashes, lightheadedness – these could merely be signs that one is falling in love. However, individuals suffering from panic disorder often interpret these bodily sensations as signifying an imminent catastrophe such as a heart attack. Psychological models of panic disorder postulate that such biased interpretations serve to maintain the disorder (e.g., Beck, Emery, & Greenberg, 1985; Clark, 1986; McNally, 1994). In particular, these models postulate that patients suffering from a panic disorder automatically interpret bodily sensations as threatening, inciting a vicious circle that can culminate in panic.

Modifying a measure by Butler and Mathews (1983), McNally and Foa (1987) developed an Interpretation Questionnaire containing ambiguous scenarios that were panic-related or panic-unrelated. They found that patients suffering from agoraphobia and panic interpreted panic-related scenarios as threatening more often than did treated agoraphobia/panic patients and healthy control subjects. Other investigators replicated and extended these findings. Harvey, Richards, Dziadosz, and Swindell (1993) found that relative to social phobia patients and healthy control subjects, panic patients exhibited an interpretation bias specific for the ambiguous panic scenarios, whereas both anxiety groups exhibited a threatening interpretation bias for the panic-unrelated scenarios. Results of Clark et al. (1997) further clarified this issue, demonstrating that patients suffering from panic disorder are more likely to believe their (biased) interpretations compared to other anxiety patients and healthy controls. Finally, Rosmarin, Bourque, Antony, and McCabe (2009) showed that panic patients exhibited a self-referential, not a global interpretation bias for threat.

Extending this work, Teachman, Smith-Janik, and Saporito (2007) studied the role of dysfunctional panic-related interpretations by combining a scenario based assessment with a reaction time (RT) based assessment. The scenario based assessment (Brief Body Sensation Questionnaire, BBSQ; Clark et al., 1997) included ambiguous panic-related scenarios as well as ambiguous scenarios describing generally threatening situations. The RT assessment involved the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998), a computerized categorization task using RTs as indices for the strength of memory associations. The IAT results showed that panic patients, compared to healthy controls, had stronger associations of concepts related to the self and panic.[1] The BBSIQ results showed a panic-related interpretation bias in patients, but not in healthy subjects.

[1] Please see Teachman et al. (2007) for outcomes of a second IAT assessing different panic-related associations.

It remains unclear whether this interpretation bias is a consequence of panic disorder or a predictor, and possible causal risk factor, for the disorder (Kraemer et al., 1997). To (partly) investigate this question, Schneider, Unnewehr, Florin, and Margraf (2002) administered the Anxiety Interpretation Questionnaire for Children (AIQ-C), based on McNally and Foa's Interpretation Questionnaire, to children of panic patients, children of parents with animal phobia, and children of healthy subjects. The AIQ-C included three types of ambiguous scenarios, i.e., descriptions of panic-related and panic-unrelated body sensations as well as animal-related situations. Results demonstrated that children of parents who suffered from a panic disorder exhibited a panic-related interpretation bias, but only after they had been primed with panic-relevant but not with panic-irrelevant material.

Another way to investigate this issue is to study people who are at risk of developing panic disorder. For example, cross-sectional and longitudinal research shows that anxiety sensitivity predicts the onset of panic attacks (e.g., Cox, Endler, Swinson, & Norton, 1991; Schmidt, Lerew, & Jackson, 1997) and anxiety disorders (Schmidt, Zvolensky, & Maner, 2006). Hence, examining panic-related interpretation biases in people scoring high on anxiety sensitivity may provide valuable information. Teachman (2005) found that individuals high on anxiety sensitivity exhibited a panic-related interpretation bias (see also Richards, Austin, & Alvarenga, 2001).

Studies on patients undergoing cognitive behavior therapy (CBT) suggest that reduction in interpretation biases over the course of therapy predicts reduction in symptom severity and panic frequency (Teachman, Marker, & Clerkin, 2010). Similarly, reduction in the strength of automatic panic associations predicts symptom reduction during CBT (Teachman, Marker, & Smith-Janik, 2008). Though longitudinal, these studies could not test whether premorbid interpretation biases predict the onset of panic disorder.

Accordingly, in this study we used a prospective design to test whether a version of McNally and Foa's Interpretation Questionnaire predicted new onset of panic disorder in an epidemiologic study of young German women tested at two time points over an approximately 17-month time interval. We hypothesized that women who interpret ambiguous panic-related scenarios in a threatening manner at baseline are more likely to develop panic disorder at follow-up than are women who have benign interpretations of these scenarios at baseline. In addition, we expect that the panic-related interpretation bias retains its predictive significance, even after controlling for levels of anxiety sensitivity and for fear of bodily sensations, which are two established correlates of panic disorder.

METHOD

Participants

Participants were 1538 German women who took part in the Dresden Predictor Study (DPS; Trumpf et al., 2010). The study involved two assessments. The baseline assessment occurred between July 1996 and September 1997, and the follow-up assessment occurred about 17-months after that (M = 16.9 months, SD = 6, range = 7-30 months). During both assessments, participants completed a diagnostic interview and a battery of self-report questionnaires including the Interpretation Questionnaire (see Trumpf et al., 2010). This article includes the data of participants who completed the diagnostic interview at both time points.

Participants were female residents drawn randomly from the population register of Dresden whose age the time of the initial interview ranged between 18-25 years old. There were 5203 eligible women, and 2068 of them completed the baseline diagnostic interview and 997 of these participants completed only the questionnaires for a response rate of 58.9%. Of those who completed the diagnostic interview, 1538 (74.4%) completed the interview at follow-up.

Diagnostic Interview

At both assessments, a trained interviewer administered the 'Diagnostisches Interview bei psychischen Störungen – Forschungsversion' (F-DIPS; translation: Diagnostic Interview for Mental Disorders – Research Version; Margraf, Schneider, Soeder, & Becker, 1996). The F-DIPS is an extended version of the Anxiety Disorders Interview Schedule (ADIS-IV-L; Di Nardo, Brown, & Barlow, 1995) that assesses DSM-IV Axis I disorders. Baseline interviews assessed 7-day information and lifetime and point prevalence. Follow-up interviews also assessed 7-day information plus the time interval since baseline (for details about procedure, training of interviewers, and reliability ratings, see Trumpf et al., 2010).

Anxiety Sensitivity Index (ASI; Ehlers, 1986; Reiss, Peterson, Gursky, & McNally, 1986)

The ASI is a 16-item self-report questionnaire measuring fear and concerns regarding anxiety-related symptoms such as 'It scares me when my heart beats rapidly'. Items are rated on a five-point Likert scale (0 = 'very little' to 4 = 'very much').

Body Sensations Questionnaire (BSQ; Chambless, Caputo, Bright, & Gallagher, 1984; Ehlers, Margraf, & Chambless, 1993)

The BSQ includes 17 items that reflect specific bodily sensations (e.g., heart palpations, dizziness). Participants are asked to indicate the degree to which they experience anxiety related to these sensations by means of a five-point Likert scale (1 = 'not at all' to 5 = 'extremely').

Interpretation Questionnaire

The Interpretation Questionnaire consisted of 18 brief scenarios used in earlier studies (Ebert, 1993); 14 were translated from the Interpretation Questionnaire of McNally and Foa (1987). Nine items described panic-related situations (e.g., 'You feel discomfort in your chest area. Why?'), and the other nine described general, threat-related situations (e.g., 'You smell smoke'). Below each scenario, three interpretations appeared, one threatening. To illustrate, for the first example the following explanations were presented: (1) Something is wrong with your heart, (2) You have a sore muscle, (3) You have indigestion. Participants had to indicate the interpretation (explanation) most likely to come to mind if they were to experience the sensation in the scenario. Panic-related and general threat-related scenarios were presented alternating, and the order of threatening and non-threatening explanations was randomized across scenarios. All participants received the same order of scenarios.

RESULTS

Participant characteristics

At baseline (i.e., T1), 45 of the 1538 women met criteria for lifetime panic disorder with or without agoraphobia, and 114 women diagnosed with another lifetime psychological disorder served as a comparison group. Within this latter group, 70 suffered from a mood disorder, 19 from a somatoform disorder, 10 from a substance use disorder, and 31 from an eating disorder.[2] However, this group did not include any participants with anxiety disorders at baseline or follow-up as panic attacks occur frequently in other anxiety disorders, too (Barlow, 2002). At follow-up (i.e., T2), there were 26 new onsets of panic disorder, and 32 had remitted from panic disorder. Within the

[2] From now on, we no longer point out that these data relate to lifetime prevalence.

comparison group, there were the following new onsets: 37 suffered from a mood disorder, 13 from a somatoform disorder, 9 from a substance use disorder, and 9 from an eating disorder. At follow-up, 6 participants in the comparison group had remitted from a mood disorder, 2 from a somatoform disorder, 1 from a substance use disorder, and 4 from an eating disorder. Please find an overview of the group's means and standard deviations of the Interpretation Questionnaire, levels of anxiety sensitivity (ASI) and fear of bodily sensations (BSQ) in Table 1.

Table 1. Demographic data per diagnostic group for all four predictors, i.e., Interpretation Questionnaire (IB): IB panic, IB general threat; levels of anxiety sensitivity (ASI); and fear of bodily sensations (BSQ).

		No diagnosis at T1 and T2	No diagnosis at T1 but at T2
Diagnostic group	Measure	*M* (*SD*) *N*	*M* (*SD*) *N*
Panic			
	IB panic	0.70 (1.02) 1376	1.67 (1.74) 21
	IB threat	2.80 (1.70) 1377	3.70 (1.89) 20
	ASI	12.42 (7.35) 1400	20.41 (9.84) 22
	BSQ	1.80 (0.61) 1389	2.14 (0.69) 23
Other psych. disorders			
	IB panic	0.60 (0.93) 744	0.48 (0.73) 52
	IB threat	2.71 (1.70) 748	2.51 (1.65) 53
	ASI	11.56 (6.84) 756	10.39 (7.70) 54
	BSQ	1.73 (0.57) 754	1.82 (0.64) 54

Interpretation Questionnaire

Data preparation and statistical approach. First, participants' scores were recoded: All threatening explanations were coded with '1' (e.g., when a panic-related interpretation was checked for a panic scenario), all non-threatening ones with '0' (e.g., when a panic-unrelated interpretation was checked for a panic scenario). Second, scores were

collapsed into a sum score per participant for both panic- and general threat-related scenarios. Out of the 1538 women, we had the complete data of 1418. Sixty-eight women did not complete the questionnaire. The missing data of the remaining sample ranged from 1 to 11 items. For analyses, we used only complete data sets (see Table 1 for means and standard deviations of bias indices and *n*s).[3]

We conducted several logistic regressions. The dependent variable in each regression was new onset of the respective disorder ('0' = absent, '1' = present). The small sample size in the panic group precluded an analysis including all 4 predictors (i.e., panic- and threat-related bias, ASI, BSQ). Indeed, standard guidelines (e.g., Backhaus, Erichson, Plinke, & Weiber, 2003) specify a minimum of N = 10 per predictor, and hence a minimum of N = 40 for a full analysis in our case. However, our total sample included between 19 and 23 participants (see Table 2 for a detailed overview per predictor/predictor combination). Accordingly, the maximum number of predictors per analysis was two, and therefore we conducted several multiple regressions involving two predictors (e.g., panic-related interpretation bias with ASI). The sample size of new onsets of psychological disorders was slightly larger, but still insufficient for full analyses. Hence, we again conducted several multiple regressions.

Relationship of interpretation bias with new onsets of panic disorder and psychological disorders at follow-up

An overview of the results appears in Table 2. Analyses revealed that a panic-related interpretation bias significantly predicted new onsets of panic disorder even after we controlled statistically for anxiety sensitivity and for fear of bodily sensations in two separate regressions. In contrast, a general threat-related interpretation bias was a non-significant predictor of new onsets of panic disorder after we controlled for anxiety sensitivity, and a marginally significant predictor when we controlled for fear of bodily sensations. Finally, results showed that levels of anxiety sensitivity also significantly predicted new onsets of panic disorders after we controlled for a panic- and general threat-related interpretation bias as well as for fear of bodily sensations. Fear of bodily sensations, however, was only predictive in the regression controlling for the threat-related interpretation bias. Regarding the prediction of onset of other psychological disorders, results showed that only anxiety sensitivity and fear of bodily sensations were significant predictors, but only when these were combined in one analysis.

[3] See Trumpf et al. (2010) for attrition analyses. Analyses of missing values within the present data revealed that there was differential attrition within both panic groups. However, this is most likely due to the large sample sizes. Furthermore, effects sizes were extremely low.

Table 2. Prediction of new onsets rates of panic disorder and psychological disorders by means of Interpretation Questionnaire (IB): IB panic, IB general threat; levels of anxiety sensitivity (ASI); and fear of bodily sensations (BSQ).

			Statistics		
Diagnostic group	Predictor(s) in regression	*N*	*p*	*OR*	*CI*
Panic disorder	IB panic	21 vs 1376	*< 0.001*	1.678	1.297--2.171
	IB threat	20 vs 1377	*0.02*	1.315	1.044--1.656
	ASI	22 vs 1400	*< 0.001*	1.109	1.063--1.157
	BSQ	23 vs 1398	*0.009*	2.189	1.213--3.951
	IB panic	20 vs 1357	*0.023*	1.445	1.051--1.988
	IB threat		0.26	1.161	0.896--1.504
	IB panic	20 vs 1373	*0.036*	1.380	1.022--1.863
	ASI		*< 0.001*	1.092	1.040--1.146
	IB panic	21 vs 1372	*0.002*	1.552	1.176--2.049
	BSQ		0.106	1.715	0.891--3.3
	IB threat	19 vs 1343	0.249	1.159	0.902--1.49
	ASI		*< 0.001*	1.102	1.051--1.156
	IB threat	20 vs 1373	0.093	1.230	0.966--1.565
	BSQ		*0.043*	1.972	1.020--3.811
	ASI	22 vs 1396	*< 0.001*	1.116	1.052--1.184
	BSQ		0.757	0.879	0.389--1.989
Other psychological disorders	IB panic	52 vs 744	0.373	0.855	0.605--1.207
	IB threat	53 vs 748	0.396	0.929	0.783--1.102
	ASI	54 vs 756	0.231	0.975	0.934--1.017
	BSQ	54 vs 754	0.289	1.285	0.808--2.045
	IB panic	52 vs 738	0.587	0.902	0.620--1.310
	IB threat		0.487	0.935	0.773--1.130
	IB panic	52 vs 741	0.563	0.901	0.633--1.283
	ASI		0.245	0.974	0.931--1.018
	IB panic	52 vs 740	0.295	0.829	0.585--1.177
	BSQ		0.284	1.304	0.803--2.119
	IB threat	53 vs 745	0.564	0.95	0.797--1.132
	ASI		0.346	0.979	0.937--1.023
	IB threat	53 vs 744	0.257	0.903	0.756--1.078
	BSQ		0.187	1.381	0.855--2.228
	ASI	54 vs 752	*0.015*	0.93	0.877--0.986
	BSQ		*0.014*	2.212	1.176--4.161

Note: N: new onsets vs. no onsets, p: significance; OR: odds ratio, CI: 95% confidence interval
Significant p-values are printed in italics.

DISCUSSION

To the best of our knowledge, this is the first longitudinal study to investigate whether new onsets of panic disorder are predictable by a panic-related interpretation bias. As hypothesized, analyses revealed that women who interpreted ambiguous panic-related scenarios in a threatening manner at baseline were more likely to develop panic disorder at follow-up than were women who had benign interpretations of these scenarios. Strikingly, interpretation bias for panic-related (but not other) scenarios retained its predictive significance after we controlled for anxiety sensitivity and for fear of bodily sensations – two established correlates of panic disorder. Neither of the two bias measures predicted new onsets of other psychological disorders. However, when combined in one analysis, anxiety sensitivity and fear of bodily sensations were significant predictors for onset of psychological disorders.

One may explain our findings as follows. Women who tend to interpret bodily sensations as potentially threatening (as indicated by their interpretations of the ambiguous panic-related scenarios in the study) will make these mis-interpretations more often in day to day life. Hence, they might experience increased stress, fear, and worry in their daily life, and may regard the world as generally dangerous, thereby developing a panic-specific memory schema. This panic-specific memory schema is hypersensitive (i.e., easily activated) regarding panic-related information, and thus could, in turn, reinforce the dysfunctional processing of ambiguous panic-related cues. Having such a vulnerability increases the likelihood of developing panic disorder.

We also found that a general threat-related bias is a marginally significant predictor of developing a panic disorder. This is not surprising, as it is very likely that there is some overlap in panic- and threat-related memory schemata, respectively. Hence, activation of one memory schema will likely activate associated concepts. Findings of cross-sectional studies partly support this, showing that panic patients are also likely to misinterpret general threat-related ambiguous information (e.g., Harvey et al., 1993). Taking together, these findings support the incremental, predictive validity of panic-related interpretation biases, thereby deepening our understanding of the role of panic-related interpretation biases. As of yet, there is evidence showing that high levels of anxiety sensitivity are positively associated with panic-related interpretation biases (e.g., Teachman, 2005; Richards et al., 2001) and with having future panic attacks (e.g., Schmidt et al., 1997). Moreover, although Schmidt, Zvolensky, & Maner (2006) found that anxiety sensitivity predicted new onsets of Axis I disorders in general, they did not find that it specifically increased risk for new onsets of panic disorder per se. However, in our epidemiologic sample, we found that anxiety sensitivity predict new onsets of panic disorder, not merely panic attacks. As far as we know, this is the first demonstration of anxiety sensitivity as a predictor of panic disorder *onset*.

The present study is not without limitations. First, the sample of main interest (i.e., new onsets of panic) was small, so analyses including all four predictors as well exploratory analyses including for example participants' pre-existing (panic-related) psychopathologies were impossible. Second, our design included two assessments so (individual) change trajectories could not be examined. Hence, a multi-wave design including three or more time points would have been preferable. Third, maintaining a constant time interval between baseline and follow-up was impossible. Therefore, the 17 months is not an a priori planned interval, and we do not know whether this affected our results. Fourth, the inclusion of control explanations in the Interpretation Questionnaire (e.g., neutral, positive) would have been a more optimal approach and would have strengthened our conclusions. Finally, the results have a limited generalizability. The sample included only well-educated women scoring relatively high on socioeconomic status. Furthermore, we only tested young women.

To summarize, the present data provide new insights regarding the development of panic disorder. This becomes even more important when taking into consideration that the anxiety literature does not provide many demonstrations of the predictive power of interpretation biases. The evidence we found is restricted to studies involving (preschool) children and adolescents, and focused on anxiety in general (e.g., Pury, 2002; Creswell, Shildrick, & Field, 2011; Muris, Jacques, & Mayer, 2004). However, as of yet we do not know whether a panic-related interpretation bias should be also considered as a *causal* risk factor (Kraemer et al., 1997). Teachman et al. (2010) found that changes in catastrophic interpretations predicted positive panic-relevant treatment outcomes. We found that a panic-related interpretation bias is predictive of new onsets of panic disorder. Although these findings clearly demonstrate the important role of panic-related interpretation biases in panic disorder, what is needed now are investigations manipulating this factor, for example via cognitive bias manipulation procedures (cf. Koster, Fox, & MacLeod, 2009). To illustrate, research on social anxiety has shown that interpretation biases seemingly play a causal role in increasing anxiety proneness (e.g., Mathews & Mackintosh, 2000). Hence, investigating whether an experimentally induced panic-related interpretation bias affects the appraisal of potential panic symptoms would be a next step, bearing in mind the ethical requirements of such an approach.

Moreover, it is also important to think of ways to prevent the development of a panic disorder. In this context, the study of Woud, Postma, Holmes, & Mackintosh (2013) provides a promising line of research. Their study successfully employed appraisal training as a 'cognitive prophylaxis' in the context of analogue trauma. Hence, developing a preventative tool for panic disorder offers an interesting challenge. Finally, research is needed that extends present findings regarding panic-related biases in information

processing. To illustrate, panic patients do also suffer from panic-related attentional biases (e.g., Beck, Stanley, & Averill, 1992; Ehlers, Margraf, Davies, & Roth, 1988). Therefore, it would be worthwhile to start examining the functional relationship between panic-related interpretation and attentional biases, respectively.

In conclusion, our findings provide strong support for a role of panic-related interpretation biases in the development of panic disorder.

REFERENCES

Backhaus, K., Erichson, B., Plinke, W., & Weiber, R. (2003). *Multivariate Analysemethoden: Eine anwendungsorientierte Einführung*. Berlin: Springer.

Barlow, D. H. (2002). *Anxiety and its disorders: The nature and treatment of anxiety and panic*. New York: Guilford Press.

Beck, A. T., Emery, G., & Greenberg, R. I. (1985). *Anxiety disorders and phobias*. New York: Basic Books.

Beck, J. G., Stanley, M. A., & Averill, P. M. (1992). Attention and memory for threat in panic disorder. *Behaviour Research and Therapy*, *30*, 49-58.

Butler, G., & Mathews, A. (1983). Cognitive processes in anxiety. *Advances in Behaviour Research and Therapy*, *5*, 51-62.

Chambless, D. L., Caputo, G. C., Bright, P., & Gallagher, R. (1984). Assessment of fear in agoraphobics: The Body Sensations Questionnaire and the agoraphobic cognitions Questionnaire. *Journal of Consulting and Clinical Psychology*, *52*, 1090–1097.

Clark, D. M. (1986). A cognitive approach to panic. *Behaviour Research and Therapy*, *24*, 461-470.

Clark, D. M., Salkovskis, P. M., Öst, L. G., Breitholtz, E., Koehler, K. A., Westling, B. E., Jeavons, A., & Gelder, M. (1997). Misinterpretation of body sensations in panic disorder. *Journal of Consulting and Clinical Psychology*, *65*, 203-213.

Cox, B. J., Endler, N. S., Swinson, R. P., & Norton, G. R. (1991). Situations and specific categories associated with clinical and non-clinical panic attacks. *Behaviour Research and Therapy*, *30*, 67-69.

Creswell, C., Shildrick, S., & Field, A. (2011). Interpretation of ambiguity in children: A prospective study of associations with anxiety and parental interpretation. *Journal of Child and Family Studies*, *20*, 240-250.

Di Nardo, P. A., Brown, T. A., & Barlow, D. H. (1995). *Anxiety Disorders Interview Schedule for DSM-IV: lifetime version (ADIS-IV-L)*. Albany: Graywind publication.

Ebert, S. (1993). *Zur Verarbeitung von Gefahrenreizen bei Patienten mit dem Paniksyndrom* (Doctoral dissertation, Philipps-Universität Marburg).

Ehlers, A. (1986). *Angst-Sensitivitäts-Index*. Unpublished manuscript.

Ehlers, A., Margraf, J., & Chambless, D. L. (1993). *Fragebogen zu körperbezogenen Ängsten, Kognitionen und Vermeidung*. Weinheim: Beltz.

Ehlers, A., Margraf, J., Davies, S., & Roth, W. T., (1988). Selective processing of threat cues in participants with panic attacks. *Cognition and Emotion*, *2*, 201-219.

Greenwald, A. G., McGhee, D. E., & Schwartz, L. K. (1998). Measuring individual differences in implicit cognitions: The Implicit Association Test. *Journal of Personality & Social Psychology*, *74*, 1464-1480.

Harvey, J. M, Richards, J. C., Dziadosz, T., & Swindell, M. (1993). Misinterpretations of ambiguous stimuli in panic disorder. *Cognitive Therapy and Research*, *17*, 235-248.

Koster, E. H. W., Fox, E., & MacLeod, C. (2009). Introduction to the special section on cognitive bias modification in emotional disorders. *Journal of Abnormal Psychology*, *118*, 1-4.

Kraemer, H. C., Kazdin, A. E., Offord, D. R., Kessler, R. C., Jensen, P. S., & Kupfer, D. J. (1997). Coming to terms with terms of risk. *Archives of General Psychiatry*, *54*, 337-343.

Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety. *Journal of Abnormal Psychology*, *109*, 602-615.

Margraf, J., Schneider, S., Soeder, U., & Becker, E. S. (1996). *F-DIPS: Diagnostisches Interview bei psychischen Störungen (Forschungsversion)*. Unpublished manuscript, Dresden University of Technology.

McNally, R. J. (1994). Cognitive bias in panic disorder. *Current Directions in Psychological Science*, *3*, 129-132.

McNally, R. J., & Foa, E. B. (1987). Cognition and agoraphobia: Bias in the interpretation of threat. *Cognitive Therapy and Research*, *11*, 567-581.

Muris, P., Jacques, P., & Mayer, B. (2004). The stability of threat perception abnormalities and anxiety disorder symptoms in non-clinical children. *Child Psychiatry and Human Development*, *34*, 251-265.

Pury, C. L. S. (2002). Information-processing predictors of emotional response to stress. *Cognition and Emotion*, *16*, 667-683.

Reiss S., Peterson, R. A., Gursky, D. M., & McNally, R. J. (1986). Anxiety sensitivity, anxiety frequency and the prediction of fearfulness. *Behavior Research and Therapy*, *24*, 1-8

Richards, J. C., Austin, D. W., & Alvarenga, M. E. (2001). Interpretation of ambiguous interoceptive stimuli in panic disorder and nonclinical panic. *Cognitive Therapy and Research*, *3*, 235-246.

Rosmarin, D. H., Bourque, L. M., Antony, M. M., & McCabe, R. E. (2009). Interpretation bias in panic disorder: Self-referential or global? *Cognitive Therapy and Research*, *33*, 624-632.

Schneider, S., Unnewehr, S., Florin, I., & Margraf, J. (2002). Priming panic interpretations in children with panic disorder. *Anxiety Disorders*, *16*, 605-624.

Schmidt, N. B., Lerew, D. R., & Jackson, R. J. (1997). The role of anxiety sensitivity in the pathogenesis of panic: Prospective evaluation of spontaneous panic attacks during acute stress. *Journal of Abnormal Psychology*, *106*, 355-364.

Schmidt, N. B., Zvolensky, M. J., & Maner, J. K. (2006). Anxiety sensitivity: Prospective prediction of panic attacks and Axis I pathology. *Journal of Psychiatric Research*, *40*, 691-699.

Teachman, B. A. (2005). Information processing and anxiety sensitivity: Cognitive vulnerability to panic reflected in interpretation and memory biases. *Cognitive Therapy and Research*, *29*, 479-499.

Teachman, B. A., Marker, C. D., & Clerkin, E. M. (2010). Catastrophic misinterpretations as a predictor of symptom change during treatment for panic disorder. *Journal of Consulting and Clinical Psychology*, *78*, 964-973.

Teachman, B. A., Marker, C. D., & Smith-Janik, S. B. (2008). Automatic associations and panic disorder: Trajectories of change over the course of treatment. *Journal of Consulting and Clinical Psychology*, *76*, 988-1002.

Teachman, B. A., Smith-Janik, S. B., & Saporito, J. (2007). Information processing biases and panic disorders: Relationships among cognitive symptoms measures. B*ehaviour Research and Therapy*, *45*, 1791-1811.

Trumpf, J., Vriends, N., Meyer, A. H., Becker, E. S., Neumer, S. P., & Margraf, J. (2010). The Dresden Predictor Study of anxiety and depression: Objectives, design, and methods. *Social Psychiatry and Psychiatric Epidemiology*, *45*, 853-864.

Woud, M. L., Postma, P., Holmes, E. A., & Mackintosh, B. (2013). Reducing analogue trauma symptoms by computerized cognitive reappraisal training – Considering a cognitive prophylaxis? *Journal of Behavior Therapy and Experimental Psychiatry*, *44*, 312-315.

