Cognitive Biases in Obsessive-Compulsive Disorder: Manifestation in Implicit Measures of Attention, Approach-Avoidance and Aggression

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Abstract

Obsessive-compulsive disorder (OCD) has a lifetime prevalence of 2-3%. A diagnosis of OCD has serious implications for the individuals, as OCD is associated with extensive disability covering many aspects of functioning (e.g., social life and work), increased healthcare utilization, and reduced quality of life. Both, cognitive models of OCD and the emotional processing theory highlight the role of cognitive biases in the development and maintenance of OCD. These assumptions have been supported by empirical findings in several domains, including attention, approach-avoidance and aggression. The latter is associated with dysfunctional beliefs. The emotional processing theory assumes that cognitive biases are not necessarily available to the individual through introspection. However, to date the vast majority of studies has used only explicit measures to assess cognitive biases in OCD. Assumptions regarding implicit processes in OCD often rely on results from (analog) samples of individuals with anxiety disorders. Previous research using implicit measures to assess OC biases is scarce and has mostly examined analog samples. The current dissertation aimed at shedding light on three of those cognitive biases using implicit measures in patients with OCD.

In three studies individuals with various subtypes of OCD, including patients with checking-related and contamination-related symptoms as well as a healthy control group were included. Attentional biases were assessed in patients with OCD (n = 28) and healthy controls (n = 21) using an eye tracker (study I). Participants were asked to view contamination-related, checking-related and neutral stimuli, in a free viewing paradigm. A possible vigilance bias was assessed using entry time and a maintenance bias using dwell time. An Approach-Avoidance Task (AAT) was used in study II to examine behavioral tendencies in patients with OCD (n = 63), compared to a healthy control group (n = 30). In the AAT, participants were asked to respond to the color of a stimulus or stimulus frame by pulling a joystick towards themselves or by pushing it away. Similar to the material used in study I, the stimuli in the AAT were checking-related, contamination-related, and neutral. Contrary to study I, both pictures and words were incorporated. In study III implicit aggression was investigated in patients with OCD (n = 58) and healthy controls (n = 25) with an Implicit Association Test (IAT), which is a reaction time task that assesses the strength of associations between the concept of aggressiveness and the categories *me* compared to *others*.

No general bias could be found when assessing the whole sample of patients with OCD compared to healthy controls regarding attention, approach-avoidance and aggression. However, patients with checking-related symptoms of OCD showed cognitive biases in all three paradigms compared to healthy controls. Study I showed that they viewed checking-related pictures longer than neutral pictures, lending support for a maintenance bias of attention in the checking-related subtype of OCD. Additionally, they pulled checking-related stimuli faster and pushed them slower than a healthy control group in the AAT (study II). This suggests an approach rather than an avoidance bias in patients with checking-related symptoms. Furthermore, they showed a bias regarding aggression on the IAT (study III). However, contrary to hypotheses they did not show a more aggressive but a more peaceful implicit self-concept than healthy controls. Patients with contamination-related symptoms did not show any bias in either of the studies.

The studies in the current dissertation were the first to assess *patients* with OCD to examine cognitive biases of attention, approach-avoidance and aggression with three implicit measures (eye tracking, AAT, and IAT). Results stand in contrast to previous studies using explicit measures. This might indicate that cognitive biases are influenced by processes which may not be fully assessable by explicit measures. Thus, implicit measures may prove to be important to extend previous research on cognitive biases in OCD. Furthermore, results differ from findings on anxiety disorder and most studies in subclinical samples, often assessing contamination fears only. Previous studies on attentional biases have found a vigilance bias and not a maintenance bias in anxiety disorders. Moreover, in both anxiety disorders and subclinical participants with contamination fears, an avoidance bias was found in the AAT. Hence, the discrepancy between the results of the current dissertation and prior results from studies using implicit measures in anxiety disorders underline possible differences in information processing of the two disorders, which has recently led to the separate classification of OCD and anxiety disorders in the DSM-5. Furthermore, the results of the current dissertation emphasize the issues inherent in studying OCD, due to its heterogeneity. Future studies should incorporate idiosyncratic material to better conceptualize implicit measures for the various symptoms of the disorder. Moreover, clinical control groups could help to better understand the specificity of the cognitive biases for OCD. The current dissertation showed that implicit measures could be useful in assessing cognitive biases in OCD and to better understand underlying mechanisms of the disorder. Eventually, they might also prove to be useful as a diagnostic tool, in the assessment of treatment gains and as a complementary training tool in OCD.

1. Introduction

1.1 Diagnosis of OCD

According to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; DSM-5; American Psychiatric Association, 2013) obsessive-compulsive disorder (OCD) can be diagnosed if obsessions, compulsions, or both are present. Obsessions are recurrent and persistent thoughts, images or impulses that the individual experiences as unwanted and intrusive. These obsessions cause distress or anxiety about possible negative consequences (e.g., causing a fire, becoming seriously ill). Compulsions are behaviors that are often performed repetitively to neutralize obsessive content and to reduce distress caused by the obsessions (American Psychiatric Association, 2013). OCD is a heterogeneous disorder; the content of obsessions and the rituals performed to reduce distress may vary widely between individuals with OCD (Abramowitz & Jacoby, 2015; Hirschtritt, Bloch, & Mathews, 2017). The disorder can roughly be classified in several subtypes; contamination and washing, obsessions and checking, hoarding, as well as symmetry and ordering (Katerberg et al., 2010; Mataix-Cols, Conceicao do Rosario-Campos, & Leckman, 2005). In the *DSM-5* (American Psychiatric Association, 2013) hoarding was classified as a discrete clinical syndrome, because of its difference to other subtypes of OCD.

1.2 Epidemiology of Obsessive-Compulsive Disorder

OCD shows an estimated 12-months prevalence of about 1% (Adam, Meinlschmidt, Gloster, & Lieb, 2012) and a life-time prevalence of 2-3% (Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012). OCD can already develop in early childhood but the majority of individuals develop the disorder during the teenage years into the mid-twenties (Anholt et al., 2014). Usually, OCD takes a chronic course, with about 62% of the individuals with OCD reporting at least moderate symptoms over a period of at least two consecutive years (Visser, Van Oppen, Van Megen, Eikelenboom, & Van Balkom, 2014). OCD also has a high comorbidity rate: About 40% of the individuals show a life-time diagnosis of another mental disorder (Subramaniam, Abdin, Vaingankar, & Chong, 2012). OCD is correlated with a reduced quality of life (Subramaniam, Soh, Vaingankar, Picco, & Chong, 2013). Predictors of a decreased quality of life are severity of OCD symptoms, comorbid depressive symptoms and chronicity of the disorder (Subramaniam et al., 2013; Visser et al., 2014). The majority of patients with OCD experience impairment in domains such as social life, relationships, home management and work (Subramaniam et al., 2012). Compared to other mental disorders, OCD more severely affects social relationships (Subramaniam et al., 2013) and causes high economic burden through direct costs of medical services and health care (for an overview see Markarian et al., 2010). Furthermore OCD is associated with indirect costs such as reduced productivity. Individuals with moderate to severe symptoms of OCD miss about 37% of workdays a year on average (Subramaniam et al., 2012). Despite the early onset of the disorder, it often goes unrecognized because screening is not routinely performed in primary care settings (Veldhuis et al., 2012). Even in psychiatric settings OCD is often misidentified, possibly due to its heterogeneity (Glazier, Calixte, Rothschild, & Pinto, 2013). The prevalence rates for the different subtypes vary. The checking subtype has the highest prevalence rate with 79.3%, followed by ordering (57%), and contamination (25.7% Ruscio, Stein, Chiu, & Kessler, 2010). Empirical studies on OCD often focus on only one specific subtype of the disorder, mainly contamination-related symptoms of OCD.

1.3 Cognitive Models of Obsessive-Compulsive Disorder

Even though OCD is characterized by a broad range of symptom profiles, most cognitive models of OCD do not differentiate between subtypes of OCD to explain the development and maintenance of the disorder (for an overview of models see Taylor, Abramowitz, & McKay, 2007). The model described by Salkovskis (1985) is the best known (see Figure 1). In this model it is claimed that OCD develops due to maladaptive appraisals of otherwise normal intrusive thoughts. It is assumed that most individuals regularly experience aversive intrusions without developing symptoms of OCD. In individuals with OCD, however, the subsequent negative appraisal, which is usually followed by neutralizing behavior, causes obsessive-compulsive symptoms. The model further proposes that the misinterpretation of obsessive thoughts has several effects, which include attentional and behavioral processes. For example, it is hypothesized that individuals with OCD shift their attentional focus on the intrusions themselves or on triggers in the environment, consequently increasing their salience. Furthermore, it is proposed that obsessions lead to behavioral responses, such as safety behavior and avoidance, which is believed to increase the accessibility of the persons' concerns with harm and their effort in neutralizing obsessive content. Moreover, the misinterpretation of intrusive thoughts is assumed to be triggered by cognitive processes such as dysfunctional beliefs (refined model version; Salkovskis & McGuire, 2003). One of them is an inflated sense of responsibility, which means that individuals with OCD evaluate thoughts in terms of potential harm to themselves or others for which they are personally responsible (Obsessive Compulsive Working Group, 1997; Salkovskis, 1985). According to the cognitive model of Rachman (1993) it is further assumed that an inflated sense of responsibility is associated with latent aggression, especially in OC checkers. Individuals with OCD are assumed to become frustrated, because checking behavior does usually not reduce their doubts. This frustration leads to suppressed anger as they assign the blame for their obsessional thoughts internally rather than externally (Rachman, 1993). Summarizing, cognitive models of OCD highlight the pivotal role of cognitive biases in OCD including attentional and approach-avoidance biases as well as dysfunctional beliefs, which are thought to be associated with increased latent aggression.

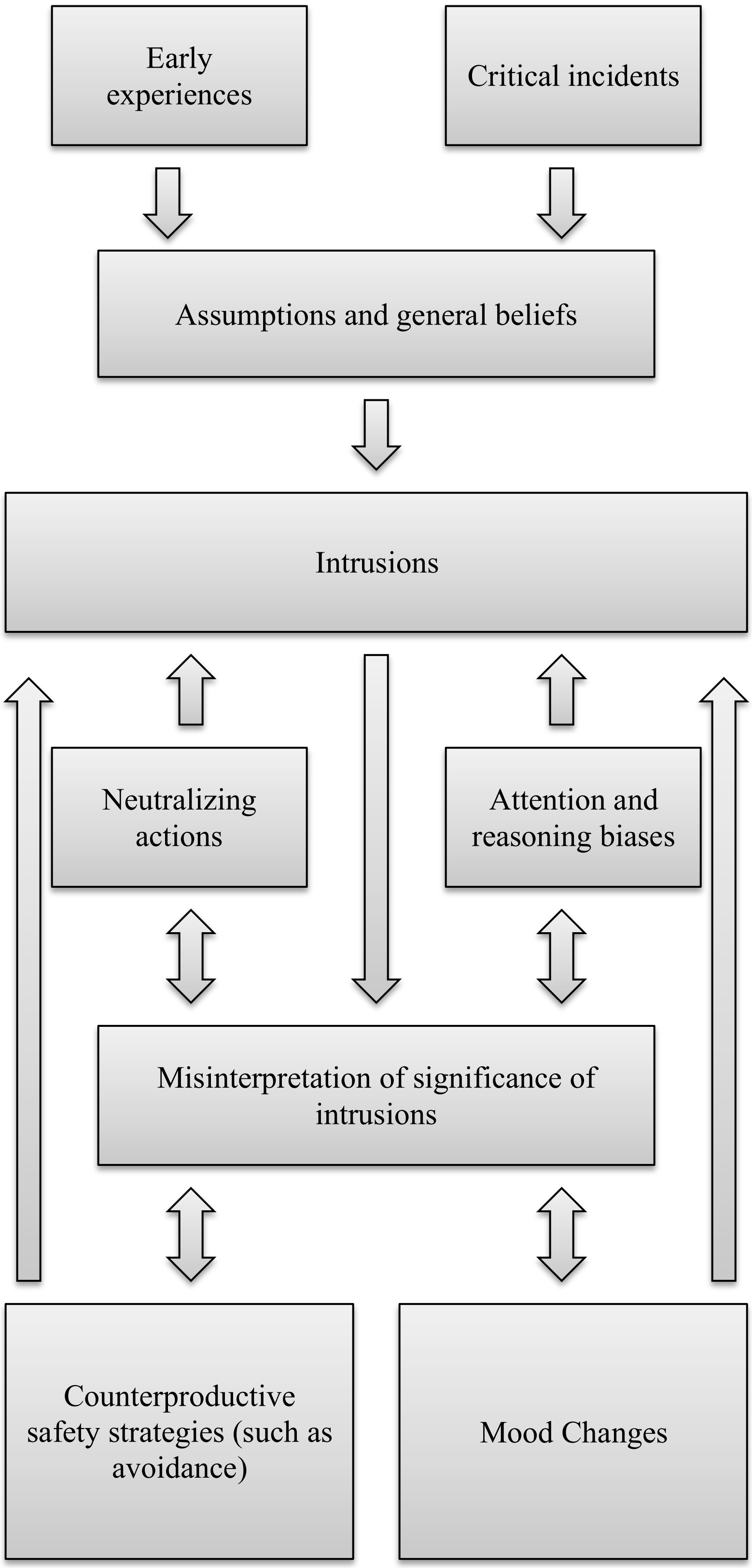

Figure 1. Cognitive Behavioral Model of OCD based on Salkovskis & McGuire (2003)

1.4 Emotional Processing Theory

Another theory to explain the development and maintenance of OCD is the emotional processing theory by Foa et al. (1986). The emotional processing theory was advanced to explain symptoms and possible mechanisms of treatments for disorders that include pathological fear (e.g., panic disorder, OCD, post-traumatic stress disorder). According to this theory, emotions are represented in a cognitive structure that includes three kinds of information: 1) information about the feared stimulus or situation, 2) information about behavioral schemata such as physiological responses or overt behavior, and 3) interpretative information about the stimulus or situation, as well as the meaning of the behavioral response. It is assumed that once one element of the fear structure is activated, the whole structure is activated in order to escape or avoid danger. Whereas in normal fear structures a realistically dangerous situation elicits adaptive responses (such as muscle tension) in pathological fear structures harmless stimuli activate the fear structure (Foa & Kozak, 1986). According to the emotional processing theory, the fear structure of OCD and the fear structure of anxiety disorders differ from one another (for an overview see Foa & McLean, 2016). In OCD, it is proposed, that individuals perceive a situation as dangerous if there is a lack of evidence for its safety (Foa & Kozak, 1986). In a person with contamination-related symptoms of OCD, the fear structure would, for example, consist of 1) doorknobs, public washrooms, 2) representation of avoidance or neutralizing behaviors (e.g., washing, cleaning), and 3) representation of the meaning of the stimuli as "disease", "death", and the meaning of the responses such as "protection from harm" (Foa & McLean, 2016). Additionally, the model proposes that due to a lack of introspection individuals are not fully aware of all elements of their fear structure. This means that associations among stimuli, behavioral responses, and their meanings can exist in the absence of conscious knowledge about them (Foa & Kozak, 1986). For example, whereas many patients with OCD report specific feared consequences (e.g., requiring AIDS), some are not able to articulate a feared consequence. Instead they say "something bad will happen" if they do not perform a certain ritual. Another example is that some individuals with OCD are driven to perform compulsions because they have a feeling that things are "just not right", without being able to specify what that means (for an overview see Foa & McLean, 2016).

1.5 Treatment of Obsessive-Compulsive Disorder

First line treatments of OCD include cognitive behavioral therapy (CBT), the use of selective serotonin reuptake inhibitors (SSRIs) and a combination of CBT and pharmacotherapy (Skapinakis et al., 2016). CBT in the treatment of OCD involves behavioral approaches, namely exposure and response prevention (ERP; Rowa, Antony, & Swinson, 2007) and cognitive approaches such as cognitive reappraisal or restructuring or a combination of both (Lakatos & Reinecker, 2016). The effect of ERP can be explained by the emotional processing theory (Foa & Kozak, 1986). According to this theory, therapeutic information must activate the fear structure and must include information that is incompatible with some elements of the fear structure (Foa & McLean, 2016). Thus, both cognitive and affective information must be integrated into the fear structure in order to reduce pathological fear. This principle was adopted in ERP because it includes exposing the patient to distressing stimuli and situations in which the patient is instructed to inhibit accompanying compulsions. According to a refined version of the emotional processing theory by Foa and McNally (1996) the pathological fear structure is not modified by ERP. Rather, an alternative structure that does not include pathological associations among stimuli, responses and meaning of both is formed. Even though the pathological structure and the new structure both remain and are thought to inherit overlapping elements so that they can both be activated by the same stimuli or behaviors, the new structure should be more easily activated after successful therapy (Foa & McLean, 2016).

The response rates (defined as more than 25% reduction of symptoms) ranged from about 30% for SSRIs to about 65% for CBT and about half of the patients receiving CBT or a combination of CBT and SSRIs no longer met diagnostic criteria for OCD after treatment (for an overview see Öst, Havnen, Hansen, & Kvale, 2015). In a five-year longitudinal study of treatment seeking adults with OCD by Eisen et al. (2013) about one third of the individuals were either partially or fully remitted over a period of at least eight weeks. In this study full remission was defined as no symptoms or only minimal symptoms and no impairment. However, of those partially or fully remitted, more than half subsequently relapsed. Relapse was indicated as fulfilling the diagnostic criteria of OCD for at least four consecutive weeks after remission (Eisen et al., 2013). The emotional processing theory (Foa & Kozak, 1986) proposes that relapse following exposure therapy suggests that instead of eliminating the fear responses inhibition of the fear responses is learned. Therefore, according to the emotional processing theory relapse occurs once the old, pathological structure is activated (see Foa & McLean, 2016).

1.6 Implicit Measures

The emotional processing theory (Foa & Kozak, 1986) suggests that some elements of OCD-related cognitive biases may be unavailable to consciousness. However, in routine care as well as psychological studies on OCD, cognitive biases and avoidance behavior are usually measured using explicit measures such as clinician-based interviews (e.g., Yale-Brown Obsessive Compulsive Scale; Y-BOCS; Goodman et al., 1989) or self-report questionnaires, (e.g., Obsessive Beliefs Questionnaire; OBQ-44; Obsessive Compulsive Cognitions Working Group, 2005). A major disadvantage of explicit measures is that they rely on metacognitive awareness, but some traits or behaviors cannot easily be accessed by individuals (Baumeister, Vohs, & Funder, 2007; Foa & Kozak, 1986). Further, explicit measures are confounded by imprecise reporting and social desirability (Greenwald & Farnham, 2000). To address some of the problems inherent to explicit measures, recent research has used implicit measures as a complementary assessment tool. Implicit measures are based on two-process models (e.g., Gawronski & Bodenhausen, 2006; Smith & DeCoster, 2000; Strack & Deutsch, 2004). One of them is the *Reflective-Impulsive Model* (Strack & Deutsch, 2004), which proposes that behavior is shaped by two complementing information processing systems. The *impulsive system* is fast requiring no attentional resources. It generates behavior through an immediate appraisal of the stimulus, leading to a motivational orientation and corresponding co-activation of behavioral schemata. In the *reflective system*, behavior is driven by knowledge about facts and values and is a consequence of deliberate decision processes. The Reflective-Impulsive model posits that the two systems interact in either synergistic or antagonistic ways. This means that it is possible that, for example, two contradictory behavioral options can be activated in the two systems at the same time. Which behavioral option is acted upon depends on the strength of the activation of a behavioral schema by the two systems and consequently whether or not the behavior is executed from the impulsive or the reflective system. It is assumed that explicit measures tap into the reflective system whereas implicit measures tap more into the automatic or associative processes of the impulsive system. Therefore, it is believed that implicit measures can counter some of the issues inherent in using explicit measures. Instead of directly asking the participant, the implicit associations and precursors of behavior are derived from seemingly unrelated responses to stimuli.

Both cognitive models (e.g., Salkovskis, 1985) and the emotional processing theory (Foa & Kozak, 1986) highlight the role of cognitive biases in the development and maintenance of OCD. Furthermore they assume that those are not necessarily available to the individuals through introspection (Foa & Kozak, 1986). However, to date the vast majority of studies has used only explicit measures to assess cognitive biases in OCD. Assumptions regarding implicit processes in OCD often rely on results from studies on anxiety disorders or a small amount of studies assessing analog samples of OCD. In recent research the number of available implicit paradigms has grown substantially through the development of new tasks and the refinement of existing measures (for an overview see Gawronski & De Houwer, 2014). In the current dissertation three implicit measures were applied in the corresponding studies.

Eye Tracking

Over decades reaction time tasks, such as the emotional Stroop task (Williams, Mathews, & MacLeod, 1996) or the modified dot-probe paradigm (MacLeod, Mathews, & Tata, 1986) have been used to assess attentional biases in various disorders (for an overview see e.g., Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007). However, more recently eye tracking technology has been implemented to assess attentional processes. Eye tracking studies are superior to reaction time studies for several reasons, for example, underlying mechanisms of attention can be assessed (Weierich, Treat, & Hollingworth, 2008). Two competing hypotheses regarding attentional components exist (Fox, Russo, Bowles, & Dutton, 2001). The *vigilance hypothesis* proposes that individuals with anxiety disorders allocate attention to threat-relevant stimuli more quickly and shift their attention towards threat at an early period of attention. The *maintenance hypothesis* suggests difficulty moving the gaze away from threatening stimuli, once they have been attended to (for an overview see Weierich, Treat, & Hollingworth, 2008). Both hypotheses can be analyzed using eye tracking data, because indices of continuous eye movements and attentional processes over a longer period of time can be assessed. Vigilance bias is usually measured by the speed of the first fixation or the amount of first fixations on threatening stimuli, whereas the maintenance bias is assessed by the amount of time looking at a threatening stimulus (i.e. dwell time; e.g., Waechter, Nelson, Wright, Hyatt, & Oakman, 2014).

Most evidence on attentional biases in OCD stems from studies using reaction time tasks (e.g., Foa, Ilai, MCCarthy, Shoyer, & Murdoch, 1993; Harkness, Harris, Jones, & Vaccaro, 2009; Moritz et al., 2004; Moritz & Von Mühlenen, 2008; Rao, Arasappa, Reddy, Venkatasubramanian, & Reddy, 2010; van den Heuvel et al., 2005). Those tasks have produced discrepant results in OCD (for an overview see Morein-Zamir et al., 2013), whereas in anxiety disorders studies revealed almost consistently an attentional biases to threat (Van Bockstaele et al., 2014). In anxiety disorders results from reaction times studies on attention were replicated using eye tracking technology. Anxious individuals have consistently oriented their gaze towards threat-related stimuli more frequently compared to non-anxious individuals, supporting the vigilance hypothesis. Findings regarding the maintenance hypothesis in anxiety disorders are mixed (for an overview see Armstrong & Olatunji, 2012). Only few studies have investigated attentional biases in OCD using eye tracking technology and all have used subclinical samples (Armstrong, Olatunji, Sarawgi, & Simmons, 2010; Armstrong, Sarawgi, & Olatunji, 2012; Bradley et al., 2016; Toffolo, Hout, Hooge, Engelhard, & Cath, 2013). The results have been inconsistent. One study found a vigilance bias in participants with subclinical contamination fears, when viewing contamination-related pictures (Armstrong et al., 2012). Two studies, which both used a free viewing paradigm found evidence for a maintenance bias (Armstrong et al., 2010; Bradley et al., 2016). However, one of those two studies did not include OCD-related pictures, but pictures of facial expressions in a sample with contamination-fears (Armstrong et al., 2010). The other study included subtype-specific material but did not differentiate between the different subtypes in their analyses (Bradley et al., 2016). Therefore, it remains unclear whether an attentional bias exists in patients with OCD and whether it is rather a vigilance bias, a maintenance bias, or both.