9

Ameliorating intrusive memories of distressing experiences using computerized reappraisal training

ABSTRACT

The types of appraisals that follow traumatic experiences have been linked to the emergence of post-traumatic stress disorder (PTSD). Could changing reappraisals following a stressful event reduce the emergence of PTSD symptoms? The present proof-of-principle study examined whether a non-explicit, systematic computerized training in reappraisal style following a stressful event (a highly distressing film) could reduce intrusive memories of the film, and symptoms associated with posttraumatic distress over the subsequent week. Participants were trained to adopt a generally positive or negative post-stressor appraisal style using a series of scripted vignettes after having been exposed to highly distressing film clips. The training targeted self-efficacy beliefs and reappraisals of secondary emotions (emotions in response to the emotional reactions elicited by the film). Successful appraisal induction was verified using novel vignettes and via change scores on the Post Traumatic Cognitions Inventory. Compared with those trained negatively, those trained positively reported fewer intrusive memories of the film during the subsequent week in a diary, and lower scores on the Impact of Event Scale (a widely-used measure of posttraumatic stress symptoms). Results support the use of computerized, non-explicit, reappraisal training after a stressful event has occurred and provide a platform for future translational studies with clinical populations that have experienced significant real-world stress or trauma.

This chapter is based on:
Woud, M. L., Holmes, E. A., Postma, P., Dalgleish, T. & Mackintosh, B. (2012). Ameliorating intrusive memories of distressing experiences using computerized reappraisal training. *Emotion*, *12*, 778-784.

INTRODUCTION

There is a broad consensus within philosophy (e.g., Solomon, 1993), affective science (e.g., Lazarus, 1982; Ochsner & Gross, 2008; Scherer, Schorr, & Johnstone, 2001), and abnormal psychology (e.g., Power & Dalgleish, 2008) that the emotional impact of stressful events is principally determined by how those events are appraised or interpreted. These initial event-related appraisals are frequently the starting point for iterative cycles of appraising and reappraising that extend beyond the events themselves to encompass their emotional, cognitive, and practical implications (Gross & Thompson, 2007; Lewis, 1996). The nature of these appraisal cycles seems to drive not only how we feel about events but other aspects of cognitive processing such as how well the events are remembered (see Gross, 2002) and the frequency with which such memories intrude into awareness (e.g., Schartau, Dalgleish, & Dunn, 2009). For example, we know from the literature on traumatic stress reactions to highly emotive events that appraising the self as culpable for such events or as chronically psychologically damaged by them (e.g., 'I have permanently changed for the worse'; 'The event happened because of the way I acted') is associated with increases in debilitating intrusive recollections of those events and one's role in them (Foa, Ehlers, Clark, Tolin, & Orsillo, 1999; Grey & Holmes, 2008). The very presence of these intrusive experiences can itself then become the subject of further appraisal (e.g., 'Having this flashback must mean I'm going mad'). Again, the nature of such appraisals appears to drive both further intrusive phenomenology and other symptoms of post-event distress, including in severe cases posttraumatic stress disorder (PTSD; Bryant & Guthrie, 2005; Ehlers & Clark, 2000; Meiser-Stedman, Dalgleish, Glucksman, Yule, & Smith, 2009).

A core feature of this broad cognitive appraisal model of the genesis of event-based emotions and their concomitants is that appraisals vary in the extent to which they reflect the 'reality' of a given situation. This is important, because appraisals with a low 'truth value' can then be the target for attempts at appraisal change, or reappraisal (Gross, 2002), designed to reduce associated distress and other symptoms. So, for example, appraising oneself as culpable for a negative event (as above) may well lead to significant distress and intrusive recollections, but if the evidence suggests that self-blame is misdirected then targeted re-scripting of such appraisals into a more adaptive form has the potential to down-regulate distress and intrusive reexperiencing (e.g., intrusive memories) of the event. There is now an impressive body of laboratory research looking at the beneficial effects of reappraisal as a broad emotion-regulation strategy in healthy participants (Gross, 2002) and exciting preliminary findings in those with emotional disorders (e.g., Carthy, Horesh, Apter, Edge, & Gross, 2010; Ehring, Tuschen-Caffler, Schnulle, Fischer, & Gross, 2010; Aldao, Nolen-Hoeksema,

& Schweizer, 2010). These extant studies have a number of prototypical characteristics. First, they tend to focus on modifying appraisals occurring relatively early in the appraisal cycle; i.e., on reappraising the event itself rather than its downstream implications or one's responses to it. Although this is clearly important, for a significant number of real-world situations opportunities to reappraise will occur after the events in question have already happened. In these circumstances, although it is of course possible to interpret retrospectively aspects of the event itself, modifying appraisals of the event's implications and/or one's responses to it are a potentially tractable regulation strategy that could be applied more broadly regardless of event contents. The primary aim of the current study was therefore to examine the effects of reappraisals applied following the experience of an emotive event, as opposed to prior to or during the event, and directed at the implications of the event for the person and his/her responses to it, as opposed to the actual contents of the event experience.

A second feature of existing studies is a focus on the impact of reappraisal on emotions rather than on concomitants of the cognitive-affective response such as memory intrusions (although a number of studies have looked at memory for the event itself; see Gross, 2002). This makes sense when looking at reappraisal in the local context of the event itself. However, when reappraisal efforts are employed post-event, and thus less directly targeted at event contents, alternative outcome variables should be considered. Consequently, the present study examined the effects of post-event reappraisals on intrusive and distressing memories for events and attempts to avoid them. A final characteristic of some existing studies that is worth noting (though perhaps of less importance) is that they often have not involved systematic reappraisal *training*, relying instead on single (or a limited number of) attempts to apply a reappraisal strategy. We contend that reappraisal efforts are likely to reap richer benefits following more comprehensive training. In the present study we therefore sought to train participants systematically into a more adaptive appraisal style following event exposure.

We based our training protocol on methods developed within the Cognitive Bias Modification (CBM) literature (e.g., MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002; Mathews & Mackintosh, 2000; MacLeod, Koster, & Fox, 2009). CBM involves the presentation of multiple trials in which participants are guided to respond in a systematically biased manner. CBM can therefore be used to train people out of bad 'cognitive habits', such as tendencies to attend selectively to threat or to interpret ambiguous situations in a negative manner. CBM has also been successfully deployed to alter participants' appraisals (CBM-App training) (e.g., Lang, Moulds, & Holmes, 2009; Schartau et al., 2009). Hence, we sought here to extend CBM-App training to explore the possibility of modifying appraisal style following stressor event exposure. A feature of the CBM-App training used in the present study that differs from typical

(non-CBM) reappraisals studies, is its non-explicit nature: In CBM-App, as used here, participants' appraisal styles are modified through repeated practise but participants are not explicitly informed as to the purpose of the manipulation or encouraged to make such changes explicitly.

In line with prior studies within both the reappraisal literature and the psychological trauma literature we employed a series of highly emotive film clips as the distressing event (see Holmes & Bourne, 2008; Rottenberg, Ray, & Gross, 2007). Such clips reliably induce significant levels of emotion as well as intrusive memories of the film over the subsequent weeks. They therefore provide an ideal test-bed to evaluate the efficacy of post-event CBM-App training. Consistent with the emotion-regulation literature on reappraisal which routinely compares reappraisal to an unhelpful regulation strategy (e.g., rumination or expression suppression; see Gross, 2002), we sought to compare a putatively adaptive strategy – training in positive reappraisals – with a likely unhelpful strategy – training in negative reappraisals.

We defined what is a positive or helpful versus negative or unhelpful reappraisal based on the extensive literature on appraisal styles in the wake of traumatic events (see Dalgleish, 2004). That is, after psychological trauma people can have vastly different appraisals of the same event – one person my escape from a fire relieved to be alive, another feeling guilty and that it could be their fault. Specifically, we drew on prospective work by Bryant and Guthrie (2005, 2007) who assessed a group of trainee firefighters before trauma exposure using a measure of appraisals called the Posttraumatic Cognitions Inventory (PTCI; Foa et al., 1999). They then followed them up over four years to see which pre-trauma appraisals were associated with later trauma symptoms. Interestingly, negative appraisals about the self (e.g., 'The event happened to me because of the sort of person I am'), rather than appraisals about the world, predicted later PTSD. The authors suggested that techniques to help people engage in more adaptive appraisals might help people better prepare for, or cope with, potentially traumatic events. Based on the encouraging data from Bryant and colleagues, we used the PTCI (Foa et al., 1999) as the source for our training materials.

The training itself involved repeatedly guiding participants via a computerized paradigm towards either positive versus negative appraisals (dependent on experimental condition) across a large set of scripted vignettes. After training, participants kept a one week diary recording any intrusive memories of the film. At one week they completed a questionnaire (the Impact of Event Scale-Revised, IES-R; Weiss & Marmer, 1997) measuring post-traumatic intrusive, avoidance, and hyperarousal phenomena associated with the film.

Our two hypotheses were: First, that CBM-App training would successfully induce either a functional or dysfunctional stressor-related appraisal style (dependent on

training condition and without explicit instruction). We tested this via post-training appraisals of novel ambiguous sentences and post-training scores on the PTCI. We did not expect there to be differences in the magnitude of emotional response to the film since the reappraisal target was the self-efficacy beliefs and reappraisal of secondary emotions (emotions in response to the emotional reactions elicited by the film) over a longer time period rather than immediate response to the film per se. Second, we predicted that training condition would influence the number of intrusions of the stressor film over one week and IES-R scores at one week, with training focused on functional appraisals leading to fewer intrusions and lower IES-R scores, compared with training focused on dysfunctional appraisals.

METHOD

Participants

The 76 healthy participants (39 women) were recruited through advertising at the University of East Anglia. Participants were 18-60 years and fluent in written English. All participants received a small honorarium.

Stressor film

The 20 minute distressing film was a compilation of 1-3 minute clips. These clips reliably elicit acute distress and subsequent intrusive memories in healthy volunteers (see Holmes & Bourne, 2008). To verify that engagement with the film was comparable across conditions, participants rated attention to the film, using a 10-point Likert-scale (see Holmes & Steel, 2004). The film contents comprised clips drawn from earlier studies (e.g., Bourne, Frasquilho, Roth, & Holmes, 2010; Holmes, James, Kilford, & Deeprose, 2010; Schartau et al., 2009) with scenes displaying contents relevant to the DSM-IV criteria for a traumatic event; for example, footage from the 9/11 World Trade Center terrorist attack, motor vehicle accidents such as a car on fire and a sinking car, a bomb exploding, and a rampaging elephant injuring people. To enhance self-relevance, participants were asked to view the film 'as if they were there, a bystander at the scene of the events, and to pay attention to the film as later there may be questions about film contents'.

Reappraisal training (CBM-App)

Training phase

Training comprised processing a series of reappraisal-related scripted vignettes that appeared to participants as a sentence completion task (note that explicit instructions to actively reappraise were not used). Each sentence ended in a to-be-completed word fragment such that the meaning of the sentence remained ambiguous until the final word fragment was resolved. The participant's task was to finish each sentence by completing the word fragment. Word fragments were designed such that only one possible solution could complete the sentence's meaning, and these words produced an outcome consistent with either a functional or dysfunctional reappraisal depending on training condition (positive or negative). Themes from the 'Self' subscale of the PTCI were used to develop CBM-App materials given the association of these themes with later post-stressor intrusions and distress (Bryant & Guthrie, 2005, 2007). Such items include 'If I think about the event, I will not be able to handle it' and 'I can't deal with even the slightest upset'. As a further example, there are PTCI items related to 'Trusting oneself to act appropriately in future' this theme was used to create the following training sentences: (1) *'In a crisis, I predict my responses will be h-lpf-l/u-el-ss'* (resolved as '*useless*' in the negative CBM-App condition or '*helpful*' in the positive) and: (2) *'When faced with a crisis, I now believe that I will react in a way which is r-l-able/unr-l-able'*. To encourage thorough processing of the sentences' meaning, a comprehension question was included after just under half of the sentences (e.g., for the first example 'Do you believe you will be able to respond in a useful way when there is a crisis?'). Questions were designed such that 'yes'/'no' answers occurred equally often, with error feedback for incorrect responses. It is important to reiterate that the training was deliberately not targeted at reappraising the contents of the film.

In this way, 72 training sentences and 32 comprehension questions were created, along with 8 emotionally neutral filler sentences giving a total of 80 sentences presented in blocks of 10. Blocks were presented in the same order for each participant but the sentences' order within each block was individually randomized.

A trial sequence was as follows: The sentence was displayed via computer screen without the final word fragment. Participants were instructed to proceed by pressing the 'advance' key when they had read the sentence(s). After the key press, the text disappeared revealing the final word fragment. Participants typed the first missing letter of the fragment as quickly as possible. The completed correct word then appeared on screen. Either a comprehension question followed or a new sentence was presented.

Measuring induced reappraisal bias

Induced bias was assessed following CBM-App training using a two-phase procedure

involving an initial encoding stage, followed by a later surprise recognition stage (Mathews & Mackintosh, 2000). During encoding, participants were presented with ten novel ambiguous sentences in random order, also based on PTCI items. Each sentence was introduced with a distinctive title and, unlike the former training items, remained ambiguous (see Appendix Table A1 for an example). After each, participants were required to imagine themselves vividly in the situation and rate this using a 10 point scale.

In the surprise recognition phase the original 10 encoding-phase sentence titles, each followed by a set of 4 related sentences, were presented in turn. Participants rated, on a 4 point scale, how close in meaning each new sentence seemed to the original sentence. Of the four new sentences, two represented a possible positive and a negative interpretation of the original sentence (positive and negative *target* sentences). Two more sentences, with a general positive/negative meaning respectively, had contents broadly similar to the original sentence, but not an actual resolution of the ambiguity (positive and negative *foil* items; see Appendix Table A1).

Intrusion diary

Participants were given a diary to record any intrusions of film contents during the 7 days following the experimental session. Participants were advised (both verbally and via written instructions in the diary) that intrusions were defined as 'any memory of the film (or part of the film) that appeared apparently spontaneously in their minds. Do not include any memories of the film that you deliberately or consciously bring to mind'. The diary was similar to that used in previous studies (Hagenaars, Van Minnen, Holmes, Brewin, & Hoogduin, 2008; Holmes & colleagues, 2004, 2009, 2006; Krans, Näring, Holmes, & Becker, 2009; Stuart, Holmes, & Brewin, 2006). Participants were asked to record all intrusions immediately after they occurred (whenever possible) and to set aside a regular time slot each day to check that their diary was up-to-date as a way of ensuring intrusions were not omitted if it had been impractical to write an intrusion down immediately. If participants had experienced no intrusions during any period they were also asked to make this explicit in the diary. Participants were also given instructions about the different forms intrusions can take: 'What goes through our minds can either take the form of words and phrases ('verbal thoughts'), or it can be like mental images. Although mental images often take the form of pictures they can actually include any of the five senses, so you can imagine sounds or smells too.' Participants were therefore asked to specify in their diary whether each intrusion experienced was a thought, an image intrusion or a combination of both and to describe its contents (e.g., 'A fireman carrying a baby') so as to ensure that the intrusion related

to the film. The diaries were then reviewed with participants at the start of the follow up session to resolve any uncertainties. A summary score of the number of intrusions of any type reported in the diary was produced for each participant.

Diary compliance rating

Following Davies and Clark (1998), participants were asked to rate their diary completion in comparison with the statement, 'I have often forgotten (or have been unable) to record my intrusive thoughts or images in the diary', on a scale ranging from '0' (not at all true of me) to '10' (completely true of me).

State and Trait Anxiety Inventory (STAI-S, STAI-T; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983)

The STAI-S and STAI-T were used to measure state and trait anxiety, respectively. Both subscales comprise 20 anxiety related statements describing anxiety symptoms that participants rate for occurrence and frequency. The STAI has good internal consistency, .89. The test–retest reliability of the STAI-T is .88, and .70 for the STAI-S (Barnes, Harp, & Jung, 2002).

Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996)

The BDI-II was administered to assess depressive symptoms. Participants respond to 21 depression related questions with respect to the way they felt during the past 2 weeks. The internal consistency is high with an alpha level of .90, and the test–retest reliability is also high .93 (Beck et al., 1996).

Posttraumatic Cognitions Inventory (PTCI; Foa et al., 1999)

The PTCI is a self-report measure comprising 36 statements which reflect appraisals surrounding distressing or traumatic experiences (e.g., 'I can't trust that I will do the right thing'). It contains three subscales: negative cognitions about Self (21 items), negative cognitions about theWorld (7 items) and Self-Blame (5 items). Each item is rated using a 7 point Likert scale ranging from 1 = 'totally disagree' to 7 = 'totally

agree'. Cronbach's α has been reported at .97 for the Self scale, .88 for World, and .86 for Self-Blame. Test–retest reliability has been reported at .75 and higher (Foa et al., 1999). The PTCI was presented 3 times: pre-training, immediately post-CBM-App training and at 1-week follow-up, to examine changes in appraisal style.

Impact of Event Scale-Revised (IES-R; Weiss & Marmer, 1997)

The IES-R is a self-report measure assessing current intrusion, avoidance and hyperarousal phenomena tied to a stress-inducing event. The 22 items were adapted to reflect experiences linked to the stressor films (e.g., Avoidance: 'I tried not to think about the film') as in Lang et al., (2009). Internal consistency has been reported at .97 for the total score, .86 for the Intrusion subscale, .82 for Avoidance, and .85 for Hyperarousal. Test– retest reliability has been reported at .87 for the total score, .89 for the Intrusion scale, .79 for Avoidance, and .82 for Hyperarousal (Sundin & Horowitz, 2002). The IES-R was administered 1-week post CBM-App training to measure those post-traumatic phenomena tied to the film over that week.

Visual analogue mood rating scales (VAS mood scales)

Participants completed mood ratings before and after viewing the film to assess its emotive impact. Participants rated four mood states (happiness, depression, anger, anxiety) using 11 point scales from 0 = 'not at all' to 10 = 'extremely' (Davies & Clark, 1998). Scores across the 4 scales were averaged (happiness reverse scored) to provide a single index of mood at each time point. Cronbach's α was .72 for the first mood rating, and .80 for the second mood rating.

Procedure

Prior to viewing the stressor film, participants completed a number of widely-used, standardized self-report measures assessing variables putatively involved with stress-related reappraisals. These data enabled us to check comparability on these variables across CBM-App conditions and comprised the: Trauma History Checklist (THC; Holmes et al., 2004) – a short measure of trauma history; STAI-S and STAI-T, and BDI-II. Participants then completed the first VAS mood ratings and PTCI. Participants were left alone to watch the stressful film projected onto the white wall of a darkened

testing room to maximize impact, followed by the attention to film rating and the second mood rating.
The CBM-App training and bias assessment were presented next, followed by the third mood rating and second PTCI. Finally, the diary was distributed with instructions as to its completion during the following week.
One week later participants returned for completion of the third PTCI, IES-R and a review of their diary to ensure that subsequent analysis only included intrusions categorized as being related to the film clips. They were then debriefed, thanked and paid for their participation.

RESULTS

Participant characteristics, baseline measures and compliance checks

Data from 2 participants who did not comply with instructions (they were unable to watch the film clips) were set aside (according in advance to standardised laboratory protocols such as refusing to watch the stressful film and pressing the same key press throughout the training phase without reading the computer screen), leaving a final sample of 74 participants (37 women; mean age = 22.47, *SD* = 5.96). There were no significant between-group (CBM-positive vs. – negative) differences on demographics or baseline measures: age, $t(72) = 1.31$, **p** = .19; THC, $t(72) = 1.44$, $p = .16$, STAI-S, STAI-T, and BDI, and baseline mood, *t*'s < 1, nor for attention paid to the film *t*'s < 1, or diary compliance, $t(72) = 1.18$, $p = .24$ (see Table 1).

Table 1. Demographic data, self report questionnaire, mood and diary data of the sample.

	Negative group (n = 37, 19 female)		Positive group (n = 37, 18 female)		t-test
Measure	*M*	*SD*	*M*	*SD*	
Age	21.57	3.80	23.38	7.47	$t(72) = 1.31$, $p = .19$
THC	2.05	1.68	1.57	1.19	$t(72) = 1.44$, $p = .16$
STAI-S	31.62	6.84	33.22	8.04	$t(72) = 0.92$, $p = .36$
STAI-T	36.76	8.09	38.62	9.23	$t(72) = 0.92$, $p = .36$
BDI-II	6.62	4.13	7.49	5.75	$t(72) = 0.74$, $p = .46$
Pre-film mood	1.64	1.08	1.73	1.22	$t(72) = 0.33$, $p = .74$
Post-film mood	3.99	2.08	3.74	1.90	$t(72) = 0.54$, $p = .59$
Attention to film	9.41	.69	9.24	.80	$t(72) = 0.94$, $p = .35$
Diary compliance	1.70	.81	1.46	.96	$t(72) = 1.18$, $p = .24$
No of intrusions in 7 day diary	6.43	5.10	4.32	3.60	$t(72) = 2.06$, $p < .05$
PTCI Time 1	86.30	31.12	84.24	29.00	$t(72) = 0.29$, $p = .77$
PTCI Time 2	88.05	35.66	77.30	25.41	$t(72) = 1.49$, $p = .14$
PTCI Time 3	85.73	33.28	69.62	24.21	$t(72) = 2.38$, $p < .03$
IES-R	23.57	19.15	15.68	11.47	$t(72) = 2.15$, $p < .04$

Note: THC: Trauma history checklist; STAI-S/T: Spielberger State-Trait Anxiety Inventory-State/Trait version; BDI-II: Beck Depression Inventory-II; PTCI: Posttraumatic Cognitions Inventory; IES-R: Revised Impact of Event Scale.

Effects of film on mood

A mixed-model ANOVA with Time (pre vs. post film) as a within-subjects factor and Group (negative vs. positive CBM-App) as a between-subjects factor on the combined mood scores (see Table 1), showed a significant main effect of Time, $F(1,72) = 95.59$,

$p < .001$, $\eta_p^2 = .57$, but no significant effect of Group, nor a Time x Group interaction, *F*'s < 1, revealing that both groups experienced strong and comparable increases in negative mood post-film.

Hypothesis 1: Modification of reappraisal bias and changes in PTCI scores

The raw data from the test/recognition phase were converted into an index of bias, that is the degree to which ambiguous sentences had been appraised as having a positive (or negative) meaning by subtracting the mean ratings for negative targets from positive targets. This 'Bias Index' yields a positive score for a positive bias and negative score for a negative bias. A between-group comparison of the 'Bias Index' confirmed a significant difference $t(72) = 8.33$, $p < .001$, $d = 1.96$, (positive group: $M = 1.54$, $SD = .83$; negative group $M = -0.55$, $SD = 1.28$), with each group yielding a mean bias significantly different from zero in the anticipated direction (negative: $t(36) = 2.63$, $p < .02$, $d = .43$ positive: $t(36) = 11.30$, $p < .001$, $d = 1.86$), indicating that biases had been successfully induced in both directions.

PTCI change (see Table 1) was explored, using a mixed model ANOVA. There was a significant interaction between Training group and Time, $F(2,71) = 4.63$, $p < .02$, $\eta_p^2 = .06$, and a main effect of Time $F(2,71) = 5.49$, $p < .01$, $\eta_p^2 = .07$. Follow-up analysis indicated that the positive group significantly improved (lower scores), relative to baseline, both immediately after training $t(36) = 2.70$, $p < .02$, $d = 0.26$, and at one week, $t(36) = 4.73$, $p < .001$, $d = .56$. No significant changes were noted for the negative group, *t*'s < 1.

Hypothesis 2: Film intrusions over 1-week and IES-R scores

In total 69 participants reported intrusions. As anticipated, intrusions were rated as generally distressing in both conditions (negative, $M = 38.10$, $SD = 20.00$; positive, $M = 41.80$, $SD = 18.17$). Critically, participants receiving positive CBM-App training reported less frequent intrusions, $t(72) = 2.06$, $p < .05$, $d = 0.49$, and the mean number of intrusions (4.3 vs 6.4 in the positive and negative groups respectively), are in line with those found in earlier studies using similar film material (e.g., Bourne et al., 2010; Holmes et al., 2009). In addition, those trained positively reported lower IES-R scores, indicative of lower levels of post-film symptomatology, than those trained negatively, $t(72) = 2.15$, $p < .04$, $d = .52$ (Table 1).

DISCUSSION

Our aim was to investigate whether systematic computerized training in positive and functional reappraisals (positive CBM-App) *following* the experience of a distressing event (an emotive set of film clips), and unrelated to the specific contents of that event, could reduce intrusive memories of that event and other associated symptomatology (e.g., avoidance) compared with training of dysfunctional appraisals (negative CBM-App). CBM-App training successfully modified appraisal styles in the intended directions as assessed by independent vignettes immediately post-training (both groups) and by scores on the PTCI (positively trained group) both post-training and at one week. Most importantly, participants who received positive CBM-App training reported significantly fewer intrusions of the distressing film over the subsequent week and lower scores on the IES-R for that period, compared with those who received negative training.

The findings are encouraging. They demonstrate, in principle, that reappraisal interventions can successfully be applied *following* an experimental event, as opposed to during that event (or just prior), and can modify intrusive re-experiencing of that event. This is in line with recent psychophysiological work on reappraisal by Sheppes, Catra, and Meiran (2009) highlighting the success of targeting appraisals subsequent to, rather than in advance of, an emotional situation. Furthermore, this particular post-event strategy (even though at a preliminary phase) has the advantage of not tying reappraisal to specific event contents, but to broader appraisals about for example, self and symptoms that straddle different types of stressful events. The data, though still at an early stage, therefore have clear translational possibilities for assisting individuals who are emotionally troubled by events in their past to which they have attached dysfunctional appraisals. To that extent, the current CBM-App protocol could be regarded as a computerized instantiation of aspects of Cognitive Behavioural Therapy (CBT) as provided to survivors of distressing events such as trauma and bereavement who are suffering from clinical distress, including PTSD. However, CBT is time consuming, expensive, requires a professional therapist, and the event survivors must first identify themselves as needing help. The further and careful translational development of computerized CBM-App could ultimately provide individuals with the facility to undergo the training at home, with minimal professional support. This might provide a flexible and motivating approach for a computer literate generation. There is now a clear need for *incremental* follow-on studies focussing on replication *in the laboratory* and extension to survivors of real-life, as opposed to analogue, distressing events, and with a greater focus on individual differences variables that may modulate training effects (e.g., habitual use of reappraisal as an emotion regulation strategy).

There are limitations regarding the present study that merit discussion. Our design did not include an additional control group who received for example neutral or no training. Therefore, it is not clear what produced the observed effects, i.e. whether the negative appraisal training lead to more intrusions, whether the positive appraisal training reduced the intrusions, or whether both effects occurred. Adding a neutral control group would have enabled us to draw more precise conclusions. The lack of such a control group is less important for the bias modification checks (on PTCI) as we had pre-training or 'no bias' baseline for this measure. It would also have been interesting to examine whether the way that participants appraised new stressful experiences following training (e.g., a second film) had been altered.

In sum, we show that functional reappraisal training (relative to dysfunctional training) following an emotive experience can reduce intrusive memories and other associated symptoms over the following week. This provides proof-of-principle support for exploring the translational potential of such reappraisal training for use following real world stressors.

APPENDIX

Table A1. Examples of stimuli used to measure induced reappraisal bias including title, ambiguous encoding sentence, and recognition sentences used to assess induced bias following bias modification. Each recognition sentence was rated for similarity to the original titled sentence using a four point scale ranging from 1 (very different in meaning) to 4 (very similar in meaning).

Title	"Aftermath of events."
Encoding sentence	"People come to terms with the aftermath of these types of events in many different ways. My reactions are very indicative of the way I seem to be dealing with it. "
Recognition sentences	
Negative target	"People come to terms with the aftermath of these types of events in many different ways, but my reactions mean my coping skills are poor. "
Positive target	"People come to terms with the aftermath of these types of events in many different ways, but my reactions mean my coping skills are healthy. "
Negative foil	"People come to terms with the aftermath of these types of events in many different ways, but my reactions mean my coping skills are suspicious. "
Positive foil	"People come to terms with the aftermath of these types of events in many different ways, but my reactions mean my coping skills are trustworthy. "

REFERENCES

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion regulation strategies and psychopathology: A meta analysis. *Clinical Psychology Review*, *30*, 217-237.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck Depression Inventory - II Manual* (2nd ed.). San Antonio, TX: The Psychological Corporation.

Barnes, L. L. B., Harp, D., & Jung, W. S. (2002). Reliability generalization of scores on the Spielberger State–Trait Anxiety Inventory. *Educational and Psychological Measurement*, *62*, 603–618.

Bourne, C., Frasquilho, F., Roth, A. D., & Holmes, E. A. (2010). Is it mere distraction? Peri-traumatic verbal tasks can increase analogue flashbacks but reduce voluntary memory performance. *Journal of Behavior Therapy and Experimental Psychiatry*, *41*, 316-324.

Bryant, R. A., & Guthrie, R. M. (2005). Maladaptive appraisals as a risk factor for post traumatic stress. A study of trainee fire fighters. *Psychological Science*, *16*, 749-752.

Bryant, R. A., & Guthrie, R. M. (2007). Maladaptive self-appraisals before trauma exposure predict post traumatic stress disorder. *Journal of Consulting and Clinical Psychology*, *75*, 812-815.

Carthy, T., Horesh, N., Apter, A., Edge, M. D., & Gross, J. J. (2010). Emotional reactivity and cognitive regulation in anxious children. *Behaviour Research and Therapy*, *48*, 384-93.

Dalgleish, T. (2004). Cognitive theories of posttraumatic stress disorder: The evolution of multi-representational theorizing. *Psychological Bulletin*, *130*, 228-260

Davies, M., & Clark, D.M. (1998). Predictors of analogue post-traumatic intrusive cognitions. *Behavioural and Cognitive Psychotherapy*, *26*, 303-314.

Ehlers, A., & Clark, D. M. (2000). A cognitive model of posttraumatic stress disorder. *Behaviour Research and Therapy*, *38*, 319-345.

Ehring, T., Tuschen-Caffier, B., Schnulle, J., Fischer, S., & Gross, J. J. (2010). Emotion regulation and vulnerability to depression: Spontaneous versus instructed use of emotion suppression and reappraisal. *Emotion*, *10*, 563-572.

Foa, E. B., Ehlers, A., Clark, D. M., Tolin, D. F., & Orsillo, S. M. (1999). The Posttraumatic Cognitions Inventory (PTCI): Development and validation. *Psychological Assessment*, *11*, 303-314.

Grey, N., & Holmes, E. A. (2008). "Hotspots" in trauma memories in the treatment of post traumatic stress disorder: A replication. *Memory*, *16*, 788-796.

Gross, J. J. (2002). Emotion regulation: Affective, cognitive, and social consequences. *Psychophysiology*, *39*, 281–291.

Gross, J. J., & Thompson, R. A. (2007). Emotion regulation: Conceptual foundations. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 3-24). New York, NY: Guilford Press.

Hagenaars, M. A., Van Minnen, A., Holmes, E. A., Brewin, C. R., & Hoogduin, C. A. L. (2008). The effect of hypnotically-induced somatoform dissociation on the development of intrusions after an aversive film. *Cognition and Emotion*, *22*, 944–963.

Holmes, E. A., & Bourne, C. (2008). Inducing and modulating intrusive emotional memories: A review of the trauma film paradigm. *Acta Psychologica*, *127*, 553-566.

Holmes, E. A., Brewin, C. R., & Hennessy, R. G. (2004). Trauma films, information processing, and intrusive memory development. *Journal of Experimental Psychology: General*, *133*, 3-22.

Holmes, E. A., James, E. L., Coode-Bate, T., & Deeprose, C. (2009). Can playing the computer game 'Tetris' reduce the build-up of flashbacks for trauma?' A proposal from cognitive science. *PLoS ONE*, *4*(1).

Holmes, E. A., James, E. L., Kilford, E. J., & Deeprose, C. (2010). Key steps in developing a cognitive vaccine against traumatic flashbacks: Visuospatial tetris versus verbal pub Quiz. *PLoS ONE*, *5*(11).

Holmes, E. A., & Steel, C. (2004). Schizotypy as a vulnerability factor for traumatic intrusions: An analogue investigation. *Journal of Nervous and Mental Disease*, *192*, 28-34.

Krans, J., Näring, G., Holmes, E. A., & Becker, E. S. (2009). Tell me more: Can a memory test reduce analogue traumatic intrusions? *Behaviour Research and Therapy*, *47*, 426-430

Lang, T. J., Moulds, M. L., & Holmes, E. A. (2009). Reducing depressive intrusions via a computerized cognitive bias modification of appraisals task: Developing a cognitive vaccine. *Behaviour Research and Therapy*, *47*,139-145.

Lazarus, R. S. (1982). Thoughts on the relations between emotion and cognition. *American Psychologist*, *37*, 1019-1024.

Lewis, M. D. (1996). Self-organizing cognitive appraisals. *Cognition and Emotion*, *10*, 1-25.

MacLeod, C., Koster, E. H. W., & Fox, E. (2009). Whither cognitive bias modification research? Commentary on the special section articles. *Journal of Abnormal Psychology*, *118*, 89-99.

MacLeod, C., Rutherford, E., Campbell, L., Ebsworthy, G., & Holker, L. (2002). Selective attention and emotional vulnerability: Assessing the causal basis of their association through the experimental manipulation of attentional bias. *Journal of Abnormal Psychology*, *111*, 107-123.

Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety. *Journal of Abnormal Psychology*, *109*, 602-615.

Meiser-Stedman, R., Dalgleish, T., Glucksman, E., Yule, W., & Smith, P. (2009). Maladaptive cognitive appraisals mediate the evolution of posttraumatic stress reactions: A 6-month follow up of child and adolescent assault and motor vehicle accident survivors. *Journal of Abnormal Psychology*, *118*, 778-787.

Ochsner, K. N., & Gross, J. J. (2008). Cognitive emotion regulation: Insights from social cognitive and affective neuroscience. *Currents Directions in Psychological Science*, *17*, 153-158.

Power, M. J., & Dalgleish, T (2008). *Cognition and emotion: From order to disorder* (2nd ed.). Hove: Taylor Francis.

Rottenberg, J., Ray, R. D., & Gross, J. J. (2007). Emotion elicitation using films. In: J. A. Coan & J. J. B. Allen (Eds.), *The handbook of emotion elicitation and assessment* (pp. 9-28). London: Oxford University Press.

Schartau, P., Dalgleish, T., & Dunn, B. (2009). Seeing the bigger picture: Training in perspective broadening reduces self-reported affect and psychophysiological response to distressing films and autobiographical memories. *Journal of Abnormal Psychology*, *118*, 15-27.

Scherer, K. R., Schorr, A., & Johnstone, T. (2001). *Appraisal processes in emotion: Theory, Methods, Research*. New York, NY: Oxford University Press.

Sheppes, G., Catran, E., & Meiran, N. (2009). Reappraisal (but not distraction) is going to make you sweat: Physiological evidence for self-control effort. *International Journal of Psychophysiology*, *71*, 91-96.

Solomon, R. C. (1993). The philosophy of emotions. In M. Lewis & J. M. Haviland (Eds.), *Handbook of Emotions* (pp. 3-15). New York, NY: Guildford Press.

Stuart, A. D. P., Holmes, E. A., & Brewin, C. R. (2006). The influence of a visuospatial grounding task on intrusive images of a traumatic film. *Behaviour Research and Therapy*, *44*, 611-619.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

Sundin, E. C., & Horowitz, M. J. (2002). Impact of Event Scale: psychometric properties. *British Journal of Psychiatry*, *180*, 205–209.

Weiss, D. S., & Marmer, C. R. (1997). The Impact of Event Scale – Revised. In J. P. Wilson & T. M. Keane (Eds.), *Assessing Psychological Trauma and PTSD: A handbook for Practitioners* (pp. 399-411). New York, NY: Guildford Press.

10

Reducing analogue trauma symptoms by computerized reappraisal training – Considering a cognitive prophylaxis?

ABSTRACT

Distressing intrusions are a hallmark of posttraumatic stress disorder (PTSD). Dysfunctional appraisal of these symptoms may exacerbate the disorder, and conversely may lead to further intrusive memories. This raises the intriguing possibility that learning to 'reappraise' potential symptoms more functionally may protect against such symptoms. Woud, Holmes, Postma, Dalgleish, & Mackintosh (2012) found that 'reappraisal training' when delivered after *an analogue stressful event reduced later intrusive memories and other posttraumatic symptoms. The present study aimed to investigate whether reappraisal training administered* before *a stressful event is also beneficial. Participants first received positive or negative reappraisal training (CBM-App training) using a series of scripted vignettes. Subsequently, participants were exposed to a film with traumatic content. Effects of the CBM-App training procedure were assessed via three distinct outcome measures, namely: (a) post-training appraisals of novel ambiguous vignettes, (b) change scores on the Post Traumatic Cognitions Inventory (PTCI), and (c) intrusive symptom diary. CBM-App training successfully induced training-congruent appraisal styles. Moreover, those trained positively reported less distress arising from their intrusive memories of the trauma film during the subsequent week than those trained negatively. However, the induced appraisal bias only partly affected PTCI scores. The study has the following limitations: First, participants used their own negative event as a reference for the PTCI assessments. Second, the events may have differed regarding their emotional impact. Third, there was no control group. We conclude that CBM-App training has also some beneficial effects when applied before a stressful event and may serve as a cognitive prophylaxis against trauma-related symptomatology.*

This chapter is based on:
Woud, M. L., Postma, P., Holmes, E. A., & Mackintosh, B. (2013). Reducing analogue trauma symptoms by computerized reappraisal training – Considering a cognitive prophylaxis? *Journal of Behavior Therapy and Experimental Psychiatry*, *44*, 312-315.

INTRODUCTION

Posttraumatic stress disorder (PTSD) is a distressing psychological reaction to a traumatic event (Diagnostic and Statistical Manual for Mental Disorders; DSM-IV-TR, 2000). Distressing intrusions, i.e., the involuntary re-experiencing of the trauma, are a hallmark symptom. According to cognitive models of PTSD (e.g., Dalgleish, 2004; Ehlers & Clark, 2000), a maintaining factor is the maladaptive appraisals associated with having intrusions ('Having these flashbacks means I'm going mad'), as they may be interpreted as a sign of permanent psychological damage. Furthermore, models stress the role of maladaptive appraisals when developing PTSD. Prospective studies such as executed by Bryant and Guthrie (2005, 2007) support this. In their studies, trainee fire-fighters completed the Post Traumatic Cognitions Inventory (PTCI; Foa, Ehlers, Clark, Tolin, & Orsillo, 1999), which measures appraisals following trauma, before they were exposed to stressful situations. Fire-fighters were assessed for PTSD symptomatology after six months (Bryant & Guthrie, 2005) and after four years (Bryant & Guthrie, 2007) of fire-fighting-duty. Results showed that a baseline tendency to engage in maladaptive appraisals predicted subsequent PTSD, particularly scores on the PTCI-Self subscale.

This raises the intriguing possibility that learning to 'reappraise' may be of importance in PTSD. There is an emerging body of research investigating the beneficial effects of reappraisal, for example as an emotion-regulation-strategy in healthy participants (Gross, 2002), in clinical contexts such as depression (e.g., Lang, Moulds, & Holmes, 2009) and in analogue posttraumatic-stress (e.g., Woud, Holmes, Postma, Dalgleish, & Mackintosh, 2012). To illustrate, Woud et al. (2012) trained participants to engage in positive or negative appraisal styles after having been exposed to distressing films. The computerized training targeted self-efficacy beliefs and reappraisals of secondary emotions, i.e., emotions in response to the emotional reactions elicited by the films. Procedures were based on methods developed within the Cognitive Bias Modification (CBM) framework (cf. Koster, Fox, & MacLeod, 2009). Results demonstrated that the CBM-Appraisal (CBM-App) training successfully induced training congruent appraisal styles. Moreover, compared to those trained negatively, those trained positively reported fewer intrusive memories of the film, and had lower scores on the PTCI (Foa et al., 1999) as well as on the Impact of Event Scale-Revised (IES-R; Weiss & Marmer, 1997) at one-week follow-up (the IES-R is a widely-used clinical measure of posttraumatic stress). In sum, results support that reappraisal training does have therapeutic effects when applied *after* the traumatic event. However, could it also have prophylactic effects when applied *before* the traumatic event? The current study set out to explore this. Therefore, we adapted the procedure of Woud et al. (2012) such that participants first

completed positive or negative CBM-App training and then watched the distressing films. We predicted that CBM-App training would successfully induce either an adaptive or maladaptive appraisal style (depending on the training condition). This was tested via post-training appraisals of novel ambiguous vignettes and via PTCI scores post-film and at one-week follow-up. Second, we predicted that those trained positively would report fewer intrusions of the stressor films and less intrusion distress than those trained negatively.

METHOD

Participants

Out of the panel of community based volunteers of the MRC Cognition and Brain Sciences Unit, 54 participants were recruited. Selection criteria were fluent written English ability, no reported psychological problems or past traumatic experiences, and sub-clinical scores on the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) and on the Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996), i.e., at or below 40 and 13, respectively (Harrison & Turpin, 2003).

Self report measures

State-Trait anxiety was assessed via the State and Trait Anxiety Inventory (STAI-S, STAI-T; Spielberger et al., 1983). Depressive symptoms were measured via the Beck Depression Inventory-II (BDI-II; Beck et al., 1996). The Posttraumatic Cognitions Inventory (PTCI; Foa et al., 1999) was used to assess appraisals surrounding distressing and / or traumatic experiences, including all three subscales (negative cognitions about Self, the World and Self-Blame).

Mood rating

Four mood states were assessed (happiness, depression, anger, anxiety) using a 11-point Likert scale ranging from 0 = 'not at all' to 10 = 'extremely' (Davies & Clark, 1998). Scores were averaged (with reversed happiness scores) to provide a single mood index.

Reappraisal training (CBM-App)

Training phase

A detailed description of the applied CBM-App training procedure can be found in Woud et al. (2012). Participants were presented with a series of ambiguous, reappraisal-related scripted vignettes (henceforth called 'scripts') that ended in a to-be-completed word fragment. Participants had to complete the word fragment by typing in its first missing letter. These words then produced an outcome which was consistent with either an adaptive or maladaptive appraisal of the ambiguous script.

Scripts were based on items of the PTCI Self subscale. For example, 'Trusting oneself to act appropriately in future' was adapted as follows: *'In a crisis, I predict my responses will be h-lpf-l/u-el-ss*' (resolved as '*helpful*' in the positive or '*useless*' in the negative CBM-App condition). Just under half of these scripts were followed by a question to test ongoing comprehension. The training comprised 72 training and 8 emotionally neutral filler scripts (presented in blocks of 10). Blocks were presented in the same order for each participant but the sentences' order within each block was individually randomized.

Measuring induced reappraisal bias

The training's success was assessed via a two-phase-procedure (Mathews & Mackintosh, 2000). During the encoding-phase, participants read 10 novel ambiguous scripts in random order. Scripts started with a title and, unlike the former training items, remained ambiguous. Participants were asked to imagine themselves vividly in the described situation (assessed via a 10-point Likert scale). In the recognition-phase, the 10 encoding-phase titles were presented again, followed by a set of 4 related sentences. By means of a 4-point Likert scale, participants rated how close in meaning each sentence was to the original script of that title. There were two target sentences, representing a possible positive and negative interpretation of the original script, and there were two *foil* sentences, representing a general positive and negative meaning that did not resolve the script's ambiguity.

Stressor film

The 20-minute distressing film was a compilation of 1-3 minute clips that have been used in Woud et al. (2012), displaying contents such as footages from the 9/11 World Trade Center terrorist attack or motor vehicle accidents. Participants had to view the film 'as if they were there, a bystander at the scene of the events, and to pay attention

to the film as later there may be questions about film content'. By means of a 10-point Likert scale participants rated their attention paid to the film (see Holmes & Steel, 2004).

Intrusion diary

To record film-related intrusions as well as intrusion distress, participants received a 7-day-diary (see Holmes & colleagues, 2004, 2009). Intrusions were defined as 'any memory of the film (or part of the film) that appeared apparently spontaneously in your mind. Do not include any memories of the film that you deliberately or consciously bring to mind.' Participants were instructed to record all intrusions immediately after they occurred (whenever possible) and to check their diary each day at a fixed time point to make sure that it was up-to-date.
Explanations were given about the types of intrusions: 'What goes through our minds can either take the form of words and phrases ('verbal thoughts'), or it can be like mental images. Although mental images often take the form of pictures they can actually include any of the five senses, so you can imagine sounds or smells too.' Participants were asked to specify whether their intrusion was a thought or image or a combination of both, and what its exact contents was.

Diary compliance rating

Participants rated their diary completion in comparison with the statement 'I have often forgotten (or have been unable) to record my intrusive thoughts or images in the diary' on a scale ranging from '0' (not at all true of me) to '10' (completely true of me) (Davies & Clark, 1998).

Procedure

After informed consent, participants completed the STAI-T and BDI-II. Based on the STAI-T and BDI-II selection criteria, twelve participants were excluded. Then, STAI-S, PTCI and the first mood rating followed. As PTCI-responses are anchored to a specific traumatic event, participants were asked to use an own negative event as a reference (see Bryant & Guthrie, 2005, 2007). This instruction was used during all three PTCI assessments. The CBM-App training was presented next, with participants randomly

allocated to either positive or negative CBM-App. Again, participants used an own negative event as a reference. After that, the encoding-recognition phase followed. Participants then watched the stressor film and completed the attention-to-film-assessment and the second mood and PTCI rating, respectively. Finally, the 7-day-diary and PTCI were distributed. One week later participants were contacted via telephone to discuss their diary entries. They were debriefed and thanked and if they had not already done so, prompted to return the diary, the PTCI and diary compliance rating using a pre-paid envelope that had been supplied.

RESULTS

Participant characteristics

Data of 7 participants were excluded. Two participants failed to submit the diaries, the remaining 5 participants were indentified as multivariate outliers on BDI, intrusion frequency and distress (2 in negative and 3 in positive CBM-App condition) by calculating Mahalanobis distance with the criterion for outliers set at $p = .05$ (Tabachnick & Fidell, 1996). The final sample included 47 participants (31 women, $M_{age} = 29.06$, $SD = 10.02$). The two CBM-App Training Groups did not differ on age, STAI-S, STAI-T, BDI and mood, nor on attention paid to the film or diary compliance (see for means, standard deviations and significances Table 1).

Table 1. Demographics and self report data, mood, PTCI and diary data.

	Negative CBM-App (n = 25, 16 female)		Positive CBM-App (n = 22, 15 female)			
Measure	*M*	*SD*	*M*	*SD*	*t*(45)	*p*
Age	29.88	10.16	28.13	10.02	.59	.56
STAI-S	26.52	5.59	27.91	6.48	.79	.43
STAI-T	29.84	5.73	31.23	6.15	.80	.43
BDI-II	2.56	2.22	3.95	3.42	1.68	.10
Baseline mood	1.03	.73	1.35	.79	1.46	.15
Post-film mood	2.64	1.93	2.42	1.79	.40	.69
Attention to film	9.40	.76	9.50	.60	.50	.62
Diary compliance	.72	1.17	.73	.98	.02	.98
PTCI Time 1	84.44	35.18	95.18	42.38	.95	.35
PTCI Time 2	93.60	43.78	92.31	39.31	.11	.92
PTCI Time 3	80.80	37.60	83.00	39.30	.20	.85

Note: STAI-S/T: Spielberger State-Trait Anxiety Inventory-State/Trait version; BDI-II: Beck Depression Inventory-II; PTCI: Posttraumatic Cognitions Inventory.

Effects of film on mood

A mixed-model ANOVA with Time (pre vs. post film mood) as a within-subjects factor and CBM-App Training Group (negative vs. positive) as a between-subjects factor showed a significant main effect of Time, $F(1,45) = 29.10$, $p < .001$, $\eta_p^2 = .39$, though no significant main effect of Training Group, $F(1,45) = .02$, $p = .88$. Importantly, there was no significant Time x CBM-App Training Group interaction, $F(1,45) = 1.19$, $p = .28$, confirming that the film had a negative impact on mood across both groups (see Table 1 for means and standard deviations).

Manipulation check: Assessment bias index and PTCI scores

The raw data from the recognition-phase were converted into a bias index by subtracting the mean ratings for negative targets from those of positive targets. Hence, a positive bias index indicated that positive targets were rated closer in meaning to the ambiguous sentences than negative targets, and vice versa for a negative bias index. Analyses revealed a significant difference in bias index between the two CBM-App training groups, $t(45) = 14.09$, $p < .001$, $d = 4.10$, with each group yielding a mean bias significantly different from zero in the anticipated direction, positive CBM-App group: $t(21) = 11.51$, $p < .001$, $d = 2.44$ ($M = 1.78$, $SD = .73$), negative CBM-App group: $t(24) = 8.91$, $p < .001$, $d = 1.78$ ($M = -1.58$, $SD = .89$).

PTCI changes were explored via a mixed model ANOVA. There was no significant main effect of CBM-App Training Group, $F(1,45) = .12$, $p = .73$, though a significant main effect of Time, $F(2,44) = 8.42$, $p < .01$, $\eta_p^2 = .28$, and a significant interaction between Time and Training Group, $F(2,44) = 3.17$, $p = .052$, $\eta_p^2 = .13$. Investigating this interaction more thoroughly, analyses revealed a significant improvement (lower scores) when comparing baseline versus one-week follow-up in the positive CBM-App group, $t(21) = 2.93$, $p < .01$, $d = .30$. No improvement was found when comparing baseline versus post-film assessment, $t(21) = .70$, $p = .49$. Scores in the negative CBM-App group became significantly worse (higher scores) when comparing baseline versus post-film assessment, $t(24) = 3.54$, $p < .01$, $d = .23$. However, the baseline versus one-week follow-up comparison was not significant, $t(24) = .88$, $p = .39$.

Film intrusions over 1-week

Intrusions were experienced by 80% of participants in the negative CBM-App group and 77.3% of participants in the positive negative CBM-App group with no significant

group differences, $\chi^2(1) = .05$, $p = .82$. The analysis of intrusion distress was necessarily confined to the 78.7% of those who had experienced intrusions. There was a significant difference between CBM-App training groups $t(35) = 2.23$, $p = .03$, $d = .79$, with less distress for those trained positively (positive: M =12.23, SD = 9.25, negative: M = 22.74, SD = 17.46). However, there was no significant difference between the two groups regarding the frequency of intrusions, $t(45) = .26$, $p = .79$ (positive: $M = 7.14$, $SD = 8.08$; negative: $M = 6.56$, $SD = 6.95$).

DISCUSSION

CBM-App training successfully induced training-congruent appraisal styles: Participants trained positively appraised novel ambiguous vignettes in a more adaptive manner than participants trained negatively. Regarding the PTCI, those trained positively did not improve immediately after the training phase (i.e., baseline vs. post-film), though did improve when comparing baseline versus one-week follow-up. PTCI scores of those trained negatively became worse post-film, but no difference was found between baseline versus one-week follow-up. Results of the 7-day-diary showed that those trained positively experienced less intrusion distress than those trained negatively. No significant difference was found regarding the frequency of film-related intrusions. The present findings corroborate the significant role of reappraisal in PTSD, showing that CBM-App training can have some preventative function in analogue traumatic stress. Results support assumptions of cognitive models of PTSD (e.g., Ehlers & Clark, 2000) and provide an interesting extension of the CBM-training literature. Moreover, these data could encourage some first, careful clinical applications for assisting individuals who may encounter traumatic events such as policeman or firefighters. However, they also demonstrate the boundaries of such CBM procedures: PTCI scores were only partly affected, and the change in scores might be to some extent driven by the non-significant baseline differences between the two training groups. Finally, CBM-App training only reduced intrusion distress. The prospective nature of this study might explain this. Maybe, participants were less engaged during the training, as nothing actively distressed them at that point. Moreover, participants' STAI and BDI scores were low (compared to those reported in Woud et al., 2012), and this also may have influenced the trainings' effect.

The present findings are not without limitations. During the PTCI measurements, participants had to think of their own stressful event. However, we do not know anything of the emotional impact of the event and whether participants were compliant in general. Hence, although this procedure has been applied successfully before (e.g.,

Bryant & Guthrie, 2005, 2007), this is may be an element in our procedure that may have produced noise. Second, our design did not include a control group receiving neutral CBM-App training. Nevertheless, results showed training-congruent biases that differed from zero.

To conclude, CBM-App training also has beneficial effects on trauma-related symptomatology when applied before a stressful event. These findings clearly advance our understanding of the role of reappraisal in PTSD: CBM-App training not only has a therapeutic (Woud et al., 2012), but also a *prophylactic* effect. Future research now has to target the potential underlying mechanisms of CBM-App training in order to crystallize the processes that produced the effects and to optimize its application.

REFERENCES

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck Depression Inventory - II Manual* (2nd ed.). San Antonio, TX: The Psychological Corporation.

Bryant, R. A., & Guthrie, R. M. (2005). Maladaptive Appraisals as a risk factor for post traumatic stress. A study of trainee fire fighters. *Psychological Science*, *16*, 749-752.

Bryant, R. A., & Guthrie, R. M. (2007). Maladaptive self-appraisals before trauma exposure predict post traumatic stress disorder. *Journal of Consulting and Clinical Psychology*, *75*, 812-815.

Dalgleish, T. (2004). Cognitive theories of posttraumatic stress disorder: The evolution of multi-representational theorizing. *Psychological Bulletin*, *130*, 228-260.

Davies, M., & Clark, D. M. (1998). Predictors of analogue post-traumatic intrusive cognitions. *Behavioural and Cognitive Psychotherapy*, *26*, 303-314.

Ehlers, A., & Clark, D. M. (2000). A cognitive model of posttraumatic stress disorder. *Behaviour Research and Therapy*, *38*, 319-345.

Foa, E. B., Ehlers, A., Clark, D. M., Tolin, D. F., & Orsillo, S. M. (1999). The Posttraumatic Cognitions Inventory (PTCI): Development and validation. *Psychological Assessment*, *11*, 303-314.

Gross, J. J. (2002). Emotion regulation: Affective, cognitive, and social consequences. *Psychophysiology*, *39*, 281–291.

Harrison, L. K., & Turpin, G. (2003). Implicit memory bias and trait anxiety: A psychophysiological analysis. *Biological Psychology*, *62*, 97-114.

Holmes, E. A., Brewin, C. R., & Hennessy, R. G. (2004). Trauma films, information processing, and intrusive memory development. *Journal of Experimental Psychology: General*, *133*, 3-22.

Holmes, E. A., James, E. L., Coode-Bate, T., & Deeprose, C. (2009). Can playing the computer game 'Tetris' reduce the build-up of flashbacks for trauma?' A proposal from cognitive science. *PLoS ONE 4: e4153*.

Holmes, E. A., & Steel, C. (2004). Schizotypy as a vulnerability factor for traumatic intrusions: An analogue investigation. *Journal of Nervous and Mental Disease, 192*, 28-34.

Koster, E. H. W., MacLeod, C., & Fox, E. (2009). Introduction to the special section on cognitive bias modification in emotional disorders. *Journal of Abnormal Psychology*, *118*, 1-4.

Lang, T. J., Moulds, M. L., & Holmes, E. A. (2009). Reducing depressive intrusions via a computerized cognitive bias modification of appraisals task: Developing a cognitive vaccine. *Behaviour Research and Therapy*, *47*, 139-145.

Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety. *Journal of Abnormal Psychology*, *109*, 602-615.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

Tabachnick, B. G., & Fidell, L. S. (1996). *Using multivariate statistics* (3rd ed.). New York: HarperCollins.

Weiss, D. S., & Marmer, C. R. (1997). The Impact of Event Scale – Revised. In J. P. Wilson & T. M. Keane (Eds.), *Assessing Psychological Trauma and PTSD: A handbook for Practitioners* (pp. 399-411). New York, NY: Guildford Press.

Woud, M. L., Holmes, E. A., Postma, P., Dalgleish, T., & Mackintosh, B. (2012). Ameliorating intrusive memories of distressing experiences using computerized reappraisal training. *Emotion*, *12*, 778-784.

11

Discussion

Dysfunctional automatic associations and interpretations are hallmark features of many different psychological disorders. According to various (disorder specific) psychological models, these cognitive processes underlie the development, maintenance, and relapse of psychopathology. Hence, the general aim of this dissertation was to advance the present understanding of the role of dysfunctional automatic associations and interpretations in psychopathology.