Approach-Avoidance Task (AAT; Rinck & Becker, 2007)

The Approach-Avoidance Task (AAT; Rinck & Becker, 2007) is a computer task that is set up to assess behavioral tendencies. It relies on the assumption that positive stimuli facilitate approach and inhibit avoidance, whereas negative stimuli facilitate avoidance and inhibit approach. Explicit versions of the task exist (for an overview see Phaf, Mohr, Rotteveel, & Wicherts, 2014), but the AAT by Rinck & Becker (2007) is regarded as implicit because participants are required to respond to a content-irrelevant feature of a picture (e.g., orientation, color of the picture frame) presented on a computer screen. Participants either push or pull the lever of a joystick as quickly as possible, moving it away from or towards themselves. Several versions of implicit AATs exist, but only the AAT by Rinck & Becker (2007) offers the opportunity to serve as an implicit measure while almost consistently finding approach-avoidance tendencies. The consistent results probably emerged because the AAT includes a zooming function. Due to the visual feedback this version of the AAT is resistant to cognitive reinterpretation (Phaf, Mohr, Rotteveel, & Wicherts, 2014). The zooming effect emerges because the size of the pictures changes according to the direction that the joystick is moved. The picture increases in size when the joystick is pulled and decreases in size when the joystick is pushed. This gives the visual impression of the stimulus moving towards or away from the participant, respectively.

The implicit version of the AAT (Rinck & Becker, 2007) has been used to assess implicit behavioral tendencies in a variety of anxiety disorders using clinical and subclinical samples, such as spider phobia (e.g., Bartoszek & Winer, 2015; Rinck & Becker, 2007), social anxiety disorder (e.g., Heuer et al., 2007; Roelofs et al., 2010; Voncken, Rinck, Deckers, & Lange, 2012), and post-traumatic stress disorder (Fleurkens et al., 2014; Wittekind et al., 2015). In all of these studies but the one by Wittekind et al. (2015), anxious participants almost consistently demonstrated implicit avoidance tendencies in response to anxiety-related pictures, whereas no approach-avoidance tendencies were found in response to neutral pictures. Non-anxious individuals commonly did not respond differently to anxiety-related compared to neutral pictures. Only one study has assessed approach-avoidance tendencies in OCD using the AAT (Najmi, Kuckertz, & Amir, 2010). In this study, a subclinical sample scoring high in contamination-related fears responded significantly more slowly when pulling (approaching) contamination-related compared to neutral pictures. However, no RT differences emerged between the picture types when the pictures had to be pushed. Participants low in contamination-related fear reacted equally fast to contamination-related and neutral stimuli. Taken together, it remains unclear whether approach-avoidance biases exist in *patients* with OCD and whether they can be found in other subtypes of OCD.

Implicit Association Test (IAT; Greenwald et al., 1998)

The Implicit Association Test (IAT; Greenwald et al., 1998) is a reaction time task that was created to assess implicit attitudes or self-concepts. In the IAT, participants have to classify stimuli into target and descriptor categories. It is set up in a way that one target and one descriptor category are assigned to one key and the other categories to another key. The combination of categories switches throughout the task so that the trial is either compatible or incompatible with the to-be-measured psychological attributes. The IAT is based on the assumption that quick and accurate responses are facilitated when the key mapping in the task is compatible with the participant's preference, but impaired when the key mapping is incompatible to the preference (Greenwald et al., 1998). The IAT has been used in a wide variety of domains ranging from self-esteem to stereotypes to attitudes towards consumer products (for an overview see Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005).

In the current dissertation an Aggressiveness-IAT (Agg-IAT) was employed (Schmidt, Zimmermann, Banse, & Imhoff, 2015). The Agg-IAT has previously been used in non-clinical settings to assess implicit associations between aggressive behavior and the self (Banse et al., 2015; Grumm, Hein, & Fingerle, 2011; Richetin et al., 2010; Schmidt et al., 2015). In these studies, results on the Agg-IAT have predicted overt and observable aggressive behavior (Banse, Messer, & Fischer, 2015), negative evaluation of an experimenter who provoked the participant (Richetin, Richardson, & Mason, 2010) and reactive aggression under impeded self- regulatory resources (Schmidt et al., 2015). To date, no study has used the Agg-IAT or any other implicit measure to assess aggression in OCD. Results from explicit measures revealed that OC symptoms, especially checking, were often associated with higher anger (Moscovitch, McCabe, Antony, Rocca, & Swinson, 2008; Radomsky, Ashbaugh, & Gelfand, 2007; Whiteside & Abramowitz, 2004). And OCD patients reported elevated scores of latent aggression (Moritz et al., 2009; Moritz, Kempke, Luyten, Randjbar, & Jelinek, 2011; Moscovitch et al., 2008; Whiteside & Abramowitz, 2004). As outlined by cognitive models, in patients with checking-related symptoms of OCD dysfunctional beliefs were associated with suppression of anger (Radomsky et al., 2007). However, it remains unclear whether patients with OCD and especially those with checking-related symptoms of OCD show a more aggressive implicit self-concept.

1.7 Aims of the Current Dissertation

The current dissertation aimed at examining underlying processes of OCD (attention, approach-avoidance and aggression) using implicit measures. As stated above, one challenge in studying OCD is the heterogeneity of the symptom spectrum (Hirschtritt et al., 2017) and previous studies have often focused on only one subtype (e.g., Armstrong et al., 2010, 2012; Najmi et al., 2010), even though most individuals show an overlap between symptom dimensions (Mataix-Cols et al., 2005). Additionally, there is evidence against a specificity effect in attentional biases in OCD (Pergamin-Hight, Naim, Bakermans-Kranenburg, van Ijzendoorn, & Bar-Haim, 2015). Therefore, and to extend previous research based on analog samples (Armstrong et al., 2010, 2012; Bradley et al., 2016; Najmi et al., 2010) all studies of the current dissertation included patients with varying symptoms of OCD, including contamination- and checking-related symptoms, and healthy controls. Both, study I (eye tracking) and study II (AAT), used OCD-related material that comprised contamination- and checking-related stimuli as well as neutral stimuli. The three studies of the current dissertation were designed to assess whether implicit cognitive biases are specific to each subtype type of OCD or represent a general bias, independent from the OC subtype. Each study was reported in a separate manuscript. The following sections outline aims and hypotheses of the three studies.

1.7.1 Study I: Attentional Biases in Obsessive-Compulsive Disorder using Eye Tracking

The aim of the first study was to assess the vigilance and maintenance bias of attention in patients with several subtypes of OCD using eye tracking technology. A free viewing paradigm was implemented, since the most robust findings for the vigilance and maintenance hypothesis in anxiety disorders have been achieved using free viewing tasks (Armstrong & Olatunji, 2012). Pictures used in the task consisted of checking-related, contamination-related and neutral pictures that had been taken from an OCD-related picture set (BOCD; Simon, Kischkel, Spielberg, & Kathmann, 2012), the IAPS picture set (Lang, Bradley, & Cuthbert, 1999) and pictures that had been used in a previous study (Wittekind, Feist, Schneider, Moritz, & Fritzsche, 2015). The incorporated pictures were chosen according to an expert rating, which had been conducted prior to the eye tracking study. Participants were patients with OCD (including checking-related and contamination-related symptoms) that had been recruited as part of an out-patient psychotherapy study (Külz et al., 2014) as well as a healthy control group. In line with previous eye tracking studies in anxiety disorders, it was hypothesized that patients with OCD would show an initial orientation towards subtype-specific pictures (vigilance hypothesis). Consistent with studies using free viewing paradigms in participants with subclinical symptoms of OCD (Armstrong et al., 2010; Bradley et al., 2016), it was hypothesized that patients with OCD would maintain their gaze on subtype-specific pictures longer than the healthy control group (maintenance hypothesis).

1.7.2 Study II: Approach-Avoidance Tendencies in Obsessive-Compulsive Disorder using AAT

Study II used the same recruitment strategy as study I and also included patients with OCD (including checking-related and contamination-related symptoms) and a healthy control group. However, participants only took part in one of the studies. Similar material was used for the AAT as for eye tracking (study I). The stimuli consisted of checking-related, contamination-related and neutral words and pictures that were selected according to an expert rating. Consistent with previous studies using the AAT (Rinck & Becker, 2007) in individuals with symptoms of anxiety (e.g., Bartoszek & Winer, 2015; Fleurkens et al., 2014) and fear of contamination (Najmi et al., 2010), it was hypothesized that patients with OCD would show avoidance of OCD-related subtype-specific material by faster pushing and slower pulling compared to neutral material. Because no study had previously assessed correlations between explicit measures of OCD and implicit approach-avoidance tendencies, we did not have a directed hypothesis as to whether behavioral tendencies would be associated with explicit measures. Previous studies in anxiety disorders found correlations between avoidance tendencies in the AAT and explicitly reported avoidance on self-report measures (e.g., Fleurkens et al., 2014). Therefore, we felt it was conceivable that explicit ratings of avoidance and contamination- or checking-related symptoms would correlate positively with behavioral tendencies as assessed by the AAT.

1.7.3 Study III: Aggression in Obsessive-Compulsive Disorder using IAT

The aim of the third study was to better understand aggression in OCD by using an implicit measure of aggression (Agg-IAT). The Agg-IAT was implemented in an out-patient sample that had been recruited as part of a larger study (Jelinek, Hauschildt, Hottenrott, Kellner, & Moritz, 2014) and healthy controls. This version of the AAT had previously been used in a study on aggression in a non-clinical setting (Schmidt et al., 2015). As no previous study had used implicit measures to assess aggression in OCD, we based our hypotheses on cognitive theories (Rachman, 1997) and previous research using self-report measures (e.g., Moritz et al., 2011; Moscovitch et al., 2008). We assumed higher implicit aggression for patients with checking-related symptoms of OCD compared to healthy controls when assessed with the Agg-IAT. In patients with OCD, we further expected a positive association between checking symptoms and aggression scores on the Agg-IAT.

2. Study I: Attentional Biases in Obsessive-Compulsive Disorder: An Eye Tracking Study

Cludius, B., Wenzlaff, F., Briken, P., Wittekind, C.E. (submitted). Attentional Biases in Obsessive-Compulsive Disorder: An Eye Tracking Study. *Journal of Obsessive Compulsive and Related Disorders.*

Background and objectives: Attentional biases play an important role in the development and maintenance of obsessive-compulsive disorder (OCD). Previous studies using reaction time tasks in OCD have produced inconsistent results. This is the first study to measure attentional biases in patients with several subtypes of OCD using eye tracking.

Methods: Twenty-eight patients with OCD and 21 healthy controls were assessed using a free viewing paradigm, incorporating contamination-related, checking-related and neutral stimuli. Attentional patterns were measured using an eye tracker. A possible vigilance bias was assessed using entry time and a maintenance bias using dwell time.

Results: Patients with checking-related symptoms of OCD showed a maintenance but no vigilance bias in regard to checking-related compared to neutral stimuli. No differences in attention were found in patients with contamination-related symptoms.

Limitations: Even though subtype-specific stimuli were used, our stimuli may not have been specific enough to elicit attentional biases, especially in patients with contamination-related symptoms of OCD.

Conclusions: Patients with checking-related symptoms of OCD show a maintenance bias to checking-related stimuli. Because of the heterogeneous content of obsessions and compulsions in OCD, future studies should create a free viewing paradigm using material tailored to the specific symptoms of the individual.

3. Study II: Implicit Approach and Avoidance in Patients with Obsessive-Compulsive Disorder (OCD)

Cludius, B., Külz, A. K., Landmann, S., Moritz, S., & Wittekind, C. E. (in press). Implicit Approach and Avoidance in Patients with Obsessive-Compulsive Disorder (OCD). *Journal of Abnormal Psychology*.

Background and objectives: Avoidance is regarded as an important feature for the development and maintenance of obsessive-compulsive disorder (OCD) and is usually assessed using explicit measures such as self-report scales. However, some behavioral schemata are unavailable to introspection, making them partially inaccessible by explicit measures.

Methods: We used an approach-avoidance task (AAT) as an implicit measure to examine behavioral tendencies in patients with OCD, including patients with checking- and contamination-related symptoms (n = 63), compared to a healthy control group (n = 30). Participants were asked to respond to the color of a stimulus or stimulus frame by pulling a joystick towards themselves or by pushing it away. The stimuli were comprised of checking-related, contamination-related, and neutral pictures and words.

Results: Patients with contamination-related symptoms were slower when responding to OCD-related stimuli, independent of approach or avoidance. Unexpectedly, patients with checking-related symptoms were faster at pulling (approaching) and slower at pushing (avoiding) checking-related material compared to neutral stimuli. The slower pushing (avoiding) of checking-related compared to neutral material correlated positively with explicit ratings of avoidance.

Conclusions: These results suggest a biased approach-avoidance tendency in patients with checking-related symptoms of OCD, but not in those with contamination-related symptoms of OCD. Future studies are necessary to assess whether the AAT might be useful in the assessment of treatment gains as well as whether it might be a training tool to enhance psychotherapeutic changes in OCD.

4. Study III: Implicit aggressiveness in patients with obsessive-compulsive disorder as assessed by an Implicit Association Test

Cludius, B., Schmidt, A. F., Moritz, S., Banse, R., & Jelinek, L. (2017). Implicit aggressiveness in patients with obsessive-compulsive disorder as assessed by an Implicit Association Test. *Journal of Behavior Therapy and Experimental Psychiatry*, *55*, 106–112.

Background and Objectives: Cognitive models of obsessive-compulsive disorder (OCD) highlight the role of cognitive biases for the development of the disorder. One of these biases, an inflated sense of responsibility has been associated with higher anger scores and latent aggression on self-report scales, especially in patients with compulsive checking. Validity of self-report assessment is, however, compromised by inaccuracy, social desirability and low metacognitive awareness of traits and behaviors. The aim of the present study was to extend the research on latent aggression in individuals with OCD by using an indirect, implicit measure of aggression.

Methods: Fifty-eight patients with OCD and 25 healthy controls were assessed with an Aggressiveness-Implicit Association Test (IAT), which is a reaction time task that assesses the strength of associations between the concept of aggressiveness and me compared to others.

Results: Contrary to our expectation, OCD patients with checking symptoms showed a more peaceful implicit self-concept than healthy controls. This result was corroborated by negative correlations between checking symptoms and implicit aggressiveness in the OCD sample.

Limitations: No self-report measures on aggression or anger were included in the study.

Conclusions: In comparison to previous research using self-report measures, our study indicates that implicit aspects of aggression do indeed differ from controlled aspects in patients with checking compulsions. Future research is necessary to better understand the role aggressiveness in OCD and to derive implications for therapy.

5. Discussion

The aim of the current dissertation was to assess if OCD is associated with cognitive biases of attention, approach-avoidance and aggression using implicit measures. According to cognitive models of OCD (Rachman, 1993; Salkovskis & McGuire, 2003) and the emotional processing theory (Foa & Kozak, 1986), these processes are assumed to be important in the development and maintenance of the disorder. First, shifting and maintaining the attentional focus on obsessions or on triggers of obsessional thoughts are thought to increase the salience of the concerns (Salkovskis & McGuire, 2003). Second, behavioral responses such as avoidance are proposed to increase the connection between the individuals' concerns and danger (Foa & Kozak, 1986; Salkovskis & McGuire, 2003). Third, aggression is expected to be closely related to dysfunctional beliefs and can trigger obsessional thoughts (Rachman, 1993). In three clinical studies the cognitive biases were assessed using implicit measures. Participants were patients with OCD (including patients with checking-related and/or contamination-related symptoms), recruited as part of out-patient psychotherapy studies, as well as healthy controls. Attentional processes were tested using a free viewing paradigm in an eye tracking study, showing pictures of contamination-related, checking-related and neutral content (study I). In line with previous eye tracking studies in anxiety disorders, it was hypothesized that patients with OCD would show an initial orientation towards subtype-specific pictures (vigilance hypothesis). Consistent with studies using free viewing paradigms in participants with subclinical symptoms of OCD (Armstrong et al., 2010; Bradley et al., 2016), it was hypothesized that patients with OCD would maintain their gaze on subtype-specific pictures longer than the healthy control group (maintenance hypothesis). Similar pictures and additional words were used to examine approach-avoidance tendencies using an AAT (study II). Consistent with previous studies using the AAT (Rinck & Becker, 2007) in individuals with symptoms of anxiety (e.g., Bartoszek & Winer, 2015; Fleurkens et al., 2014) and fear of contamination (Najmi et al., 2010), it was hypothesized that patients with OCD would show avoidance of OCD-related subtype-specific material by faster pushing and slower pulling compared to neutral material. Implicit self-concepts of aggression were tested using the Agg-IAT (study III). In line with previous studies using explicit measures (e.g., Moritz et al., 2011; Moscovitch et al., 2008) higher implicit aggression was assumed for patients with checking-related symptoms of OCD compared to healthy controls when assessed with the Agg-IAT.

Although across groups with different subtypes of OCD no bias could be found regarding attention, approach-avoidance and aggression, patients with checking-related symptoms showed a bias in all three areas. In line with one of the hypotheses they viewed checking-related pictures longer, lending support for a maintenance bias of attention in the checking subtype of OCD (study I). However, contrary to the other hypothesis, patients with checking-related symptoms did not show a faster initial fixation of checking-related stimuli. Furthermore, again, contrary to the hypothesis regarding the responses in the AAT, they *pulled* checking-related stimuli faster and *pushed* them slower than a healthy control group in an AAT (study II). This suggests an approach rather than an avoidance bias in patients with checking-related symptoms. Using the Agg-IAT patients with checking-related symptoms of OCD, as hypothesized, showed a bias regarding implicit aggression. However, surprisingly they showed a more peaceful implicit self-concept than healthy controls. Patients with contamination-related symptoms did neither show any of the expected attentional biases (study I) nor an approach-avoidance tendency (study II). But those patients generally reacted slower to contamination-related stimuli compared to neutral stimuli, irrespective of approach or avoidance (study II). Healthy controls did not show any difference in approach or avoidance to contamination-related compared to neutral stimuli.

In summary, the results from the three studies generally support the assumption of cognitive models of OCD, which proposed cognitive biases in individuals with checking-related symptoms of OCD (Rachman, 1993; Salkovskis & McGuire, 2003). However, only the hypothesis regarding the maintenance bias of attention was confirmed. Even though biases were revealed in patients with checking-related symptoms in regard of approach-avoidance and aggression, the results showed biases opposite to the expected direction. The lack of cognitive biases in patients with contamination-related symptoms is also in contrast to the majority of prior research assessing cognitive biases of attention, approach-avoidance and aggression in OCD and anxiety disorders. In the following section reasons that may account for the discrepancy in results to previous research is summarized according to differences between prior studies and the studies in the dissertation project. First, differences in instruments (explicit compared to implicit) could explain the results and could show the value of implicit measures in extending research using explicit measures. Second, differences in sample selection could account for the discrepancies. The majority of prior studies included analog samples instead of a patient samples with OCD, assessed anxiety disorders and not OCD or included individuals with contamination fears or contamination-related symptoms of OCD instead of individuals with checking-related symptoms.

Instruments

The direction of the approach-avoidance tendencies (study II) and the more peaceful implicit self-concept (study III) stand in contrast to cognitive models of OCD (Rachman, 2002; Salkovskis & McGuire, 2003). First, according to the models, avoidance of checking-related stimuli, rather than approach would be expected. Second, elevated aggression scores would be expected, because aggression is associated with an inflated sense of responsibility, which leads to frustration and anger, as obsessive content cannot be (fully) neutralized. One possible way to reconcile the discrepancies could be based on the Reflective-Impulsive model (Strack & Deutsch, 2004). According to the model, the execution of behavior, including approach or avoidance and aggressive impulses, depends on the strength of the behavioral schemata triggered in the impulsive and reflective systems. The Reflective-Impulsive model suggests that the impulsive system influences behavior by spreading activation and is fast due to its implicit precursors, whereas in the reflective system behavior is a consequence of deliberate decision processes (i.e., controlled precursors of behavior). Therefore, it is hypothesized that if the two systems interact in synergetic ways, the behavior is acted out. However, if they interact in antagonistic ways, a behavioral tendency can be stifled and therefore will not be the executed behavior. It is assumed that processes in the reflective system can be reported explicitly but that behavioral tendencies from the impulsive system may be unavailable to consciousness, although the latter are thought to be assessable using implicit measure. Therefore, following the assumptions of the Reflective-Impulsive model, in our study patients with checking-related symptoms of OCD might have an approach tendency in the impulsive system (which would be revealed in an AAT) and an avoidance tendency in the reflective system (which would be reported on explicit measures). Similarly, based on the Reflective-Impulsive model, the reflective system would also depend on the personal appraisal of aggressiveness in OCD patients. Especially patients with checking-related symptoms have high moral and/or religious standards and an inflated sense of responsibility (Rachman, 1993). Therefore, it is conceivable, that the implicit peaceful self-concept, as assessed by the Agg-IAT (study III) cannot be reported explicitly. Patients with checking-related symptoms may evaluate themselves as relatively more aggressive due to aggressive intrusions that may be more frightening or run counter their less aggressive self-concepts. Following the assumptions of the Reflective-Impulsive Model it is not surprising that results from study II and study III in the current dissertation stand in contrast to results using explicit measures on avoidance (Hand & Büttner-Westphal, 1991) and on anger and aggression (Moritz et al., 2009, 2011; Moscovitch et al., 2008; Whiteside & Abramowitz, 2004). Therefore, the results of the current dissertation extend results from previous research using explicit measures and may support the notion that both explicit and implicit measures should be used when assessing underlying processes of OCD.

Sample

All previous studies on OCD have included subclinical samples when assessing attentional biases using eye tracking (Armstrong et al., 2010, 2012; Bradley et al., 2016; Toffolo et al., 2013) or approach-avoidance tendencies using an AAT (Najmi et al., 2010). The results of the current dissertation showing longer dwell times in patients with checking-related symptoms of OCD are supported by two of the previous studies that revealed a maintenance bias in analog samples of OCD (Armstrong et al., 2010; Bradley et al., 2016). However, our results in individuals with contamination-related symptoms stand in contrast to both previous studies in subclinical samples with contamination fears (Armstrong et al., 2010, 2012). Similarly, the results from the current dissertation are contrary to the results of the AAT study by Najmi et al. (2010), in which contamination-fearful participants were slower at pulling in response to contamination-related pictures than in response to neutral pictures. No difference in RTs emerged across conditions when pushing (Najmi et al., 2010). The discrepancies between study I and study II of the current dissertation and previous studies may have emerged due to sample differences. Even though subclinical samples of OCD are highly relevant to understanding OCD, they differ in important ways from patient samples. For example, whereas individuals with OCD show both obsessions and compulsions defined as repetitive ritualistic behavior (McKay et al., 2004), subclinical samples mostly use covert rituals such as reassurance seeking or focused distraction as neutralizing behavior (for an overview see Abramowitz et al., 2014). Further, both avoidance and neutralizing behavior (such as compulsions) are more pronounced in patients with OCD compared to healthy controls (Morillo, Belloch, & Garcı, 2007). Thus, the results of the current dissertation may emphasize the importance of extending research on subclinical samples by studying patient samples when assessing OCD.

Moreover, as shown in study I – III it seems of high importance to investigate several subtypes of OCD, including checking-related and contamination-related symptoms simultaneously. All three studies of this dissertation project only show biases in patients with checking-related symptoms of OCD. In the eye tracking paradigm (study I) and the AAT (study II) an explanation could be the relevance of the material for the two subtypes, which may be associated with differences in sample selection. The patients with checking-related symptoms of OCD were selected according to the only specific Y-BOCS item on checking compulsions (i.e., "checking locks, stove, appliances etc."; Bloch, Landeros-Weisenberger, Rosario, Pittenger, & Leckman, 2008). The category for contamination-related obsessions or compulsions was broader (e.g., "Concerned will get ill because of contaminant", "excessive ritualized showering, bathing etc."). Thus, the group of patients with checking-related symptoms may show more similar concerns than the patients with contamination-related symptoms. Therefore, it cannot be ruled out that discrepancies to previous eye tracking and AAT studies in anxiety disorders and subclinical samples of OCD (Armstrong & Olatunji, 2012; Bartoszek & Winer, 2015; Najmi et al., 2010; Rinck & Becker, 2007) may have emerged due to a lack of specificity of the stimuli in the current dissertation. In contrast to OCD, stimuli that elicit fears in anxiety disorders are much more specific and homogenous (e.g., a spider). However, similar to previous studies on OCD we used subtype-specific stimuli, which were rated as OCD-related by the participants.

A theoretical explanation for difference between individuals with checking-related and contamination-related symptoms of OCD in study I and study II could be related to the emotional processing theory (Foa & Kozak, 1986). The results of the current dissertation are in line with the assumption that the fear structure serves to help individuals escape danger. The stimuli related to the two subtypes may differ in the appropriate responses to prevent harm. Checking-related stimuli (e.g., a fire, injuring others) might pose a more immediate threat than contamination-related material (e.g., AIDS). Thus, whereas patients with contamination-related symptoms of OCD may be able to ignore a stimulus, patients with checking-related symptoms may feel the urge to maintain attention on the checking-related stimulus. In line with this explanation, a maintenance bias was only found in individuals with subclinical fear of spiders in an experiment using a real live tarantula (Lange, Tierney, Reinhardt-Rutland, & Vivekananda-Schmidt, 2004), but not in those using mere images of spiders (e.g., Rinck & Becker, 2006). This could also be taken as evidence for sustained attention only in situations with urgent threat cues, whereas anxious individuals may risk ignoring low urgency threat cues (e.g., a picture of a spider) to experience anxiety reduction. Furthermore, a greater urgency of threat could mean that approach may be the appropriate strategy to prevent danger from happening (e.g., extinguishing a fire), whereas in situations with contamination-related stimuli exiting the allegedly threatening situation may be the means to escape danger (e.g., not using a possibly contaminated toilet). Furthermore, the different subtypes of OCD (contamination and washing, obsessions and checking, hoarding, symmetry and ordering; Mataix-Cols et al., 2005) are associated with differential impairments in quality of life, for example, only contamination and symmetry are associated with impairments in social relationships (Schwartzman et al., 2017). Furthermore, the subtypes are associated with different degrees of profit from psychotherapeutic interventions, for example, patients with contamination-related symptoms profit more than patients with any other subtype from CBT (McKay et al., 2015). Individuals with checking-related symptoms show some unique characteristics, for example, they have an inflated sense of responsibility for harm (Foa, Sacks, Tolin, Prezworski, & Amir, 2002), a declined confidence in their own memory function (Van Den Hout & Kindt, 2003) and have a higher guilt sensitivity (Melli, Carraresi, Poli, Marazziti, & Pinto, 2017). Thus, it is possible that the tested cognitive biases in all three studies may be specific for individuals with checking-related symptoms. Interventions have recently been developed to target distinctive features inherit in individuals with checking-related symptoms of OCD (Alcolado & Radomsky, 2016; Radomsky, Shafran, Coughtrey, & Rachman, 2010). However, more research is necessary to test whether they are superior to more established psychotherapies.

Additionally, our results on attentional biases (study I) as well as approach-avoidance tendencies (study II) differ from previous findings in anxiety disorders. Even though anxiety disorders and OCD are closely related, our results could be explained by the differences in cognitive-emotional processing between the disorders (for an overview, see Stein et al., 2010). Anxiety disorders are associated with a vigilance rather than a maintenance bias of attention (for an overview see Armstrong & Olatunji, 2012) and previous studies on approach-avoidance tendencies have shown a faster avoidance and slower approach of anxiety-related compared to neutral stimuli (e.g., spider phobia: Bartoszek & Winer, 2015; Rinck & Becker, 2007; social anxiety disorder Heuer et al., 2007; Roelofs et al., 2010; Voncken, Rinck, Deckers, & Lange, 2012; post-traumatic stress disorder Fleurkens et l., 2014). Even though, both anxiety disorders and OCD are characterized by avoidance of situations related to their fears, individuals with OCD change their behavior, once confronted with an anxiety-provoking stimulus or situation. Most commonly individuals with OCD, especially those with checking-related behavior, show compulsions instead of avoidance as a behavioral response (Abramowitz & Jacoby, 2015). For example, an individual with checking-related symptoms might repeatedly approach a stove and maintain his gaze on it to check that it has been turned off properly. Therefore, once a stimulus has provoked anxiety individuals with OCD, at least those with checking-related symptoms, mostly view OCD-related stimuli longer and engage in actions involving the stimulus or situation, which can also involve *approaching* the stimulus. This could explain both the results of a maintenance bias (study I), as well as an approach tendency (study II). Hence, our results may underline the differences between anxiety disorders and OCD. This is in line with the current change in the DSM-5 in which OCD and anxiety disorders were reclassified in separate sections (American Psychiatric Association, 2013). Future studies are necessary to simultaneously assess anxiety disorders and OCD using implicit measures to further investigate the differences in cognitive biases between OCD and anxiety disorders.

Taken together, an issue inherent in studying cognitive biases in OCD, especially when using OCD-related material is the heterogeneity of the disorder. As previous research has mostly focused on only one subtype (e.g., Armstrong et al., 2010; Najmi et al., 2010), this dissertation provides an important extension in assessing cognitive biases in OCD by including several subtypes simultaneously. However, even when examining certain subtypes, obsessions and compulsion can vary widely as they are idiosyncratic in nature. For example, contamination obsessions range from a feeling of disgust with bodily waste to repetitive concerns over spreading illnesses. Contamination-related compulsions can include excessively washing one's hands but also wiping down all groceries brought into the kitchen. Obsessions and compulsions of individuals with checking-related symptoms can be similarly varied. They may feel anxiety that the oven is not turned off, which could cause a fire but may also worry about losing their keys or hitting a pedestrian when driving. Similarly, checking compulsions can vary from repeatedly checking locks and appliances to driving back or listening to the news to check that no accidents had been caused (Abramowitz & Jacoby, 2015; Hirschtritt et al., 2017).

5.1 Reliability and Validity of Implicit Measures

Reliability scores were reported in all three studies of the current project. Even though low reliabilities can limit the interpretability of results from implicit measures, many studies using reaction time tasks fail to report reliability scores (Rodebaugh et al., 2016). A general problem when using implicit measures is that they generally show low to moderate reliability scores, when assessing difference scores using Cronbach's alpha. The IAT seems to pose an exception and generally shows good to excellent internal consistencies, which are comparable to those of explicit measures (Bar-Anan & Nosek, 2014; Gawronski & De Houwer, 2014). In the current dissertation the reliability for the Agg-IAT (study III) was almost excellent (Cronbach's $\alpha = .87$). However, poor to moderate reliability scores have been found using eye tracking (Waechter et al., 2014) and reaction time tasks (for an overview see Gawronski & De Houwer, 2014). The reliabilities of difference scores in the eye tracking paradigm (study I) and the AAT (study II) were similar or better compared to previous studies but still ranged between poor and good. A reason for the moderate reliabilities in eye tracking (study I) and AAT (study II) of the current dissertation may have emerged due to certain trials which may rather speak for the validity of the two tasks. Low reliability scores were especially evident in the healthy control sample in the eye tracking paradigm (study I). In this study we would expect patients to show a consistent viewing pattern (possibly reflecting an attentional bias), whereas healthy controls may show a fully random attentional pattern. As healthy controls are expected to show no preference of viewing OCD-related or neutral material, they may shift their gaze between the pictures without any traceable pattern, causing low reliabilities due to high intrapersonal variability. This assumption is supported by the fact that reliability scores are higher in patients with OCD compared to healthy controls (study I). A similar explanation could account for moderate reliabilities in the AAT (study II), in which low reliabilities were found only on neutral trials. Whereas consistent tendencies can be expected in reaction with approach (pull) or avoidance (push) to OCD-related material, no difference can be expected in the neutral trials. Thus, the response pattern would be inconsistent on neutral trials leading to low reliability scores. Again, this assumption is supported by higher internal consistencies on OCD-related than on neutral trials. Low reliabilities affect statistical analyses as well as the interpretation of results for clinical decision-making, for example, the appropriate selection of patients for cognitive bias modification (CBM; see section 5.3). For an overview of the difficulties posed by unreliable measures of attentional biases see Rodebaugh et al. (2016). Practical implications for future studies using implicit measures are that they should report reliabilities and should improve the methodology to further enhance reliabilities. In free viewing paradigms in eye tracking studies, for example, pictures could be arranged diagonally (bottom left and top right) instead of horizontally, which could work counter “look up” and “look left” biases (Rodebaugh et al., 2016; Waechter et al., 2014).

Implicit measures have been useful to explain variance in a range of psychopathological behaviors that explicit measures could not fully explain (Roefs, Macleod, Jong, & Jansen, 2011). However, the construct validity of implicit measures is not well established. A study by Bar-Anan & Nosek (2014) provides evidence for the validity of the IAT. It is sensitive to detect group differences, for example, it showed differences regarding political attitudes between liberals and conservatives. It correlates with other implicit and explicit measures, when assessing the same construct and it shows predictive validity (Bar-Anan & Nosek, 2014). The incremental validity of the AAT has been assessed by explaining behavior above explicit measures (Rinck & Becker, 2007). It would, however, be desirable to test whether the IAT and AAT indeed assess implicit processes (Bar-Anan & Nosek, 2014; Borsboom, 2006; Phaf et al., 2014). Implicit measures are hypothesized to assess processes that are automatic, which can be defined as unintentional, unconscious, uncontrollable or resource-independent (Moors & De Houwer, 2006). In line with the assumptions of the Reflective-Impulsive model (Strack & Deutsch, 2004), previous studies have shown that whereas explicit measures are superior at predicting deliberate behavior, implicit measures can better predict spontaneous behavior (e.g., Asendorpf, Banse, & Mücke, 2002; Agg-IAT: Schmidt et al., 2015). This effect, called double dissociation, may account for the incremental validity of implicit measures, when explaining behavior (Asendorpf et al., 2002). However, it remains unclear whether there is a direct link between affect and behavior or whether it is indirect and includes appraisals of specific behavioral tendencies (Phaf et al., 2014). Another result that favors the usage of implicit measures is an increased difficulty to intentionally distort responses in experiments using implicit tasks. However, even though implicit measures may assess unintentional processes, they are not entirely prone to faking (for an overview see Gawronski & De Houwer, 2014). To date the only evidence that implicit measures assess unconscious processes stems from the fact that explicit and implicit measures often show low correlations (for an overview see e.g., Hofmann, Gschwendner, Nosek, & Schmitt, 2005). However, available evidence rather suggests that those differences emerge due to factors such as motivational influences rather than low introspective awareness (for an overview see Gawronski & De Houwer, 2014). Furthermore, the association between behavior and implicit or explicit measures depends on the degree of constraint of processing resources. Whereas explicit measures were stronger associated with a certain behavior, when processing resources were not constrained, implicit measures show stronger associations to behavior than explicit measures when resources are depleted (for an overview see Gawronski & De Houwer, 2014, in aggression: Schmidt et al., 2015). Therefore, former research has lent some support for the notion that implicit measures assess automatic processes. However, future research is necessary to further assess the underlying mechanisms of implicit measures and to enhance their methodological shortcomings.

5.2 Limitations and Future Research

In the following section limitations specific to the studies presented in the current dissertation will be discussed. First, the inclusion of patients with several subtypes of OCD and the presentation of subtype-specific stimuli in the studies using eye tracking (study I) and AAT (study II) can be viewed as a main strength of these studies but causes limitations at the same time. It is not possible to differentiate whether the null results in patients with contamination-related symptoms of OCD is a consequence of a lack of specifity of stimuli or if patients with contamination-related symptoms of OCD do not show any of the studied cognitive biases using implicit measures. Second, we did not include a clinical control group in any of the three studies. Especially the inclusion of patients with anxiety disorders might have helped to further investigate the differences of OCD and anxiety disorders as proposed in separating the disorders in the DSM-5 (American Psychiatric Association, 2013). It is not very likely that OCD-related material in the eye tracking (study I) and AAT (study II) also elicits biases in other disorders, as individuals with anxiety disorders show disorder-specific biases (e.g., Armstrong & Olatunji, 2012; Bartoszek & Winer, 2015). However, cognitive biases related to aggression may also be evident in other disorders. Indeed, in most psychiatric disorders subjective anger is elevated. The highest rates were reported for major depressive disorder, post-traumatic stress disorder and personality disorder. Overt aggression scores were especially elevated in impulse control disorders and post-traumatic stress disorder (Genovese, Dalrymple, Chelminski, & Zimmerman, 2017). Therefore, incorporating several disorders in future studies using implicit measures would help to assess disorder-specific or trans-diagnostic effects of aggression. This would also be in line with the Research Domain Criteria (RDoC) framework, which inspires research on a trans-diagnostic level to better understand underlying processes of mental disorders and human behavior across traditional diagnostic categories (Cuthbert, 2014). To further understanding regarding cognitive biases in OCD, future studies could include participants from all subtypes of OCD as well as clinical control groups. Because of the heterogeneous content of obsessions and compulsions in OCD, future studies should create paradigms using idiosyncratic material tailored to the specific symptoms of the individual. Furthermore, they could incorporate psychophysiological assessments (e.g., electrodermal activity and heart rate) as an objective measure for arousal. This could help to disentangle the effects, of OCD-relevance, subtype-relevance and general assumptions or higher arousal, which may also be inherit in other psychiatric groups. Third, a limitation specific to the Agg-IAT study (study III) is that no self-report measures on aggression were included in the study. As implicit measures benefit from being less transparent to the participant and are believed to tap into automatic associations it is not fully unexpected that our results are in contrast to previous research on aggression in OCD. However, including explicit measures of attention would have allowed to directly compare the current results with previous findings. A direct comparison would help to disentangle whether the differences occurred due to assessment method or are indeed a difference between implicit self-concepts of aggressiveness and explicitly reported self-concepts. To shed light on this question, a follow-up study is currently running at the University Medical Center Hamburg-Eppendorf. This study assess inpatients with OCD using the Agg-IAT and a self-report measure of aggression (Spielberger, 2010), as well as measures on social desirability (social desirability scale-17; Stöber, 2001) and obsessive beliefs (OBQ-44; Obsessive Compulsive Cognitions Working Group, 2005).

5.3 Clinical Implications

As stated above (see section 1.5) about half of the patients with OCD no longer meet diagnostic criteria of OCD after being treated with CBT (Öst et al., 2015). However, relapse rates are high, with about half of those remitted experiencing a subsequent relapse (Eisen et al., 2013). According to the emotional processing theory (Foa & Kozak, 1986) relapse following ERP occurs once the old, pathological structure is activated (see Foa & McLean, 2016). The Reflective-Impulsive model could also help to explain relapse after successful remission. According to the model high levels of arousal can interfere with processes in the reflective system (Strack & Deutsch, 2004). This could explain, why patients, who profit from CBT, often experience a relapse through stressful life events (Hammen, 2005). Therefore, additionally to changing processes in the reflective system in CBT it may be useful to specifically target processes of the impulsive system using implicit measures in OCD to enhance remission and reduce relapse rates. Implicit measures have already been successfully tested as a training tool in several disorders (for overviews see e.g., social anxiety disorder: Heeren, Mogoase, Philippot, & McNally, 2015; anxiety disorders and depression: Cristea, Kok, & Cuijpers, 2015; eating disorder and alcohol use disorder: Kakoschke, Kemps, & Tiggemann, 2017). However, especially in anxiety disorders meta-analyses revealed small effect sizes and significant heterogeneity in results for attentional bias modification (ABM) and CBM (Cristea, Kok, & Cuijpers, 2015; Heeren et al., 2015), indicating that more research is necessary to assess the appropriate setting and manner in which implicit measures can be used as a complementary training tool.

In anxiety disorders, ABM has proven useful in reducing attention to threat and anxiety symptoms (MacLeod & Grafton, 2016). However, the majority of studies reported a reduction of anxiety in both, the treatment as well as the active control condition. A review of effects of ABM on anxiety (Mogg, Waters, & Bradley, 2017) revealed that the inconsistency in results may depend on the implemented procedures and could accordingly be due to issues of reliability or validity. Different ABM procedures have led to different consistency in results: whereas ABM-threat-avoidance (facilitating orienting attention away from threat) led to inconsistent findings (for overviews see e.g., Cristea et al., 2015; Macleod & Clarke, 2015), ABM-positive-search (promoting goal-directed search for positive or neutral stimuli among negative or threat-related distractors) appears promising in reducing anxiety. Results for ABM-positive-search rely on a smaller amount of studies and are in need for replication (for an overview see Mogg et al., 2017). Another explanation for inconsistent results in ABM may be that anxiety reduction of ABM is rather an effect of enhancing other factors such as cognitive control (Mogg et al., 2017). In OCD, some studies have assessed the effect of ABM on OC symptoms. After participating in an attention disengagement training, an analog sample with contamination fears showed a significant reduction in attention bias and moved significantly closer towards a feared object compared to a control group in a behavioral approach task (Najmi & Amir, 2010). A study by Amir, Kuckertz, Najmi, & Conley (2015) used several CBM procedures, including ABM, and paired them with self-conducted ERP in OCD. The CBM procedures were effective in reducing the targeted cognitive bias and OC symptoms. The symptoms reduction was comparable to the gold standard of clinician administered ERP in OCD. However, due to the small sample size, results can only be seen as preliminary (Amir et al., 2015). Future studies are necessary to specifically test possible reasons for a successful reduction of attentional biases and OCD symptoms using ABM.

Approach-avoidance tendencies have successfully been targeted in several domains, including alcohol use disorders (e.g., Sharbanee et al., 2014; Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011), unhealthy eating behaviors (e.g., Brockmeyer, Hahn, Reetz, Schmidt, & Friederich, 2015; Schumacher, Kemps, & Tiggemann, 2016), and smoking (e.g., Machulska, Zlomuzica, Rinck, Assion, & Margraf, 2016; Wittekind, Feist, Schneider, Moritz, & Fritzsche, 2015). More importantly, the reduction of approach tendencies has led to a reduction of consumption and relapse rates in patients with alcohol use disorder (for an overview see Kakoschke et al., 2017). In a study by Amir, Kuckertz, and Najmi (2013) on OCD, participants high in contamination concerns were randomized into two conditions. One condition consisted of a single session of AAT training the other was a waitlist control condition. Participants in the training condition showed an increased approach tendency compared to participants in the control condition. This approach tendency also predicted the completion of more steps towards a contamination-related stimulus in a behavioral approach task (Amir et al., 2013). This study shows that training with an AAT could be beneficial in changing pathological behavioral tendencies and, more importantly, overt behaviors in individuals with OCD. The study could represent an important first step to incorporate AAT in the treatment of OCD. However, the results of the current dissertation suggest that patients with checking-related symptoms show an approach not an avoidance bias. Thus, provided that the results are replicated, patients should be trained to avoid rather than approach OCD-related material.

The current dissertation showed that implicit measures could be useful in assessing cognitive biases in OCD and to better understand underlying mechanisms of the disorder. Future research is necessary to assess the benefit of implicit measures in retraining cognitive biases of OCD, which could both enhance treatment gains and reduce relapse rates.

5.4 Conclusion

The findings of the current dissertation project support the notion that cognitive biases exist in OCD, at least in patients with checking-related symptoms of OCD, and that those biases can be assessed using implicit measures. As most results were in contrast to previous studies using explicit measures, the current dissertation may show the importance of extending existing research by studies using implicit measures. Implicit measures may prove to be valuable to broaden our understanding of underlying processes in OCD. Furthermore, the results of the current dissertation show that research using patient samples with OCD can lead to different results than analog samples as previous research in analog samples has either shown inconsistent results (eye tracking) or an avoidance and not an approach tendency (AAT). This underlines the importance of incorporating patient samples when assessing cognitive biases in OCD to ultimately be able to create appropriate diagnostic and training tools for clinical samples. Moreover, the results of the current dissertation may indicate differences in implicit cognitive biases between anxious samples and OCD samples. Possible indications for processes and mechanisms in OCD are often taken from research using anxious samples, as they are thought to be closely related. Previous research has shown a vigilance bias of attention and avoidance tendencies in anxiety disorders. The results of the current dissertation show a maintenance bias of attention and approach tendencies. Therefore, the results of the current dissertation underline the importance to advance studies using samples with OCD. Future studies, which include patients with anxiety disorders and OCD simultaneously, are necessary to better understand the nature of the differences. In contrast to patients with checking-related symptoms, patients with contamination-related symptoms did not show any implicit cognitive bias in the current dissertation project. Several factors could explain the discrepancy between the two subtypes. First, patients with checking-related symptoms and contamination-related symptoms may qualitatively differ in their cognitive biases. This would suggest that CBM interventions could only prove to be beneficial in patients with checking-related symptoms of OCD. Second, the material may not have been specific enough for patients with contamination-related symptoms, which may be a general problem when assessing patients from this subtype. Future studies should try to disentangle this controversy by adapting the methodology of implicit measures, for example, by using idiosyncratic material. In summary, implicit measures might prove to be useful as a diagnostic tool, in the assessment of treatment gains and as a complementary training tool in OCD. This may help to improve remission rates and reduce relapse rates, which is especially important in OCD, as the disorder is often chronic and severely reduces quality of life. However, before implementing CBM in OCD, the current dissertation suggests that future research is necessary to better understand who should be trained and what should be trained in order to benefit from the intervention.