The theoretical framework was provided by a newly developed dual process model of abnormal behavior with a specific focus on dysfunctional automatic associations and interpretations. According to this model, two cognitive processing styles influence an individual's response to both internal and external stimuli, i.e., associative processing and propositional processing. In associative processing, a stimulus is processed quickly and automatically, without requiring any cognitive resources. Associative memory networks are considered as the base for this type of processing. That is, associations are activated spontaneously and this activation then spreads out via the associative network. This occurs outside an individual's control or awareness. As a consequence, the individual cannot examine whether these associations are true or false. However, these associations nevertheless trigger a behavioral response. In propositional processing, a stimulus is processed in a slower, more effortful and reflective manner. As such, the generated explicit associations and interpretations can be validated. Based on this validation, a behavioral response is triggered. However, such processing requires cognitive resources and motivation.

Generally, automatic processing does not lead to major negative consequences for our daily human life. However, from a psychopathological perspective, the situation is different. Here, automatic associations and interpretations as well as the elicited behavioral responses are often dysfunctional, for example, when an individual is unable to deactivate or to correct automatic associations and interpretations. As such, a better understanding of the role of dysfunctional automatic associations and interpretations can lead to a better understanding of the development, maintenance, and relapse of psychopathology.

The investigation of the role of dysfunctional automatic associations and interpretations in psychopathology within the present dissertation is characterized by three features: First, the role of dysfunctional automatic associations and interpretations was examined as a correlate, predictor, and causal risk factor of psychopathology. Second, different types of psychopathology, and different kinds of samples (risk and clinical samples), were examined. Third, a variety of paradigms were used to assess dysfunctional associations and interpretations, ranging from more direct to indirect approaches.

In this final chapter, I will summarize and discuss the main findings of the studies included in my dissertation. The overarching structure will be provided by the three

features outlined above. Thus, I will start with presenting the findings regarding the role of dysfunctional automatic associations and interpretations as a correlate, predictor, and causal risk factor. This includes a discussion of the expected as well as relevant additional findings. In addition, the findings will be embedded within a broader context and again linked to the dual process model of abnormal behavior. Moreover, limitations, future directions, and implications will be presented. This section will be followed by a discussion of the results obtained in risk samples and clinical samples, both within the present dissertation, but also from a more general perspective. Next, the applied paradigms will be evaluated. The aims and objectives of this dissertation as specified in the Introduction will be integrated throughout the discussion. Finally, the implications for theory, research and clinical practice will be presented.

SUMMARY AND DISCUSSION OF EMPIRICAL FINDINGS – THE ROLE OF DYSFUNCTIONAL AUTOMATIC ASSOCIATIONS AND INTERPRETATIONS

In this section I will first present findings regarding the role of dysfunctional automatic associations and interpretations as a correlate, then as a predictor, and finally as a causal risk factor for psychopathology.

CORRELATE

Chapter 2: This study aimed to expand self-report procedures, and tested the suitability of an indirect measure in the context of 'thinspiration' versus 'fear of fat'. Therefore, a stimulus response compatibility task (SRC; Mogg, Bradley, Field, & De Houwer, 2003) was applied whereby undergraduate female students were asked to categorize pictures of models as either thin or chubby by moving a manikin figure either towards or away from the pictures. Participants were faster to approach than to avoid thin models, however, there was no difference in approach-avoidance responses to chubby models. Moreover, approach-avoidance responses were associated with important eating-related cognitive schemata, e.g., participants' level of drive for thinness, thin-ideal internalization, body dissatisfaction and their weight control behaviors.
Chapter 3: This chapter involved two studies and examined automatic associations towards spiders. The aim was to test the sensitivity of a newly developed variation of the

Single Target Implicit Association Test (STIAT; Wigboldus, Holland, & van Knippenberg, 2004), namely a STIAT including a task-irrelevant instruction. Study 1 compared spider-fearful individuals to non-fearful controls, Study 2 compared spider enthusiasts to non-fearful controls. The novel STIAT version was indeed sensitive to group differences in automatic spider associations. In Study 1, the STIAT successfully distinguished between spider-fearful individuals and non-fearful controls, i.e., the former group showed stronger automatic negative associations toward spiders than the latter group. Moreover, STIAT scores predicted automatic fear responses best, whereas controlled avoidance behavior was best predicted by explicit fear of spiders. Results of Study 2 demonstrated that the novel STIAT version was also able to differentiate between spider enthusiasts and non-fearful controls, i.e., the former group showed stronger automatic positive associations than the latter group.

Chapter 4: This study aimed at replicating previous findings regarding alcohol-related interpretation biases. However, compared to previous approaches, the study employed a scenario-based approach to provide a more ecologically valid assessment of such biased cognitions. Heavy and light drinking male students were asked to complete open-ended ambiguous scenarios that were either alcohol-related or neutral in context. Results showed that heavy drinking students generated more alcohol continuations for ambiguous alcohol-related scenarios than light drinking students, and this bias correlated positively with levels of harmful drinking and alcohol-related problems.

Chapter 5: This study also aimed to replicate findings from prior research in the context of alcohol-related interpretation biases. This time, however, an encoding recognition task was used, including scenarios related to positive and negative reinforcement drinking (i.e., coping and enhancement). Male and female students were presented with ambiguous scenarios and were asked to rate possible interpretations of these scenarios. Coping motives were a unique predictor of the tendency to interpret negative ambiguous alcohol-relevant situations in an alcohol-related manner, while enhancement motives were a unique predictor of the tendency to interpret positive ambiguous alcohol-relevant situations in an alcohol-related manner. However, there was not an expected moderating effect of executive control on the prediction of prospective drinking by the two types of biases.

Chapter 6: The aim of this study was to extend the scenario-based approach as applied in Chapter 4 to a clinical sample. Clinically diagnosed alcohol-dependent patients as well as clinically diagnosed control patients completed 12 open-ended ambiguous scenarios (i.e., seven alcohol-relevant, five emotionally relevant). The probability of generating an alcohol-related continuation on all scenario types was higher for alcohol-dependent patients than for control patients. Moreover, the alcohol-related interpretation bias was positively associated with levels of harmful drinking.

Chapter 7: This study aimed to investigate the effect of negative affective primes on the activation of alcohol-related associations. Again, alcohol-dependent patients as well as control patients were tested. Alcohol-dependent patients did not show the expected enhanced priming effect following negative primes. In addition, there was no expected moderating effect of levels of depressive symptoms. Finally, group membership could not be predicted by the interaction between priming effect and executive control, nor by the interaction between priming effect, executive control and depressive symptoms.

Discussion & Conclusions

The discussion of Chapters 2-7 is structured as follows. First, results of Chapters 2-6 will be addressed as these results were in line with our expectations. This discussion starts with integrating the main findings of these chapters into the model of Kraemer et al. (1997). That is, I will briefly discuss the role of dysfunctional automatic associations and interpretations as a correlate of (levels of) psychopathology, based on what we as well as others have found. Next, the findings will be explained in more detail by means of the dual process model of abnormal behavior. After that, an overview will be given of the valuable extra information Chapters 2-6 provided. That is, this overview will highlight those findings that go beyond the role of dysfunctional automatic associations and interpretations as a correlate of (levels of) psychopathology. Within this overview, results of the single chapters will be discussed but I will also link results of multiple chapters in order to discuss these findings from a more overarching perspective. This overview will end with an integration of the additional findings into the dual process model of abnormal behavior. Finally, the null findings of Chapter 7 will be addressed.
According to Kraemer et al. (1997), investigating whether a factor is a correlate of (levels of) psychopathology is the first important step when aiming to obtain more insight into the typology of a potential risk factor. The studies described in Chapters 2-7 focused on this step and tested whether particular risk groups/types of psychopathology are characterized by specific dysfunctional automatic associations and interpretations. Here, the general expectation was that a high-risk group/a group suffering from a type of psychopathology, compared to a low-risk group/a group not suffering from psychopathology, would show disorder-congruent automatic associations and interpretations.
The results of Chapter 2-6 (but not Chapter 7) were consistent with this hypothesis: Dysfunctional automatic approach-avoidance associations were related to important dysfunctional eating-related concepts (Chapter 2), spider fearful individuals showed

stronger fear-related spider associations compared to non-fearful controls (Chapter 3), and there was evidence of dysfunctional alcohol-related interpretations in analogue risk samples (Chapter 4 and 5) as well as in a clinical population of alcohol-dependent patients (Chapter 6). To conclude, findings obtained in three different clinical domains (i.e., eating pathology, anxiety, alcohol misuse and dependency) indicated that dysfunctional automatic associations and interpretations are indeed a correlate of (levels of) psychopathology. Observing this relationship in three different clinical domains supports the argument that dysfunctional automatic associations and interpretations are a *general* feature of psychopathology, particularly when integrated within the broader literature demonstrating that many other clinical domains are also characterized by such dysfunctional cognitive processes: Social phobia, panic disorder and generalized anxiety disorders are some examples within the anxiety domain, and depression is a prominent example within the mood disorders domain (for reviews, see e.g., Mathews & MacLeod, 2005; Roefs et al., 2011). In addition, dysfunctional automatic associations and interpretations also exist in other addictions, e.g., nicotine dependence (for review, see Rooke, Hine, & Thorsteinsson, 2008; Stacy & Wiers, 2010). As such, the present results are clearly in line with findings obtained in other disorders that are characterized by dysfunctional cognitive processing styles. Moreover, the present results extended our present understanding of the role of automatic dysfunctional associations and interpretations as a correlate of (levels of) psychopathology and by this further emphasize their importance.

The dual process model of abnormal behavior as described in detail in the Introduction provides the theoretical foundation for explaining the present findings (see page 15). According to this model, a stimulus is processed by means of two cognitive processing styles. In associative processing, a stimulus is processed quickly and automatically via the spreading activation of associative memory networks. As a consequence, the individual cannot examine whether these associations are true or false. In propositional processing, a stimulus is processed in a slower and reflective manner. As such, the generated explicit associations and interpretations can be validated. The interplay of both propositional and associative processing is considered to be responsible for behavior. Applying these assumptions to the obtained results suggest the following: On perceiving a (disorder-relevant) stimulus, associative processing, propositional processing or both styles became activated, and this activation then produced a corresponding response. Misevaluations as well as misinterpretations are two likely cognitive responses, and both phenomena were found in the present results. To illustrate, the results of Chapter 3 are a good example of a misevaluation. During the STIAT, spider pictures were presented on the screen. As soon as a spider-fearful individual recognized the spider, automatic negative associations were activated. This

activation affected the categorization speed during the STIAT correspondingly, i.e., spider-fearful individuals showed faster RTs when spiders required the same response as fear-related words, than when spiders required the same response as pleasant words. The results of Chapter 4 are a good illustration of a misinterpretation: During the processing of ambiguous alcohol-related scenarios, alcohol-related memory schemata, which were established and strengthened during previous experiences with alcohol, became active. Due to their higher levels of alcohol consumption, alcohol-related associations were strongest in heavy drinking students. Hence, heavy drinking students interpreted the ambiguous alcohol scenarios in an alcohol-related manner more often than light drinking students.

Having discussed the role of dysfunctional automatic associations and interpretations as a correlate of (levels of) psychopathology, I will now highlight some valuable additional information provided by the results of Chapters 2-6. There are five issues I will discuss in more detail here. First, there was a relationship between dysfunctional automatic associations and deliberative cognitions measured via self-report. For example, results of Chapter 3 demonstrated a correlation between automatic negative spider associations and self-reported fear of spiders. Regarding the strength of the correlations, the lowest was $r = .30$ and the highest $r = .72$, and this range reflects moderate relationships. These findings seem to indicate that automatic associations were not independent from the assessed explicit associations (see 'Evaluation of the paradigms' for an in-depth discussion of this issue).

Second, meaningful relationships were found despite differences in context and time of the assessment. In Chapter 6, it was found that the alcohol-related interpretation bias assessed in a clinical sample of alcohol-dependent patients was correlated with harmful levels of drinking (i.e., AUDIT scores), and so were alcohol-related continuations on other ambiguous emotionally relevant scenarios (e.g., depression-relevant scenarios). However, the scenario task and the AUDIT were administered in two different contexts (at the patient's home vs. at the clinic) and there was a 3-4 week time gap between the two assessments. Hence, this finding is quite noteworthy because it is an indication of the stability of the two assessed psychological concepts.

Third, dysfunctional interpretations generalized to other (emotionally-relevant) ambiguous contexts (Chapter 2 and 6). Regarding Chapter 2, for example, participants also coded some of their continuations of ambiguous neutral scenarios as alcohol-related. The results of Chapter 6 also showed such a generalization effect, as alcohol-dependent patients had a higher probability of generating alcohol-related continuations for panic- and depression-relevant scenarios. Such generalization effects are not restricted to the clinical domain of alcohol abuse and misuse. There is similar empirical evidence from other domains To illustrate, Harvey, Richards, Dziadosz, and Swindell (1993)

found that both panic patients and patients suffering from social phobia were more likely than healthy controls to interpret ambiguous scenarios as being threat-related. This suggests that anxiety disorders might be characterized by a general predisposition to interpret ambiguous information as threatening (for a more detailed elaboration, see Williams, Watts, MacLeod, & Mathews, 1988). A similar mechanism could be true for alcohol abuse and misuse, i.e., a general predisposition to interpret ambiguous information that is partially related to alcohol and its consumption as being alcohol-related. The work of Krank and colleagues on the role of context effects in addiction would offer support for this hypothesis (e.g., Krank & Wall, 2006; Krank, Wall, Stewart, Wiers, & Goldmann, 2005).

Fourth, correlational patterns between dysfunctional interpretations and other relevant concepts were unique. In Chapter 5, analyses revealed that coping motives were a unique predictor of a negative alcohol-related interpretation bias, while enhancement motives were a unique predictor of a positive alcohol-related interpretation bias. Similar results have been obtained by Salemink and Wiers (2013), although they employed a Word Sentence Association Paradigm (WSAP; Beard & Amir, 2009) to assess alcohol-related interpretations. However, examining the differences between and similarities of positive and negative drinking motives by means of more indirect tasks has not yet received much attention (for an exception, see Stewart, Hall, Wilkie, & Birch, 2002). Hence, although the present correlations were rather weak, these data might nevertheless motivate further examination of the functional properties of such congruency effects in the context of alcohol misuse.

Fifth, dysfunctional automatic associations, compared to explicit associations, were a better predictor of dysfunctional automatic behavior. In Chapter 3, it was found that fear-related spider associations, compared to explicit fear of spiders, were the best predictor of spontaneous fear responses. That is, dysfunctional automatic fear-related spider associations had a unique predictive validity regarding disorder-congruent behavioral responses. This was true although a variant of the STIAT had been applied, namely a STIAT with a task-irrelevant instruction. On the one hand, this finding complements other findings in the domain of spider fear, reported by Huijding and de Jong (2006). They showed that the EAST was the best predictor of automatic fear responses (i.e., startle reflex). In contrast, self-reported spider fear was the only predictor of relatively controllable fear responses (i.e., behavioral avoidance). On the other hand, the present finding contributes to the assumption that different measures have differential predictive validity regarding the prediction of behavior (for related findings, see Asendorpf, Banse, & Mücke, 2002; Egloff & Schmuckle, 2002; Klein, Becker, & Rinck, 2011; Reinecke, Becker, & Rinck, 2010).

To conclude, these additional results not only provide evidence that automatic dys-

functional associations and interpretations are a correlate of (levels of) psychopathology, but also provide additional insights into their nature and role. In order to obtain a more in-depth understanding of these additional results, I will now integrate them into the dual process model of abnormal behavior. This elaboration will be done for each of the five results I described in the previous sections. To start with, the results of Chapter 3 demonstrated a positive correlation between automatic negative spider associations and self-reported fear of spiders, i.e., the stronger participants' automatic negative spider associations, the stronger their explicit negative spider associations. This suggests that (1) both associative and propositional processing lead to similar activation patterns and therefore generated similar outcomes, or (2) the output of the associative system did not get rejected during propositional processing and/or overruled propositional processing. Moreover, the results of Chapter 3 showed that automatic negative spider associations were the best predictors of automatic fear responses, compared to self-report. This finding is indicative of the direct disorder-congruent route between automatic associations and behavioral responses as described in the dual process model of abnormal behavior. Moreover, it underlines the value of including both direct and indirect measures of associations when aiming to predict behavioral outcomes as in Klein et al. (2010).

Theoretically interesting, but not per se relevant for the specific topic of this dissertation, are results of the second study of Chapter 3. Here, the novel STIAT version was also able to differentiate between spider enthusiasts and non-fearful controls, i.e., the former group showed stronger automatic positive associations than the latter group. This is still in line with the functional properties of dual process models, albeit more with models of normal behavior (e.g., Gawronski & Bodenhausen, 2006; Smith & DeCoster, 2000; Strack & Deutsch, 2004). In addition, these results contradict the assumption that (ST)IAT effects are the result of general negative associations towards spiders (e.g., Karpinski & Hilton, 2001).

Regarding results of Chapter 5 in the context of alcohol misuse, relationships were found between specific biases and drinking motives: Coping motives were a unique predictor of a negative alcohol-related interpretation bias, while enhancement motives were a unique predictor of a positive alcohol-related interpretation bias. These findings suggest that different measures not only have unique differential predictive validity regarding the prediction of behavioral responses, different measures might also have a unique, i.e., valence-congruent relationship. This could be considered as a kind of 'valence-congruent interplay' within the dual process model of abnormal behavior.

Finally, assumptions of the dual process model of abnormal behavior are also in line with the generalization effects reported in Chapter 2 and 6: Here, the spreading activation account becomes particularly relevant via the role of the contextual cues

presented within the (emotionally relevant) ambiguous scenarios: These scenarios involved cognitions, affective states, and bodily symptoms that may be associated with alcohol and its consumption. Hence, these contextual cues activated the corresponding alcohol-related memory schemata which then biased the processing of the ambiguous scenarios in an alcohol-related manner. Finally, the fact that the correlational pattern between alcohol-related interpretation biases and levels of harmful drinking as reported in Chapter 6 was found despite the difference in context and time of assessment could be an extra indication of the associative strength between these concepts. As this study included alcohol-dependent patients who were dependent for quite a long time, these associative paths were 'developed well.'

The final part of this discussion section concerns the finding of Chapter 7. These results were not as expected. It was predicted that alcohol-dependent inpatients, compared to control inpatients, would show an enhanced alcohol priming effect following negative primes. In addition, it was predicted that this effect would be further qualified by participants' levels of depressive symptoms. However, negative words did not prime alcohol-related concepts in alcohol-dependent inpatients, and there was no moderating role of depressive symptoms. Finally, it was expected that the interaction between executive control and priming effect as well as the interaction between executive control, priming effect and depressive symptoms would be predictive of group membership. Again, results did not confirm this.

In terms of Kraemer et al. (1997), this would imply that automatic alcohol-related associations, as operationalized in this study, should be considered as a non-correlate. That is, there is no direct relationship between automatic negative alcohol-related associations and alcohol dependency. However, assumptions put forward by the dual process model of abnormal behavior as well as negative reinforcement theories of addiction (e.g., Baker, Piper, Fiore, McCarthy, & Majeskie, 2004; Koob & Le Moal, 2001) would have clearly predicted such a relationship: According to negative reinforcement theories of addiction, reducing negative affective states is the most prominent drinking motive in alcohol dependency. When combining this with predictions of the dual process model of abnormal behavior, one could have expected a strong association between negative affect and alcohol in alcohol-dependent patients, which should have been even stronger in those patients experiencing negative affective states on top of their alcohol dependency. The most plausible explanation here is the low reliability of the affective priming task we used, and thus it will be useful to examine this relationship using alternative tasks.

Limitations, Future Directions & Implications

In the next sections, I will discuss the limitations of the studies we conducted to investigate the role of dysfunctional automatic associations and interpretations as a correlate of (levels of) psychopathology. This discussion only includes the findings of Chapter 2-6 as the limitations of Chapter 7 have been addressed intensively in the chapter itself. Moreover, within the particular discussions of Chapter 2-6, several limitations have already been addressed. However, I would nevertheless like to re-highlight a few overarching considerations and elaborate on them in more detail (please see 'Evaluations of paradigms' for limitations specifically related to the direct versus indirect issue).

The first limitation is that we investigated dysfunctional cognitive processes in isolation. However, recent theorizing has adopted a novel perspective on this matter. According to Hirsch, Clark, and Mathews (2006), "cognitive biases do not operate in isolation, but rather can influence each other and/or can interact so that the impact of each on another variable is influenced by the other. Via both these mechanisms we argue than combinations of biases have a greater impact on disorders than if individual cognitive processes acted in isolation" (p. 224). This perspective is based on demonstrations of various dysfunctional cognitive processes in social anxiety (e.g., attention, interpretation, memory). However, it seems very likely that this rationale can be applied also to other types of psychopathology (for the 'combined cognitive bias hypothesis in depression', see Everaert, Koster, & Derakshan, 2012; Holmes, Lang, & Deeprose, 2009). To investigate this, we are currently running a study in the context of alcohol misuse, which tests the presence as well as the functional properties of three dysfunctional cognitive processes related to attention, interpretation, and memory. Of course, such an integrative approach is also recommended for the other areas we investigated, i.e., eating pathology and fear of spiders.

Another limitation is related to the paradigms used to assess dysfunctional interpretations, i.e., the scenario task (Chapter 4 and 6) and the encoding recognition task (Chapter 5). A problem all these tasks have in common is that any bias found might be due to a response bias. That is, the results may not be an index of an individual's actual interpretation, but might instead be due to a greater tendency in an individual to endorse a more disorder-congruent interpretation, even without necessarily believing it. In order to obtain more insight into this matter, an alcohol homograph priming is currently used in the context of alcohol dependency. That is, we are examining the effect of ambiguous alcohol-related primes on the activation of alcohol-related interpretations in a clinical sample of alcohol-dependent inpatients and a control inpatient group. During the homograph priming, alcohol and soft drinks words are used as targets, and primes consist of either alcohol-related or alcohol-unrelated homo-

graphs (e.g., 'shot' versus 'bank'). If alcohol-dependency is indeed characterized by alcohol-related interpretation biases, results should show that alcohol dependent inpatients, compared to control inpatients, are faster to categorize alcohol targets when primed with alcohol-related homographs. Homograph priming tasks have been used successfully before, for example when assessing interpretation biases in social anxiety (Richards & French, 1992). Of course, applying an RT based paradigm has also some disadvantages (see 'Evaluations of paradigms'). However, if interpreted with the necessary caution, these findings might nevertheless advance the understanding of the role of dysfunctional interpretations in alcohol-dependency.

In line with the previous limitation is another limitation regarding the generalization effect we found to other (emotionally-relevant) ambiguous scenarios within the scenario-based approach. For example, in Chapter 4 we found that alcohol-dependent patients had a higher probability of generating alcohol-related continuations also for ambiguous panic-and depression-relevant scenarios (for related findings, see Chapter 6). So far, we argued that this generalization effect is due to the spreading activation and put forward that emotionally ambiguous scenarios involve cues that also activate alcohol-related memory schemata. This nevertheless means that we regard these scenarios as distinctive, i.e., they relate to different kinds of cognitions. To illustrate, ambiguous depression-relevant scenarios were designed based on cognitions that are highly relevant in depression, whereas ambiguous alcohol-relevant scenarios were designed based on cognitions that are highly relevant in alcohol dependency. However, we do not know whether this operationalization was indeed successful. Put differently: We do not know whether depression-relevant scenarios were truly depression-specific and whether alcohol-relevant scenarios were truly alcohol-specific. To illustrate, both the depression and alcohol scenarios contained negative affective states. However, we do not know whether these negative affective states were indeed disorder specific. To illustrate, the cognition 'I am a failure' is a typical depression-relevant cognition but could also be a relevant negative affective state in alcohol dependency. Hence, a lack of specificity then would be the most plausible explanation for the generalization effects we found.

Another problem concerning some of the present studies is that they are 'proof of the principle' studies. That is, they should be regarded as a first step towards a better understanding of the role of dysfunctional automatic associations and interpretations in the particular type of psychopathology. Hence, replications and extensions are needed to substantiate and refine the present findings. The findings which would benefit most from replicating and extending them are those of Chapter 2. Here, we tested the suitability of an indirect measure in the context of thinspiration versus fear of fat by means of an SRC task. Results showed an approach bias towards thin models,

and approach-avoidance responses were related to important eating-related cognitive schemata. However, to the best of our knowledge, there are no follow-up studies that further investigated the relationship between dysfunctional approach-avoidance associations and eating pathology/body image disturbance by means of an indirect measure. A paradigm which might provide a very ecologically valid extension of the present findings is the Approach-Avoidance Task (AAT; Rinck & Becker, 2007). During the AAT, participants are instructed to pull a joystick towards themselves (approach movement) or to push it away from themselves (avoidance movement) in response to pictures presented on the computer screen. The time participants need to fully execute these valenced movement provides an index of their spontaneous behavioral tendencies towards the particular picture category. As such, the AAT might provide a valuable extension from measuring dysfunctional approach-avoidance associations to dysfunctional approach-avoidance behavioral tendencies in the context of eating pathology and body image.

Finally, many (cognitive) models of psychology postulate that highly specific dysfunctional automatic associations and interpretations maintain psychopathology. Hence, trying to identify these specific associations and interpretations with a variety of measures seems a very important next step. For example, for the STIAT applied in Chapter 3 to assess spider-related associations, we used fear-related versus pleasant words as attributes. However, there are many more concepts that are relevant in fear of spiders, for example spiders could be evaluated negatively because people consider them as being disgusting (see Huijding & de Jong, 2007), uncontrollable, hairy etc. Hence, it might be worthwhile to disentangle which negative concept is triggered when and which negative concept is indeed crucial for a spider fearful individual. Specifying the associations' nature is also important from a theoretical point of view, namely in order to test the validity of the dual process model of abnormal behavior regarding its prediction that there are indeed disorder-specific dysfunctional automatic associations and interpretations.

Last but not least, when following recommendations of Kraemer et al. (1997), future research should address the role of the assessed dysfunctional automatic associations and interpretations as a predictor and causal risk factor (i.e., not simply as correlates).

Regarding the clinical implications of these findings the following aspects are important. First, obtaining more insight into the specificity of dysfunctional automatic associations and interpretations would be also beneficial for the treatment of a particular disorder. By this, the observed emotional, behavioral, and physiological responses can be understood better. Moreover, different associations and interpretations including their corresponding response might require different approaches during treatment. For example, exposure might be helpful to reduce the fear towards a spider, whereas

learning something about the many skills spiders do have (e.g., spinning webs and producing silk) might be helpful to reduce disgust. Another important clinical implication lies in the role of context effects. There are empirical demonstrations suggesting that the activation of automatic dysfunctional associations and interpretations depends on which aspect of a particular stimulus is made salient (e.g., Mitchell, Nosek, & Banaji, 2003). This becomes particularly important when aiming to understand treatment effects and antecedents of relapse. For example, there are observations demonstrating that relapse after successful treatment is frequently attributed to negative affective states (Marlatt, 1996). Hence, reducing negative affect is the 'active' salient aspect of the concept alcohol, and not aspects such as arousal or excitement, and this is important in light of relapse prevention. Moreover, in order to gain a better understanding of treatment effects, it seems worthwhile to also examine the changes in dysfunctional automatic associations and interpretations over the course of a treatment. This could provide useful information regarding the processes the treatment targets. However, this of course requires valid and reliable measures which, for example, are sensitive enough to detect such (subtle) changes (for a related discussion concerning the application of indirect measures to assess treatment change, see e.g., Huijding & de Jong, 2007).

PREDICTOR

Chapter 8: This study investigated whether a panic-related interpretation bias is predictive of the onset of panic disorder, by means of a prospective longitudinal design. At time point 1, female participants completed an interpretation questionnaire including two types of ambiguous scenarios: panic-related and general threat-related. We found that a panic-related interpretation bias predicted the onset of panic disorder at time point 2, even after controlling for two established risk factors: anxiety sensitivity and fear of bodily sensations.

Discussion & Conclusions

In the model of Kraemer et al. (1997), the second step to determine the typology of a potential risk factor is to examine whether it precedes psychopathology. Hence, the study reported in Chapter 8 investigated whether dysfunctional interpretations are predictive of the development of psychopathology. The general expectation regarding this step was that those individuals who misinterpret ambiguous scenarios are more likely later to develop a psychological disorder. The study of Chapter 8 was conducted

in the context of panic disorder. As it is well-established that panic disorder is indeed characterized by panic-related interpretation biases (i.e., is a correlate), examining whether such a bias *precedes* panic disorder (i.e., is a predictor) was therefore a question warranting research.