References

Abramowitz, J. S., Fabricant, L. E., Taylor, S., Deacon, B. J., McKay, D., & Storch, E. A. (2014). The relevance of analogue studies for understanding obsessions and compulsions. *Clinical Psychology Review*, *34*(3), 206–217. http://doi.org/10.1016/j.cpr.2014.01.004

Abramowitz, J. S., & Jacoby, R. J. (2015). Obsessive-Compulsive and Related Disorders: A Critical Review of the New Diagnostic Class. *Annual Review of Clinical Psychology*, *11*(1), 165–186. http://doi.org/10.1146/annurev-clinpsy-032813-153713

Adam, Y., Meinlschmidt, G., Gloster, A. T., & Lieb, R. (2012). Obsessive-compulsive disorder in the community: 12-month prevalence, comorbidity and impairment. *Social Psychiatry and Psychiatric Epidemiology*, *47*(3), 339–349. http://doi.org/10.1007/s00127-010-0337-5

Alcolado, G. M., & Radomsky, A. S. (2016). A novel cognitive intervention for compulsive checking: Targeting maladaptive beliefs about memory. *Journal of Behavior Therapy and Experimental Psychiatry*, *53*, 75–83. http://doi.org/10.1016/j.jbtep.2015.02.009

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: American Psychiatric Association.

Amir, N., Kuckertz, J. M., & Najmi, S. (2013). The effect of modifying automatic action tendencies on overt avoidance behaviors. *Emotion*, *13*(3), 478–84. http://doi.org/10.1037/a0030443

Amir, N., Kuckertz, J. M., Najmi, S., & Conley, S. L. (2015). Preliminary Evidence for the Enhancement of Self-Conducted Exposures for OCD Using Cognitive Bias Modification. *Cognitive Therapy and Research*, *39*(4), 424–440. http://doi.org/10.1007/s10608-015-9675-7

Anholt, G. E., Aderka, I. M., van Balkom, A. J. L. M., Smit, J. H., Schruers, K., van der Wee, N. J. A., … van Oppen, P. (2014). Age of onset in obsessive-compulsive disorder: admixture analysis with a large sample. *Psychological Medicine*, *44*(1), 185–194. http://doi.org/10.1017/S0033291713000470

Armstrong, T., & Olatunji, B. O. (2012). Eye tracking of attention in the affective disorders: A meta-analytic review and synthesis. *Clinical Psychology Review*. http://doi.org/10.1016/j.cpr.2012.09.004

Armstrong, T., Olatunji, B. O., Sarawgi, S., & Simmons, C. (2010). Orienting and Maintenance of Gaze in Contamination Fear: Biases for Disgust and Fear Cues. *Behaviour Research and Therapy. 48*(5), 402–408.

http://doi.org/10.1016/j.brat.2010.01.002

Armstrong, T., Sarawgi, S., & Olatunji, B. O. (2012). Attentional bias toward threat in contamination fear: Overt components and behavioral correlates. *Journal of Abnormal Psychology*, *121*(1), 232–237. http://doi.org/10.1037/a0024453

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*(2), 380–393. http://doi.org/10.1037//0022-3514.83.2.380

Banse, R., Messer, M., & Fischer, I. (2015). Predicting aggressive behavior with the aggressiveness-IAT. *Aggressive Behavior*, *41*, 65–83. http://doi.org/10.1002/AB.21574

Bar-Anan, Y., & Nosek, B. a. (2014). A comparative investigation of seven indirect attitude measures. *Behavior Research Methods*, *46*(3), 668–688. http://doi.org/10.3758/s13428-013-0410-6

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

Bartoszek, G., & Winer, E. S. (2015). Spider-fearful individuals hesitantly approach threat, whereas depressed individuals do not persistently approach reward. *Journal of Behavior Therapy and Experimental Psychiatry*, *46*, 1–7. http://doi.org/10.1016/j.jbtep.2014.07.012

Baumeister, R. F., Vohs, K. D., & Funder, D. C. (2007). Psychology as the Science of Self-Reports and Finger Movements: Whatever Happened to Actual Behavior? *Perspectives on Psychological Science*. http://doi.org/10.1111/j.1745-6916.2007.00051.x

Bloch, M. H., Landeros-Weisenberger, A., Rosario, M. C., Pittenger, C., & Leckman, J. F. (2008). Meta-analysis of the symptom structure of obsessive-compulsive disorder. *American Journal of Psychiatry*, *165*(12), 1532–1542. http://doi.org/10.1176/appi.ajp.2008.08020320

Borsboom, D. (2006). The attack of the psychometricians. *Psychometrika*, *71*(3), 425–440. http://doi.org/10.1007/s11336-006-1447-6

Bradley, M. C., Hanna, D., Wilson, P., Scott, G., Quinn, P., & Dyer, K. F. W. (2016). Obsessive-Compulsive Symptoms and Attentional Bias: An Eye-Tracking Methodology. *Journal of Behavior Therapy and Experimental Psychiatry*, *50*, 303–308. http://doi.org/10.1016/j.jbtep.2015.10.007

Brockmeyer, T., Hahn, C., Reetz, C., Schmidt, U., & Friederich, H. C. (2015). Approach Bias

Modification in Food Craving - A Proof-of-Concept Study. *European Eating Disorders Review*, *23*(5), 352–360. http://doi.org/10.1002/erv.2382

Cristea, I. A., Kok, R. N., & Cuijpers, P. (2015). Efficacy of cognitive bias modification interventions in anxiety and depression: Meta-analysis. *British Journal of Psychiatry*, *206*(1), 7–16. http://doi.org/10.1192/bjp.bp.114.146761

Cuthbert, B. N. (2014). The RDoC framework: Facilitating transition from ICD/DSM to dimensional approaches that integrate neuroscience and psychopathology. *World Psychiatry*, *13*(1), 28–35. http://doi.org/10.1002/wps.20087

Eisen, J. L., Sibrava, N. J., Boisseau, C. L., Mancebo, M. C., Stout, R. L., Pinto, A., & Rasmussen, S. A. (2013). Five-year course of obsessive-compulsive disorder: Predictors of remission and relapse. *Journal of Clinical Psychiatry*, *74*(3), 233–239. http://doi.org/10.4088/JCP.12m07657

Fleurkens, P., Rinck, M., & Minnen, A. Van. (2014). Implicit and explicit avoidance in sexual trauma victims suffering from posttraumatic stress disorder: a pilot study. *European Journal of Psychotraumatology*, *5: 21359*. http://doi.org/10.3402/ejpt.v5.21359

Foa, E. B., Ilai, D., MCCarthy, P. R., Shoyer, B., & Murdoch, T. (1993). Information processing in obsessive compulsive disorder. *Cognitive Therapy and Research*, *17*(2), 173–189. http://doi.org/10.1007/BF01172964

Foa, E. B., & Kozak, M. J. (1986). Emotional Processing of Fear : Exposure to Corrective Information. *Psychological Bulletin*, *99*(1), 20–35. http://doi.org/10.1037/0033-2909.99.1.20

Foa, E. B., & McLean, C. P. (2016). The efficacy of exposure therapy for anxiety-related disorders and its underlying mechanisms: The case of OCD and PTSD. *Annual Review of Clinical Psychology*, *12*, 1–28. http://doi.org/10.1146/annurev-clinpsy-021815-093533

Foa, E. B., Sacks, M. B., Tolin, D. F., Prezworski, A., & Amir, N. (2002). Inflated perception of responsibility for harm in OCD patients with and without checking compulsions: a replication and extension. *Journal of Anxiety Disorders*, *16*(4), 443–453. http://doi.org/10.1016/S0887-6185(02)00128-7

Fox, E., Russo, R., Bowles, R., & Dutton, K. (2001). Do Threatening Stimuli Draw or Hold Visual Attention in Subclinical Anxiety?, *130*(4), 681–700.

Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin*, *132*(5), 692–731. http://doi.org/10.1037/0033-2909.132.5.692

Gawronski, B., & De Houwer, J. (2014). Implicit measures in social and personality psychology. *Handbook of Research Methods in Social and Personality Psychology*, *1*(519), 283–310. Retrieved from http://users.ugent.be/~jdhouwer/chapterbertram.pdf

Genovese, T., Dalrymple, K., Chelminski, I., & Zimmerman, M. (2017). Subjective anger and overt aggression in psychiatric outpatients. *Comprehensive Psychiatry*, *73*, 23–30. http://doi.org/10.1016/j.comppsych.2016.10.008

Glazier, K., Calixte, R. M., Rothschild, R., & Pinto, A. (2013). High rates of OCD symptom misidentification by mental health professionals. *Annals of Clinical Psychiatry*, *25*(3), 201–209.

Goodman, W. K., Price, L. H., Rasmussen, S. A., Mazure, C., Fleischmann, R. L., Hill, C. L., … Charney, D. S. (1989). The Yale-Brown Obsessive Compulsive Scale. I. Development, use, and reliability. *Archives of General Psychiatry*, *46*, 1006–1011. http://doi.org/10.1001/archpsyc.1989.01810110048007

Greenwald, A. G., & Farnham, S. D. (2000). Using the Implicit Association Test to Measure Self-Esteem and Self-Concept. *Journal of Personality and Social Psychology*, *79*(6), 1022–1038. http://doi.org/10.1037//0022-3514.79.6.I022

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The Implicit Association Test. Journal of Personality and Social Psychology, 74, 1464–1480. doi:10.1037/0022-3514.74.6.1464 Greenwald,

Hammen, C. (2005). Stress and depression. *Annual Review of Clinical Psychology*, *1*(1), 293–319. http://doi.org/10.1146/annurev.clinpsy.1.102803.143938

Hand, I., & Büttner-Westphal, H. (1991). Die Yale-Brown Obsessive Compulsive Scale (Y-BOCS): Ein halbstrukturiertes Interview zur Beurteilung des Schweregrades von Denk- und Handlungszwängen. *Verhaltenstherapie*, *1*(3), 223–225. http://doi.org/http://dx.doi.org/ 10.1159/000257972.

Harkness, E. L., Harris, L. M., Jones, M. K., & Vaccaro, L. (2009). No evidence of attentional bias in obsessive compulsive checking on the dot probe paradigm. *Behaviour Research and Therapy*, *47*(5), 437–443. http://doi.org/10.1016/j.brat.2009.02.004

Heeren, A., Mogoase, C., Philippot, P., & McNally, R. J. (2015). Attention bias modification for social anxiety: A systematic review and meta-analysis. *Clinical Psychology Review*, *40*, 76–90. http://doi.org/10.1016/j.cpr.2015.06.001

Heuer, K., Rinck, M., & Becker, E. S. (2007). Avoidance of emotional facial expressions in social anxiety: The Approach-Avoidance Task. *Behaviour Research and Therapy*, *45*, 2990–3001. http://doi.org/10.1016/j.brat.2007.08.010

Hirschtritt, M., Bloch, M., & Mathews, C. (2017). Obsessive-compulsive disorder: Advances in diagnosis and treatment. *JAMA*, *317*(13), 1358–1367. http://dx.doi.org/10.1001/jama.2017.2200

Hofmann, W., Gawronski, B., Gschwendner, T., Le, H., & Schmitt, M. (2005). A Meta-Analysis on the Correlation Between the Implicit Association Test and Explicit Self-Report Measures. *Personality and Social Psychology Bulletin*, *31*(10), 1369–1385. http://doi.org/10.1177/0146167205275613

Hofmann, W., Gschwendner, T., Nosek, B. A., & Schmitt, M. (2005). What moderates implicit—explicit consistency? *European Review of Social Psychology*, *16*(1), 335–390. http://doi.org/10.1080/10463280500443228

Jelinek, L., Hauschildt, M., Hottenrott, B., Kellner, M., & Moritz, S. (2014). Further evidence for biased semantic networks in obsessive-compulsive disorder (OCD): When knives are no longer associated with buttering bread but only with stabbing people. *Journal of Behavior Therapy and Experimental Psychiatry*, *45*(4), 427–434. http://doi.org/10.1016/j.jbtep.2014.05.002

Kakoschke, N., Kemps, E., & Tiggemann, M. (2017). Approach bias modification training and consumption: A review of the literature. *Addictive Behaviors*, *64*, 21–28. http://doi.org/10.1016/j.addbeh.2016.08.007

Katerberg, H., Delucchi, K. L., Stewart, S. E., Lochner, C., Denys, D. A. J. P., Stack, D. E., … Cath, D. C. (2010). Symptom dimensions in OCD: Item-level factor analysis and heritability estimates. *Behavior Genetics*, *40*(4), 505–517. http://doi.org/10.1007/s10519-010-9339-z

Kessler, R. C., Petukhova, M., Sampson, N. A., Zaslavsky, A. M., & Wittchen, H. U. (2012). Twelve-month and lifetime prevalence and lifetime morbid risk of anxiety and mood disorders in the United States. *International Journal of Methods in Psychiatric Research*, *21*, 169–184. http://doi.org/10.1002/mpr.1359

Külz, A. K., Landmann, S., Cludius, B., Hottenrott, B., Rose, N., Heidenreich, T., … Moritz, S. (2014). Mindfulness-based cognitive therapy in obsessive-compulsive disorder: protocol of a randomized controlled trial. *BMC Psychiatry*, *14*, 1–9. http://doi.org/10.1186/s12888-014-0314-8

Lakatos, A., & Reinecker, H. (2016). *Kognitive Verhaltenstherapie bei Zwangsstörungen* (4th ed.). Göttingen: Hogrefe.

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

Lange, W. G. T., Tierney, K. J., Reinhardt-Rutland, A. H., & Vivekananda-Schmidt, P. (2004). Viewing behaviour of spider phobics and non-phobics in the presence of threat and safety stimuli. *The British Journal of Clinical Psychology / the British Psychological Society*, *43*, 235–243. http://doi.org/10.1348/0144665031752989

Machulska, A., Zlomuzica, A., Rinck, M., Assion, H.-J., & Margraf, J. (2016). Approach bias modification in inpatient psychiatric smokers. *Journal of Psychiatric Research*, *76*, 44–51. http://doi.org/10.1016/j.jpsychires.2015.11.015

Macleod, C., & Clarke, P. J. F. (2015). The attentional bias modification approach to anxiety intervention. *Clinical Psychological Science*, *3*(1), 58–78. http://doi.org/10.1177/2167702614560749

MacLeod, C., & Grafton, B. (2016). Anxiety-linked attentional bias and its modification: Illustrating the importance of distinguishing processes and procedures in experimental psychopathology research. *Behaviour Research and Therapy*, *86*, 68–86. http://doi.org/10.1016/j.brat.2016.07.005

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

Markarian, Y., Larson, M. J., Aldea, M. A., Baldwin, S. A., Good, D., Berkeljon, A., … McKay, D. (2010). Multiple pathways to functional impairment in obsessive-compulsive disorder. *Clinical Psychology Review*, *30*(1), 78–88. http://doi.org/10.1016/j.cpr.2009.09.005

Mataix-Cols, D., Conceicao do Rosario-Campos, M., & Leckman, J. F. (2005). A Multidimenionsal Model of Obsessive-Compulsive Disorder. *The American Journal of Psychiatry*, *162*(2), 228–238. http://doi.org/10.1176/appi.ajp.162.2.228

McKay, D., Abramowitz, J. S., Calamari, J. E., Kyrios, M., Radomsky, A., Sookman, D., … Wilhelm, S. (2004). A critical evaluation of obsessive-compulsive disorder subtypes: Symptoms versus mechanisms. *Clinical Psychology Review*, *24*(3), 283–313. http://doi.org/10.1016/j.cpr.2004.04.003

McKay, D., Sookman, D., Neziroglu, F., Wilhelm, S., Stein, D. J., Kyrios, M., … Veale, D. (2015). Efficacy of cognitive-behavioral therapy for obsessive-compulsive disorder. *Psychiatry Research*, *227*(1), 104–113. http://doi.org/10.1016/j.psychres.2015.02.004

Melli, G., Carraresi, C., Poli, A., Marazziti, D., & Pinto, A. (2017). The role of guilt sensitivity in OCD symptom dimensions. *Clinical Psychology and Psychotherapy*, (December 2016), 1–11. http://doi.org/10.1002/cpp.2071

Mogg, K., Waters, A. M., & Bradley, B. P. (2017). Attention Bias Modification (ABM): Review of Effects of Multisession ABM Training on Anxiety and Threat-Related Attention in High-Anxious Individuals. *Clinical Psychological Science*, 216770261769635. http://doi.org/10.1177/2167702617696359

Moors, A., & De Houwer, J. (2006). Automaticity: A Theoretical and Conceptual Analysis. *Psychological Bulletin*, *132*(2), 297–326. http://doi.org/10.1037/0033-2909.132.2.297

Morein-Zamir, S., Papmeyer, M., Durieux, A., Fineberg, N. a., Sahakian, B. J., & Robbins, T. W. (2013). Investigation of attentional bias in obsessive compulsive disorder with and without depression in visual search. *PLoS ONE*, *8*(11), 1–15. http://doi.org/10.1371/journal.pone.0080118

Morillo, C., Belloch, A., & Garcı, G. (2007). Clinical obsessions in obsessive – compulsive patients and obsession-relevant intrusive thoughts in non-clinical , depressed and anxious subjects : Where are the differences?, *Behaviour Research and Therapy*, *45*, 1319–1333. http://doi.org/10.1016/j.brat.2006.11.005

Moritz, S., Jacobsen, D., Kloss, M., Fricke, S., Rufer, M., & Hand, I. (2004). Examination of emotional Stroop interference in obsessive-compulsive disorder. *Behaviour Research and Therapy*, *42*(6), 671–682. http://doi.org/10.1016/S0005-7967(03)00190-6

Moritz, S., Kempke, S., Luyten, P., Randjbar, S., & Jelinek, L. (2011). Was Freud partly right on obsessive-compulsive disorder (OCD)? Investigation of latent aggression in OCD. *Psychiatry Research*, *187*(1–2), 180–184. http://doi.org/10.1016/j.psychres.2010.09.007

Moritz, S., & Von Mühlenen, A. (2008). Investigation of an attentional bias for fear-related material in obsessive-compulsive checkers. *Depression and Anxiety*, *25*(3), 225–229. http://doi.org/10.1002/da.20294

Moritz, S., Wahl, K., Ertle, A., Jelinek, L., Hauschildt, M., Klinge, R., & Hand, I. (2009). Neither saints nor wolves in disguise: ambivalent interpersonal attitudes and behaviors in obsessive-compulsive disorder. *Behavior Modification*, *33*(2), 274–292. http://doi.org/10.1177/0145445508327444

Moscovitch, D. a., McCabe, R. E., Antony, M. M., Rocca, L., & Swinson, R. P. (2008). Anger experience and expression across the anxiety disorders. *Depression and Anxiety*, *25*(2), 107–113. http://doi.org/10.1002/da.20280

Najmi, S., & Amir, N. (2010). The effect of attention training on a behavioral test of contamination fears in individuals with subclinical obsessive-compulsive symptoms. *Journal of Abnormal Psychology*, *119*(1), 136–142. http://doi.org/10.1037/a0017549

Najmi, S., Kuckertz, J. M., & Amir, N. (2010). Automatic avoidance tendencies in individuals with contamination-related obsessive-compulsive symptoms. *Behaviour Research and Therapy*, *48*(10), 1058–62. http://doi.org/10.1016/j.brat.2010.06.007

Obsessive Compulsive Cognitions Working Group. (2005). Psychometric validation of the obsessive belief questionnaire and interpretation of intrusions inventory--Part 2: Factor analyses and testing of a brief version. *Behaviour Research and Therapy*, *43*(11), 1527–1542.

Obsessive Compulsive Working Group. (1997). Cognitive assessment of obsessive-compulsive disorder. *Behaviour Research and Therapy*, *35*(7), 667–81. http://doi.org/10.1016/S0005-7967(97)00017-X

Öst, L.-G., Havnen, A., Hansen, B., & Kvale, G. (2015). Cognitive behavioral treatments of obsessive–compulsive disorder. A systematic review and meta-analysis of studies published 1993–2014. *Clinical Psychology Review*, *40*, 156–169. http://doi.org/10.1016/j.cpr.2015.06.003

Pergamin-Hight, L., Naim, R., Bakermans-Kranenburg, M. J., van IJzendoorn, M. H., & Bar-Haim, Y. (2015). Content specificity of attention bias to threat in anxiety disorders: A meta-analysis. *Clinical Psychology Review*, *35*, 10–18. http://doi.org/10.1016/j.cpr.2014.10.005

Phaf, H. R., Mohr, S. E., Rotteveel, M., & Wicherts, J. M. (2014). Approach, avoidance, and affect: A meta-analysis of approach-avoidance tendencies in manual reaction time tasks. *Frontiers in Psychology*, *5*, 1–16. http://doi.org/10.3389/fpsyg.2014.00378

Rachman, S. (1993). Obsessions, responsibility and guilt. *Behaviour Research and Therapy*, *31*(2), 149–154. http://doi.org/10.1016/0005-7967(93)90066-4

Rachman, S. (1997). A cognitive theory of obsessions. *Behaviour Research and Therapy*, *35*(9), 793–802. http://doi.org/10.1016/S0005-7967(97)00040-5

Rachman, S. (2002). A cognitive theory of compulsive checking. *Behaviour Research and Therapy*, *40*(6), 625–639. http://doi.org/10.1016/S0005-7967(01)00028-6

Radomsky, A. S., Ashbaugh, A. R., & Gelfand, L. a. (2007). Relationships between anger, symptoms, and cognitive factors in OCD checkers. *Behaviour Research and Therapy*, *45*(11), 2712–2725. http://doi.org/10.1016/j.brat.2007.07.009

Radomsky, A. S., Shafran, R., Coughtrey, A. E., & Rachman, S. (2010). Cognitive-Behavior Therapy for Compulsive Checking in OCD. *Cognitive and Behavioral Practice*, *17*(2), 119–131. http://doi.org/10.1016/j.cbpra.2009.10.002

Rao, N. P., Arasappa, R., Reddy, N. N., Venkatasubramanian, G., & Reddy, Y. C. J. (2010). Emotional interference in obsessive-compulsive disorder: A neuropsychological study using optimized emotional Stroop test. *Psychiatry Research*, *180*(2–3), 99–104. http://doi.org/10.1016/j.psychres.2009.10.017

Richetin, J., Richardson, D. S., & Mason, G. D. (2010). Predictive validity of IAT aggressiveness in the context of provocation. *Social Psychology*, *41*(1), 27–34. http://doi.org/10.1027/1864-9335/a000005

Rinck, M., & Becker, E. S. (2006). Spider fearful individuals attend to threat, then quickly avoid it: evidence from eye movements. *Journal of Abnormal Psychology*, *115*(2), 231–238. http://doi.org/10.1037/0021-843X.115.2.231

Rinck, M., & Becker, E. S. (2007). Approach and avoidance in fear of spiders. *Journal of Behavior Therapy and Experimental Psychiatry*, *38*, 105–120. http://doi.org/10.1016/j.jbtep.2006.10.001

Rodebaugh, T. L., Scullin, R. B., Langer, J. K., Dixon, D. J., Huppert, J. D., Bernstein, A., … Lenze, A. (2016). Unreliability as a Threat to Understanding Psychopathology: The Cautionary Tale of Attentional Bias. *Journal of Abnormal Psychology*, *125*(6), 840–851. http://doi.org/10.1037/abn0000184

Roefs, A., Macleod, C. M., Jong, P. J. De, & Jansen, A. T. M. (2011). Implicit Measures of Association in Psychopathology Research. *Psychological Bulletin*, *137*(1), 149–193. http://doi.org/10.1037/a0021729

Roelofs, K., Putman, P., Schouten, S., Lange, W.-G., Volman, I., & Rinck, M. (2010). Gaze direction differentially affects avoidance tendencies to happy and angry faces in socially anxious individuals. *Behaviour Research and Therapy*, *48*(4), 290–4. http://doi.org/10.1016/j.brat.2009.11.008

Rowa, K., Antony, M. M., & Swinson, R. P. (2007). Exposure and response prevention. In M. M. Antony, C. Purdon, & L. J. Summerfeldt (Eds.), *Psychological Treatment of Obsessive–Compulsive Disorder* (pp. 79–109). Washington, DC: American Psychological Association.

Ruscio, A. M., Stein, D. J., Chiu, W. T., & Kessler, R. C. (2010). The epidemiology of obsessive-compulsive disorder in the National Comorbidity Survey Replication. *Psychiatry Research*, *15*(1), 53–63. http://doi.org/10.1038/mp.2008.94

Salkovskis, P. M. (1985). Obsessional-compulsive problems: A cognitive-behavioural analysis. *Behaviour Research and Therapy*, *23*(5), 571–583. http://doi.org/10.1016/0005-7967(85)90105-6

Salkovskis, P. M., & McGuire, J. (2003). Cognitive-behavioural theory of OCD. In R. G. Menzies & P. De Silva (Eds.), *Obsessive-compulsive Disorder: theory, research and* *treatment* (pp. 59–78). Chichester: Wiley.

Schmidt, A. F., Zimmermann, P. S., Banse, R., & Imhoff, R. (2015). Ego Depletion Moderates the Influence of Automatic and Controlled Precursors of Reactive Aggression. *Social Psychology*, *46*(3), 132–141. http://doi.org/10.1027/1864-9335/a000233

Schumacher, S. E., Kemps, E., & Tiggemann, M. (2016). Bias modification training can alter approach bias and chocolate consumption. *Appetite*, *96*(October), 219–224. http://doi.org/10.1016/j.appet.2015.09.014

Schwartzman, C. M., Boisseau, C. L., Sibrava, N. J., Mancebo, M. C., Eisen, J. L., & Rasmussen, S. A. (2017). Symptom subtype and quality of life in obsessive-compulsive disorder. *Psychiatry Research*, *249*(February 2016), 307–310. http://doi.org/10.1016/j.psychres.2017.01.025

Sharbanee, J. M., Hu, L., Stritzke, W. G. K., Wiers, R. W., Rinck, M., & MacLeod, C. (2014). The effect of approach/avoidance training on alcohol consumption is mediated by change in alcohol action tendency. *PLoS ONE*, *9*(1). http://doi.org/10.1371/journal.pone.0085855

Simon, D., Kischkel, E., Spielberg, R., & Kathmann, N. (2012). A pilot study on the validity of using pictures and videos for individualized symptom provocation in obsessive-compulsive disorder. *Psychiatry Research*, *198*, 81–88. http://doi.org/10.1016/j.psychres.2011.12.022

Skapinakis, P., Caldwell, D. M., Hollingworth, W., Bryden, P., Fineberg, N. A., Salkovskis, P., … Lewis, G. (2016). Pharmacological and psychotherapeutic interventions for management of obsessive-compulsive disorder in adults: a systematic review and network meta-analysis. *The Lancet Psychiatry*, *3*(8), 730–739. http://doi.org/10.1016/S2215-0366(16)30069-4

Smith, E. R., & DeCoster, J. (2000). Dual-Process Models in Social and Cognitive Psychology. *Personality and Social Psychology Review*, *4*(2), 108–131. http://doi.org/10.1207/S15327957PSPR0402

Spielberger, C. D. (2010). State-Trait Anger Expression Inventory. In *The Corsini Encyclopedia of Psychology*. http://doi.org/10.1002/9780470479216.corpsy0942

Stein, D. J., Fineberg, N. a., Bienvenu, O. J., Denys, D., Lochner, C., Nestadt, G., … Phillips, K. A. (2010). Should OCD be classified as an anxiety disorder in DSM-V? *Depression and Anxiety*, *27*(6), 495–506. http://doi.org/10.1002/da.20699

Stöber, J. (2001). The Social Desirability Scale-17 (SDS-17). *European Journal of*

Psychological Assessment, *17*(3), 222–232. http://doi.org/10.1027//1015-5759.17.3.222

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, *8*, 220–247. http://doi.org/10.1207/s15327957pspr0803_1

Subramaniam, M., Abdin, E., Vaingankar, J. A., & Chong, S. A. (2012). Obsessive-compulsive disorder: Prevalence, correlates, help-seeking and quality of life in a multiracial Asian population. *Social Psychiatry and Psychiatric Epidemiology*, *47*(12), 2035–2043. http://doi.org/10.1007/s00127-012-0507-8

Subramaniam, M., Soh, P., Vaingankar, J. A., Picco, L., & Chong, S. A. (2013). Quality of life in obsessive-compulsive disorder: impact of the disorder and of treatment. *CNS Drugs*, *27*(5), 367–383. http://doi.org/10.1007/s40263-013-0056-z

Taylor, S., Abramowitz, J. S., & McKay, D. (2007). Cognitive-Behavioral Models of Obsessive-Compulsive Disorder. *American Psychological Association*, 9–29. http://doi.org/10.1037/11543-001

Toffolo, M. B. J., Hout, M. A. Van Den, Hooge, I. T. C., Engelhard, I. M., & Cath, D. C. (2013). Mild Uncertainty Promotes Checking Behavior in Subclinical Obsessive-Compulsive Disorder. *Clincial Psychological Science, 1*(2), 103–109. http://doi.org/10.1177/2167702612472487

Van Bockstaele, B., Verschuere, B., Tibboel, H., De Houwer, J., Crombez, G., & Koster, E. H. W. (2014). A review of current evidence for the causal impact of attentional bias on fear and anxiety. *Psychological Bulletin*, *140*(May 2017), 682–721. http://doi.org/10.1037/a0034834

van den Heuvel, O. A., Veltman, D. J., Groenewegen, H. J., Witter, M. P., Merkelbach, J., Cath, D. C., … van Dyck, R. (2005). Disorder-specific neuroanatomical correlates of attentional bias in obsessive-compulsive disorder, panic disorder, and hypochondriasis. *Archives of General Psychiatry*, *62*(8), 922–933. http://doi.org/10.1001/archpsyc.62.8.922

Van Den Hout, M., & Kindt, M. (2003). Phenomenological validity of an OCD-memory model and the remember/know distinction. *Behaviour Research and Therapy*, *41*(3), 369–378. http://doi.org/10.1016/S0005-7967(02)00097-9

Veldhuis, J., Dieleman, J. P., Wohlfarth, T., Storosum, J. G., van Den Brink, W., Sturkenboom, M. C. J. M., & Denys, D. (2012). Incidence and prevalence of "diagnosed OCD" in a primary care, treatment seeking, population. *International Journal of Psychiatry in Clinical Practice*, *16*(2), 85–92.

http://doi.org/10.3109/13651501.2011.617454

Visser, H. A., Van Oppen, P., Van Megen, H. J., Eikelenboom, M., & Van Balkom, A. J. (2014). Obsessive-compulsive disorder; Chronic versus non-chronic symptoms. *Journal of Affective Disorders*, *152–154*(1), 169–174. http://doi.org/10.1016/j.jad.2013.09.004

Voncken, M. J., Rinck, M., Deckers, a, & Lange, W.-G. (2012). Anticipation of Social Interaction Changes Implicit Approach-Avoidance Behavior of Socially Anxious Individuals. *Cognitive Therapy and Research*, *36*(6), 740–749. http://doi.org/10.1007/s10608-011-9408-5

Waechter, S., Nelson, A. L., Wright, C., Hyatt, A., & Oakman, J. (2014). Measuring attentional bias to threat: Reliability of dot probe and eye movement indices. *Cognitive Therapy and Research*, *38*(3), 313–333. http://doi.org/10.1007/s10608-013-9588-2

Weierich, M. R., Treat, T. A., & Hollingworth, A. (2008). Theories and measurement of visual attentional processing in anxiety. *Cognition & Emotion*, *22* (6), 985-1018. http://doi.org/10.1080/02699930701597601

Whiteside, S. P., & Abramowitz, J. S. (2004). Obsessive-compulsive symptoms and the expression of anger. *Cognitive Therapy and Research*, *28*(2), 259–268. http://doi.org/10.1023/B:COTR.0000021544.64104.29

Wiers, R. W., Eberl, C., Rinck, M., Becker, E. S., & Lindenmeyer, J. (2011). Retraining Automatic Action Tendencies Changes Alcoholic Patients' Approach Bias for Alcohol and Improves Treatment Outcome. *Psychological Science*, *22*(4), 490–497. http://doi.org/10.1177/0956797611400615

Williams, J. M. G., Mathews, A., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin*, *120*(1), 3–24. http://doi.org/10.1037/0033-2909.120.1.3

Wittekind, C. E., Behmer, F., Muhtz, C., Fritzsche, A., Moritz, S., & Jelinek, L. (2015). Investigation of automatic avoidance in displaced individuals with chronic Posttraumatic Stress Disorder (PTSD). *Psychiatry Research*, *228*(3), 887–893. http://doi.org/10.1016/j.psychres.2015.05.003

Wittekind, C. E., Feist, A., Schneider, B. C., Moritz, S., & Fritzsche, A. (2015). The approach-avoidance task as an online intervention in cigarette smoking: A pilot study. *Journal of Behavior Therapy and Experimental Psychiatry*, *46*, 115–120. http://doi.org/10.1016/j.jbtep.2014.08.006

Appendix A

Cludius, B., Wenzlaff, F., Briken, P., Wittekind, C.E. (submitted). Attentional Biases in Obsessive-Compulsive Disorder: An Eye Tracking Study. *Journal of Obsessive Compulsive and Related Disorders.*

Attentional Biases in Obsessive-Compulsive Disorder: An Eye Tracking Study

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Abstract

Background and objectives: Attentional biases play an important role in the development and maintenance of obsessive-compulsive disorder (OCD). Previous studies using reaction time tasks in OCD have produced inconsistent results. This is the first study to measure attentional biases in patients with several subtypes of OCD using eye tracking.

Methods: Twenty-eight patients with OCD and 21 healthy controls were assessed using a free viewing paradigm, incorporating contamination-related, checking-related and neutral stimuli. Attentional patterns were measured using an eye tracker. A possible vigilance bias was assessed using entry time and a maintenance bias using dwell time.

Results: Patients with checking-related symptoms of OCD showed a maintenance but no vigilance bias in regard to checking-related compared to neutral stimuli. No differences in attention were found in patients with contamination-related symptoms.

Limitations: Even though subtype-specific stimuli were used, our stimuli may not have been specific enough to elicit attentional biases, especially in patients with contamination-related symptoms of OCD.

Conclusions: Patients with checking-related symptoms of OCD show a maintenance bias to checking-related stimuli. Because of the heterogeneous content of obsessions and compulsions in OCD, future studies should create a free viewing paradigm using material tailored to the specific symptoms of the individual.

Keywords: Obsessive-compulsive disorder, attentional bias, eye tracking, eye movements

Introduction

Current cognitive models of obsessive-compulsive disorder (OCD) claim that OCD develops due to the misinterpretation of otherwise normal intrusive thoughts. It is presumed that this misinterpretation has several effects, for example, focusing attention on the intrusions themselves or on triggers in the environment (Rachman, 2002; Salkovskis & McGuire, 2003). Such attentional biases are believed to increase the salience and accessibility of the persons' concerns with harm and lead to an increasing effort in neutralizing obsessive content. Similarly, the emotional processing theory (Foa & Kozak, 1986) claims that cognitive and emotional processes within a fear structure are activated once an individual perceives OCD-related stimuli. Therefore, theories highlight the pivotal role of attentional processes in the development and maintenance of OCD.

Over decades reaction time (RT) tasks such as the emotional Stroop task (Williams, Mathews, & MacLeod, 1996) or the modified dot-probe paradigm (MacLeod, Mathews, & Tata, 1986) have been used to assess attentional biases in various disorders. Results from studies using these tasks show that anxiety disorders are related to attentional biases to threat (Van Bockstaele et al., 2014), whereas discrepant results have emerged in studies on OCD. Some studies found evidence for attentional biases in clinical and subclinical samples of OCD, however, a larger amount of studies did not find any difference between OCD and healthy samples (for an overview see Morein-Zamir et al., 2013). One explanation for these discrepant results may be that RT tasks are not reliable enough to be useful in detecting attentional biases. Especially the modified dot-probe tasks has been criticized for its low reliability making interpretation of previous results almost impossible (Rodebaugh et al., 2016; Waechter, Nelson, Wright, Hyatt, & Oakman, 2014).

Another limitation posed by RT tasks is that they cannot assess the underlying mechanisms of attentional biases. Two competing hypotheses regarding attentional components exist (for an overview see Weierich, Treat, & Hollingworth, 2008). The *vigilance hypothesis* proposes that individuals with anxiety disorders allocate attention to threat-relevant stimuli more quickly (attentional vigilance) and shift their attention towards threat more often at an early period of attention. The *maintenance hypothesis* suggests difficulty shifting attention away from threatening stimuli, once they have been attended to. Whereas RT tasks cannot assess more complex and dynamic patterns of attention, eye tracking technology provides indices of continuous eye movement and offers the opportunity to assess attentional processes over a longer period of time. This makes it possible to assess both vigilance and maintenance biases independently through continuous measurement of fixations and saccades (Weierich et al., 2008). Vigilance bias is usually measured by the speed of the first fixation or the amount of first fixations on threatening stimuli, whereas the maintenance bias is assessed by the amount of time looking at a threatening stimulus (dwell time). In eye tracking studies, anxious individuals have consistently oriented their gaze towards threat-related stimuli more frequently compared to non-anxious individuals supporting the vigilance hypothesis. Findings regarding the maintenance hypothesis in anxiety disorders are mixed (for an overview see Armstrong & Olatunji, 2012).

Only a small number of studies have investigated attentional biases in OCD using eye tracking technology (Armstrong, Olatunji, Sarawgi, & Simmons, 2010; Armstrong, Sarawgi, & Olatunji, 2012; Bradley et al., 2016; Toffolo, Hout, Hooge, Engelhard, & Cath, 2013) and have produced mixed results. One study found a vigilance bias in participants with subclinical contamination fears (Armstrong et al., 2012). Two studies found evidence for a maintenance but not for a vigilance bias. In the first study, participants high in contamination fears maintained gaze longer on disgusted and fearful facial expressions (Armstrong et al., 2010). In the second study, the severity of OC symptoms in a non-clinical sample predicted higher frequency and duration of fixation on OCD-related images (checking, washing, ordering, hoarding), but not on aversive (not OCD-related) or neutral images (Bradley et al., 2016). Even though these studies on subclinical OCD were important first steps in the assessment of attentional biases, no study has assessed *patients* with OCD in an eye tracking experiment.
One challenge in assessing attentional biases in OCD is the heterogeneity of the disorder. The stimuli eliciting concerns in individuals can be idiosyncratic in nature, but can roughly be classified in several subtypes; contamination and washing, checking, hoarding, as well as symmetry and ordering (e.g., Mataix-Cols, Conceicao do Rosario-Campos, & Leckman, 2005). Most previous studies have been limited to assessing one subtype of OCD. However, the vast majority of patients display symptoms from various subtypes and evidence supporting a specificity effect in attentional biases in OCD is lacking (Pergamin-Hight, Naim, Bakermans-Kranenburg, van IJzendoorn, & Bar-Haim, 2015).

The aim of the present study was to assess the vigilance and maintenance bias in patients with several subtypes of OCD using eye tracking technology. The study was designed to assess whether an attentional bias is specific to each subtype of OCD or is instead a general bias to OCD-related material. Therefore, patients with various subtypes of OCD including patients with contamination-related and checking-related symptoms of OCD were assessed as well as a healthy control group. Furthermore, to enhance ecological validity compared to previous studies (Armstrong et al., 2010; Toffolo et al., 2013), OCD-related pictures (contamination- and checking-related) were used. A free viewing paradigm was implemented because the most robust findings for the vigilance and maintenance hypothesis in anxiety disorders have been achieved using free viewing tasks (Armstrong & Olatunji, 2012). In line with the emotional processing theory and previous eye tracking studies in anxiety disorders, it is hypothesized that patients with OCD would show an initial orientation towards subtype-specific pictures (vigilance hypothesis). Consistent with studies using free viewing paradigms in participants with subclinical symptoms of OCD, it is hypothesized that patients with OCD will maintain their gaze on subtype-specific pictures longer than the healthy control group (maintenance hypothesis).

Methods

Participants

Twenty-eight patients with OCD were recruited in the context of a larger study (Külz et al., 2014). Recruitment was conducted through OCD and anxiety wards of psychiatric clinics, psychotherapists seeing patients on an outpatient basis, disorder specific online fora, and newspaper advertisements. Participants were excluded if they were younger than 18 or older than 70 years, had been diagnosed with any severe neurological disorder (e.g., stroke, epilepsy), mania, psychotic disorder, borderline personality disorder, current severe depressive episode, acute suicidality, current substance or alcohol dependence, or mental retardation (IQ < 70).

A diagnosis of OCD and possible comorbidity were assessed using the Mini International Neuropsychiatric Interview (M.I.N.I.; Sheehan et al., 1998). Additionally, the section on Specific Phobia of the Structured Clinical Interview for DSM-IV-TR (SCID) was administered (First, Spitzer, Gibbon, & Williams, 2002). To assess severity of OC symptoms, the German version of the Yale-Brown Obsessive Compulsive Scale (Y-BOCS; Hand & Büttner-Westphal, 1991) was used. This semi-structured interview consists of two parts. The symptom checklist asks for the occurrence of past and present symptoms of obsessions and compulsions. Individuals were classified as “washers” if any of the items relating to contamination obsessions, washing or cleaning compulsions were present. Patients were only classified as “checkers” if the item “Checking locks, stove, appliances etc.” was affirmed whereas more unspecific items (e.g., checking that nothing terrible did/will happen) were discarded, because they show a high overlap with other factors of OCD (Bloch, Landeros-Weisenberger, Rosario, Pittenger, & Leckman, 2008). According to the Y-BOCS checklist, four patients affirmed checking-related and six patients contamination-related symptoms of OCD only. Fourteen patients showed both contamination-related as well as checking-related symptoms of OCD. The remaining four patients showed other symptoms of OCD, for example, aggressive or sexual obsessions or repeating rituals. The second part of the interview serves to assess severity of obsessions and compulsions. The German version of the Y-BOCS has shown good internal consistency and inter-rater reliability (Jacobsen, Kloss, Fricke, Hand, & Moritz, 2003). To assess distress caused by OC symptoms the Obsessive Compulsive Inventory Revised (OCI-R; Gönner, Leonhart, & Ecker, 2007) was used. The OCI-R is a self-report measure comprising a total score and six subscales: washing, checking and doubting, obsessing, mental neutralizing, ordering, and hoarding. The scale shows good validity and excellent reliability on all but the neutralizing subscales (Gönner, Leonhart, & Ecker, 2008). Severity of depressive symptoms was assessed using the Beck Depression Inventory (BDI-II; Kühner, Bürger, Keller, & Hautzinger, 2007).

Twenty-two participants served as healthy controls and were comparable as to age, gender, and education relative to the OCD sample (see Table 1) as well as to patients with contamination-related symptoms of OCD, *p*s > .37, and patients with checking-related symptoms of OCD, *p*s > .25. Additional exclusion criteria for healthy controls were a lifetime diagnosis of OCD or any current psychiatric diagnosis, which was verified with the M.I.N.I.. The study was approved by the Ethics Committee of the Freiburg University Medical Center. All participants gave written informed consent prior to study participation. The required sample size for the main analyses was calculated using G*Power (Faul et al., 2009). Based on the study by Armstrong et al. (2012) we used an effect size of partial $\eta^2 = 0.08$ for our calculations. To achieve 95% test-power at an error rate of $\alpha = .05$ with a partial $\eta^2 = 0.08$ and an assumed correlation of $r = 0.70$ the power analysis revealed a total of 20 necessary participants for each group.

Free viewing Task

The free viewing task consisted of pictures with OCD-related (checking- and contamination-related) and neutral content. For an expert rating of stimuli, pictures were chosen from the International Affective Picture System (Lang, Bradley, & Cuthbert, 1999a), the Berlin Obsessive Compulsive Disorder-Picture Set (Simon, Kischkel, Spielberg, & Kathmann, 2012), complemented by pictures from flickr.com used in prior studies on OCD (Moritz, von Mühlenen, Randjbar, Fricke, & Jelinek, 2009) and smoking (Wittekind, Feist, Schneider, Moritz, & Fritzsche, 2015). Ten psychologists with expertise on diagnosing and treating OCD rated the pictures according to the following criteria: relevance for checking- and contamination-related OCD, personal valence and amount of details depicted. Twenty pictures that were high on OCD relevance (contamination- and checking-related) with a range of scores in valence and 20 that were low in OCD relevance and neutral in valence were selected for the free viewing task. For an overview of the expert rating see Table 2 and for examples of the pictures used in the free viewing task see Table 3. Efforts were undertaken to match the pictures according to the amount of details they presented. All of the pictures were fitted to the same size. The free viewing task involved the presentation of 20 trials. Each trial consisted of a slide containing two pictures, of which one was presented on the right and one on the left side of a computer screen. On "checking" slides ($n = 10$), one picture was related to checking-related symptoms of OCD (e.g. a key lying in the grass) and in "contamination" slides ($n = 10$), one picture was related to contamination-related symptoms of OCD (e.g. a toilet). The second picture on all slides was of neutral content. In half of the trials the OCD images were presented on the left and in the other half on the right of the screen. Two parallel versions were created in which neutral and OCD-related pictures were counterbalanced by side. Table 4 shows internal consistencies (Cronbach's α) for each Relevance x Stimulus Type combination (OCD, neutral pictures on contamination- and checking-related trials) for each dependent variable (entry time and dwell time). Internal consistencies for each trial type varied between unacceptable and good, but were acceptable or good in patients with OCD. The results are comparable to internal consistencies that have been described in previous eye tracking studies in anxiety disorders (Waechter et al., 2014).