The results of Chapter 8 confirmed the predictor hypothesis: Women who interpreted ambiguous panic-related scenarios in a threatening manner at baseline were more likely to develop panic disorder at follow-up compared to women who had benign interpretations of these scenarios. In addition, the interpretation bias for panic-related scenarios remained a significant predictor, after controlling for anxiety sensitivity and fear of bodily sensations. To the best of our knowledge, these data are the first to show that new onsets of panic disorder are predictable by a panic-related interpretation bias. In general, there are not many prospective studies examining the role of interpretation biases as a predictor of psychopathology. There are some results involving (preschool) children and adolescents in the context of anxiety. Here, Pury (2002), for example, found that threat-related interpretation biases were predictive for negative affect during a stressful period in undergraduates (see also Creswell, Shildrick, & Field, 2011; Muris, Jacques, & Mayer, 2004). When also including studies assessing the predictive power of dysfunctional associations, the prospective study of Glashouwer, de Jong, and Penninx (2011) provides valuable information. This study included three groups (healthy controls, depressed individuals, individuals remitted from an anxiety disorder) and explicit as well as automatic negative self-associations were assessed. Here, automatic as well as explicit negative self-associations were predictive of the onset of an anxiety disorder at follow-up. In particular, automatic negative self-associations were predictive in the depressed and remitted group (but only in the single predictor analysis), whereas explicit negative self-associations were predictive for the onset of anxiety across all three groups (for related findings, see Glashouwer, de Jong, & Pennix, 2012).

Linking the findings of Chapter 8 back to the dual process model of abnormal behavior, the following vicious circle could, at least in part, provide an explanation: Women who tend to interpret bodily sensations as potentially threatening (as indicated by their interpretations of the ambiguous panic-related scenarios in the study) will make these mis-interpretations more often in day to day life. It is likely that these mis-interpretations will be accompanied by many dysfunctional cognitive, emotional, and behavioral responses such as increased stress, fear, and worry. As a result of experiencing such dysfunctional responses, a panic-specific memory schema might be established. This panic-specific memory schema is hypersensitive (i.e., easily activated by panic-related information such as certain body sensations), and thus could, in turn, reinforce the dysfunctional processing of further ambiguous cues as being panic-related. This

reinforcing element is indicated by the bi-directional link between the 'Disorder congruent interpretations' and 'Responses' in the dual process model of abnormal behavior (page 15), i.e., there is a reinforcing connection between cognitive processing and outcome. Hence, having such a vulnerability could increase the likelihood of developing a panic disorder, once the panic-specific memory schema reaches a certain level of hypersensitivity.

This study also provided valuable additional information: The panic-related interpretation bias was predictive over and above two well-known risk factors, i.e., anxiety sensitivity and fear of bodily sensations. Again, these results suggest a uniqueness regarding dysfunctional interpretations. However, it has to be noted that anxiety sensitivity also predicted new onsets of panic disorder. This is not surprising from the perspective of the dual process model of abnormal behavior: On the one hand, it is likely that there is a panic-specific memory schemata. On the other hand, however, it also likely that this panic-schemata is embedded in a general anxiety-related memory schemata, as panic can be regarded as a subset of anxiety. Hence, when interpreting ambiguous panic-related information, not only the panic, but also the general anxiety-related memory schemata might have been activated. As such, both concepts have predictive validity in this context. However, what is different is the measurement procedure: Panic-related interpretations were measured via a scenario task whereby contextual cues automatically activated panic-related interpretations. In contrast, levels of anxiety sensitivity were measured by self-report whereby participants explicitly evaluated their fear.

Limitations, Future Directions & Implications

A detailed overview of the limitations of this study can be found in Chapter 8. However, I would like to re-emphasize one limitation and elaborate on it in more detail: The sample of main interest at time point 2, i.e., new onsets of panic, was very small. Hence, an analysis including all four predictors was impossible. However, given the results of Glashouwer et al. (2011) showing that the predictive validity of automatic as well as explicit negative associations changed when all predictors where entered into the regression, such an analysis could have provided useful information to refine the present results. Moreover, the small sample size did not allow for any exploratory analyses including for example participants' pre-existing psychopathologies. However, investigating this seems crucial when taking, for example, results by Trumpf, Margraf, Vriends, Meyer, and Becker (2010) into account. Their prospective study investigated

whether young women with specific phobia had an increased risk of developing other mental disorders at a period of 17 months later. They found that women with specific phobia had a greater risk of developing another anxiety disorder, depression, and any somatoform disorder at time point 2. Hence, controlling for participants' pre-existing psychopathologies might also have been important for our study.

Following these limitations, there are plenty of topics for future research. For example, thoroughly examining the role of other risk factors as well as other psychopathologies is an important next research target. In line with this, more studies are needed to investigate possible mediators and moderators regarding the prediction of panic onset via panic-related interpretations biases. Furthermore, a replication study is recommended to test the predictive validity of panic-related interpretation biases when using different interpretation measures. However, given the fact that these suggestions require a longitudinal prospective design including many participants and several assessments points, the implementation of such a study is not an easy endeavor. A final suggestion for future research brings us back again to the model of Kraemer et al. (1997). Now that research has shown that panic-related interpretation biases are a correlate as well as a predictor of the onset of panic, a next intriguing question is whether this bias can be changed and whether this change would have an effect on panic-related symptoms. Put differently, it has to be examined whether a panic-related interpretation bias is a causal risk factor. Here, one could test whether it is possible to induce a panic-related interpretation bias in a high risk sample, and whether this has an effect on the appraisal of potential panic symptoms. Second, one could investigate whether it is possible to change panic-related interpretation biases in a high risk sample, and whether this has beneficial effects on panic-related symptoms. Finally, the clinical implications. As pointed out earlier when discussing the clinical implications of the findings concerning the role of dysfunctional associations and interpretations as a correlate, the findings of Chapter 8 are also important for the improvement and extension of present therapeutic interventions for panic disorder. Perhaps more important, however, is that the present findings provide a strong rationale for early interventions to prevent development of panic disorder. Our results showed that a panic-related interpretation bias precedes the onset of panic disorder. This may provide a focus for the screening and identification of potentially vulnerable individuals, and if the bias does in fact play a causal role, may offer a target for a focused preventative intervention.

CAUSAL RISK FACTOR

Chapter 9: This study investigated the causal role of (dys)functional interpretations in the context of Post Traumatic Stress Disorder (PTSD), and tested the effect of positive and negative reappraisal training (CBM-App training) on analogue trauma symptoms. It was expected that positive CBM-App training would lead to fewer analogue trauma symptoms than negative CBM-App training. To test this hypothesis, participants were exposed to highly distressing film clips and were then randomly allocated to either positive or negative CBM-App training. Results showed that CBM-App training successfully induced training-congruent appraisal styles. Moreover, compared to those trained negatively, those trained positively reported fewer intrusive memories of the film, and had lower scores on the Post Traumatic Cognition Inventory (PTCI; Foa, Ehlers, Clark, Tolin, & Orsillo, 1999) as well as on the Impact of Event Scale-Revised (IES-R; Weiss & Marmer, 1997) at one-week follow-up.
Chapter 10: The aim of this study was to test the prophylactic effect of CBM-App and used a reversed order of tasks, i.e., first CBM-App training and then exposure to highly distressing film clips. Again, results showed that CBM-App training successfully induced training-congruent appraisal styles. In addition, those trained positively reported less distress arising from their intrusive memories. However, the induced appraisal bias only partly affected PTCI scores.

Discussion & Conclusions

According to Kraemer et al. (1997), investigating whether a factor is causal risk factor involves two steps. First, it has to be tested whether the factor can change or whether it can be changed. In case this is possible, the factor should be considered as a variable risk factor. Second, it has to be examined whether this change then has an effect on the outcome, i.e., whether it affects (levels of) psychopathological behavior/psychopathology. If this is indeed the case, then the variable risk factor should be regarded as a causal risk factor. The studies reported in Chapter 9 and 10 focused on these two steps by means of two analogue experimental studies. It was expected that it would be possible to induce functional versus dysfunctional appraisal styles, and that this would lead to training-congruent differences in analogue trauma symptoms.
Regarding step 1 (whether the factor can be changed), both studies showed that it is possible to induce a training-congruent appraisal style: Following the CBM-App training, positive-trained participants appraised novel ambiguous vignettes in a more adaptive manner than participants who were trained negatively. This finding is novel

within the context of PTSD (for related findings, see Schartau, Dalgleish, & Dunn, 2009). In contrast, in the domain of social anxiety, for example, it is relatively well established that computerized interpretation training (i.e., Cognitive Bias Modification - Interpretation, CBM-I) can affect the interpretation of socially ambiguous scenarios in a training-congruent manner (for a recent review and meta-analysis of CBM in anxiety and depression, see Hallion & Ruscio, 2011, and for additional reviews on CBM, see e.g., Hertel & Mathews, 2011; MacLeod & Mathews, 2012). CBM-I research on the modification of negative depression-related interpretation, for example, is in its infancy. However, there are first promising effects, including studies which combined CBM-I with mental imagery techniques (e.g., Blackwell & Holmes, 2010; Holmes, Lang, & Shah, 2009).

Regarding step 2 (does changing the putative risk factor have an impact on the outcome), we found that the two CBM-App training groups differed regarding their analogue trauma symptoms, and that this difference was in the expected training-congruent manner: Those who received positive CBM-App training, compared to those who received negative CBM-App training, showed generally less analogue trauma symptoms. Research in the anxiety and depression domain has also found such transfer effects. However, this is not always the case. According to the meta-analysis of Hallion & Ruscio (2011), CBM-I had small effects on symptoms, even when symptoms were assessed in the presence of a stressor (which the authors suggest might be necessary as it is the interplay between dysfunctional cognitive processing and a stressor which influences anxiety- and depression-related symptoms). Moreover, training effects do not always transfer to other measures of interpretation (e.g., Salemink, van den Hout, & Kindt, 2007). The lack of transfer/generalization could be an indication that effects are limited to the training paradigm and thus do not affect other measures of interpretation. In addition, these findings could be due to poor validity and reliability of the applied measures.

Based on the dual process model of abnormal behavior, the findings of Chapter 9 and 10 could be explained as follows. During the training, which targeted self-efficacy beliefs and reappraisals of secondary emotions (i.e., emotions in response to the emotional reactions elicited by the films), a training-congruent trauma-appraisal memory schema was established. This schema became activated following the perception of an analogue trauma-related internal and/or external stimulus, and this stimulus was then processed in a training congruent manner. For example, those who received positive CBM-App training might have interpreted the occurrence of an intrusion as a normal part of processing the trauma films. Those who received negative CBM-App training, however, might have interpreted such an intrusion as a sign that the trauma films still affected him/her negatively. As a consequence, training-congruent, i.e.,

functional or dysfunctional responses were triggered, e.g., acceptance vs. avoidance, staying calm vs. becoming stressed. In turn, these functional or dysfunctional responses might have reinforced the training-congruent associations and/or interpretations, as indicated by the bi-directional link in the dual process model of abnormal behavior.
An in-depth discussion regarding the slightly different outcomes when applying the CBM-App training before versus after the analogue trauma event in combination with the dual process model of abnormal behavior goes beyond the scope of this dissertation. The same is true for a detailed discussion of the underlying mechanisms of the applied CBM-App training (and CBM-I). Regarding the latter, there is an ongoing debate, including priming-related mechanisms (e.g., Hoppitt, Mathews, Yiend, & Mackintosh, 2010) or the idea that the training induces an implicit production rule to generate and select training-congruent interpretations when processing new ambiguous information (e.g., Mathews & MacLeod, 2002; Wilson, MacLeod, Mathews, & Rutherford, 2006), both sharing some features with the dual process model of abnormal behavior.

Limitations, Future Directions & Implications

There are several limitations that apply to both studies. First, there was no pre-training assessment. Hence, strictly speaking, we do not know whether appraisal styles changed by means of the CBM-App training. As a consequence, mediational analyses to examine whether a change in appraisal is related to the observed group differences on analogue trauma symptoms post CBM-App training could not be conducted (see MacLeod, Koster, & Fox, 2009). Moreover, there was no neutral control condition, so it is unclear what exactly produced the observed differences between the two training groups: Did the positive CBM-App training reduce analogue trauma symptoms, or did negative CBM-App increase them, or both? Furthermore, nothing is known about the temporal aspects of the CBM-App training effect nor its moderators. Concerning the latter, Salemink and Wiers (2012) identified level of regulatory control as a moderator of CBM-I effects in anxiety disorder. Finally, both studies were analogue experimental studies, implying that we do not know whether we could also find such effects in clinical samples. In order to obtain more insight into this matter, a randomized control trial is currently being conducted, testing the effects of positive CBM-App versus control CBM-App prior to standard Cognitive Behavioral Therapy, in a clinical sample of patients with PTSD.
Regarding the clinical applications of the findings of Chapter 9 and 10, in the absence of any evidence for the clinical effects of CBM-App in the context of PTSD, it is prema-

ture to make concrete recommendations (see Woud & Krans, 2013). However, a few thoughts concerning the advantages of such a computerized training, in case it would be effective, may be allowed. Please note that these suggestions do not imply replacing, for example, Cognitive Behavioral Treatment (CBT) by CBM-App. We rather regard CBM-App as a beneficial addition as it could be used to specifically target one important process, namely dysfunctional appraisals, whereas CBT is a complex multicomponent intervention. Generally, CBT has been proven to be an effective approach in the treatment of PTSD (Foa, 2000). However, it is time-consuming and patients must first identify themselves as needing help. In contrast, CBM-App could allow the patient to do the training at home, with minimal professional support, and this might provide a much more flexible and motivating approach. Moreover, it would allow participants to self-administer and adjust their 'dose' according to their needs. In addition, its use avoids potential stigmatism and concerns of potential recipients about admitting to suffering from mental health problems associated with PTSD.

FINDINGS OBTAINED IN RISK SAMPLES VERSUS CLINICAL SAMPLES

Throughout this dissertation, different types of psychopathology were examined. Moreover, this included different levels of psychopathology, e.g., risk samples and clinical samples. Studying different types of psychopathology is important because dysfunctional automatic associations and interpretations could be considered as a shared cognitive vulnerability factor. The approach in the present dissertation has some similarities with a transdiagnostic perspective (e.g., Barlow, Allen, & Choate, 2004; Harvey, Watkins, Mansell, & Shafran, 2004; Mansell, Harvey, Watkins, & Shafran, 2009; Nolen-Hoeksema & Watkins, 2011). However, strictly speaking, we did not examine one specific risk factor that is involved in multiple and comorbid psychological disorders, such as stress or rumination. Instead, general cognitive phenomena (i.e., dysfunctional automatic associations and interpretations) were examined, whose specific expression depended on the particular type of psychopathology. Nevertheless, examining the mere presence of such phenomena is also informative as it provides insight into fundamental cognitive processes underlying psychopathology. In the context of emotional disorders, McEvoy, Nathan, and Norton (2009) state "… that commonalities across emotional disorders may outweigh the differences" (page 20), and this might be true for more than just emotional disorders. Moreover, it provides insight into fun-

damental cognitive processes itself, namely how meaning is given to the world. As described at the beginning of the Introduction, different minds create different meanings. Hence, by investigating this in psychopathology, specifically across different types of psychopathology, it can be shown how this meaning-making process can take many different directions.

Examining different types of psychopathology at different stages is also important because it might provide valuable information regarding the presence as well as the specificity of dysfunctional automatic associations and interpretations. Hence, extending studies that were conducted with risk samples to clinical populations will always be a crucial part of clinical research. Such results can provide useful input for the improvement and refinement of ways to study and to treat psychopathology. Nevertheless, it is critical to note that when relating data obtained in risk samples to that obtained in clinical samples, we do not know whether these samples are indeed comparable and therefore should generate similar results on task applied in both samples.

In the present dissertation, risk samples and a clinical sample in the context of alcohol abuse and misuse were studied (Chapter 4, 5 and 6). Within both samples, the presence of alcohol-related interpretation biases was investigated by means of a scenario-based approach. Both samples showed alcohol-related interpretation biases. This might be a demonstration of the significance of such dysfunctional interpretations, and in addition is theoretically very important: If alcohol-related interpretation biases were only observed in clinical samples, it would be impossible to argue that such biases could be crucial regarding the development of an alcohol dependency. However, if found in risk as well as clinical samples, then one is allowed to start forming hypotheses about the causal role of such a factor. Hence, conducting follow-up studies to further examine the (causal) typology of such a potential risk factor seems worthwhile (Kraemer et al., 1997). Clinical research addressing the role of dysfunctional interpretations in other psychological disorders would support such an approach, as there are many more demonstrations that dysfunctional interpretations indeed exist in risk samples as well as clinical samples, for example in depression (for review, see Gotlib & Joormann, 2010) or social phobia (for review, see Hirsch & Clark, 2004).

However, there is also evidence that observations in risk samples and clinical populations do not match. Moreover, findings can be inconsistent even within one population. Research on interpretation biases in depression, for example, has revealed many mixed findings. In the context of alcohol abuse and misuse as studied in this dissertation, there is little research comparing the role of dysfunctional automatic associations and interpretations in risk samples to clinical samples (for an exception, see the work of Zack and colleagues, 1999, 2003; and for a review, see Stacy & Wiers, 2010). However, there is some evidence regarding another dysfunctional cognitive process, namely

automatic attention. Here, it has been shown that heavy drinkers show an attentional bias towards alcohol (e.g., Field, Mogg, Zetteler, & Bradley, 2004), whereas abstaining alcohol-dependent patients show an attentional bias away from alcohol (e.g., Noël et al., 2006). Several explanations could account for such inconsistencies, for example the properties of or variations in paradigms, the qualitative differences between risk and clinical samples, the inaccuracy regarding the psychological model used to derive a specific hypothesis or the different interplay between various cognitive processes in risk versus clinical samples (for elaborations in the area of depression, see e.g., Vrijsen, Van Oostrom, Isaac, Becker, & Speckens, 2013). In any case, these findings are important but have to be interpreted very cautiously. Given the open questions regarding differences and similarities among risk and clinical samples, a very systematic investigation is needed in order to fully understand the role of dysfunctional automatic associations and interpretations across different types of psychopathology.

EVALUATION OF THE PARADIGMS

A third characteristic of this dissertation was that a variety of paradigms were used to assess dysfunctional associations and interpretations ranging from more direct to indirect approaches (Chapter 2, 3, 4, 5, 6, 7 and 8). Discussions following the emergence of dual process models (e.g., Gawronski & Bodenhausen, 2006; Smith & DeCoster, 2000; Strack & Deutsch, 2004) raised the issue whether direct and indirect tasks should be regarded as complementary or competing. As such, it seems necessary to employ both types of tasks when aiming to assess dysfunctional automatic associations and interpretations. However, because not all tasks were used with all samples and disorders studied within this dissertation, each particular paradigm can only be evaluated for the specific situations studied here.

Moreover, two issues need to be mentioned before starting this evaluation: First, this discussion only concerns the assessment studies, i.e., studies in which the direct versus indirect issue is relevant. Second, this discussion only focuses on limitations related to the direct versus indirect issue, as other limitations and considerations have been addressed before.

I would like to start with some background regarding the terms 'implicit', 'direct versus indirect' and 'automaticity', in combination with topics such as 'measurement procedure' and 'a measurement procedure's outcome'. Throughout the literature, many tasks are described as 'implicit', for example the STIAT. However, according to De Houwer (2006), the functional properties of the term 'implicit' are neither fully understood

nor defined very well. Moreover, De Houwer (2006) puts forward that there is an important difference between a measurement procedure and a procedure's outcome. To start with, referring to a measurement procedure as implicit which has, for example, sometimes been equated with 'unconscious', does not seem very appropriate, given the fact that people are mostly aware of what is measured. Instead, the terms 'direct' versus 'indirect' are more suitable here (De Houwer, 2006). 'Direct' refers to a measurement procedure whereby the concept of interest is inferred directly. In contrast, 'indirect' refers to a measurement procedure whereby the concept of interest is inferred indirectly, for example, from a behavioral performance. Asking a spider-fearful individual to evaluate a spider by means of a Liktert scale refers to a direct measurement procedure of spider-related associations. However, comparing the categorization times of a spider-fearful individual during the different blocks of an STIAT can be considered as an indirect measurement procedure. Following this, De Houwer suggests that only a measurement procedure's outcome can be considered as to be implicit. However, this also bears some disadvantages (for detailed elaborations, see De Houwer, 2006; De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009). Hence, the term 'automaticity' comes into play. According to De Houwer (2006), defining a measurement procedure's outcome as 'automatic' seems most appropriate as automatic embraces a number of functional properties that largely (but not fully) overlap with the term implicit. With regard to the tasks used in this dissertation, properties like fast, effortless, goal-independent and unintentional are most relevant. As such, the tasks' outcome can be considered to be the product of the individual's automatic reaction towards the stimulus, without any effects of, for example, the individual's goals or awareness (De Houwer et al., 2009).

The following tasks are included in this dissertation: an SRC task (Chapter 2), an STIAT (Chapter 3), a scenario task (Chapter 4 and 6), an encoding recognition task (Chapter 5), an affective priming task (Chapter 7) and the Interpretation Bias Questionnaire (Chapter 8). When looking at the criteria for indirect measurement procedures, all the tasks can be regarded as indirect. Regarding the SRC, STIAT and affective priming task, participants' categorization times served as an index of the concept of interest (i.e., automatic associations). The scenario task as well as the encoding recognition task can also be considered as indirect. Within both tasks, alcohol-related interpretation biases were the concept of interest. Regarding the scenario task, participants' continuations were used an index, regarding the encoding recognition task, participants' ratings were used an index to infer the concept of interest, respectively. Finally, during the Interpretation Bias Questionnaire, participants had to choose the explanation that fitted best with the corresponding ambiguous scenario. Here, the sum score of chosen panic-related explanations served as a bias index.

Whether the procedures' outcomes can be considered as automatic, or which property of automaticity has been operationalized within a particular procedure, is extremely hard to evaluate (for a recent elaboration of the concept 'automaticity' in the area of anxiety and depression, see Teachman, Joormann, Steinman, & Gotlib, 2013). Hence, given the variety of the employed tasks in combination with the fact that this issue has not been examined particularly thoroughly, if at all, for each of the tasks, an in-depth discussion is beyond the scope of this discussion. Nevertheless, it is worth raising a few points of interest. One issue is whether participants are aware of what is being measured by the task. For the reaction times-based paradigms (i.e., SRC, STIAT, affective priming task), this might be harder for participants to discover but it is nevertheless possible. For example, during the SRC task (Chapter 2), participants were explicitly instructed to, for example, 'move the manikin towards chubby and away from thin models'. As such, the pictures' contents was task-relevant and this may have directed participants' attention to the task's aim. Making use of task-irrelevant instructions might have prevented this (see, e.g., Rinck & Becker, 2007; Wiers, Rinck, Dictus, & van den Wildenberg, 2009). The STIAT version we employed indeed used such a variation and it successfully distinguished between the tested groups (Chapter 3). However, a direct comparison between different tasks using task-relevant versus task-irrelevant instructions is needed in order to draw valid conclusion regarding the effect of such a variation in instructions (for an exception, see Field, Caren, Fernie, & De Houwer, 2011). The role of demand characteristics is particularly relevant for the results of the scenario task of Chapter 4. Here, 40% of participants indicated that they were aware of the task's aim. However, the awareness score did not correlate with the bias index, suggesting that the findings were not simply the result of demand effects. Another critical issue concerning the role of demand characteristics when using the scenario task is that participants might have censured their first interpretation (Chapter 4 and 6). Hence, we do not know what the 'true score' is. The Interpretation Bias Questionnaire (Chapter 8) also bears a disadvantage that might influence participants' responses: By providing several explanations of the ambiguous scenarios, including dysfunctional as well as functional/neutral ones, it becomes very obvious that the scenarios are ambiguous. Once participants realize this, demand effects cannot be ruled out. To conclude, indirect tasks do offer a lot of advantages. However, these tasks are also not without limitations. Hence, this should be kept in mind when interpreting their results.

Another issue regarding the evaluation of the tasks is the question of whether or not direct and indirect tasks should be regarded as complementary or competing. To the extent that indirect measures, compared to direct measures, indeed provide unique information it seems plausible to regard them as independent. In fact, this argument

is used frequently to explain the absence of a correlation between direct and indirect measures, mostly in combination with discussing the measures' validity. However, from the perspective of dual process models (e.g., Gawronski & Bodenhausen, 2006; Smith & DeCoster, 2000; Strack & Deutsch, 2004), a correlation can and should be expected. This would then imply that direct and indirect measures are not independent. This argument is, of course, used by researchers who found a correlation (as we did in the present dissertation). To conclude, interpreting the absence, presence, or strength of a correlation between direct and indirect measures might be a matter of perspective. In this context, Reinecke et al. (2010) put forward a very elegant solution, suggesting the addition a behavioral task, as indirect measures should be a (better) predictor of the more automatic behavioral components (see also Klein et al., 2011). A final and related issue in this context: Tasks should not only be evaluated regarding their validity, but also their reliability is important. According to Borsboom, Mellenbergh, & van Heerden (2004) and Tuerlinckx, De Boeck, & Lens (2002), a measure can be valid without being reliable. The issue of reliability becomes, for example, very important when intending to predict future behavior, which is a crucial part of clinical research. In the present dissertation, we found that STIAT scores were the best predictors of predicted automatic fear responses (Chapter 3). Hence, the replication of these findings would be an important next step to examine whether STIAT scores remain stable over time and are thus a stable predictor.

IMPLICATIONS FOR THEORY, RESEARCH AND CLINICAL PRACTICE

In the Introduction, a dual process model of abnormal behavior was presented, which provided the theoretical framework for the studies reported in this dissertation. Developing such a model was necessary because the role of dysfunctional automatic associations and interpretations was examined across different types of psychopathology, and as of yet, the literature did not provide such a model. The underlying assumption of this model is that dysfunctional automatic associations and interpretations should be considered as a shared cognitive vulnerability factor. Hence, as pointed out before, this has some overlap with a transdiagnostic perspective (e.g., Barlow et al., 2004; Harvey et al., 2004; Mansell et al., 2009; Nolen-Hoeksema & Watkins, 2011). Now, when considering the implications for theory, research, and clinical practice following the findings of this dissertation, this perspective becomes even more important.

The Diagnostic and Statistical Manual of Mental Disorders (DSM V; American Psychiatric Association, 2013), which provides an overview of criteria for the classification of mental disorders, is the output of the recent perspective on psychopathology. This recent perspective implies that disorders are classified according to specific cognitive, behavioral, and physiological symptoms. As well as the many advantages of this approach (e.g., easy and efficient communication between users of the DSM), such a classification system also confers many disadvantages (e.g., Kraemer, 2007). In light of the present dissertation, the most relevant disadvantage is that such a categorical classification is not in line with observations from clinical reality: Many different types of psychopathology share many (dysfunctional) cognitive phenomena and there are high comorbidity rates. Given these observations, a different perspective is needed. A perspective which may be more in line with the reality of clinical presentations is a dimensional perspective (Harvey et al., 2004). According to this perspective, psychopathology should not be classified into discrete psychological disorders. Instead, psychopathology should be classified by processes.

The dual process model of abnormal behavior represents such a transdiagnostic perspective as it assumes that dysfunctional automatic associations and interpretations are general cognitive psychopathological phenomena, i.e., they can be present in many different types of disorders because they are the output of fundamental (albeit dysfunctional) cognitive processes. The findings of the present dissertation generally support this assumption because dysfunctional automatic associations and interpretations have been found across three different domains of psychopathology: eating pathology, anxiety, and alcohol misuse and dependency (for an exception, see findings of Chapter 7). However, other types of psychopathology are also characterized by dysfunctional automatic associations and interpretations such as emotional and somatoform disorders (for review, see e.g., Hallion & Ruscio, 2011; Mathews & MacLeod, 2005; Roefs et al., 2011). When regarded from a process perspective, Harvey et al. (2004) conclude that the following cognitive processes are reliably associated with multiple disorders: interpretation and expectancy biases, selective attention and memory, specific metacognitive beliefs, attentional avoidance, recurrent memories, overgeneral memory, emotional reasoning, recurrent negative thinking (e.g., worry, rumination), thought suppression, and safety behaviors.

What kind of research implications does such a transdiagnostic perspective bring along? According to Nolen-Hoeksema and Watkins (2011), all present transdiagnositic models have one problem in common: "Current transdiagnostic models, however, have difficulty simultaneously explaining the mechanisms by which a transdiagnostic risk factor leads to multiple disorders (i.e., multifinality) and why one individual with a particular transdiagnostic risk factor develops one set of symptoms while another

with the same transdiagnostic risk factor develops another set of symptoms (i.e., divergent trajectories)" (page 589). Targeting this problem seems impossible at first sight, however, the heuristic for the development of transdiagnostic models of psychopathology introduced by Nolen-Hoeksema and Watkins offers many exciting routes for future research. I would like to highlight three research routes which are derived from the heuristic. The first research route focuses on the investigation of the three components described in the heuristic. There are two types of risk factor, namely distal risk factors (e.g., environmental context) as well as proximal risk factors (e.g., basic cognitive and biological factors). Then, there are moderators (e.g., biological or environmental features affecting the sensitivity to and rewarding value of internal/external stimuli). Investigating these three components seems a worthwhile endeavor because this provides insight into which specific factors and moderators contribute to (comorbid) disorders. The second research route focuses on the mechanisms described in the model. Examples of these mechanisms are shaping, classical and operant conditioning, modeling, and observational learning. Obtaining more insight into the functional properties and (boundary) conditions of these mechanisms is also important. The third research route focuses on both the components and mechanisms, for example, via experimental or longitudinal research, to examine how the interplay of components and mechanisms contribute to the development and maintenance of (comorbid) disorders.

Before discussing the clinical implications, I would like to add a final issue concerning the implications for future research. As mentioned already briefly when evaluating the paradigms that were employed, not all tasks were used with all samples and disorders. When considering this as a matrix, the present dissertation thus only addressed a few cells. To illustrate, we examined the role of dysfunctional interpretations in alcohol misuse and dependency (Chapter 4, 5, and 6). However, this seems also an adequate research topic in the area of fear of spiders (Chapter 3). Hence, what is needed is more research which fills these gaps by investigating every process in every disorder. This could also be useful to further specify the dual process model of abnormal behavior, as the exact underlying mechanisms are not yet fully understood nor is it suitable to make exact predictions regarding the responses following the two processing styles (i.e., associative processing and propositional processing).

Finally, I will consider some clinical implications that arise from this dissertation in combination with the transdiagnostic heuristic provided by Nolen-Hoeksema and Watkins (2011). A first clinical implication concerns prevention. We found that dysfunctional interpretations are predictive of developing psychopathology (Chapter 8). Hence, by further advancing the understanding of which types of risk factors are involved in (comorbid) disorders and how (comorbid) disorders emerge given the

specific risk factors, individuals who are at risk of developing psychopathology could be identified more easily. Moreover, this insight could help to refine our understanding of the temporal aspects regarding psychopathology, i.e., how a risk of psychopathology develops and changes over time. From a preventative perspective, this would imply that individuals who are indentified as being vulnerable (i.e., who show dysfunctional automatic associations and interpretations, see e.g., Chapter 2-5) should be checked on a regular basis. Moreover, once an individual has a psychological disorder (see Chapter 6), it would be important to examine the course of dysfunctional automatic associations and interpretations, for example, before and after treatment. From a more therapeutic perspective, it might be helpful to add process-focused approaches to standard (disorder-specific) treatments (Harvey et al., 2004). To illustrate, a Cognitive Bias Modification – Appraisal training (see Chapter 9 and 10) targeting rumination, which is supposed to be related to a number psychopathologies (for review, see Aldao, Nolen-Hoeksema, & Schweizer, 2010), could be a very fruitful addition.

This last issue brings up a more general clinical implication, namely the extension of existing interventions. CBT is a very successful approach for many disorders. However, there is not much research addressing the question of whether CBT also changes dysfunctional automatic associations and interpretations (for exceptions, see e.g., Bowler et al., 2012; Huijding & de Jong, 2007, 2009; Reinecke, Soltau, Hoyer, Becker, & Rinck, 2012). Moreover, relapse is a serious problem in many disorders. Hence, if dysfunctional automatic associations and interpretations are indeed (one of the) underlying factors of psychopathology, their assessment and their modification might have to become a more integral part of treatment. Regarding assessment, it might be worthwhile to supplement interview-based diagnostic procedures with a test battery including tasks that target dysfunctional automatic associations and interpretations. Ideally, this test battery is applied before, during and after treatment. Regarding modification, it might be worthwhile to extend the more direct CBT approaches with tasks targeting the automatic features of associations and interpretations. CBT often uses very explicit strategies, such as reflecting on pros and cons, formulating correct alternative cognitions, and so on. Hence, CBM procedures might offer a very valuable addition here as they are supposed to target more automatic processing (see e.g., Williams, Blackwell, Mackenzie, Holmes, & Andrews, 2013). However, a very important note in this context: Not all patients are characterized by dysfunctional automatic associations and interpretations. For example, while on average a group of spider-fearful individuals may show an interpretation bias, this bias will not be present for every single individual in this group. Therefore, screening is needed to identify those patients who would indeed benefit from a CBM procedure, as CBM would not be an appropriate treatment for patients in whom the targeted processes were not in fact dysfunctional. Developing

reliable forms of such screening will be an important challenge for future research. Having summarized and discussed the main findings from the studies in my dissertation, and subsequently the implications for theory, research, and clinical practice, I will finish with a short recapitulation and summary. However, first I would like to remind the reader of the very starting point of this dissertation, as this provides the rationale for carrying out such a series of studies across several disorders, in different types of samples, and using various methods. That is, that evaluating and assigning meaning are fundamental parts of our everyday human life, and that the (partly) automatic nature of these processes can be very beneficial. However, this also means that when systematic distortions start to enter this meaning-making system, the consequences can be far-reaching and potentially even lead to psychological disorders. Understanding such a fundamental system requires taking a broad view across psychopathology. Such an approach offers many challenges, but also many exciting avenues for research, perhaps most importantly in the potential for clinical interventions. Therefore, I hope that my dissertation has been evaluated and interpreted as an inspiration and motivation to even further advance our understanding of the role of dysfunctional automatic associations and interpretations in psychopathology.

REFERENCES

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review, 30*, 217–237.

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Asendorpf, J. B., Banse, R., & Mücke, D. (2002). Double dissociation between implicit and explicit personality self-concept: The case of shy behavior. *Journal of Personality and Social Psychology*, *83*, 380-393.

Baker, T. B., Piper, M. E., Fiore, M. C., McCarthy, D. E., & Majeskie, M. R. (2004). Addiction motivation reformulated: An affective processing model of negative reinforcement. *Psychological Review, 111*, 33-51.

Barlow, D. H., Allen, L. B., & Choate, M. L. (2004). Toward a unified treatment for emotional disorders. *Behavior Therapy*, *35*, 205–230.

Beard, C., & Amir, N. (2009). Interpretation in social anxiety: When meaning precedes ambiguity. *Cognitive Therapy and Research*, *33*, 406-415.

Blackwell, S. E., & Holmes, E. A. (2010). Modifying interpretation and imagination in clinical depression: a single case series using cognitive bias modification. *Applied Cognitive Psychology*, *24*, 338-350.

Borsboom, D., Mellenbergh, G. J., & van Heerden, J. (2004). The concept of validity. *Psychological Review*, *111*, 1061–1071.

Bowler, J. O., Mackintosh, B., Dunn, B. D., Mathews, A., Dalgleish, T., & Hoppitt, L. (2012). A comparison of cognitive bias modification for interpretation and computerized cognitive behavior therapy: Effects on anxiety, depression, attentional control, and interpretive bias. *Journal of Consulting and Clinical Psychology*, *80*, 1021-1033.

Creswell, C., Shildrick, S., & Field, A. (2011). Interpretation of ambiguity in children: A prospective study of associations with anxiety and parental interpretation. *Journal of Child and Family Studies*, *20*, 240-250.

De Houwer, J. (2006). What are implicit measures and why are we using them. In R. W. Wiers & A. W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp. 11–28). Thousand Oaks, CA: Sage Publishers.

De Houwer, J., Teige-Mocigemba, S., Spruyt, A., & Moors, A. (2009). Implicit measures: A normative analysis and review. *Psychological Bulletin*, *135*, 347–368.

Egloff, B., & Schmuckle, S. C. (2002). Predictive validity of an implicit association test for assessing anxiety. *Journal of Personality and Social Psychology*, *83*, 1441-1455.

Everaert, J., Koster, E. H. W., & Derakshan, N. (2012). The combined cognitive bias hypothesis in depression. *Clinical Psychology Review*, *32*, 413-24.

Field, M., Mogg, K., Zetteler, J., & Bradley, B. P. (2004). Attentional bias for alcohol cues in heavy and light social drinkers: The role of initial orienting and maintaining attention. *Psychopharmacology*, *176*, 88-93.

Field, M., Caren, R., Fernie, G., & De Houwer, J. (2011). Alcohol approach tendencies in heavy drinkers: Comparison of effects in a Relevant Stimulus-Response Compatibility Task and an approach/avoidance Simon task. *Psychology of Addictive Behaviors*, *25*, 697-701.

Foa, E. B., Ehlers, A., Clark, D. M., Tolin, D. F., & Orsillo, S. M. (1999). The Posttraumatic Cognitions Inventory (PTCI): Development and validation. *Psychological Assessment*, *11*, 303-314.

Foa, E. B. (2000). Psychosocial treatment of post traumatic stress disorder. *Journal of Clinical Psychiatry*, *61*, 543-48.

Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin*, *132*, 692-731.

Glashouwer, K. A., de Jong, P. J., & Penninx, B. W. J. H. (2011). Predictive validity of automatic self-associations for the onset of anxiety disorders. *Journal of Abnormal Psychology*, *120*, 607-616.

Glashouwer, K. A., de Jong, P. J., & Penninx, B. W. J. H. (2012). Prognostic value of implicit and explicit self-associations for the course of depressive and anxiety disorders. *Behaviour Research and Therapy*, *50*, 479-486.

Gotlib, I. H., & Joormann, J. (2010). Cognition and depression: Current status and future directions. *Annual Review of Clinical Psychology*, *27*, 285–312.

Hallion, L. S., & Ruscio, H. M. (2011). A meta-analysis of the effect of cognitive bias modification on anxiety and depression. *Psychological Bulletin*, *137*, 940-58.

Harvey, J. M, Richards, J. C., Dziadosz, T., & Swindell, M. J. (1993). Misinterpretations of ambiguous stimuli in panic disorder. *Cognitive Therapy and Research*, *17*, 235-248.

Harvey, A., Watkins, E., Mansell, W., & Shafran, R. (2004). *Cognitive behavioral processes across psychological disorders. A transdiagnostic approach to research and treatment*. Oxford: University press.

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

Hirsch, C. R., & Clark, D. M. (2004). Information-processing bias in social phobia. *Clinical Psychology Review*, *24*, 799-825.

Hirsch, C. R., Clark, D. M., & Mathews, A. (2006). Imagery and interpretations in social phobia: Support for the combined cognitive biases hypothesis. *Behavior Therapy*, *37*, 223–236.

Huijding, J., & de Jong, P. J. (2006). Specific predictive power of automatic spider-related affective associations for controllable and uncontrollable fear responses toward spiders. *Behaviour Research and Therapy*, *44*, 161-176.

Huijding, J., & de Jong, P. J. (2007). Beyond fear and disgust: The role of (automatic) contamination-related associations in spider phobia. *Journal of Behaviour Therapy and Experimental Psychiatry*, *38*, 200–211.

Huijding, J., & de Jong, P. J. (2009). Implicit and explicit attitudes toward spiders: Sensitivity to treatment and predictive validity for generalization of treatment effects. *Cognitive Therapy and Research*, *33*, 211–220.

Holmes, E. A., Lang, T. J., & Deeprose, C. (2009). Mental imagery and emotion in treatment across disorders: Using the example of depression. *Cognitive Behaviour Therapy*, *38*, 21–28.

Holmes, E. A., Lang, T. J., & Shah, D. M. (2009). Developing interpretation bias modification as a 'cognitive vaccine' for depressed mood: Imagining positive events makes you feel better than thinking about them verbally. *Journal of Abnormal Psychology*, *118*, 76–88.

Hoppitt, L., Mathews, A., Yiend, J., & Mackintosh, B. (2010). Cognitive mechanisms underlying the emotional effects of bias modification. *Applied Cognitive Psychology*, *24*, 312-325.

Karpinksi, A., & Hilton, J. L. (2001). Attitudes and the Implicit Association Test. *Journal of Personality and Social Psychology*, *81*, 774-778.

Klein, A., Becker, E. S., & Rinck, M. (2011). Direct and indirect measures of spider fear predict unique variance in children's fear-related behavior. *Cognition and Emotion*, *25*, 1205-1213.

Kraemer, H. C. (2007). DSM categories and dimensions in clinical and research contexts. *International Journal of Methods in Psychiatric Research*, *16*, 8-15.

Kraemer, H. C., Kazdin, A. E., Offord, D. R., Kessler, R. C., Jensen, P. S., & Kupfer, D. J. (1997). Coming to terms with terms of risk. *Archives of General Psychiatry*.

Krank, M. D., & Wall, A. M. (2006). Context and retrieval effects on implicit cognition for substance abuse. In R. W. Wiers & A. W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp.281-292). Thousand Oaks, CA: Sage Publishers.

Krank, M. D., Wall, A. M., Stewart, S. H., Wiers, R. W., & Goldmann, M. S. (2005). Context effects on alcohol cognitions. *Alcoholism: Clinical Experimental Research*, *29*, 196-206.

Koob, G. F., & Le Moal, M. (2001). Drug addiction, dysregulation of reward, and allostasis. *Neuropsychopharmacology*, *24*, 97- 129.

MacLeod, C., & Mathews, A. (2012). Cognitive bias modification approaches to anxiety. *Annual Review of Clinical Psychology*, *8*, 189–217.

MacLeod, C., Koster, E. H. W., & Fox, E. (2009). Whither cognitive bias modification research? Commentary on the special section articles. *Journal of Abnormal Psychology*, *118*, 89–99.

Mansell, W., Harvey, A., Watkins, E., & Shafran, R. (2009). Conceptual foundations of the transdiagnostic approach to CBT. *Journal of Cognitive Psychotherapy*, *23*, 6–19.

Marlatt, G. A. (1996). Taxonomy of high-risk situations for alcohol relapse: evolution and development of a cognitive-behavioral model. *Addiction*, *91*, 37-49.

Mathews, A., & MacLeod, C. (2002). Induced processing biases have causal effects on anxiety. *Cognition and Emotion*, *16*, 331–354.

Mathews, A., & MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annual Review of Clinical Psychology*, *1*, 167-195.

McEvoy, P. M., Nathan, P., & Norton, P. J. (2009). Efficacy of transdiagnostic treatments: A review of published outcome studies and future research directions. *Journal of Cognitive Psychotherapy*, *23*, 20-33.

Mitchell, J. P., Nosek, B., & Banaji, M. R. (2003). Contextual variations in implicit evaluation. *Journal of Experimental Psychology: General*, *132*, 455– 469.

Mogg, K., Bradley, B. P., Field, M., & De Houwer, J. (2003). Eye movements to smoking-related pictures in smokers: Relationship between attentional biases and implicit and explicit measures of stimulus valence. *Addiction*, *98*, 825–836.

Muris, P., Jacques, P., & Mayer, B. (2004). The stability of threat perception abnormalities and anxiety disorder symptoms in non-clinical children. *Child Psychiatry and Human Development*, *34*, 251-265.

Noël, X., Colmant, M., Van Der Linden, M., Bechara, A., Bullens, Q., Hanak, C., & Verbanck, P. (2006). Time course of attention for alcohol cues in abstinent alcohol patients: The role of initial orienting. *Alcoholism: Clinical Experimental Research*, *30*, 1871-1877.

Nolen-Hoeksema, S., & Watkins, E. R. (2011). A heuristic for developing transdiagnostic models of psychopathology: Explaining multifinality and divergent trajectories. *Perspectives on Psychological Science*, *6*, 589-609.

Ouimet, A. J., Gawronski, B., & Dozois, D. J. A. (2009). Cognitive vulnerability to anxiety: A review and an integrative model. *Clinical Psychology Review*, *29*, 459–470.

Pury, C. L. S. (2002). Information-processing predictors of emotional response to stress. *Cognition and Emotion*, *16*, 667-683.

Reinecke, A., Becker, E. S., & Rinck, M. (2010). Test retest reliability and validity of three indirect tasks assessing implicit threat associations and behavioral response tendencies. *Zeitschrift für Psychologie/Journal of Psychology*, *218*, 4-11.

Reinecke, A., Soltau, C., Hoyer, J., Becker, E. S., & Rinck, M. (2012). Treatment sensitivity of implicit threat evaluation, avoidance tendency and visual working memory bias in specific phobia. *Journal of Anxiety Disorders*, *26*, 321-328.

Richards, A., & French, C. (1992). An anxiety-related bias in semantic activation when processing threat/neutral homographs. *The Quarterly Journal of Experimental Psychology Section A: Human Experimental Psychology*, *45*, 503-525.

Rinck, M., & Becker, E. S. (2007). Approach and avoidance in fear of spiders. *Journal of Behaviour Therapy and Experimental Psychiatry*, *38*, 105–120.

Roefs, A., Huijding, J., Smulders, F., MacLeod, C. M., de Jong, P. J., Wiers, R. W., & Jansen, A. T. (2011). Implicit measures of association in psychopathology research. *Psychological Bulletin*, *137*, 149–193.

Rooke, S. E, Hine, D. W., & Thorsteinsson, E. B. (2008). Implicit cognition and substance use: A meta-analysis. *Addictive Behaviors*, *33*, 1314-1328.

Salemink, E., van den Hout, M., & Kindt, M. (2007). Trained interpretive bias: Validity and effects on anxiety. *Journal of Behaviour Therapy and Experimental Psychiatry*, *38*, 212-224.

Salemink, E., & Wiers, R. W. (2012). Adolescent threat-related interpretive bias and its modification: The moderating role of regulatory control. *Behaviour Research and Therapy*, *50*, 40-46.

Salemink, E., & Wiers, R. W. (in press). Alcohol-related memory associations in positive and negative affect situations: Drinking motives, working memory capacity, and

prospective drinking. *Psychology of Addictive Behaviors*.

Schartau, P., Dalgleish, T., & Dunn, B. (2009). Seeing the bigger picture: Training in perspective broadening reduces self-reported affect and psychophysiological response to distressing films and autobiographical memories. *Journal of Abnormal Psychology*, *118*, 15-27.

Smith, E. R., & DeCoster, J. (2000). Dual-process models in social and cognitive psychology: Conceptual integration and links to underlying memory systems. *Personality and Social Psychology Review*, *4*, 108–131.

Stacy, A., & Wiers, R. W. (2010). Implicit cognition and addiction: A tool for explaining paradoxical behavior. *Annual Review of Clinical Psychology*, *6*, 551-575.

Stewart, S. H., Hall, E., Wilkie, H., & Birch, C. (2002). Affective priming of alcohol schema in coping and enhancement motivated drinkers. *Cognitive Behaviour Therapy*, *31*, 68-80.

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, *8*, 220-247.

Teachman, B. A., Joormann, J., Steinman, S. A., & Gotlib, I. H. (2013). Automaticity in anxiety disorders and major depressive disorder. *Clinical Psychology Review*, *32*, 575-603.

Tuerlinckx, F., De Boeck, P., & Lens, W. (2002). Measuring needs with the Thematic Apperception Test: A psychometric study. *Journal of Personality and Social Psychology*, *82*, 448–461.

Trumpf, J., Margraf, J., Vriends, N., Meyer, A. H., & Becker, E. S. (2010). Specific phobia predicts psychopathology in young women. *Social Psychiatry and Psychiatric Epidemiology*, *45*, 1161–1166.

Vrijsen, J. N., Van Oostrom, I., Isaac, L., Becker, E. S., & Speckens, A. (in press). Coherence between attentional and memory biases in sad and formerly depressed individuals. *Cognitive Therapy and Research*.

Weiss, D. S., & Marmer, C. R. (1997). The Impact of Event Scale – Revised. In J. P. Wilson & T. M. Keane (Eds.), *Assessing psychological trauma and PTSD: A handbook for practitioners* (pp. 399-411). New York, NY: Guildford Press.

Wiers, R. W., Rinck, M., Dictus, M., & Van den Wildenberg, E. (2009). Relatively strong automatic appetitive action-tendencies in male carriers of the OPRM1 G-Allele. *Genes, Brain & Behavior*, *8*, 101-106.

Wigboldus, D. H. J., Holland, R. W., & van Knippenberg, A. (2004). *Single target implicit associations*. Unpublished manuscript.

Williams, A. D., Blackwell, S. E., Mackenzie, A., Holmes, E. A., & Andrews, G. (2013). Combining imagination and reason in the treatment of depression: A randomized controlled trial of internet-based cognitive bias modification and internet-CBT for depression. *Journal of Consulting and Clinical Psychology*, *81*, 793-799.

Williams, J. M. G., Watts, F. N., MacLeod, C., & Mathews, A. (1988). *Cognitive psychology and emotional disorders*. Chichester: Wiley.

Wilson, E., MacLeod, C., Mathews, A., & Rutherford, E. M. (2006). The causal role of interpretive bias in vulnerability to anxiety. *Journal of Abnormal Psychology*, *115*, 103–111.

Woud, M. L., & Krans, J. (2013). Cognitive Bias Modification (CBM) technieken bij posttraumatische stresstoornis (PTSS): Eerste bevindingen en toekomstige perspectieven. *Directieve Therapie*, *33*, 170-187.

Zack, M., Poulos, C. X., Fragopoulos, F., & MacLeod, C. M. (2003). Effects of negative and positive mood phrases on priming of alcohol words in young drinkers with high and low anxiety sensitivity. *Experimental and Clinical Psychopharmacology*, *11*, 176-185.

Zack, M., Toneatto, T., & MacLeod, C. M. (1999). Implicit activation of alcohol concepts by negative affective cues distinguishes between problem drinkers with high and low psychiatric distress. *Journal of Abnormal Psychology*, *108*, 518- 531.

12

Recapitulation and summary

The general aim of this dissertation was to advance the understanding of the role of dysfunctional automatic associations and interpretations in psychopathology. Dysfunctional automatic associations and interpretations are core features of various psychological disorders. According to many psychological models, these cognitive processes underlie the development, maintenance, and relapse of psychopathology. There are three important features regarding this dissertation. First, the role of dysfunctional automatic associations and interpretations was examined as a correlate, predictor, and causal risk factor of psychopathology. Second, different types of psychopathology, and different kinds of samples (risk and clinical samples), were examined. Third, a variety of paradigms were used to assess dysfunctional associations and interpretations ranging from more direct to indirect approaches.

The theoretical framework underlying the studies included in this dissertation was provided by a dual process model of abnormal behavior with a specific focus on dysfunctional automatic associations and interpretations. This model was specifically developed for the present dissertation. Dual process models of normal behavior (e.g., Gawronski & Bodenhausen, 2006; Smith & DeCoster, 2000; Strack & Deutsch, 2004) and the dual process model of anxiety (Ouimet, Gawronski, & Dozois, 2009) were used to develop the dual process model of abnormal behavior. The procedural framework for the studies in this dissertation was provided by Kraemer et al. (1997). Their model provides a stepwise approach of how to examine the psychopathologic typology of a risk factor, i.e., whether it is a correlate, predictor, and causal risk factor of psychopathology. Applied to the present dissertation, the psychopathologic typology of dysfunctional automatic associations and interpretations was thus examined.

This dissertation includes 9 empirical studies. Chapters 2-7 focused on the role of dysfunctional automatic associations and interpretations as a correlate of (levels of) psychopathology. These studies were conducted in three different clinical domains: eating pathology, anxiety, and alcohol abuse and dependency. Moreover, a variety of paradigms were used, ranging from more direct to indirect approaches. Finally, these studies included risk groups and clinical samples, thus investigated dysfunctional cognitive processes at different levels of psychopathology severity. Chapter 8 addressed the role of dysfunctional interpretations as a predictor of psychopathology, namely onset of panic disorder and included a longitudinal epidemiological study. Finally, Chapter 9 and 10 investigated the causal role of (dys)functional interpretations. To this end, two analogue experimental studies in the context of Post Traumatic Stress Disorder (PTSD) were conducted to test the effect of positive versus negative reappraisal training (Cognitive Bias Modification - Appraisal training) on subsequent intrusive memories to an analogue trauma.

The present dissertation has three main outcomes: The first is that dysfunctional automatic associations and interpretations were indeed found to be a correlate, predictor, and causal risk factor of (levels of) several different types of psychopathology. This result provides more insight into the specific contribution of dysfunctional automatic associations and interpretations to the development, course, and modification of psychopathology. Within the studies investigating dysfunctional automatic associations and interpretations as a correlate, there are also several additional findings. Relationships were demonstrated between dysfunctional automatic associations and deliberative cognitions measured via self-report. Moreover, relationships were unique and found despite differences in time and context of the assessment. In addition, dysfunctional interpretations generalized to other (emotionally relevant) ambiguous contexts. Finally, dysfunctional automatic associations, compared to explicit associations, were a better predictor of dysfunctional automatic behavior. As such, these results provide more insight into the specific conditions of the relationship between dysfunctional automatic associations and interpretations and psychopathology.

The second outcome of this dissertation is that dysfunctional automatic associations and interpretations were found in risk as well as clinical samples. This result demonstrates that dysfunctional automatic associations and interpretations are present at different stages of psychopathology.

The third outcome is that the presence of such dysfunctional cognitions could be demonstrated by means of a variety of paradigms, ranging from more direct to indirect approaches. This result shows that dysfunctional automatic associations and interpretations are present at different levels of information processing.

Overall, these findings suggest that dysfunctional automatic associations and interpretations can be considered as general cognitive psychopathological phenomena. This is generally supportive of a dimensional, i.e., a process-based, perspective on psychopathology, rather than a categorical perspective. While there are limitations specific to individual studies, recurring limitations were cautions regarding the tasks' validity. Therefore, future research is needed to extend, replicate and refine the present findings. Moreover, this line of investigation could prove useful in specifying further the dual process model of abnormal behavior. Developing such a general model of the role of and interplay between dysfunctional automatic associations and interpretations across psychopathology could help to build theoretically-informed bridges between different disorders in terms of our basic understanding and clinical approaches. This in turn could aid the development of more effective strategies for the prevention and treatment of psychopathology.

REFERENCES

Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin*, *132*, 692-731.

Kraemer, H. C., Kazdin, A. E., Offord, D. R., Kessler, R. C., Jensen, P. S., & Kupfer, D. J. (1997). Coming to terms with terms of risk. *Archives General Psychiatry*, *54*, 337-343.

Ouimet, A. J, Gawronski, B., & Dozois, D. J. A. (2009). Cognitive vulnerability to anxiety: A review and an integrative model. *Clinical Psychology Review*, *29*, 459–470.

Smith, E. R., & DeCoster, J. (2000). Dual-process models in social and cognitive psychology: Conceptual integration and links to underlying memory systems. *Personality and Social Psychology Review*, *4*, 108–131.

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, *8*, 220-247.