Procedure

Subsequent to the demographic and psychopathological assessment, the eye tracking experiment started. Participants placed their head in a chin rest with their forehead touching a crossbar. The chin rest was positioned so the eyes were 50 cm away from a 22-inch widescreen monitor (Dell P2213). Pictures were presented against a white background using

(ExperimentCenter TM 3.5.169) with a resolution of 1680 x 1050 pixels (32 BIT), and a refresh rate of 59 Hz. Eye movements were recorded using the iViewX RED-II system from SensoMotoricInstruments (SMI) with a sampling rate of 120 Hz and a spatial resolution of approximately < 0.5°. The eye tracking procedure started with a calibration and validation. Before the free viewing task began, participants were told that the eye tracking cameras would measure pupil dilation during the task. This was done to conceal the recording of gaze in order to reduce demand effects (Armstrong et al., 2010). The slides were presented for the duration of five seconds each and in random order to each participant. During stimulus presentation, participants were asked to look at the pictures without further instruction or constraints. The inter trial interval was two seconds during which the participants were asked to look at a fixation cross in the middle of the screen.

After completing the free viewing task participants were asked to rate the presented pictures according to valence and OCD relevance ("For me personally, the picture is...") on a scale consisting of "positive and relevant for my obsessions or compulsions", "positive", "neutral", "negative" and "negative and relevant for my obsessions or compulsions". After the rating, participants were debriefed and told that not only the pupil dilation, but also their gaze direction had been recorded.

Eye movement data reduction and data analysis

The standard settings of BeGaze 3.5.101, the software from SensoMotoric Industries (SMI), were used to define eye movement events. Fixations were classified as having a minimum duration of 80 ms and a maximal dispersion of 100 pixels. The OCD-related and neutral picture on each slide were each defined as one area of interest. Trials were excluded if gaze was not directed at the fixation target during picture onset or if the gaze moved away from the fixation region within 80 ms of picture onset, or if no eye movements occurred during the trial (Armstrong et al., 2010). Due to technical issues, data from one healthy participant was not recorded in the eye tracking experiment. First, two 2 Picture Type (OCD-related, neutral) x 2 Group (patients, healthy controls) repeated measures ANOVAs were conducted for entry time and dwell time that compared the whole OCD sample to healthy controls. Second, similar repeated measures ANOVAs were computed separately for entry time and dwell time for the two subgroups of patients (those with contamination- and checking-related symptoms of OCD) compared to the healthy controls. Pearson correlations were computed to investigate the association of attentional biases with scores on the Y-BOCS and subscales of the OCI-R.

Results from subjective ratings were used to evaluate OCD-relevant and OCD-irrelevant pictures as well as differently valenced pictures (2 = "positive", 3 = "neutral" and 4 = "negative"). To estimate attentional biases to stimuli with personal OCD-relevance or personal valence we conducted exploratory analyses. For both entry and dwell time, a repeated measures ANOVA with 2 (OCD-relevant, OCD-irrelevant) factors was conducted in patients with OCD. Similarly, two 2 Valence (negative, neutral and positive) x Group (patients, healthy controls) repeated measures ANOVAs were calculated. Effect sizes for the ANOVA results were expressed as follows: $\eta_p^2 \approx .01$, representing a weak effect, $\eta_p^2 \approx .06$, representing a medium effect, and $\eta_p^2 \approx .14$ representing a large effect.

Results

Demographic and psychopathological characteristics

Patients with OCD and healthy controls did not differ on any of the demographic variables. As expected, OCD patients scored significantly higher on all relevant psychopathological ratings including OC symptoms and depressive symptoms (see Table 1). Patients showed a total score of M = 21.43, SD = 6.74 on the Y-BOCS with M = 9.96, SD = 3.56 for the obsessions subscale and M = 11.46, SD = 4.00 for the compulsions subscale. Fifteen patients fulfilled at least one comorbid diagnosis according to the M.I.N.I. and the SCID section for specific phobia (major depression: n = 8, dysthymia: n = 5, panic disorder: n = 2, agoraphobia: n = 4, social anxiety disorder: n = 2, generalized anxiety disorder: n = 2, specific phobia: n = 3). Patients with contamination-related symptoms of OCD had an average of M = 5.89, SD = 3.78 on the washing subscale of the OCI-R, whereas patients with checking-related symptoms had an average of M = 8.13, SD = 3.04 on the checking subscale of the OCI-R. Fourteen patients reported no use of psychopharmacological medication. The remaining patients stated that they used one antidepressant (n = 10) or a combination of antidepressant and neuroleptic agent (n = 4).

Ratings of Stimuli

In order to analyze group differences in ratings of the stimuli, a repeated measures ANOVA with Group (patients, healthy) as the between-subject factor and Stimulus Type (contamination-, checking-related, neutral) as the repeated factor was conducted. The main effects of Stimulus Type and Group were significant, but were modified by a significant Stimulus Type x Group interaction, $F(2, 47) = 6.69$, $p = .003$, $\eta_p^2 = .22$. Follow-up t-tests (Bonferroni-corrected) revealed that patients rated both contamination- and checking-related pictures, but not neutral pictures, as more negative and more relevant to their OC symptoms than the healthy control group (see Table 5). To assess the specific ratings of each subgroup of patients, paired-samples t-tests were used.[1] Both subgroups of patients rated contamination- and checking-related stimuli as more negative than neutral stimuli, ps < .001. However, only patients with contamination-related symptoms of OCD rated contamination-related stimuli (M = 4.15, SD = 0.48) as more negative than checking-related stimuli (M = 3.62, SD = 0.58), $t(19) = 3.95$, $p = .001$, $d = 0.88$, whereas patients with checking-related symptoms did not differ in their ratings of contamination-related (M = 4.06, SD = 0.58) and checking-related stimuli (M = 3.84, SD = 0.67), $t(17) = 1.12$, $p = .28$, $d = 0.27$. Notably, all

[1] Due to the high overlap between the subgroups, t-tests instead of a repeated measures ANOVA were calculated.

but four patients showing checking-related symptoms also reported contamination-related symptoms of OCD.

Error rates

Trials in which invalid first fixations occurred (i.e. gaze was not directed at the fixation target during picture onset or gaze was moved away from the fixation region within 80 ms of picture onset) were removed (OCD patients: 2.95% of trials; healthy controls: 3.57%). No trials occurred in which the participants did not fixate either of the pictures presented. Notably, in previous studies using eye tracking in OCD the percentages ranged between 5 – 11 % (Armstrong & Olatunji, 2012; Armstrong et al., 2010).

Attentional bias in all patients combined

The ANOVA analyzing the vigilance bias using entry time data from all patients compared to healthy controls revealed a significant main effect of Stimulus Type, $F(1,47) = 5.04$, $p = .030$, $\eta_p^2 = .10$, but no main effect of Group or a Group x Stimulus Type interaction (all others *p*s > .14). Follow-up t-tests showed a quicker entry time for OCD-related than neutral pictures, $t(48) = 2.45$, $p = .02$, $d = 0.35$. Similarly, when analyzing the maintenance bias using dwell time only a main effect of Stimulus Type emerged $F(1,47) = 13.63$, $p = .001$, $\eta_p^2 = .23$. The main effect of Group and the Group x Stimulus Type interaction were non-significant (all others *p*s > .30). Follow-up t-tests showed a longer dwell time for OCD-related than neutral pictures, $t(48) = 3.87$, $p < .001$, $d = 0.56$.

Subtype-specific attentional biases

With regard to our hypotheses that patients with OCD would show a vigilance bias of subtype-specific material by quicker orientation towards OCD-related compared to neutral material, an ANOVA analyzing average entry times of patients with contamination-related symptoms of OCD and healthy controls showed no significant main effect or interaction (all *p*s > .12). When analyzing data assessing a potential maintenance bias (i.e. longer dwell time) in patients with contamination-related symptoms and healthy controls a significant main effect of Stimulus Type emerged, $F(1,46) = 5.76$, $p = .02$, $\eta_p^2 = 1.11$. Follow-up t-tests showed a longer dwell time for neutral compared to contamination-related pictures, $t(47) = 2.19$, $p = .02$, $d = 0.52$. However, neither the main effect for Group nor the postulated interaction of Stimulus Type x Group were significant (*p*s > .27).

The ANOVA assessing entry times of patients with checking-related symptoms of OCD and healthy controls showed no significant main effects nor any interactions (all *p*s > .19). The ANOVA computing a maintenance bias using dwell times from patients with checking-related symptoms of OCD and healthy controls revealed a significant main effect of

Stimulus Type, $F(1,37) = 17.36$, $p < .001$, $\eta_p^2 = .32$. Most importantly, the expected Stimulus Type x Group interaction was significant, $F(1,37) = 4.87$, $p = .034$, $\eta_p^2 = .12$, with a medium to large effect. Bonferroni-corrected follow-up t-tests showed that patients with checking-related symptoms maintained their gaze significantly longer on checking-related (*M* = 2333.05, *SD* = 466.15) compared to neutral material (*M* = 1846.36, *SD* = 319.92), $t(17) = 3.42$, $p = .003$, $d = 0.93$, with a large effect. Healthy participants did not show a difference in dwell time between checking-related (*M* = 2145.39, *SD* = 370.94) and neutral stimuli (*M* = 1995.61, *SD* = 383.15), $t(20) = 2.09$, $p = .05$, $d = 0.46$.

Correlational Analyses

No significant correlation emerged for any subgroup of patients (contamination-related or checking-related symptoms) between attentional bias scores (difference between contamination-related or checking-related and neutral stimuli for entry and dwell time) and the Y-BOCS scores or the respective subscale (contamination or checking) on the OCI-R, *r*s < .14, *p*s > .20.

Exploratory Analysis

In regard to personal OCD-relevant pictures in patients with OCD, the ANOVA assessing entry time did not reach significance $F(1,20) = 2.88$, $p = .11$, $\eta_p^2 = .13$. Notably, the effect size showed an almost large effect. Dwell time did not differ between OCD-relevant and irrelevant pictures $F(1,20) = 1.59$, $p = .22$, $\eta_p^2 = .07$ in patients. Concerning the valence of the stimuli (negative, neutral, positive), patients did not differ from healthy controls in either entry or dwell time as no significant main effect or interaction emerged for either of the ANOVAs (all *p*s > . 07).

Discussion

The aim of this study was to assess attentional biases in several subtypes of OCD using a free viewing paradigm. Patients with different symptoms, including contamination- and checking-related, were recruited in order to assess whether attentional biases are specific for two prevalent subtypes of OCD or reflect a general tendency in OCD to quickly direct attention to or dwell longer on OCD-related stimuli. Consistent with the emotional processing theory (Foa & Kozak, 1986) and in line with results from two of three previous eye tracking studies on attentional biases in OCD, we hypothesized that patients with OCD would show a vigilance and a maintenance bias for OCD-related subtype-specific material.

The overall sample of patients with OCD did neither show vigilance nor maintenance in regard to OCD-related material compared to healthy controls. This may indicate that patients with OCD do not show a general attentional bias in relation to OCD-related stimuli.

The lack of a general attentional bias stands in contrast to results from a meta-analysis (Pergamin-Hight et al., 2015) in which no specificity effect was found for OCD. However, the studies incorporated in the meta-analysis might have included stimuli that were not specific enough for the heterogeneous symptoms of OCD.

In regard to our hypotheses, neither patients with contamination-related nor checking-related symptoms of OCD showed a vigilance bias for subtype-specific material. This is in line with most previous studies assessing subclinical samples using eye tracking technology. However findings diverge from research on anxiety disorders, which consistently has shown a vigilance bias (for an overview see Armstrong & Olatunji, 2012). Even though the two disorders are closely related, differences have recently been highlighted. Individuals with OCD differ from patients with anxiety disorder, for example, in regard to cognitive flexibility or response inhibition (for an overview, see Stein et al., 2010). Therefore, our results further support the separation of anxiety disorders and obsessive-compulsive and related disorders in the fifth edition of the *Diagnostic Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013).

Patients with contamination-related symptoms of OCD did not show a maintenance bias when viewing contamination-related pictures. However, as hypothesized, patients with checking-related symptoms of OCD maintained their gaze longer on checking-related compared to neutral pictures. Healthy controls did not show a difference between the two picture types. Similarly, in a previous study on approach-avoidance tendencies, only patients with checking-related symptoms showed a behavioral tendency to approach subtype-specific stimuli (Cludius, Külz, Landmann, Moritz, & Wittekind, in press). One possible explanation for the difference between the two subtypes could be that checking-related stimuli (e.g., a fire or injuring others) may present a more urgent threat than contamination-related stimuli (e.g., a deadly disease such as AIDS). The emotional processing theory claims that the fear structure serves to help individuals escape danger (Foa & Kozak, 1986). Thus, whereas patients with contamination-related symptoms may be able to ignore a stimulus, patients with checking-related symptoms may feel the urge to maintain attention on the checking-related stimulus to prevent immediate harm. Similarly, in individuals with subclinical fear of spiders a maintenance bias was only found in an experiment using a real live tarantula (Lange, Tierney, Reinhardt-Rutland, & Vivekananda-Schmidt, 2004), but not in those using mere images of spiders (e.g., Rinck & Becker, 2006). This could also be taken as evidence for sustained attention only in situations with urgent threat cues, whereas anxious individuals may risk ignoring low urgency threat cues (e.g., a picture of a spider) to experience anxiety reduction.

A similar explanation was put forward in the study assessing approach-avoidance tendencies using an approach-avoidance task (Cludius et al., in press). Whereas situations involving checking-related stimuli may pose an immediate threat in which approach may the way to prevent danger from happening, in situations with contamination-related stimuli exiting the allegedly threatening situation may be that means to escape danger. Thus, sustained attention may only be necessary in situations in which approach needs to be assessed, not in those where avoidance seems to be the appropriate response. Another explanation for the difference between the two subtypes could be that the stimuli may not have been specific enough for patients with contamination-related symptoms. This subgroup was selected according to the category of contamination obsessions and washing compulsions on the Y-BOCS. Items include for example "Excessive concern with animals (e.g., insects)" or "excessive ritualized handwashing". Patients with checking-related symptoms of OCD were selected according to the only specific item on checking compulsions, which states, "checking locks, stove, appliances etc.". However, the two groups of patients did not differ in their explicit ratings of OCD-relevance for subtype-specific (contamination- or checking-related) stimuli.

The maintenance bias is thought to reflect the goal-directed system of attention (Corbetta & Shulman, 2002). This may be associated with the misinterpretation of intrusive thoughts as posed by cognitive models of OCD (Rachman, 2002; Salkovskis & McGuire, 2003). Similar to over-valuing intrusions, individuals with checking-related symptoms of OCD may over-focus towards OCD-related stimuli at later stages of information processing. Furthermore, according to the emotional processing theory a longer focus on threatening material can increase state anxiety by activating the fear structure (Foa & Kozak, 1986). Following cognitive models of OCD, attentional biases and elevated anxiety could further increase the occurrence of obsessions leading to a preservation of the disorder. However, our results suggest that this mechanism may only be present in individuals with checking-related symptoms of OCD.

There are a number of limitations that need to be addressed in the present study. First, the moderate reliabilities in our study may have affected our results. The small amount of stimuli (n = 10) in each category may have caused low reliability scores. Even though previous studies assessing first fixations and dwell time have found similar or even lower reliability scores (Waechter et al., 2014), our study underlines the problem inherent to attentional bias research. Low reliabilities limit the use of mediation analyses or selection of individuals for personalized treatment (such as attentional bias modification). For an overview of the difficulties posed by unreliable measures of attentional biases see Rodebaugh et al.

(2016). In our study, however, the low reliabilities found when internal consistencies were computed for the whole sample may be explained by a fully random attentional pattern of healthy controls. As healthy controls seem to show no preference of viewing OCD-related or neutral material, they may shift their gaze between the pictures without any traceable pattern, causing low reliabilities due to high intrapersonal variability. This assumption is supported by the fact that reliability scores are higher in patients with OCD, which reflects a more consistent viewing pattern (possibly reflecting an attentional bias). Nevertheless, even though eye tracking studies are probably more reliable than RT tasks to assess attentional biases, future eye tracking studies should adapt the eye tracking methodology to further enhance reliabilities (Waechter et al., 2014). Second, it cannot be ruled out that discrepancies to previous studies on anxiety disorders and subclinical samples of OCD (Armstrong & Olatunji, 2012) may have emerged due to a lack of specificity of the stimuli in our study. Even though we used subtype-specific stimuli, which were rated as OCD-related by the participants, the material may not have been specific enough to find an effect. The almost large, but non-significant effect of differing entry times in personal OCD-relevant trials may support this assumption. In contrast to OCD, stimuli that elicit fears in anxiety disorders are much more specific and homogenous (e.g., a spider). Because of the heterogeneous content of obsessions and compulsions in OCD, future studies should create a free viewing paradigm using idiosyncratic material tailored to the specific symptoms of the individual.

Eye Tracking might be useful as a complementary diagnostic tool and in the assessment of treatment gains in OCD. As exposure and response prevention is a key element of a successful treatment of OCD (Olatunji, Davis, Powers, & Smits, 2013), eye tracking could, for example, monitor attentional biases in the course of exposure and response prevention treatments. Furthermore, attentional bias modification has shown positive effects on symptomatology and reducing attention to threat (MacLeod & Grafton, 2016). Based on the results from this study future studies could assess whether training patients to direct gaze away from checking-related material is associated with a reduction of attentional biases and OCD-symptoms and may improve the effectiveness of treatment. Provided that our results are replicated in another study, they suggest that unlike patients with anxiety disorder, patients with checking-related symptoms should be trained to disengage attention from symptom-related material.

This is the first study to assess attentional biases in patients with several subtypes of OCD using eye tracking technology. An attentional bias was only found in patients with checking-related symptoms of OCD, who gazed longer at subtype specific pictures than neutral pictures (maintenance bias). Contrary to hypotheses, no vigilance bias was found in patients with checking-related symptoms and no attentional bias was found for patients with contamination-related symptoms. These results may suggest that an attentional bias exists only for patients with checking-related symptoms. However, due to the heterogeneity of symptoms it cannot be ruled out that a lack of attentional bias in this study results from the non-specificity of the stimuli. Future eye tracking studies should use idiosyncratic material to assess attentional biases in OCD.

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References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: American Psychiatric Association.

Armstrong, T., & Olatunji, B. O. (2012). Eye tracking of attention in the affective disorders: A meta-analytic review and synthesis. *Clinical Psychology Review*. http://doi.org/10.1016/j.cpr.2012.09.004

Armstrong, T., Olatunji, B. O., Sarawgi, S., & Simmons, C. (2010). Orienting and Maintenance of Gaze in Contamination Fear: Biases for Disgust and Fear Cues. *Behaviour Research and Therapy. 48*(5), 402–408. http://doi.org/10.1016/j.brat.2010.01.002

Armstrong, T., Sarawgi, S., & Olatunji, B. O. (2012). Attentional bias toward threat in contamination fear: Overt components and behavioral correlates. *Journal of Abnormal Psychology*, *121*(1), 232–237. http://doi.org/10.1037/a0024453

Bloch, M. H., Landeros-Weisenberger, A., Rosario, M. C., Pittenger, C., & Leckman, J. F. (2008). Meta-analysis of the symptom structure of obsessive-compulsive disorder. *American Journal of Psychiatry*, *165*(12), 1532–1542. http://doi.org/10.1176/appi.ajp.2008.08020320

Bradley, M. C., Hanna, D., Wilson, P., Scott, G., Quinn, P., & Dyer, K. F. W. (2016). Obsessive-Compulsive Symptoms and Attentional Bias: An Eye-Tracking Methodology. *Journal of Behavior Therapy and Experimental Psychiatry*, *50*, 303–308. http://doi.org/10.1016/j.jbtep.2015.10.007

Cludius, B., Külz, A. K., Landmann, S., Moritz, S., & Wittekind, C. E. (n.d.). Implicit Approach and Avoidance in Patients with Obsessive-Compulsive Disorder (OCD). *Journal of Abnormal Psychology*.

Corbetta, M., & Shulman, G. L. (2002). Control of Goal-Directed and Stimulus-Driven Attention in the Brain. *Nature Reviews Neuroscience*, *3*(3), 215–229. http://doi.org/10.1038/nrn755

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. (2002). *Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Patient Edition. (SCID-I/P)*. New York: Biometrics Research, New York State Psychiatric Institute.

Foa, E. B., & Kozak, M. J. (1986). Emotional Processing of Fear : Exposure to Corrective Information. *Psychological Bulletin*, *99*(1), 20–35. http://doi.org/10.1037/0033-2909.99.1.20

Gönner, S., Leonhart, R., & Ecker, W. (2007). The German version of the obsessive -

compulsive inventory-revised: A brief self-reportmeasure for the multidimensional assessment of obsessive -compulsive symptoms. *Psychotherapie, Psychosomatik,Medizinische Psychologie*, *57*, 395–404.

Gönner, S., Leonhart, R., & Ecker, W. (2008). The Obsessive-Compulsive Inventory-Revised (OCI-R): Validation of the German version in a sample of patients with OCD, anxiety disorders, and depressive disorders. *Journal of Anxiety Disorders*, *22*, 734–749. http://doi.org/10.1016/j.janxdis.2007.07.007

Hand, I., & Büttner-Westphal, H. (1991). Die Yale-Brown Obsessive Compulsive Scale (Y-BOCS): Ein halbstrukturiertes Interview zur Beurteilung des Schweregrades von Denk- und Handlungszwängen. *Verhaltenstherapie*, *1*(3), 223–225. http://doi.org/http://dx.doi.org/ 10.1159/000257972.

Jacobsen, D., Kloss, M., Fricke, S., Hand, I., & Moritz, S. (2003). Reliabilität der Deutschen version der Yale-Brown Obsessive Compulsive Scale. *Verhaltenstherapie*, *13*(2), 111–113. http://doi.org/10.1159/000072184

Kühner, C., Bürger, C., Keller, F., & Hautzinger, M. (2007). Reliabilität und Validität des revidierten Beck-Depressionsinventars (BDI-II). *Nervenarzt*, *78*, 651–656.