13

Dutch summary

In ons dagelijks leven zijn wij voortdurend bezig dingen te beoordelen en te interpreteren. Wij proberen dingen te begrijpen. Wij interpreteren en definiëren. Hierdoor creëert ieder persoon een eigen realiteit. De basis hiervoor is het geheugen: Gebeurtenissen uit het verleden beïnvloeden namelijk onze interpretatie in het hier en nu.
Een persoonlijk voorbeeld ter illustratie: Tijdens een etentje met collega's vertelde ik over mijn onderzoek naar interpretatie processen. Een collega gaf aan dat het woord 'Mars' een mooi voorbeeld is om uit te leggen wat ambigue prikkels en interpretatievertekeningen zijn. Ik vond dat maar een raar voorbeeld en was in de war: 'Hoezo, Mars is toch niet ambi …'. Toen ik de gezichten van mijn collega's zag besloot ik de zin niet meer af te maken. Mars is een chocoladereep, maar ja, het is ook een planeet en de god van de oorlog. Echter, deze alternatieve interpretaties kwamen niet bij mij op. Hoe kon dit gebeuren? En zo snel en automatisch?
Het antwoord ligt in mijn verleden, mijn 'chocolade verleden'. Op het moment dat ik het woord 'Mars' hoorde, werden verschillende positieve associaties actief, variërend van 'zoet' – 'zacht' naar 'maakt me gelukkig' en 'dit zal me nooit teleurstellen'. De activering van mijn chocoladegerelateerde geheugenschema maakte het voor mij onmogelijk aan iets anders te denken dan aan chocolade. Mijn interpretatie stond dus vast: Mars is een chocoladereep.
Een belangrijke eigenschap van dit voorbeeld is hoe automatisch ik deze prikkel verwerkt en geïnterpreteerd heb. In ons dagelijks leven leveren automatische en snelle verwerkingen vaak veel voordelen op, bijvoorbeeld tijdens het auto rijden. Bovendien is het gedrag dat hierop volgt vaak zonder ernstige gevolgen en kan desnoods gecorrigeerd worden. Automatische associaties en interpretaties en de corresponderende gedragsconsequenties kunnen echter wel erg disfunctioneel worden. Dit kan wederom een erg negatieve invloed op een individu hebben en, in het ergste geval, tot een psychische stoornis leiden.
Onderzoek heeft laten zien dat disfunctionele automatische associaties en interpretaties inderdaad belangrijke kenmerken zijn van verschillende psychische stoornissen (voor een overzicht, zie Mathews & MacLeod, 2005; Roefs et al., 2011). Veel psychologische theorieën gaan ervan uit dat deze processen een belangrijke rol spelen bij het ontstaan en in stand houden van psychopathologie. Anders geformuleerd: disfunctionele automatische associaties en interpretaties kunnen mensen kwetsbaar maken voor het krijgen en behouden van een psychologische stoornis. Het bestuderen van deze processen is daarom een belangrijke taak en kan ons helpen beter te begrijpen hoe psychologische stoornissen ontstaan en waarom deze stoornissen zo persistent zijn. Het doel van dit proefschrift was daarom meer inzicht te krijgen in de rol van disfunctionele automatische associaties en interpretaties in psychopathologie.

THEORETISCHE ACHTERGROND

Het duale procesmodel van abnormaal gedrag, wat specifiek voor dit proefschrift werd ontwikkeld, vormt het theoretische kader van dit proefschrift. Dit model richt zich met name op disfunctionele automatische associaties en interpretaties. Duale procesmodellen van normaal gedrag (bijvoorbeeld Gawronski & Bodenhausen, 2006; Smith & DeCoster, 2000; Strack & Deutsch, 2004) en het duale procesmodel van angst (Ouimet, Gawronski, & Dozois, 2009) werden gebruikt als basis voor het duale procesmodel van abnormaal gedrag.

Het duale procesmodel van abnormaal gedrag gaat ervan uit dat er twee systemen zijn die ons gedrag bepalen, namelijk een associatief en een propositioneel systeem. Het associatieve systeem verwerkt prikkels op een snelle en automatische manier. Deze verwerking vindt plaats buiten de bewuste controle van het individu. Het propositionele systeem verwerkt daarentegen prikkels op een langzame en bewuste manier. Het individu kan de informatie toetsen en erover nadenken. Zoals eerder aangeven, heeft een automatische verwerking van prikkels meestal geen ernstige gevolgen. Echter, binnen de psychopathologie kan dit wel nadelig zijn, bijvoorbeeld wanneer bepaalde prikkels automatisch als bedreigend worden ervaren terwijl de prikkels eigenlijk helemaal niet bedreigend zijn. Mensen die bijvoorbeeld bang zijn voor spinnen hebben bij het zien van een spin de meest uiteenlopende negatieve automatische associaties, zoals 'eng', 'oncontroleerbaar' of 'springt op mij'. Dit kan sterke gevoelens van angst oproepen. Vermijdingsgedrag is een mogelijk gevolg hiervan en maakt een correctie van de irrationele gedachten onmogelijk: Zou de persoon gewoon rustig voor de spin blijven staan zal snel duidelijk worden dat er eigenlijk niet veel gebeurt. Er zijn ook positieve disfunctionele associaties en interpretaties. Wanneer iemand die veel drinkt het woord 'rondje' hoort, is een positieve alcoholgerelateerde associatie en interpretatie het meest waarschijnlijk voor deze persoon. Hierdoor zal deze persoon eerder geneigd zijn een biertje te bestellen dan een cola. Dit zijn maar enkele voorbeelden maar een ding zal zeker duidelijk worden: Op lange termijn zal een dergelijke 'vertekende verwerking' niet veel goeds brengen.

Het procedurele kader voor dit proefschrift is gebaseerd op het model van Kraemer et al. (1997). Dit model beschrijft een stapsgewijze benadering van hoe men de aard van een risico factor (in dit geval dus disfunctionele automatische associaties en interpretaties) kan onderzoeken. Stap 1 omvat studies die onderzochten of disfunctionele automatische associaties en interpretaties samenhangen met (de mate van) psychopathologie. De vraag hier was dus of disfunctionele automatische associaties en interpretaties een 'correlaat' zijn van (de mate van) psychopathologie. Bij stap 2 werd gekeken in hoeverre disfunctionele interpretaties voorspellend zijn voor het ontstaan van een

psychische stoornis. Hier werd dus onderzocht of disfunctionele interpretaties een 'predictor' zijn van psychopathologie. Stap 3 richtte zich op de vraag in hoeverre het mogelijk is (dis)functionele interpretaties te manipuleren, en of dit de symptomen van een psychische stoornis kan verminderen. Door middel van deze laatste stap kon gekeken worden of disfunctionele interpretaties een 'causale risico factor' zijn.
Het onderzoek binnen dit proefschrift heeft drie kenmerken. Ten eerste werd de rol van disfunctionele automatische associaties en interpretaties onderzocht als correlaat, predictor en causale risico factor van psychopathologie. Een zodanige aanpak biedt de mogelijkheid op een structurele manier te onderzoeken in hoeverre disfunctionele automatische associaties en interpretaties betrokken zijn bij het ontstaan en voortbestaan van psychopathologie. Ten tweede werden verschillende psychologische stoornissen, als ook verschillende steekproeven (risico en klinische steekproeven) onderzocht. Dit is gebaseerd op de veronderstelling dat disfunctionele automatische associaties en interpretaties samengaan met een 'cognitieve kwetsbaarheid' voor psychopathologie. Onderzoek dat zich richt op verschillende soorten stoornissen tijdens verschillende fases van een stoornis, is daarom van groot belang. Ten derde werden verschillende paradigma's gebruikt om disfunctionele automatische associaties en interpretaties te meten, variërend van meer directe tot meer indirecte benaderingen. Dit onderscheid is van belang voor recente discussies omtrent de vraag of directe en indirecte metingen wel of niet complementair zijn.

DE ROL VAN DISFUNCTIONELE AUTOMATISCHE ASSOCIATIES EN INTERPRETATIES ALS CORRELAAT, PREDICTOR EN CAUSALE RISICOFACTOR IN PSYCHOPATHOLOGIE

CORRELAAT

Hoofdstukken 2-7 richten zich op de rol van disfunctionele automatische associaties en interpretaties als correlaat van (de mate van) psychopathologie.
Hoofdstuk 2 beschrijft een studie waarbij een indirecte maat werd ingezet om de concepten 'thinspiration' en 'fear of fat' nader te onderzoeken, namelijk een zogenaamde stimulus response compatibility task (SRC; Mogg, Bradley, Field, & De Houwer, 2003). Tijdens deze computer taak moesten vrouwelijke studenten plaatjes in twee categorieën indelen (dun of mollig). Dit werd met behulp van een klein poppetje

gedaan dat op het computerscherm verscheen. Dat poppetje kon de plaatjes benaderen óf vermijden. De resultaten lieten zien dat de proefpersonen sneller waren in het benaderen van dunne modellen vergeleken met dikke modellen. Wat betreft het benaderen en vermijden van dikke modellen werd geen verschil gevonden. Verder werd gevonden dat de toenaderings- en vermijdingsbewegingen gecorreleerd waren met verschillende, aan eten gerelateerde cognities zoals tevredenheid met het eigen lichaam, internalisering van het dunne ideaal, mate van gewichtscontrole, enzovoorts.

Hoofdstuk 3 bevat twee studies waarin automatische associaties ten opzichte van spinnen onderzocht werden. Hierbij werd een variant van de Single Target Implicit Association Test (STIAT; Wigboldus, Holland, & van Knippenberg, 2004) gebruikt, namelijk een STIAT met een taak-irrelevante instructie. Dit betekende dat de proefpersonen spinnenplaatjes niet in, bijvoorbeeld, de categorie 'spinnen' moesten categoriseren, maar in de categorie 'plaatje'. In Studie 1 werden spinnenangstige met niet-angstige proefpersonen vergeleken, in Studie 2 spinnenliefhebbers met niet-liefhebbers. De nieuwe STIAT variant liet inderdaad verschillen tussen de desbetreffende groepen zien: in Studie 1 vertoonden spinnenangstige proefpersonen, vergeleken met niet-angstige proefpersonen, sterkere automatische negatieve associaties ten opzichte van spinnen. Bovendien waren de STIAT scores een betere voorspeller voor automatische angstreacties, terwijl expliciet gemeten angst een betere voorspeller was voor gecontroleerd vermijdingsgedrag. De resultaten van Studie 2 lieten zien dat de STIAT ook groepsverschillen tussen spinnenliefhebbers en niet-liefhebbers kon aantonen: Spinnenliefhebbers hadden, vergeleken met niet-liefhebbers, sterkere automatische positieve associaties ten opzichte van spinnen.

Hoofdstuk 4 is een replicatiestudie van eerdere bevindingen omtrent alcoholgerelateerde interpretatievertekeningen. Binnen dit onderzoek werd een scenariotaak gebruikt waarbij de proefpersonen een einde moesten bedenken voor ambigue, alcoholgerelateerde of neutrale verhaaltjes. De resultaten toonden aan dat mannelijke studenten die veel dronken, vergeleken met mannelijke studenten die weinig dronken, vaker een aan alcoholgerelateerd einde bedachten voor ambigue alcoholgerelateerde verhaaltjes. Verder werd gevonden dat hoe sterker deze alcoholgerelateerde interpretatievertekening was, hoe hoger de mate van schadelijk drinken en alcoholgerelateerde problemen was.

Het doel van hoofdstuk 5 was gelijk aan dat van hoofdstuk 4. Echter, gebruikten we hier een zogenaamde 'encoding recognition' taak. Bovendien werden verhaaltjes gebruikt die gerelateerd waren aan positieve en negatieve drinkmotieven, namelijk 'coping' en 'enhancement'. Proefpersonen waren mannelijke en vrouwelijke drinkende studenten. Zij kregen ambigue verhaaltjes aangeboden en per verhaal een set van interpretaties die beoordeeld moest worden. Er werd gevonden dat coping-gerelateerde drinkmotieven een unieke voorspeller waren voor een alcoholgerelateerde

interpretatievertekening ten opzichte van negatieve alcohol verhaaltjes, terwijl enhancement-gerelateerde drinkmotieven een unieke voorspeller waren voor een alcoholgerelateerde interpretatievertekening ten opzichte van positieve alcohol verhaaltjes. Echter, toekomstig drinkgedrag werd niet voorspeld door de twee alcoholgerelateerde vertekeningen.
In hoofdstuk 6 word de scenario taak zoals gebruikt in hoofdstuk 4 toegepast binnen een klinische setting, namelijk bij een groep alcoholverslaafde patiënten en een controle groep. Er waren 12 ambigue verhaaltjes (zeven alcoholgerelateerd en vijf paniek- en depressiegerelateerd). De resultaten toonden aan dat de kans om een alcoholgerelateerd einde te bedenken groter was bij alcoholverslaafde patiënten dan bij controle patiënten. Dit was het geval voor alle drie soorten verhaaltjes. Bovendien werd een positieve correlatie gevonden tussen de sterkte van de alcoholgerelateerde interpretatievertekening en de mate van schadelijk drinken.
Hoofdstuk 7 onderzocht het effect van negatieve prikkels op de activering van alcoholgerelateerde concepten met behulp van een priming taak. De proefpersonen waren een groep alcoholverslaafde patiënten en in een controle groep. Tegen de verwachting in lieten alcoholverslaafde patiënten geen sterkte activering van alcoholgerelateerde concepten zien nadat zij blootgesteld werden aan negatieve prikkels.
De resultaten van Hoofdstukken 2-6 tonen aan dat disfunctionele automatische associaties en interpretaties inderdaad een correlaat zijn van (de mate van) psychopathologie. Bovendien zijn er additionele resultaten die deze bevindingen nuanceren. Er werden correlaties aangetoond tussen directe en indirecte metingen. De correlaties waren uniek en werden gevonden ondanks verschillen in tijd en context van de meting. Disfunctionele interpretaties generaliseerden naar andere ambigue contexten. Tenslotte kon aangetoond worden dat disfunctionele automatische associaties, vergeleken met zelfrapportage, een betere predictor waren voor automatische angstreacties.

PREDICTOR

Hoofdstuk 8 richtte zich op de rol van disfunctionele automatische associaties en interpretaties als predictor van psychopathologie. Specifiek werd onderzocht in hoeverre disfunctionele paniekgerelateerde interpretaties voorspellend zijn voor het ontstaan van een paniekstoornis. Hiervoor werd een longitudinale epidemiologische studie uitgevoerd met twee meetpunten. De resultaten lieten zien dat disfunctionele paniekgerelateerde interpretaties inderdaad een predictor zijn voor het ontstaan van een paniekstoornis, ook wanneer gecontroleerd werd voor twee andere belangrijke risicofactoren (namelijk angstgevoeligheid en lichamelijke gewaarwordingen).

CAUSALE RISICO FACTOR

In hoofdstukken 9 en 10 werd de causale rol van disfunctionele interpretaties onderzocht. Er werden twee experimentele studies uitgevoerd in de context van posttraumatische stresstoornis (PTSS) waarbij het effect van positief versus negatief interpretatie training (Cognitive Bias Modification – Appraisal, ofwel CBM-App) op analoge trauma symptomen werd onderzocht. In hoofdstuk 9 werd de CBM-App training na een stressvolle film aangeboden. De resultaten lieten zien dat de mensen in de positieve training groep, vergeleken met mensen in de negatieve training groep, minder intrusies hadden en lager scoorden op analoge trauma symptomen. In hoofdstuk 10 werd de training vóór de stressvolle film aangeboden. Hier werd gevonden dat de mensen in de positieve training groep, vergeleken met mensen in de negatieve training groep, hun intrusies als minder stressvol hebben ervaren.

IMPLICATIES VOOR THEORIE, ONDERZOEK EN KLINISCHE PRAKTIJK

Dit proefschrift heeft drie hoofdbevindingen. Ten eerste werd gevonden dat disfunctionele automatische associaties en interpretaties een correlaat, predictor en causale risico factor zijn voor (de mate van) psychopathologie. Ten tweede werd aangetoond dat verschillende soorten psychische stoornissen gekenmerkt zijn door de aanwezigheid van disfunctionele automatische associaties en interpretaties in verschillende fases van psychopathologie. Ten derde kon de aanwezigheid van disfunctionele automatische associaties en interpretaties worden aangetoond met behulp van verschillende paradigma's, variërend van meer directe tot meer indirecte metingen.

Deze bevindingen bieden ondersteuning voor een dimensioneel, ofwel procesmatig, in plaats van een categorisch perspectief op psychopathologie. Dit houdt in dat disfunctionele automatische associaties en interpretaties een soort algemeen fenomeen zijn. Dit is in overeenstemming met het duale procesmodel van abnormaal gedrag. Bovendien bieden deze bevindingen ondersteuning voor een transdiagnostisch perspectief op psychopathologie (bijvoorbeeld Barlow, Allen, & Choate, 2004; Harvey, Watkins, Mansell, & Shafran, 2004; Nolen-Hoeksema & Watkins, 2011). Transdiagnostisch houdt in dat men over stoornissen heen kijkt en niet slechts binnen een stoornis.

Gezien deze uitkomsten zijn disfunctionele automatische associaties en interpretaties te beschouwen als een risicofactor voor psychopathologie. Toekomstig onderzoek moet

zich daarom op drie aspecten richten: Ten eerste moeten replicatie- en verdiepingsstudies worden uitgevoerd om verder inzicht te vergaren in disfunctionele automatische associaties en interpretaties. Ten tweede moeten de hieraan onderliggende mechanismen verder onderzocht en gespecificeerd worden. Ten derde moet de interactie tussen disfunctionele automatische associaties en interpretaties en de onderliggende mechanismen in kaart gebracht worden.

Wat betreft de implicaties zijn er de volgende aanbevelingen. De eerste aanbeveling richt zich op de preventie van psychopathologie. Wanneer er meer inzicht is in disfunctionele automatische associaties en interpretaties en hun onderliggende mechanismen zouden kwetsbare individuen eerder geïdentificeerd kunnen worden. Wanneer een individu al een psychologische stoornis heeft, is bijvoorbeeld het onderzoeken van de aard als ook van het beloop van disfunctionele automatische associaties en interpretaties voor en na therapie een informatieve stap. Verder zou het zinvol zijn de aanwezigheid van disfunctionele automatische associaties en interpretaties met verschillende paradigma's te onderzoeken. Tenslotte, een aanbeveling voor de praktijk: Procesmatige interventies (bijvoorbeeld een interpretatie training) zouden een waardevolle toevoeging kunnen zijn aan de huidige therapievormen.

Wanneer deze implicaties voor onderzoek en praktijk worden opgevolgd zou het duale procesmodel van abnormaal gedrag verder gespecificeerd en genuanceerd kunnen worden. De ontwikkeling van een zodanig model zou het mogelijk maken de rol van alsmede de interactie tussen disfunctionele automatische associaties en interpretaties over verschillende soorten psychopathologie heen beter te begrijpen. Dit zou wederom tot effectievere behandelingsstrategieën kunnen leiden en op lange termijn tot een verbetering van de kwaliteit van de zorg voor de patiënt kunnen resulteren.

REFERENCES

Barlow, D. H., Allen, L. B., & Choate, M. L. (2004). Toward a unified treatment for emotional disorders. *Behavior Therapy*, *35*, 205–230.

Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin*, *132*, 692-731.

Harvey, A., Watkins, E., Mansell, W., & Shafran, R. (2004). *Cognitive behavioral processes across psychological disorders. A transdiagnostic approach to research and treatment*. Oxford: University press.

Kraemer, H. C. (2007). DSM categories and dimensions in clinical and research contexts. *International Journal of Methods in Psychiatric Research*, *16*, 8-15.

Mathews, A., & MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annual Review of Clinical Psychology, 1*, 167-195.

Mogg, K., Bradley, B. P., Field, M., & De Houwer, J. (2003). Eye movements to smoking-related pictures in smokers: Relationship between attentional biases and implicit and explicit measures of stimulus valence. *Addiction*, *98*, 825–836.

Nolen-Hoeksema, S., & Watkins, E. R. (2011). A heuristic for developing transdiagnostic models of psychopathology: Explaining multifinality and divergent trajectories. *Perspectives on Psychological Science*, *6*, 589–609.

Ouimet, A. J, Gawronski, B., & Dozois, D. J. A. (2009). Cognitive vulnerability to anxiety: A review and an integrative model. *Clinical Psychology Review*, *29*, 459–470.

Roefs, A., Huijding, J., Smulders, F., MacLeod, C. M., de Jong, P. J., Wiers, R. W., & Jansen, A. T. (2011). Implicit measures of association in psychopathology research. *Psychological Bulletin*, *137*, 149–193.

Smith, E. R., & DeCoster, J. (2000). Dual-process models in social and cognitive psychology: Conceptual integration and links to underlying memory systems. *Personality and Social Psychology Review*, *4*, 108–131.

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, *8*, 220-247.

Wigboldus, D. H. J., Holland, R. W., & van Knippenberg, A. (2004). *Single target implicit associations*. Unpublished manuscript.

APPENDIX

ASSOCIATIONS

Rating scales

Many different rating scales have been developed to measure associations. The most widely used is the Likert Scale (Likert, 1932), which, for example, requires participants to provide a rating of the concept/object of interest. It makes use of a continuum, e.g., ranging from very negative until very positive, and includes a fixed choice response format.

Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998).

The IAT is reaction time (RT) paradigm, which aims to measure the relative associative strength between two concepts. Participants are asked to sort stimuli (e.g., word and/or pictures) into four categories by means of two response keys: two categories represent a target concept (e.g., me vs. other), and two categories represent two poles of an attribute dimension (e.g., calm vs. anxious). Each target category is paired with both attributes. As such, faster RTs during a particular target-attribute combination suggest a strong association between the two stimuli. In research on anxiety and depression, for example, results of Glashouwer and de Jong (2010) showed that patients suffering from an anxiety disorder exhibited stronger self-anxious associations than depressed patients and controls did. In contrast, patients suffering from depression exhibited stronger self-depressive associations compared to anxious patients and controls.
During the past years, many IAT variants have been developed. This was (partly) motivated to overcome limitations of the original IAT. However, the type of stimuli and basic task elements are similar to the original IAT, i.e., participants are asked to sort word or picture stimuli into predefined categories. To illustrate, a well known problem of the IAT is its double-relative nature, because it assesses the relative strength of associations between two targets and two attributes (De Houwer, 2003). The Single Target Implicit Association Test (STIAT; Wigboldus, Holland, & van Knippenberg, 2004) partly avoids this problem by presenting only a single target category. In addition, a STIAT is independent of whether the target of interest has an immanently meaningful contrast category or not. Huijding and de Jong (2006a) applied a STIAT in the context of nicotine dependence (target category: smoking, attribute category: positive, negative) and found that nicotine-related associations were positive in smokers but negative in non-smokers.

The Extrinsic Affective Simon Task (EAST; De Houwer, 2003) is another example of a categorization task assessing associations towards one target concept. During the EAST, participants sort attribute stimuli (e.g., positive and negative) by meaning, making use of two response keys. Given these instructions, it is assumed that the response keys become extrinsically associated with the meaning of the attribute stimuli assigned to them. As a result, an extrinsically positive and an extrinsically negative response key are created. In contrast, target words (e.g., spider-related words) have to be categorized by means of a task irrelevant feature, (e.g., color), using the same two response keys. Following this, the associative strength is defined via the RT difference between giving an extrinsically negative response to the target versus giving an extrinsically positive response to the target. To illustrate, in research on fear of spiders, Huijding and de Jong (2005) found evidence that the EAST tends to differentiate between individuals scoring high and low on spider fear (for similar results, see Huijding & de Jong, 2006b). Other examples of IAT variations are the Personalized Implicit Association Test, the Uniploar Implicit Association Test, the Go/No-go Implicit Association Test (Nosek & Banaji, 2001), and the Affective Simon Task (De Houwer, Crombez, Baeyens, & Hermans, 2001).

Approach Avoidance Tasks

Dysfunctional approach avoidance associations are characteristic features of both addictions and anxiety disorders. A paradigm to assess such associations is the Approach Avoidance Task (AAT; Rinck & Becker, 2007). During the AAT, participants are instructed to pull a joystick toward themselves and to push it away from themselves in response to pictures presented on the computer screen. Given this operationalization, pulling represents an approach and pushing an avoidance movement. The time participants need to fully execute these valenced movements provides an index of their spontaneous behavioral tendencies towards a particular picture category. Most AATs make use of a 'task irrelevant feature'. That is, the push and pull movements are not determined by the pictures' contents but by the pictures' format or tilt (e.g., push landscape vs. pull portrait pictures). These instructions are stimulus-independent and therefore might direct participants' attention away from the research aim. In order to support the visual illusion of approach avoidance and to disambiguate the movements, the AAT employs a zoom function. That is, pictures increase during pulling and decrease during pushing. The study of Wiers, Rinck, Dictus, & van den Wildenberg (2009), for example, showed that hazardously drinking students were faster to pull than to push the joystick in response to alcohol pictures.

Another variant of an approach avoidance task is the Stimulus Response Compatibility task (SRC; Mogg, Bradley, Field, & De Houwer, 2003). During this task, participants are instructed to move a manikin figure on the computer monitor towards and away from a picture. That is, participants are executing symbolic approach avoidance responses instead of actual motor responses like the AAT requires. The time to initiate the manikin's movement is used as an index of participants' approach avoidance associations towards the particular picture category. To illustrate, the study of Mogg, Field, & Bradley (2005) applied a SRC task to examine nicotine-related approach associations. Results showed that smokers with lower levels of nicotine dependence showed faster symbolic approach responses to smoking-related cues than smokers with moderate levels of dependence.

Priming paradigms

There are two priming paradigms that have been used frequently to measure associations, namely affective priming tasks (APT; Fazio, Sanbonmatsu, Powell, & Kardes, 1986) and semantic primings. During a typical APT, participants are asked to categorize target words into two categories, e.g., palatable food vs. unpalatable food. Before a target word appears, however, a valenced prime is presented (e.g., a positive or negative word). These primes are presented very briefly and participants are instructed to not react to them. It is assumed that the primes either facilitate or aggravate the target's categorization, i.e., a categorization should be faster for valence congruent prime-target trials than incongruent ones. The APT has been frequently used in research on food associations. However, it has not always revealed the expected results: Roefs et al. (2005), for example, found that anorexia nervosa patients did not show more positive associations towards palatable than unpalatable food. However, unrestrained controls did show such a preference. When comparing an obese sample with unrestrained lean controls, results showed that the former but not the latter group exhibited more positive associations towards low- than high-fat palatable food.

Semantic priming tasks are based on the same principle, i.e., a prime is presented which is supposed to affect a target's categorization. Hill and Paynter (1992), for example, found that alcohol-related but not alcohol-unrelated primes facilitated the categorization of alcohol-related targets words in alcohol-dependent drinkers but not in non-dependent drinkers.

INTERPRETATIONS

Questionnaires

Various questionnaires have been developed to assess interpretation processes, all making use of the same principle: Participants are presented with ambiguous information, e.g., a sentence or a scenario, and are supposed to interpret this information. The act of interpreting can include many forms. A very common way is to ask participants to rank order different interpretations according to their interpretational fit with the ambiguous information. One of these interpretations always involves the disorder-congruent one. By making use of such an approach, results of McNally and Foa (1987), for example, showed that patients suffering from agoraphobia and panic disorder more often assigned a high ranking to threat-related interpretations of ambiguous panic-related scenarios than treated agoraphobia/panic patients and healthy controls did.

Recognition tests

Classical recognition tests usually involve two phases. During phase one, participants are presented with an ambiguous scenario and are simply instructed to read (or listen) to it. During phase two, possible interpretations are provided and participants have to indicate whether these interpretations are similar in meaning to the previously presented ambiguous information by means of a rating scale. Using such a recognition test, Eysenck, Mogg, May, Richards, & Mathews (1991), for example, found that currently anxious participants were more likely than recovered anxious participants and normal controls to interpret ambiguous sentences in a threatening rather than in a nonthreatening manner, respectively.

Completion tasks

Presenting participants with open-ended ambiguous scenarios and requiring them to generate an ending for these scenarios is a frequently used operationalization of a completion task. For example, Hertel, Brozovich, Joormann, and Gotlib (2008) used such an approach to asses interpretation (and memory) biases in Generalized Social Phobia (GSP). Individuals diagnosed with GSP and controls were asked generate continuations for ambiguous nonsocial and ambiguous social scenarios. Results indicated

that the former group produced more socially anxious and negative interpretations for ambiguous social scenarios than did the latter group.
Sentence stem completion tasks are another operationalisation. In a study by Stoler and McNally (1991), symptomatic agoraphobics, recovered agoraphobics, and healthy controls had to complete a set of ambiguous and unambiguous sentence stems that had either a potentially threatening or a nonthreatening meaning. Results showed that symptomatic agoraphobics generated more threat-related interpretations compared to healthy controls.

Word association paradigms

During word associations tasks, participants give their first spontaneous interpretation to an ambiguous cue, i.e., a homograph. A homograph is a word for which the written form has more than one meaning, for example, a disorder-related and disorder-unrelated meaning (e.g., 'shot': an alcoholic drink or a gunshot). Hence, it is expected to find a positive correlation between the number of disorder-congruent interpretations and levels of symptomatology. To illustrate, research has shown that individuals with a Posttraumatic Stress Disorder (PTSD) showed a greater tendency to give a threat-related interpretation to homographs than individuals without PTSD (Amir, Coles, & Foa, 2002). In research on alcohol abuse, results have repeatedly demonstrated that individuals with high levels of alcohol consumption generate more alcohol-related interpretations on ambiguous alcohol-related cues (e.g., Ames & Stacy, 1998; Stacy, 1995; 1997). Here, also ambiguous situations (e.g. 'Friday night') or phrases including affective components (e.g. 'feeling good'), as well as compound cues using a combination of ambiguous situations and affective components (e.g. 'Friday night – Feeling good') have been used, all revealing the expected positive correlation between levels of alcohol consumption and number of generated alcohol-related interpretations.

Word Sentence Association Paradigm (WSAP; Beard & Amir, 2009)

During the WSAP, participants decide whether or not a word (e.g., threat-related or benign) is related to an ambiguous sentence. Given that the word precedes the ambiguous sentence, the type of word thus influences the interpretation of the ambiguous sentence. The decision time as well the endorsement rates of the relatedness between word and sentence are used as interpretation indices. By means of the WSAP, Beard and Amir (2009) showed that socially anxious participants were significantly faster to

endorse than to reject threat interpretations, and, compared to controls, socially anxious participants endorsed more social threat interpretations and fewer social benign interpretations.

Lexical decision tasks

The basic procedure of lexical decision tasks involves the measurement of how quickly participants classify probes as words or non-words, in combination with presented information related to the probe. Either the probe or the presented information is ambiguous. Calvo, Eysenck, and Estevez (1994), for example, applied such a lexical decision task whereby ambiguous sentences (ego-threat, physical-threat, or non-threat events) were presented to high- and low-test anxiety participants. Sentences were followed by either a disambiguating word or a non-word. Results showed that anxious participants were biased towards an ego-threat meaning, i.e., they were faster to classify ego-threat confirming word than ego-threat disconfirming word compared with low anxious participants. In Richard and French's study (1992), high and low-trait anxious participants were presented with ambiguous probes (threat-related or neutral) that were followed by threat-related, threat-unrelated or neutral targets. Results demonstrated faster responses for threat-related compared to threat-unrelated targets in the high-anxiety group (but only for longer SOA's), providing evidence of a threat-related interpretation bias in the high-anxious group.

Word blends

Word blends are an acoustical blend of word pairs that, optimally, differ by only one phoneme (e.g., cry – dry, sad – sand). Hence, the result of the blending is an auditory ambiguous stimulus. In case participants are not informed about the fact that two words are presented, they are instructed to simply write down what they heard. If participants are informed about the nature of the stimuli, they are instructed to select the word they think they had heard out of 2 or more provided response options. The study of Dearing and Gotlib (2009) used such a word blend task to study interpretation biases in a sample of daughters of depressed mothers following a negative mood induction. It included negative-neutral, positive-neutral, depressotypic-neutral, and social-threat blends. They applied the forced-choice answering format. Results indicated that daughters of depressed mothers, compared to daughters of never-disordered mothers, interpreted ambiguous word blends more negatively and less positively.

Homophones

A homophone is a word that is pronounced the same as another word but differs in spelling and meaning, e.g., 'die/dye'. Mathews, Richards, and Eysenck (1989) used such homophones to study clinical anxiety. The homophones involved either a threatening or a neutral meaning. Results showed that clinically anxious participants identified the threatening spellings relatively more often than controls. Participants who had recovered from their anxiety were in-between.

REFERENCES

Ames, S. L., & Stacy, A. W. (1998). Implicit cognition in the prediction of substance use among drug offenders. *Psychology of Addictive Behaviors*, 12, 272-281.

Amir, N., Coles, M., & Foa, E. B. (2002). Automatic and strategic activation and inhibition of threat-relevant information in posttraumatic stress disorder. *Cognitive Therapy and Research*, *26*, 645-655.

Beard, C., & Amir, N. (2009). Interpretation in social anxiety: When meaning precedes ambiguity. *Cognitive Therapy and Research*, *33*, 406-415.

Calvo, M. G., Eysenck, M. W., & Estevez, A. (1994). Ego-threat interpretive bias in test anxiety: On-line inferences. *Cognition and Emotion*, *8*, 127-146.

Dearing, K. F., & Gotlib, I. H. (2009). Interpretation of ambiguous information in girls at risk for depression. *Journal of Abnormal Child Psychology*, *37*, 79-91.

De Houwer, J. (2003). The Extrinsic Affective Simon Task. *Experimental Psychology*, *50*, 77-85.

De Houwer, J., Crombez, G., Baeyens, F., & Hermans, D. (2001). On the generality of the affective Simon effect. *Cognition & Emotion*, *15*, 189–206.

Eysenck, M. W., Mogg, K., May, J., Richards, A., & Mathews, A. (1991). Bias in interpretation of ambiguous sentences related to threat in anxiety. *Journal of Abnormal Psychology*, *100*, 144-150.

Fazio, R. H., Sanbonmatsu, D. M., Powell, M. C., & Kardes, F. R. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology*, *50*, 229–238.

Glashouwer, K. A., & de Jong, P. J. (2010). Disorder specific automatic self associations in depression and anxiety: Results of The Netherlands Study of Depression and Anxiety. *Psychological Medicine*, *40*, 1101-1111.

Greenwald, A. G., McGhee, D. E., & Schwartz, L. K. (1998). Measuring individual differences in implicit cognitions: The Implicit Association Test. Journal of *Personality and Social Psychology, 74*, 1464-1480.

Hertel, P. T., Brozovich, F., Joormann, J., & Gotlib, I. H. (2008). Biases in interpretation and memory in generalized social phobia. *Journal of Abnormal Psychology*, *117*, 278-288.

Hill, A. B., & Paynter, S. (1992). Alcohol dependence and semantic priming of alcohol-related words. *Personality and Individual Differences*, *13*, 745-750.

Huijding, J., & de Jong, P. J. (2005). A pictorial version of the Extrinsic Affective Simon Task: Sensitivity to generally affective and phobia-relevant stimuli in high and low spider fearful individuals. *Experimental Psychology*, *52*, 289–295.

Huijding, J., & de Jong, P. J. (2006a). Automatic associations with the sensory aspects of smoking: Positive in habitual smokers but negative in non-smokers. *Addictive Behaviors*, *31*, 182–186.

Huijding, J., & de Jong, P. J. (2006b). Specific predictive power of automatic spider-related affective associations for controllable and uncontrollable fear responses toward spiders. *Behaviour Research and Therapy*, *44*, 161-176.

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology*, *140*, 1–55.

Mathews, A., Richards, A., & Eysenck, M. (1989). Interpretation of homophones related to threat in anxiety states. *Journal of Abnormal Psychology*, *98*, 31-4.

McNally, R. J., & Foa, E. (1987). Cognition and agoraphobia: Bias in the interpretation of threat. *Cognitive Therapy and Research*, *11*, 567-581.

Mogg, K., Field, M., & Bradley, B. P. (2005). Attentional and approach biases for smoking cues in smokers: An investigation of competing theoretical views of addiction. *Psychopharmacology*, *180*, 333–341.

Mogg, K., Bradley, B. P., Field, M., & De Houwer, J. (2003). Eye movements to smoking-related pictures in smokers: Relationship between attentional biases and implicit and explicit measures of stimulus valence. *Addiction*, *98*, 825–836.

Nosek, B. A., & Banaji, M. R. (2001). The go/no-go association task. *Social Cognition*, *19*, 625–666.

Richards, A., & French, C. C. (1992). An anxiety-related bias in semantic activation when processing threat/neutral homographs. *Quarterly Journal of Experimental Psychology A: Human Experimental Psychology*, *45*, 503-525.

Rinck, M., & Becker, E. S. (2007). Approach and avoidance in fear of spiders. *Journal of Behavior Therapy and Experimental Psychiatry*, *38*, 105–120.

Roefs, A., Stapert, D., Isabella, L. A., Wolters, G., Wojciechowski, F., & Jansen, A. (2005). Early associations with food in anorexia nervosa patients and obese people assessed in the affective priming paradigm. *Eating Behaviors, 6*, 151-163.

Stacy, A. W. (1995). Memory associations and ambiguous cues in models of alcohol and marijuana use. *Experimental and Clinical Psychopharmacology*, *3*, 183-194.

Stacy, A. W. (1997). Memory activation and expectancy as prospective predictors of alcohol and marijuana use. *Journal of Abnormal Psychology*, *106*, 61-73.

Stoler, L. S., & McNally, R. J., (1991). Cognitive bias in symptomatic and recovered agoraphobics. *Behaviour Research and Therapy, 29*, 539–545.

Wiers, R. W., Rinck, M., Dictus, M., & van den Wildenberg, E. (2009). Relatively strong automatic appetitive action-tendencies in male carriers of the OPRM1 G-Allele. *Genes, Brain and Behavior*, *8*, 101–106.

Wigboldus, D. H. J., Holland, R. W., & van Knippenberg, A. (2004). *Single target implicit associations*. Unpublished manuscript.

ACKNOWLEDGMENT

GRATITUDE: THE STATE OF BEING GRATEFUL; THANKFULNESS.

My dissertation is not the product of me alone. Many people contributed to this work, in various manners and at various stages, so there are lots of people to be thankful to.

Eni Becker and Mike Rinck, Mike Rinck and Eni Becker. The best supervisors someone could wish for.
Eni, I will never forget your first lecture during the clinical psychology course, which sparked my interest in research. From that moment on, you were my mentor and my role model in science. Thank you for your warm and encouraging support, and your patience with my stubbornness, during all these years.
Mike, I truly admire your sharp and clear mind. Your critical attitude challenged and inspired me and provided many crucial insights. Thank you for showing me how to contribute to science in a meaningful and valuable manner.
Dear both, you understood very quickly how I function best. Thank you for giving me the freedom to develop my own research ideas and your trust. And most important: Thank you for your friendship, the most valuable thing I could have taken with me when leaving Radboud University.

I also had the opportunity to work with other (international) senior researchers during the past years. In 'the order of appearance' I owe big thanks to the following persons. Bundy Mackintosh and Emily Holmes, we collaborated during my research master internship but this collaboration actually never ended. And I am extremely happy about this! Thank you to both of you for the opportunities and chances you offered to me. Bundy, you are not only a wonderful researcher but also a wonderful person. I cannot wait to plan our horse riding adventure in the mongolian steppes. Emily, I am learning a lot from you, and I am looking forward to learn even more from you. Your excitement and creativity in doing science is amazing. Dear both, you make the UK a very inspiring but also a very warm place to be, thank you so much.
Reinout Wiers, I am very happy that our paths crossed. It is a great experience to work with you and I learned a lot from your expertise in the area of addiction research. You said once that 'One should always have an affinity with the research topic one is working on' – I will try to comply with this in the most healthy way possible. Thank you very much for your support, enthusiasm, and the many cheerful moments.

Colin MacLeod, I am still deeply impressed by your great and fast mind. When introducing my research idea during my research visit at your lab, you stopped me after approximately 2.5 sentences because this idea would not work. And although it is still hard to admit today: you were right. Thank you so much for the amazing time in Perth and for sharing your enthusiasm for Australia with me. I will never forget our fantastic camping trip and the BBQ you organized, at 12pm at 36°C. A warm thank you also to those who worked in your lab and other people I met during that time: Jason, Ben, Dan, Alea, Andrew, Anne, Amy, John, Claire and Sky.
Richard McNally, working with you was such a valuable experience. Thank you very much for having me in your lab. You made me think a lot about how we do things and how we should do things. Moreover, our shared interest in the history of psychology always led to many exciting as well as funny discussions. You are a personified history book and this is always fascinating. Although I will never give up in finding a German who was always a bit faster than the American. Thank you also to Phil, Don, Dianne and Nicole for their help and all the cheerful chats.
Stefan Hofmann, thank you very much for all your invitations during my time in Cambridge / Boston. I enjoyed every single curry we shared and I agree: they are the best. I am very much looking forward to further editorial work with you for Cognitive Therapy and Research, thank you for this great opportunity.
Jürgen Margraf, we started working on our panic project in 2012 and now I am a post doctoral researcher in your lab. Thank you very much for the opportunity to further develop and refine my research skills, and for thinking along with me when planning my way to become a true professional researcher. I am very happy to have you as a supervisor.

When not working abroad, I was working among many many wonderful colleagues. It is impossible to mention all those nice colleagues on and around the 7th floor. However, I'd like to name a few people I am particularly grateful to. Ladies first, and again in the order of appearance.
Julie, your calmness and humor have been a blessing when I started my PhD. It was great to have an office so close to yours, for the professional and the unprofessional moments. Particularly the latter moments turned you in a close friend very quickly and I am still very happy about this. I will never forget our amazing trip to Japan, including our unforgettable 'Informer' Karaoke performance. Janna, we started as friends and then became colleagues. It is impossible to mention all the memorable moments we shared, and this includes conferences and writing weeks as well as (sushi) trips to New York. However, there is one thing all these moments have in common, and that is that I experienced you as the most warm but also the most funny person. Our PhD

journey started and ended at the same time, literally, as I am going to have my defence a day after yours. However, I am looking forward to many many more journeys with you, wherever they will take us. Joyce, I think I can safely conclude that the two of us are quite different personalities. However, or maybe therefore, we always got along very well. It was nice to get to know you better and better during all these years, you are a very amiable person. Linda I., 'I am very grateful' that we met. I truly hope to stay in contact with you, despite the geographical distance. Dorien, you have a big heart and on the right spot, take care. Maartje, you always had the time for some nice chats in between work. I really enjoyed these little breaks with you. Rianne v. N., thank you for being such a nice roommate during the last year of my PhD. Lotte, sitting in the next room but still being able to hear your cheerful laugh, that's how it should be. Rianne d. K., I am very happy that we set up our RCT. I enjoy working with you a lot and you are big fun.

Gero, Oreg, Gore, Erog… In whatever way I put it, the conclusion remains the same: You are an amazing colleague. 'Keks boxing', 'Akzeleration vs. Dezeleration', just name it, we have it. It is impossible to count all our fits of laughter. However, what is possible is to keep on having them. Hence, I am very much looking forward to experience more of them in the future. And so far, I am very happy to have you as my paranimf….!

Olli, the master mind. Whenever I had research-related questions I knew you would help. Thank you for your patience but also for the many many jolly moments. You are definitely a fun master mind. Dan, working with you was always a pleasure. Thank you for all the good and nice conversations. Thomas, you became a loyal and trusted companion so quickly, professionally and personally. I hope we stay in touch.

Further, I'd like to thank some other colleagues who made work such a nice place, junior as well as senior colleagues: Anke, Linda K., Henndy, Jenny, Naline, Bernd, Verena, Lisa, Jacobien, Inge, Henk, Ger, Agnes, Cilia, Cor, Tatjana, Gérard, Rien, Toon en Tessa.

Gina, Martin, Mira, Nessa, Xija, the new PhD generation. It was super great to get to know you and I am sure you will rock! Nessa and Evelien, thank you for the amazing time in Shapley Road, I would not have survived without you. Hannah, I like working with you a lot, I hope we continue doing so. Anne, thank you for all your (immediate) help, you are an amazing research assistant.

A big thank you to all those who work 'behind the scenes of science': Maria and Wies, thank you for all your help and our lovely chats; Thea, who always has an answer for, in fact, everything; Giovanni and Pierre, I truly enjoyed our stats discussion and learned a lot from you, thank you; Ronny, who gives the BSI lab the special touch; Hubert, who helped me a lot with my eye tracking study; Pascal, who helped me in understanding the world of Presentation; Ron, who always allowed me to do the 'the

Spinoza building is closing now' announcement, that was super!; Cor, your friendly face and our chats always cheered me up whenever I was working late.
Finally, I'd like to thank all the students who helped with the data collection of some of the studies. It was very nice to work with you and I learned a lot from you.

Besides team Radboud, there are a few other people I'd like to mention: Andrea, during our first day in Oxford we bumped into each other, which was very surprising for both of us. I am super happy that we're now moved beyond just random meetings. You have the most contagious giggle, so being with you is always such a pleasure. Elske, doing addiction research with you, also a well-known chocolate addict… Whatels(k)e could I wish for? Thank you for the good and cheerful collaboration, I am looking forward to more projects with you. Eva, CBM symposium buddy for years. You have a perspective on life and work that I can learn a lot from.
Johannes Lindenmeyer, thank you for your great support during the last years and for making so much possible. Steffen Pawelczak, always helpful when I needed answers and additional information regarding our Lindow projects. Xiao Chi, thank you for your enormous help with our panic project, I look forward to more collaborative projects in the future.

Although I spent many hours in UU, i.e., University Universe, writing this dissertation would have been impossible without my amazing friends.
Nadja, we met during the first year of our psychology study. From that moment on, we were inseparable. During the week, we sat in the library to study, during the weekend, we explored the dikes and meadows along the Waal. Although our careers developed in totally different directions, we are very similar in many ways. This is a wonderful feeling and I am very happy to have you as my friend. Simone, I will never forget all those great chocolate nights. I mean video nights during which we had some chocolate now and then. Thank you for your warm friendship during the past years. Barbara, Sonja and Wieteke, life would have been less fun without you.
Floris, my one and only roomy. I am quite sure that I will deeply regret the following words but: I learned a lot from you. Your perspective on life is so refreshing and your way of re-framing is unbeatable. Thank you for your cheerfulness, for your patience whenever I wanted your feedback on the first sentence of my introductions, and most important: Thank you for being such a lovely and adorable roomy. I am very glad to have you as my paranimf. Paul, my close friend since the early Nijmegen days. I can hardly remember not having you as my friend. You tell me when I am wrong, even if I do not ask for it. Thank you for being such a good and loyal friend. Vinc, your 'French reality kicks in' comments during my PhD were always very entertaining. Now I am a

post doc, any thoughts? Bob, thank you for your interest in my work and the many warm welcomes in the UK.
Team horse riding, including Pleun, Tirza, Rianne, Jeroen and of course Jort, my black beauty. We had so much fun together and I enjoyed every single gallop with you, also the unexpectedly fast ones.

A special thanks goes to my family to whom I am more grateful than words can ever express. However, this part starts with mentioning two beloved people who are not with me anymore. Esther, my dear little sister, I think a lot of you. Mama, you left me far too early, and sometimes it is still difficult for me to realize that you are not here anymore. There isn't a day that goes by that I am not thinking of you. You fought long and hard but in the end the cancer won. You had many good last wishes for me. One of them was that I would do well at school. I am dedicating this dissertation to you.
Papa, thank you for your unconditional support during all these years. I am grateful for your encouragement and for your confidence that I would do well. You are an open minded and sociable person, and this clearly affected my own personality in many positive ways. Angelika, you are lovely, thank you for having joined my father's life. Tante Betty en oom Wim, Horst and Marianne, your homes became my second home and I cannot describe how thankful I am for this. Tante Betty en oom Wim, your door was and is always open for me. Knowing this is simply wonderful. Rob and Arjan, my two cousins. I am very happy to have you as my substitute brothers. Horst and Marianne, thank you so much for your never-ending warmth and care. Having you in my life, including Britta, Andre and Sven, means a lot to me.

My dearest Simon. I am very grateful that you came into my life, and I start smiling while writing these words. My days end and start with you, and it feels as if it has been like this forever. I look forward to many more sunny days on the green grass at Parker's Piece while ignoring the Reality Checkpoint. Thank you for your support, the many warm and fun moments, and for simply being there. Being loved by you and loving you is such a present.

SHORT BIOGRAPHY

Marcella Lydia Woud was born on March 19th 1980 in Wesel, Germany. After finishing secondary education at the Willibrord Gymnasium in Emmerich am Rhein in 1999, she studied Social Work at the Hogeschool Arnhem Nijmegen (The Netherlands). In 2003, she received her Bachelor degree (cum laude) and then started studying for a degree in psychology at Radboud University Nijmegen (The Netherlands) in the same year. She specialized in Clinical Psychology and obtained her Bachelor degree in 2008 (cum laude). She subsequently enrolled in the Behavioural Science Research Master program at Radboud University Nijmegen. In her second year she spent 6 months in the UK, completing a research internship with Dr. Bundy Mackintosh (then at University of East Anglia, now at University of Essex) and Prof. Dr. Emily Holmes (then at University of Oxford, now at MRC Cognition and Brain Sciences Unit, Cambridge). This research visit was financed by an award to Marcella of the Huygens Scholarship Talent Grant. In 2008, she graduated from the Behavioural Science Research Master program (cum laude) and her master's thesis was judged to be the best thesis of her graduation year. Following this, Marcella started working as a PhD student and lecturer at the department of Experimental Psychopathology and Treatment at Radboud University Nijmegen. She wrote her own research project for her PhD, entitled 'Assessment and (Re-) Training of (Dysfunctional) Cognitive Processes in Psychopathology'. In 2010, she went to Perth (Australia) and visited Prof. Dr. Colin MacLeod's lab at the University of Western Australia for 5 months. An award to Marcella from the Prins Bernhard Cultuurfonds made this research visit possible. In 2012, Marcella received the Elisabeth Frye Stipendium, an annual award of the Radboud University Nijmegen, which is given to the most talented and promising female PhD students of that year. This award enabled Marcella to visit Prof. Dr. Rich McNally's lab (Harvard University, USA) for 3 months.
From 2008-2012, Marcella was an active member of the Committee of International Affairs of the Social Sciences Faculty of the Radboud University Nijmegen. Moreover, she completed a three year teaching course, receiving her certificate in 2013 (Basis Kwalificatie Onderwijs, BKO). In August 2012, Marcella started organizing a Special Issue on Cognitive Bias Modification Techniques in the journal Cognitive Therapy and Research, together with Prof. Dr. Eni Becker (Radboud University Nijmegen, The Netherlands), and she is now working as an associative editor for the same journal. Since November 2013, Marcella has been working as a post-doctoral researcher at the Center for the Study and Treatment of Mental Health (Department of Psychology, Ruhr University Bochum, Germany), supervised by Prof. Dr. Jürgen Margraf.

PUBLICATIONS

INTERNATIONAL PUBLICATIONS

Woud, M.L. & Becker, E.S. (2014). Editorial for the special issue on cognitive bias modification techniques: An introduction to a time traveller's tale. *Cognitive Therapy and Research*, *38*, 83–88.

Woud, M. L., Zhang, X. C., Becker, E. S., McNally, R. J., & Margraf, J. (2014). Don't panic: Interpretation bias is predictive of new onsets of panic disorder. *Journal of Anxiety Disorders*, *28*, 83-87. *

Woud, M. L., Pawelczak, S., Rinck, M., Lindenmeyer, J., Souren, P., Wiers, R. W., & Becker, E. S. (2014). Alcohol-related interpretation bias in alcohol-dependent patients. *Alcoholism: Clinical and Experimental Research*. doi: 10.1111/acer.12334. *

Rinck, M., & Telli, S., Kampmann, I. L., **Woud, M. L.**, Kerstholt, M., te Velthuis, S., Wittkowski, M., & Becker, E. S. (2013). Training approach-avoidance of smiling faces affects emotional vulnerability in socially anxious individuals. *Frontiers in Human Neuroscience*, 7, 1-6.

Woud, M. L., Becker, E. S., Lange, W. G., & Rinck, M. (2013). To like or not to like: The effect of approach-avoidance training on neutral, angry and smiling face stimuli. *Psychological Reports*, *113*, 199-216.

Woud, M. L., Maas, J., Becker, E. S., & Rinck, M. (2013). Make the manikin move: Symbolic approach-avoidance responses induce implicit and explicit evaluation bias. *Journal of Cognitive Psychology*, *25*, 738-744.

Woud, M. L., Wiers, R. W., Pawelczak, S., Becker, E. S., Lindenmeyer, J., & Rinck, M. (2013). Does negative affect prime alcohol in alcohol-dependent inpatients? A large- scale clinical investigation of the moderating role of depression and executive control. *Journal of Experimental Psychopathology*, *4*, 279-290. *

Woud, M. L., Postma, P., Holmes, E. A., & Mackintosh, B. (2013). Reducing analogue trauma symptoms by computerized reappraisal training – Considering a cognitive prophylaxis? *Journal of Behavior Therapy and Experimental Psychiatry*, *44*, 312-315. *

Scheibner, H., & **Woud, M. L.** (2012). Mit dem Joystick gegen die Abhängigkeit: Computer-Gestützte Trainings zur Rückfallprävention. *Konturen*, *3*, 15-20.

Woud, M. L., Fitzgerald, D. A., Wiers, R. W., Rinck, M., & Becker, E. S. (2012). 'Getting into the spirit': Alcohol-related interpretation bias in heavy drinking students. *Psychology of Addictive Behaviors*, *26*, 627–632. *

Woud, M. L., Holmes, E. A., Postma, P., Dalgleish, T., & Mackintosh, B. (2012). Ameliorating intrusive memories of distressing experiences using computerized reappraisal training. *Emotion*, *12*, 778-784. *

Woud, M. L., Becker, E. S., & Rinck, M. (2011). Induction of implicit evaluation biases by approach avoidance training: A commentary to Vandenbosch & De Houwer. *Cognition and Emotion*, *25*, 1331-1338.

Woud, M. L., Anschutz, D. J., Van Strien, T., & Becker, E. S. (2011). Measuring thinspiration and fear of fat indirectly: A matter of approach and avoidance. *Appetite*, *56*, 451-455.*

Woud, M. L., Ellwart, T., Langner, O., Rinck, M., & Becker, E. S. (2011). Task-irrelevant spider associations affect categorization performance. *Journal of Behavior Therapy and Experimental Psychiatry*, *42*, 309 – 316. *

Müller, B. C. N, van Baaren, R. B., Ritter, S. M., **Woud, M. L.**, Bergmann, H., Harakeh, Z., Engels, R. C. M. E., & Dijksterhuis, A. (2009). Tell me why…The influence of self-involvement on short term smoking behaviour. *Addictive Behaviors*, *34*, 427-431.

Woud, M. L., Becker, E. S., & Rinck, M. (2008). Implicit evaluation bias induced by approach and avoidance. Cognition and Emotion, 22, 1187-1197 (please see correction: *Cognition and Emotion*, *25*, 1309-1310)

NATIONAL PUBLICATIONS

Woud, M. L. & Krans, J. (2013). Cognitive Bias Modification (CBM) technieken bij post-traumatische stresstoornis (PTSS): Eerste bevindingen en toekomstige perspectieven. *Directieve Therapie*, *33*, 170-187.

SUBMITTED MANUSCRIPTS

Woud, M. L., Becker, E. S., Rinck, M., & Salemink, E. (2014). *Valence-congruent relations between alcohol-related interpretation biases and drinking motives*. *

Maas, J., **Woud, M. L.**, Keijsers, G. P. J., Rinck, M., Becker, E. S., & Wiers, R. W. (2014). *The attraction of sugar: An association between body mass index and impaired avoidance of sweet snacks*.

Kersbergen, I., **Woud, M. L.**, & Field, M. (2014). *The validity of different measures of automatic alcohol action tendencies*.

BOOK CHAPTERS

Krans, J., **Woud, M. L.**, Näring, G., Becker, E. S., & Holmes, E. A. (2010). Exploring involuntary recall in post-traumatic stress disorder from an information processing perspective. In J.H. Mace (Eds.). *The act of remembering: Toward an understanding how we recall the past*. Wiley-Blackwell: Malden, U.S.A.

Keijsers, G. P. J., **Woud, M. L.**, & Becker, E. S. (2009). Psychotherapie en verandering van impliciete mentale processen. In S. Colijn, S. Bögels, & W. Trijsburg (eds), *Leerboek Psychotherapie*. De Tijdstroom: Utrecht.

Papers included in this thesis are marked with an asterisk.