Külz, A. K., Landmann, S., Cludius, B., Hottenrott, B., Rose, N., Heidenreich, T., … Moritz, S. (2014). Mindfulness-based cognitive therapy in obsessive-compulsive disorder: protocol of a randomized controlled trial. *BMC Psychiatry*, *14*, 1–9. http://doi.org/10.1186/s12888-014-0314-8

Lang, P., Bradley, M., & Cuthbert, B. (1999a). International affective picture system (IAPS): Instruction manual and affective ratings. *The Center for Research in Psychophysiology, …*. Retrieved from http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:International+Affective+Picture+System+(IAPS):+Instruction+Manual+and+Affective+Ratings#0

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

Lange, W. G. T., Tierney, K. J., Reinhardt-Rutland, a H., & Vivekananda-Schmidt, P. (2004). Viewing behaviour of spider phobics and non-phobics in the presence of threat and safety stimuli. *The British Journal of Clinical Psychology / the British Psychological Society*, *43*, 235–243. http://doi.org/10.1348/0144665031752989

MacLeod, C., & Grafton, B. (2016). Anxiety-linked attentional bias and its modification: Illustrating the importance of distinguishing processes and procedures in experimental psychopathology research. *Behaviour Research and Therapy*, *86*, 68–86. http://doi.org/10.1016/j.brat.2016.07.005

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

Mataix-Cols, D., Conceicao do Rosario-Campos, M., & Leckman, J. F. (2005). A Multidimenionsal Model of Obsessive-Compulsive Disorder. *The American Journal of Psychiatry*, *162*(2), 228–238. http://doi.org/10.1176/appi.ajp.162.2.228

Morein-Zamir, S., Papmeyer, M., Durieux, A., Fineberg, N. a., Sahakian, B. J., & Robbins, T. W. (2013). Investigation of attentional bias in obsessive compulsive disorder with and without depression in visual search. *PLoS ONE*, *8*(11), 1–15. http://doi.org/10.1371/journal.pone.0080118

Moritz, S., von Mühlenen, A., Randjbar, S., Fricke, S., & Jelinek, L. (2009). Evidence for an attentional bias for washing- and checking-relevant stimuli in obsessive – compulsive disorder, 365–371. http://doi.org/10.1017/S1355617709090511

Olatunji, B. O., Davis, M. L., Powers, M. B., & Smits, J. A. J. (2013). Cognitive-behavioral therapy for obsessive-compulsive disorder: A meta-analysis of treatment outcome and moderators. *Journal of Psychiatric Research*, *47*, 33–41. http://doi.org/10.1016/j.jpsychires.2012.08.020

Pergamin-Hight, L., Naim, R., Bakermans-Kranenburg, M. J., van IJzendoorn, M. H., & Bar-Haim, Y. (2015). Content specificity of attention bias to threat in anxiety disorders: A meta-analysis. *Clinical Psychology Review*, *35*, 10–18. http://doi.org/10.1016/j.cpr.2014.10.005

Rachman, S. (2002). A cognitive theory of compulsive checking. *Behaviour Research and Therapy*, *40*(6), 625–639. http://doi.org/10.1016/S0005-7967(01)00028-6

Rinck, M., & Becker, E. S. (2006). Spider fearful individuals attend to threat, then quickly avoid it: evidence from eye movements. *Journal of Abnormal Psychology*, *115*(2), 231–238. http://doi.org/10.1037/0021-843X.115.2.231

Rodebaugh, T. L., Scullin, R. B., Langer, J. K., Dixon, D. J., Huppert, J. D., Bernstein, A., … Lenze, A. (2016). Unreliability as a Threat to Understanding Psychopathology: The Cautionary Tale of Attentional Bias. *Journal of Abnormal Psychology*, *125*(6), 840–851. http://doi.org/10.1037/abn0000184

Salkovskis, P. M., & McGuire, J. (2003). Cognitive-behavioural theory of OCD. In R. G. Menzies & P. De Silva (Eds.), *Obsessive-compulsive Disorder: theory, research and* *treatment* (pp. 59–78). Chichester: Wiley.

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., … Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of Clinical Psychiatry*, *59*(SUPPL. 20), 22–33. http://doi.org/10.1016/S0924-9338(99)80239-9

Simon, D., Kischkel, E., Spielberg, R., & Kathmann, N. (2012). A pilot study on the validity of using pictures and videos for individualized symptom provocation in obsessive-compulsive disorder. *Psychiatry Research*, *198*, 81–88. http://doi.org/10.1016/j.psychres.2011.12.022

Stein, D. J., Fineberg, N. a., Bienvenu, O. J., Denys, D., Lochner, C., Nestadt, G., … Phillips, K. A. (2010). Should OCD be classified as an anxiety disorder in DSM-V? *Depression and Anxiety*, *27*(6), 495–506. http://doi.org/10.1002/da.20699

Toffolo, M. B. J., Hout, M. A. Van Den, Hooge, I. T. C., Engelhard, I. M., & Cath, D. C. (2013). Mild Uncertainty Promotes Checking Behavior in Subclinical Obsessive-Compulsive Disorder, *1*(2), 103–109. http://doi.org/10.1177/2167702612472487

Van Bockstaele, B., Verschuere, B., Tibboel, H., De Houwer, J., Crombez, G., & Koster, E. H. W. (2014). A review of current evidence for the causal impact of attentional bias on fear and anxiety. *Psychological Bulletin*, *140*(May 2017), 682–721. http://doi.org/10.1037/a0034834

Waechter, S., Nelson, A. L., Wright, C., Hyatt, A., & Oakman, J. (2014). Measuring attentional bias to threat: Reliability of dot probe and eye movement indices. *Cognitive Therapy and Research*, *38*(3), 313–333. http://doi.org/10.1007/s10608-013-9588-2

Weierich, M. R., Treat, T. a., & Hollingworth, A. (2008). *Theories and measurement of visual attentional processing in anxiety*. *Cognition & Emotion* (Vol. 22). http://doi.org/10.1080/02699930701597601

Williams, J. M. G., Mathews, A., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin*, *120*(1), 3–24. http://doi.org/10.1037/0033-2909.120.1.3

Wittekind, C. E., Feist, A., Schneider, B. C., Moritz, S., & Fritzsche, A. (2015). The approach-avoidance task as an online intervention in cigarette smoking: A pilot study. *Journal of Behavior Therapy and Experimental Psychiatry*, *46*, 115–120. http://doi.org/10.1016/j.jbtep.2014.08.006

Table 1

Demographic and Psychopathological Data: Mean (standard deviation) or frequency.

	OCD Patients (n = 28)	Healthy Controls (n = 22)	Statistics
Demographic characteristics			
Age	39.29 (13.81)	40.09 (15.03)	$t(48) = 0.20, p = .85$
Education (years)	16.06 (3.11)	16.60 (2.84)	$t(47) = 0.64, p = .53$
Sex (m/f)	8/20	9/13	$\chi^2(1) = 0.84, p = .39$
Psychopathology			
OCI-R total	24.32 (11.90)[a]	6.68 (6.37)	$t(45) = 6.21, p < .001$
OCI-R washing	4.76 (3.97) [a]	0.90 (1.77)	$t(45) = 4.19, p < .001$
OCI-R obsessing	5.40 (2.92) [a]	0.68 (1.25)	$t(45) = 7.04, p < .001$
OCI-R hoarding	2.29 (2.60) [b]	2.40 (2.68)	$t(44) = 0.15, p = .88$
OCI-R ordering	5.16 (4.34) [a]	1.27 (1.86)	$t(45) = 3.90, p < .001$
OCI-R checking	5.63 (4.13) [b]	1.36 (1.65)	$t(44) = 4.52, p < .001$
OCI-R neutralizing	1.79 (2.67) [a]	0.09 (0.29)	$t(45) = 2.97, p < .001$
BDI-II total	19.86 (9.36) [a]	5.00 (6.36)	$t(45) = 6.28, p < .001$

Note: m = male. f = female. OCD = Obsessive-Compulsive Disorder, WST = Test of Word Power, Y-BOCS = Yale Brown Obsessive Compulsive Scale, OCI-R = Obsessive-Compulsive Inventory Revised, BDI-II = Beck Depression Inventory-II, MINI = Mini International Neuropsychiatric Interview, SCID = Structured Clinical Interview for DSM-IV-TR.

[a] based on n = 25, [b] based on n = 24

Table 2

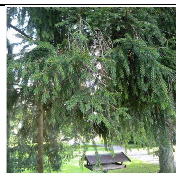
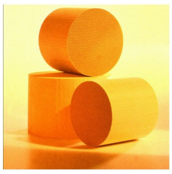
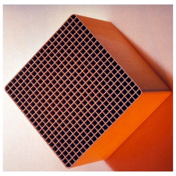
Range, Means and Standard Deviations of Expert Picture Ratings used in the Free Viewing Task.

Type of stimulus	*M* (Range)	*M* (*SD*)
OCD-relevance (1 = very much to 4 = not at all)		
Checking-related pictures	1.00 - 1.90	1.29 (0.29)
Contamination-related pictures	1.20 – 2.00	1.45 (0.29)
Neutral Pictures	2.30 – 4.00	3.62 (0.33)
Valence (1 = very positive to 5 = very negative)		
Checking-related pictures	2.90 - 4.30	3.43 (0.45)
Contamination-related pictures	2.80 - 4.50	3.91 (0.49)
Neutral Pictures	2.00 – 3.30	2.88 (0.31)
Details (1 = many to 4 = none)		
Checking-related pictures	1.90 – 3.00	2.41 (0.36)
Contamination-related pictures	1.40 – 3.10	3.91 (0.49)
Neutral Pictures	1.70 – 3.70	2.89 (0.57)

Note: OCD = Obsessive-Compulsive Disorder

Table 3

Examples of the Pictures Used in the Free Viewing Paradigm[2]*. OCD-related Pictures (left) are depicted with the Neutral Picture (right) shown on the same slide*

Contamination Neutral	 (Simon et al., 2012)	 (Wittekind et al., 2015)	 (Simon et al., 2012)	 (Wittekind et al., 2015)
	 (Simon et al., 2012)	 (Wittekind et al., 2015)	 (Simon et al., 2012)	 (Wittekind et al., 2015)
	 (Simon et al., 2012)	 (Lang, Bradley, & Cuthbert, 1999b)	 (Simon et al., 2012)	 (Wittekind et al., 2015)
Checking Neutral	 (Simon et al., 2012)	 (Lang et al., 1999b)	 (Simon et al., 2012)	 (130921_Bregenz _A 34 from weisserstier)
	 (Simon et al., 2012)	 (Lang et al., 1999b)	 (Simon et al., 2012)	 (Wittekind et al., 2015)
	 (Simon et al., 2012)	 (Lang et al., 1999b)	 (Simon et al., 2012)	 (Macbook Tasche von Waterkant Deichkönig from Sebastian Michalke)[3]

[2] The first author will gladly provide the remaining pictures upon request.

Note: [2]130921_Bregenz_A_34 by weisserstier, 2013
[https://www.flickr.com/photos/alfreddiem/10407980554/in/photolist-gRHC1A]
[3]Macbook Tasche von Waterkant Deichkönig, by Sebastian Michalke, 2013
[https://www.flickr.com/photos/56093900@N03/10950014856/in/photolist-hFBo1X-hFCBsc-hFCdD7-hFBG1q-hFCduj-hFBFVA]

Table 4

Internal Consistencies (Cronbach´s α) for Each Combination of Stimulus Type, OCD Relevance and Entry vs. Dwell Time in the Free Viewing Paradigm

Dependent Variable	Stimulus Type	Relevance	Cronbach's α		
			Total sample	Patients	Healthy Controls
Entry	Contamination	OCD	α = .64	α = .65	α = .74
Entry	Contamination	Neutral	α = .64	α = .72	α = .70
Entry	Checking	OCD	α = .61	α = .59	α = .49
Entry	Checking	Neutral	α = .48	α = .67	α = .49
Dwell	Contamination	OCD	α = .59	α = .74	α = - .20
Dwell	Contamination	Neutral	α = .73	α = .81	α = .23
Dwell	Checking	OCD	α = .69	α = .74	α = .25
Dwell	Checking	Neutral	α = .25	α = .50	α = .47

Table 5

Means and Standard Deviations of Explicit Picture Ratings as a Function of Group and Stimulus Type (1= positive and relevant for my obsessions or compulsions, 2 = positive, 3 = neutral, 4 = negative, 5 = negative and relevant for my obsessions or compulsions)

	Group		
Stimulus type	OCD	Healthy controls	Statistics
Neutral	2.81 (0.28)	2.69 (0.17)	$t(48) = 1.67$, $p = .10$
OCD contamination-related	3.94 (0.58)	3.32 (0.25)	$t(48) = 4.65$, $p < .001$
OCD checking-related	3.65 (0.62)	3.14 (0.21)	$t(48) = 3.71$, $p = .001$

Note. OCD = obsessive-compulsive disorder.

Appendix B

Cludius, B., Külz, A. K., Landmann, S., Moritz, S., & Wittekind, C. E. (in press). Implicit Approach and Avoidance in Patients with Obsessive-Compulsive Disorder (OCD). *Journal of Abnormal Psychology*.

Implicit Approach and Avoidance in Patients with Obsessive-Compulsive Disorder (OCD)

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Preliminary data was presented at two conferences in Germany. The poster displayed at the conferences showing preliminary data on patients with checking-related symptoms of OCD was shared via researchgate.net. None of the final data has been published before.

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Abstract

Avoidance is regarded as an important feature for the development and maintenance of obsessive-compulsive disorder (OCD) and is usually assessed using explicit measures such as self-report scales. However, some behavioral schemata are unavailable to introspection, making them partially inaccessible by explicit measures. We used an approach-avoidance task (AAT) as an implicit measure to examine behavioral tendencies in patients with OCD, including patients with checking- and contamination-related symptoms ($n = 63$), compared to a healthy control group ($n = 30$). Participants were asked to respond to the color of a stimulus or stimulus frame by pulling a joystick towards themselves or by pushing it away. The stimuli were comprised of checking-related, contamination-related, and neutral pictures and words. Patients with contamination-related symptoms were slower when responding to OCD-related stimuli, independent of approach or avoidance. Unexpectedly, patients with checking-related symptoms were faster at pulling (approaching) and slower at pushing (avoiding) checking-related material compared to neutral stimuli. The slower pushing (avoiding) of checking-related compared to neutral material correlated positively with explicit ratings of avoidance. These results suggest a biased approach-avoidance tendency in patients with checking-related symptoms of OCD, but not in those with contamination-related symptoms of OCD. Future studies are necessary to assess whether the AAT might be useful in the assessment of treatment gains as well as whether it might be a training tool to enhance psychotherapeutic changes in OCD.

Keywords: Obsessive-compulsive disorder, approach-avoidance task, AAT, avoidance, implicit measure

Avoidance is an important feature of obsessive-compulsive disorder (OCD). Although patients with OCD report avoidance behavior in direct measures such as interviews or questionnaires, a different behavioral pattern emerged in a study that assessed avoidance indirectly. Patients with checking-related symptoms of OCD showed a tendency of a faster approach to pictures depicting checking-related material instead of the expected pattern of faster avoidance.

Obsessive-compulsive disorder (OCD) is a psychiatric disorder with a lifetime prevalence of 2–3 % (Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012). Cognitive-behavioral models (Rachman, 2002; Salkovskis & McGuire, 2003) highlight the pivotal role of avoidance behavior for the development and maintenance of the disorder. The models posit that the misinterpretation of the importance of intrusive thoughts causes neutralizing behavior as well as avoidance of OCD-related situations, objects, or persons. The emotional processing theory (Foa et al., 1986), in turn, claims that OCD is maintained due to the activation of cognitive and emotional processes within a fear structure. The fear structure is activated once an individual perceives OCD-related stimuli. Within the fear structure, a strong association between OCD-related stimuli and danger leads to a co-activation of response patterns, resulting in avoidance. Some of these processes are thought to be unavailable to consciousness (Foa et al., 1986).

Avoidance is usually measured using explicit measures (i.e., interviews and self-report questionnaires), even though some behaviors and behavioral tendencies cannot easily be accessed by individuals (Baumeister, Vohs, & Funder, 2007; Foa et al., 1986). Thus, a major disadvantage of explicit measures is their reliance on metacognitive awareness. To address some of the problems inherent to explicit measures, recent research has used implicit measures as a complementary assessment tool. Implicit measures are based on a two-process model (e.g., Strack & Deutsch, 2004). According to this model, behavior is shaped by two interacting information-processing systems, the reflective system and the impulsive system. It is assumed that in the *reflective system*, behavior is driven by knowledge about facts and values and is a consequence of deliberate decision processes. In contrast, the *impulsive system* is assumed to be fast; it does not require attentional resources, and it generates behavior through an immediate appraisal of the stimulus, leading to a motivational orientation and the corresponding co-activation of behavioral schemata. Approach is facilitated if positive affect is elicited, whereas avoidance is elicited if the affect is negative. The model posits that the two systems interact in either synergistic or antagonistic ways. This means that it is possible that the two behavioral options of approach or avoidance can be activated in the two systems at the same time. Which behavioral option is activated depends on the strength of the activation of a behavioral schema by the two systems and consequently whether or not the behavior is executed from the impulsive or the reflective system. It is assumed that explicit measures tap into the reflective system whereas implicit measures tap more into the automatic or associative processes of the impulsive system.

To assess automatic behavioral tendencies, some implicit measures, such as the approach-avoidance task (AAT; Rinck & Becker, 2007), use reaction times (RTs) of arm flexion and extension to the display of pictures as indicators of approach and avoidance. It is assumed that the RTs reflect the compatibility between the valence of the stimulus and the expected response (see De Houwer, 2003). Several versions of the AAT exist. One version employs explicit instructions, using the affective content of the picture as the response dimension. For example, participants are asked to respond to happy facial expressions by pulling and to angry facial expressions by pushing (e.g., Radke, Güths, André, Müller, & de Bruijn, 2014). Another version of the AAT uses implicit instructions such that participants are required to respond to a content-irrelevant feature of a picture (e.g., the color of the picture frame) and not to the stimulus itself. It is assumed that the implicit AAT can assess automatic responses from the impulsive system. In the implicit AAT version by Rinck & Becker (2007) a zoom function was incorporated; the pictures decrease (i.e., avoidance = push) or increase (i.e., approach = pull) in size according to the direction of the response. Both the explicit and implicit version of the AAT reveal differences between approach-avoidance tendencies as measured by the AAT and by the explicitly reported approach or avoidance behavior (e.g., Fleurkens, Rinck, & Minnen, 2014; Heuer, Rinck, & Becker, 2007; Rinck & Becker, 2007). Furthermore, both AAT versions have yielded results implying incremental validity of the AAT compared to explicit measures (such as self-report measures) when predicting behavior. This difference suggests that the AAT captures information beyond self-report measures, but whether the AAT indeed measures more implicit processes compared to explicit measures is not fully clear. In a meta-analysis of AATs, Phaf, Mohr, Rotteveel, and Wicherts (2014) found that affective evaluations can prime approach and avoidance behavior and that both nonconscious and conscious appraisals of stimuli play a role in generating this effect. Studies using the AAT version by Rinck & Becker (2007), which uses a zoom functions pose an exception. Only if a zoom function was included in the AAT, approach-avoidance tendencies were almost consistently found with implicit instructions (i.e., response depends on a non-affective dimension; Phaf et al., 2014). Whether both the implicit and explicit versions of the AAT tap into the impulsive system according to the two-process model (Strack & Deutsch, 2004) remains to be investigated (Phaf et al., 2014).

The version of the AAT that uses implicit instructions (Rinck & Becker, 2007) has been used to assess implicit behavioral tendencies in a variety of anxiety disorders in clinical and subclinical samples, such as spider phobia (e.g., Bartoszek & Winer, 2015; Rinck & Becker, 2007), social anxiety disorder (e.g., Heuer et al., 2007; Roelofs et al., 2010; Voncken, Rinck, Deckers, & Lange, 2012), and post-traumatic stress disorder (Fleurkens et al., 2014; Wittekind et al., 2015). In these studies, anxious participants generally demonstrated implicit avoidance tendencies in response to anxiety-related pictures, whereas no approach-avoidance tendencies were found in response to neutral pictures. Non-anxious individuals commonly did not respond differently to anxiety-related compared to neutral pictures. The study by Wittekind et al. (2015) poses an exception because no implicit avoidance was found in individuals with PTSD. In most studies, disorder-specific stimuli were used (e.g., spiders in spider phobia or faces in social anxiety disorder); however, in the study by Fleurkens et al. (2014) that assessed approach-avoidance tendencies in patients who had experienced a sexual trauma, stimuli of different types of threatening scenes (sexual, accidents) were included. Patients showed implicit avoidance of high-threat sexual pictures. A similar marginally significant pattern with a medium effect size was found for high-threat accident pictures. One explanation for these results could be that higher arousal may have led to a more general avoidance tendency in patients with PTSD.

To the best of our knowledge, only one study has assessed approach-avoidance tendencies in people with OCD symptoms using the AAT (Najmi, Kuckertz, & Amir, 2010). A non-clinical sample, with one group scoring high and another scoring low in contamination-related OCD symptoms, responded to the color frame of contamination-related (e.g., toilet, garbage) or neutral pictures (e.g., household objects) by pushing or pulling a joystick. Participants high in contamination-related fears responded significantly more slowly when pulling (approaching) contamination-related compared to neutral pictures. However, no RT differences emerged between the picture types when the pictures had to be pushed. Participants low in contamination-related fear reacted equally fast to contamination-related and neutral stimuli. Even though avoidance is consensually regarded an important feature in the development and maintenance of OCD, no study has ever examined implicit approach-avoidance tendencies in a clinical sample of *patients* with OCD.

The aim of the present study was to assess implicit approach and avoidance tendencies using an AAT (Rinck & Becker, 2007) in a sample of patients with OCD. One challenge in studying OCD is the heterogeneity of the symptom spectrum. Reliable dimensions that have emerged from the literature are contamination and washing, checking, hoarding, as well as symmetry and ordering (Bloch, Landeros-Weisenberger, Rosario, Pittenger, & Leckman, 2008; Katerberg et al., 2010; Mataix-Cols, Conceicao do Rosario-Campos, & Leckman, 2005; McKay et al., 2004). However, because of its differences to other OCD subtypes, hoarding was classified as a discrete clinical syndrome in the *Diagnostic and Statistical Manual of*

Mental Disorders (5^{th} ed.; DSM-5; American Psychiatric Association, 2013). Studies on OCD often focus on only one specific dimension of the disorder (e.g., contamination fears). Contamination-related symptoms of OCD are one of the most widely studied symptoms of OCD, but they represent only about a quarter of the symptoms in OCD patients. Checking-related symptoms of OCD are the most common subtype, with a prevalence rate of 79.3% (Ruscio, Stein, Chiu, & Kessler, 2010). One disadvantage of limiting studies to one OCD subtype is that patients display various symptom dimensions. Additionally, there is evidence against a specificity effect in attentional biases in OCD (Pergamin-Hight, Naim, Bakermans-Kranenburg, van IJzendoorn, & Bar-Haim, 2015). Therefore, and to extend previous research based on a non-clinical sample with contamination-related symptoms of OCD (Najmi et al., 2010), the AAT in this study consisted of contamination- and checking-related stimuli as well as neutral stimuli. Patients with varying symptoms of OCD, including contamination- and checking-related symptoms, and a healthy control group were included in the study. The study was designed to assess whether implicit avoidance is specific to each subtype type of OCD or is instead a general avoidance of OCD-related material. Commonly, pictures are used as stimuli in the AAT (e.g., Bartoszek & Winer, 2015; Najmi et al., 2010; Rinck & Becker, 2007; Wittekind, Feist, Schneider, Moritz, & Fritzsche, 2015). However, based on semantic network models (Collins & Loftus, 1975) and research on the spreading activation of associations in OCD (Jelinek, Hauschildt, Hottenrott, Kellner, & Moritz, 2014), we expected words to be more potent due to their potential activation of semantic networks associated with OCD-related concepts. By using both pictures and words, the stimuli could be valid for a broader group of patients. Therefore, pictures and words were used as stimuli in the present study.

Consistent with the emotional processing theory and with previous studies using the AAT (Rinck & Becker, 2007) in individuals with symptoms of anxiety and fear of contamination, we hypothesized that patients with OCD would show avoidance of OCD-related subtype-specific material by faster pushing and slower pulling compared to neutral material. To be able to interpret each movement independently, we compared RTs in response to OCD-related versus neutral pictures separately for approach (pulling) and avoidance (pushing). Because no study had previously assessed correlations between explicit measures of OCD and implicit approach-avoidance tendencies, we did not have a directed hypothesis as to whether behavioral tendencies would be associated with explicit measures. However, we felt it was conceivable that explicit ratings of avoidance and contamination- or checking-related symptoms would correlate positively with behavioral tendencies as assessed by the AAT.

Methods

Participants

Sixty-three patients with OCD were recruited as part of a larger study assessing the effects of mindfulness-based cognitive therapy on symptoms of OCD compared to an active control group (Külz et al., 2014). Recruitment for the Külz et al. study, and thus also for this study, was conducted through the OCD and anxiety wards of psychiatric clinics, psychotherapists seeing clients on an outpatient basis, newspaper advertisements, and disorder-specific online forums. Patients were only included if they had previously been diagnosed with OCD by a clinician and had received cognitive-behavioral treatment for their OCD. Patients were excluded if they were younger than 18, older than 70, or suffered from a severe neurological disorder (including stroke, epilepsy, and traumatic head injuries), psychotic disorder, mania, borderline personality disorder, current substance or alcohol dependence, a current severe depressive episode, acute suicidality, or mental retardation (IQ < 70). For an overview of the demographic and psychopathological characteristics of the sample, please see Table 1.

A diagnosis of OCD and possible comorbidity was assessed using the Mini International Neuropsychiatric Interview (MINI; Sheehan et al., 1998), which is based on DSM-IV criteria. Additionally, the section on specific phobia within the Structured Clinical Interview for DSM-IV-TR (SCID) was administered (First, Spitzer, Gibbon, & Williams, 2002). The severity of OCD symptoms was assessed using the Yale-Brown Obsessive Compulsive Scale (Y-BOCS; German version by Hand & Büttner-Westphal, 1991) in the patients only. The Y-BOCS is a semi-structured interview consisting of two parts. The symptom checklist asks for the occurrence of past and present symptoms of obsessions and compulsions, and the scale assesses the severity of obsessions and compulsions. An additional item assesses general avoidance due to symptoms of OCD. According to the Y-BOCS checklist, 22 patients affirmed contamination-related and 16 patients affirmed checking-related symptoms of OCD, whereas 13 patients affirmed both contamination-related and checking-related symptoms of OCD. The remaining 12 patients reported other symptoms of OCD, including, for example, aggressive or sexual obsessions or repeating rituals. Individuals were classified as "checkers" if the item "Checking locks, stove, appliances etc." was affirmed, whereas affirmations of less specific items (e.g., "Checking that nothing terrible did or will happen") were discarded because they have a high overlap with other factors of OCD

(Bloch et al., 2008). The German version of the Obsessive Compulsive Inventory Revised (OCI-R; Gönner, Leonhart, & Ecker, 2008) was used to assess distress caused by OCD symptoms in patients and healthy controls. The OCI-R is a self-report measure comprised of a total score and of six subscales: washing, checking and doubting, obsessing, mental neutralizing, ordering, and hoarding. The scale shows good validity and excellent reliability on all subscales except for the neutralizing subscale (Gönner et al., 2008). The psychometric properties are in line with results using the English version of the OCI-R (Abramowitz & Deacon, 2006; Foa, Huppert, et al., 2002; Gönner et al., 2008). The severity of depressive symptoms was assessed using the Beck Depression Inventory-II (BDI-II; German version by Kühner, Bürger, Keller, & Hautzinger, 2007). Verbal intelligence was assessed using the Test of Word Power (WST; Schmidt & Metzler, 1992).

Thirty participants were included as healthy controls and were comparable as to age, gender, and education to the entire OCD sample (see Table 1) as well as to patients with checking-related symptoms of OCD, ps > . 22, and patients with contamination-related symptoms of OCD, ps > .29. Additional exclusion criteria for the healthy control group were a lifetime diagnosis of OCD and any current psychiatric diagnosis according to the MINI (Sheehan et al., 1998). The study was approved by the Ethics Committee of Freiburg University Medical Center. All participants gave written informed consent prior to their participation in the study. The required sample size for the main analyses was calculated using G*Power (Faul et al., 2009). Previous studies using the AAT in OCD (Najmi et al., 2010) and other anxiety disorders (Rinck & Becker, 2007) revealed effect sizes of $\eta_p^2 = .06$ to $\eta_p^2 = .12$. We calculated conservatively, using the smaller effect size, to achieve a test with 95% power at an error rate of $\alpha = .05$, with an assumed correlation of $r = .70$. The analysis revealed that a total of 27 participants for each group would be necessary to find an effect.

Approach-Avoidance Task

The AAT (Rinck & Becker, 2007) was comprised of words and pictures with OCD-related (contamination- and checking-related) and neutral content. A set of 49 pictures was chosen from the International Affective Picture System (Lang, Bradley, & Cuthbert, 1999), the Berlin Obsessive-Compulsive Disorder Picture Set (Simon, Kischkel, Spielberg, & Kathmann, 2012) and flickr.com. Thirty-five words were generated by the first author to represent the following categories: checking-related, contamination-related, and neutral. Ten psychologists with experience diagnosing OCD rated the pictures and words on Likert scales according to (a) relevance for contamination- and checking-related OCD (1 = *very much* to 4 = *not at all*), (b) personal valence (1 = *very positive* to 5 = *very negative*), and (c) clarity (pictures only; 1 = *very good* to 4 = *not at all*) or concreteness (words only; 1 = *very* to 4 = *not at all*). Subsequently, a total of 18 pictures and 18 words was selected (see Table 2), of which 12 of each mode were high in OCD relevance and varied in personal valence (six contamination-related, six checking-related) and six were low in OCD relevance and neutral in valence (for psychologists' ratings of the stimuli, see supplementary material). All of the pictures were fitted to the same size. The words in both categories had a mean number of 6.17 letters.

Similar to a prior study conducted with contamination-related material (Najmi et al., 2010), we used color as the response category. The pictures were framed with a blue or orange frame, and the words were written in either blue or orange. We created one set of stimuli in which half the participants were asked to pull the joystick if the frame or word was blue and push if it was orange (the other half were instructed to do the opposite). The participants were seated in front of a computer with a joystick placed on the desk in front of them. The AAT started with the instructions followed by eight practice trials consisting of two words and two pictures that were not used in the assessment task, presented once in each color. The assessment task consisted of 144 trials (18 stimuli x 2 stimulus modes [picture and word] x 2 colors [orange and blue] x 2 repetitions). The stimuli were presented in random order. Each trial started when the participants pressed a button on the joystick, resulting in the appearance of a medium-sized picture or word in the center of the screen. The size of the stimulus increased when the participants pulled the joystick (approach) and decreased when they pushed the joystick (avoidance). The picture disappeared when the angle of the joystick was moved approximately 30° in the correct direction (according to the instructions). When the participant brought the joystick back to the middle position and pressed the button, the next picture appeared. RTs were recorded from appearance to disappearance of the picture. Subsequently, participants were asked to rate all the previously presented stimuli according to valence and OCD relevance ("For me personally, the picture is") on a scale consisting of *negative and relevant for my compulsion*, *negative*, *neutral*, *positive*, and *positive and relevant for my compulsion*. Table 3 shows internal consistencies (Cronbach's α) for each trial type (push and pull for contamination, checking, and neutral) and of difference scores of each stimulus (e.g., push – pull for blood samples) in each category (e.g., contamination-related stimuli). Internal consistencies for each trial type varied between good and excellent. Internal consistencies for each category using difference scores were low for neutral stimuli but acceptable for checking-related and contamination-related stimuli. Comparable internal consistencies have been described in previous AAT studies (α = .66 to .70; Reinecke, Becker,

& Rinck, 2010). Correlations between the different response directions in each category were high, with *r* = .87 (checking-related push and pull), *r* = .90 (contamination-related push and pull), and *r* = .89 (neutral push and pull).

Data Analysis

Consistent with previous research using the AAT in anxious samples (e.g., Bartoszek & Winer, 2015; Najmi et al., 2010; Rinck & Becker, 2007), all error trials were removed. Error trials were defined as movement in the wrong direction at any time during the trial (i.e., moving in the wrong direction at or after initiation of movement). We excluded the results of one participant with 90 error trials from further analysis. Furthermore, all average RTs that were two or more standard deviations above the group mean were not considered for analysis. First, a repeated measures ANOVA was conducted for average RTs that compared all patients to healthy controls. The average RTs of pushing and pulling responses in the AAT were submitted to a repeated measures ANOVA using a 2 (group: patients, healthy controls) x 2 (response direction: push, pull) x 3 (stimulus type: contamination-related, checking-related, neutral) x 2 (stimulus modes: picture, word) design. Secondly, similar repeated measures ANOVAs were computed separately for average RTs for the two groups of patients (those with contamination- and checking-related symptoms of OCD) compared to the healthy controls.[3] Pearson correlations were computed to investigate the association of AAT RTs with scores on the Y-BOCS and OCI-R. Effect sizes for the ANOVA results were expressed as follows: $\eta_p^2 \approx .01$, representing a weak effect, $\eta_p^2 \approx .06$, representing a medium effect, and $\eta_p^2 \approx .14$, representing a large effect. An alpha level of $\alpha = .05$ (two-sided) was applied for all statistical tests.

Results

Demographic and Psychopathological Characteristics

Table 1 shows the demographic and psychopathological scores of patients with OCD and healthy participants. The groups did not differ in any of the demographic variables. As expected, OCD patients scored significantly higher on all psychopathological ratings, including explicit ratings of OCD symptoms as well as depressive symptoms. Patients showed a total score of *M* = 22.25, *SD* = 6.32 on the Y-BOCS with *M* = 10.94, *SD* = 3.28 for the

[3] We refrained from calculating AAT effects, which is in line with most of the recent studies using the AAT with individuals with anxiety disorders (Bartoszek & Winer, 2015; Fleurkens et al., 2014; Najmi et al., 2010). AAT effects are computed by subtracting each participant's average RT in the pull condition from the average RT in the push condition (e.g., checking push minus checking pull). Najmi et al. (2010) pointed out that AAT effects assume that approach of an object and avoidance of the object lie on the opposite ends of a continuum. However, the approach of a feared object (punishment) and the avoidance of it (negative reinforcement) might represent distinct types of reinforcement that underlie avoidance behavior. Thus, using AAT effects might prevent the assessment of independent mechanisms underlying approach and avoidance behaviors.

obsessions subscale and *M* = 11.32, *SD* = 3.56 for the compulsions subscale. Twenty-two patients affirmed a comorbid diagnosis according to the MINI and the SCID section for specific phobia (major depression: *n* = 11, dysthymia: *n* = 13, panic disorder: *n* = 2, agoraphobia: *n* = 2, social anxiety disorder: *n* = 9, generalized anxiety disorder: *n* = 4, specific phobia: *n* = 2). Patients with contamination-related symptoms of OCD had an average of *M* = 7.94, *SD* = 2.97 on the washing subscale of the OCI-R, whereas patients with checking-related symptoms had an average of *M* = 7.00, *SD* = 3.04 on the checking subscale of the OCI-R. Twenty-two patients reported no use of psychopharmacological medication. The remaining patients stated that they used one antidepressant (*n* = 19), two antidepressants (*n* = 3) or a combination of antidepressant and neuroleptic agent (*n* = 19).

Explicit Ratings of Stimuli

In order to analyze group differences in explicit ratings of the stimuli, a repeated measures ANOVA with group as the between-subject factor and the stimulus type as the repeated factor was conducted. The main effect for stimulus type and the one for group appeared significant, but were explained by the Stimulus Type x Group interaction, $F(2, 90) = 24.14$, $p < .001$, $\eta_p^2 = .35$. Follow-up t-tests (Bonferroni-corrected) revealed that, compared to the control group, patients rated OCD-related stimuli as more negative and more relevant to their OCD symptoms, whereas their ratings revealed no difference regarding neutral stimuli (see Table 4). To assess the specific ratings of each subgroup of patients, paired-samples t-tests were used.[4] Both subgroups of patients rated checking- and contamination-related stimuli as more negative than neutral stimuli, *p*s < .001. However, only patients with contamination-related symptoms of OCD rated contamination-related stimuli (*M* = 1.81, *SD* = 0.42) as more negative than checking-related stimuli (*M* = 2.21, *SD* = 0.51), $t(34) = 4.44$, $p < .001$, $d = 0.76$, whereas patients with checking-related symptoms did not differ in their ratings of contamination-related (*M* = 2.09, *SD* = 0.53) and checking-related stimuli (*M* = 2.01, *SD* = 0.56), $t(28) = 0.54$, $p = .60$, $d = 0.10$. Notably, almost half of the patients showing checking-related symptoms also reported contamination-related symptoms of OCD.

Implicit Approach Avoidance: AAT

OCD patients (6.14%) and healthy controls (5.32%) did not differ in number of error trials, $t(73) = 0.95$, $p = .34$. A Stimulus Type x Response Direction x Mode x Instruction x Group ANOVA was calculated to test whether the instructions (push orange and pull blue vs. push blue and pull orange) had an influence on RTs. Neither the main effect of the instructions nor any of the interactions of instruction and group reached significance (all *p*s >

[4] Due to the high overlap between the subgroups, t-tests instead of a repeated measures ANOVA were calculated.

.20), indicating that the instructions did not influence the main results. Thus, instruction was not included as a between-subject factor in the following analyses to increase power.

The ANOVA analyzing RTs from all patients combined revealed a significant interaction of Response Direction x Mode of Stimulus, $F(1, 88) = 17.28$, $p = .001$, $\eta_p^2 = .16$, and a significant interaction of OCD-Relevance x Response Direction x Mode, $F(1, 87) = 3.48$, $p = .035$, $\eta_p^2 = .07$. Because no interaction between group and mode of stimulus was found, RTs were collapsed across stimulus mode and a second ANOVA with stimulus type (OCD-related, neutral) as the repeated factor was calculated. No significant main effects or interactions emerged, *p*s > .15, suggesting that patients with OCD did not exhibit general avoidance tendencies to OCD-related stimuli compared to healthy controls.

Subtype-Specific AAT Reaction Times

With regard to our hypothesis that patients with OCD would show avoidance of subtype-specific material by faster pushing and slower pulling compared to neutral material, an ANOVA analyzing average RTs from patients with contamination-related symptoms of OCD and healthy controls revealed a significant Stimulus Type x Group interaction, $F(1, 62) = 6.07$, $p = .02$, $\eta_p^2 = .09$. However, none of the other main effects nor the postulated three-way interaction of Stimulus Type x Group x Response direction was significant (*p*s > .11). To break down the significant two-way interaction, follow-up t-tests showed that patients with contamination-related symptoms of OCD were significantly slower in response to contamination-related ($M = 746.65$, $SD = 156.18$) compared to neutral stimuli ($M = 726.97$, $SD = 129.36$), $t(33) = 2.60$, $p = .014$, $d = 0.45$, whereas no difference in RTs was found between contamination-related ($M = 638.29$, $SD = 79.40$) and neutral stimuli ($M = 642.60$, $SD = 74.51$) in healthy controls, $t(29) = 0.74$, $p = .47$, $d = 0.13$. Note, however, that given our sample size, we did not have adequate power to detect a medium sized effect regarding our hypothesis.[5]

[5] The required sample size was calculated using G*Power (Faul et al., 2009). The only study that has assessed behavioral tendencies in individuals with OCD-related fears is the study by Najmi et al. (2010). Concerning the difference between trials of pulling contamination-related stimuli and pulling neutral stimuli, an effect size of $d = 0.56$ was found. We used G*Power to calculate the required sample size for our post hoc comparisons. To achieve a test with 80% power at an error rate of $\alpha = .05$, with an assumed correlation of $r = .70$ and $d = 0.56$, a sample size of $n = 22$ per group should have been sufficient to find an effect. No effect was found in the study by Najmi et al. (2010) in their trials of pushing contamination-related stimuli and pushing neutral stimuli. With an effect size of $d = 0.37$, a total of $n = 47$ would have been needed in each group to be able to find an effect.

The ANOVA analyzing average RTs from patients with checking-related symptoms of OCD and healthy controls revealed a significant Stimulus Type x Response direction interaction, $F(1, 56) = 4.67$, $p = .035$, $\eta_p^2 = .08$. Most importantly, the expected Stimulus Type x Response Direction x Group interaction, $F(1, 56) = 7.80$, $p = .007$, $\eta_p^2 = .12$, was significant with a medium to large effect. As shown in Table 5, follow-up t-tests revealed that patients with checking-related symptoms were significantly faster at pulling checking-related compared to neutral stimuli and significantly slower at pushing checking-related than neutral stimuli. In the healthy control group, no differences in RTs were found between checking-related and neutral stimuli. In within-group comparisons, no differences between pushing and pulling for either checking-related or neutral stimuli emerged in healthy controls (all *p*s > .63). In contrast, patients with checking-related symptoms of OCD were faster at pulling than pushing checking-related stimuli, $t(27) = 2.72$, $p = .01$, $d = 0.51$, and slower at pulling than pushing neutral stimuli, $t(27) = 2.26$, $p = .03$, $d = 0.43$. Thus, approach tendencies seem to be specific to checking-related stimuli and do not reflect a tendency to approach stimuli in general.

Exploratory repeated measures ANOVA were conducted to test whether the cause of the reported effects in the follow-up t-tests were due to differences in the behavioral tendencies of individuals with only one subtype of OCD (contamination- or checking-related only), individuals with both subtypes, or both individuals with only one and individuals with both subtypes. We compiled a new group variable. The sample sizes in the subgroups were $n = 22$ (contamination-related symptoms only), $n = 16$ (checking-related symptoms only), $n = 13$ (both checking- and contamination-related symptoms), $n = 12$ (other symptoms of OCD only), and $n = 30$ (healthy controls). The ANOVAs included three subgroups (one subtype only, both subtypes, and healthy controls), two stimulus types (subtype-related and neutral), and response direction (push, pull). For contamination-related stimuli, the three-way interaction of Subgroup x Subtype x Response Direction did not reach significance, $F(2, 62) = 0.12$, $p = .89$, $\eta_p^2 = .004$. However, the two-way interaction of Stimulus Type x Subgroup was significant, $F(2, 62) = 4.17$, $p = .02$, $\eta_p^2 = .12$. Follow-up paired t-tests revealed that patients with contamination-related symptoms were faster at reacting to neutral compared to contamination-related stimuli, $t(21) = 2.83$, $p = .01$, $d = 0.57$, whereas patients with both checking-related and contamination-related symptoms did not react differently to contamination-related compared to neutral stimuli, $t(11) = 0.48$, $p = .64$, $d = 0.14$. This shows that the interaction of Subgroup x Stimulus Type shown in the ANOVA is due not only to the difference between healthy controls and patients with contamination-related symptoms but also to the difference between patients with contamination-related symptoms and patients who show symptoms of both subtypes. In a similar ANOVA for checking-related stimuli, the postulated three-way interaction reached significance, $F(2, 55) = 5.45$, $p = .007$, $\eta_p^2 = .16$. To break down this interaction, follow-up paired t-tests were conducted within each group. Patients with checking-related symptoms were faster at pulling in response to checking-related compared to neutral stimuli, $t(15) = 2.25$, $p = .04$, $d = 0.56$, and slower at pushing in response to checking-related compared to neutral stimuli, $t(15) = 2.80$, $p = .01$, $d = 0.70$. In patients with both checking- and contamination-related symptoms of OCD, no difference was found for pulling, $t(11) = 1.79$, $p = .10$, $d = 0.51$, nor pushing checking-related stimuli, $t(11) = 1.68$, $p = .12$, $d = 0.48$, compared to neutral stimuli. However, all t-tests revealed quite comparable effect sizes (medium effects). The lack of a significant result in patients with both checking- and contamination-related symptoms may be due to the small subsample size of $n = 13$.

Correlational Analyses

No significant correlations emerged between the difference in RTs for contamination-related and neutral stimuli and explicit scores of avoidance on the Y-BOCS and the contamination subscale of the OCI-R for patients with contamination-related symptoms of OCD, *r*s < .19, *p*s > .32, or healthy controls, *r*s < .14, *p*s > .46. No significant correlations were found between the difference in RTs for checking-related and neutral stimuli and the checking subscale of the OCI-R for patients, *r*s < .22, *p*s > .28, nor for healthy controls, *r*s < .19, *p*s > .33. However, the avoidance item of the Y-BOCS correlated significantly with the difference between pushing checking-related versus neutral stimuli, $r = .42$, $p = .03$, in patients with checking-related symptoms.

To test whether the group differences between the subgroups of patients and healthy controls might be better explained by comorbid depression in our sample, we calculated correlations of the BDI-II total score and RTs in the AAT. Separate correlations were computed for the combinations of Push x Stimulus Type (contamination-related, checking-related, and neutral) and Pull x Stimulus Type for the two subgroups of patients. None of the correlations in the sample of patients with contamination-related symptoms of OCD nor in patients with checking-related symptoms of OCD were significant (all *p*s > .06).

Discussion

This study is the first to assess implicit approach-avoidance tendencies in patients with OCD. Patients with varying symptoms, including contamination- and checking-related, were recruited in order to assess whether implicit avoidance tendencies are specific for two prevalent subtypes of OCD or are instead general for OCD-related stimuli. Consistent with the emotional processing theory (Foa et al., 1986) and in line with results from a previous study of participants with subclinical contamination fears (Najmi et al., 2010), we hypothesized that patients with OCD would show avoidance of OCD-related subtype-specific material by faster pushing and slower pulling compared to neutral stimuli and compared to healthy controls.

General Avoidance

The overall sample of patients with OCD (not differentiated according to subtype) did not show avoidance tendencies towards OCD-related material (contamination- and checking-related) compared to healthy controls, as measured by the AAT. This appears to suggest that patients with OCD do not exhibit general approach or avoidance tendencies in relation to OCD-related stimuli. The lack of approach-avoidance tendencies stands in contrast to the non-specificity of attentional biases in OCD (for meta-analysis see Pergamin-Hight et al., 2015). However, the studies summarized in the meta-analysis might have incorporated stimuli that were not specific enough for the heterogeneous symptoms of OCD. Our sample rated the OCD-related stimuli used in the AAT as negative and relevant to their OCD. Therefore, the difference between this study and previous studies on attentional biases could be due to the specificity of the stimuli.

Subtype-Specific Avoidance in Patients with Contamination-Related Symptoms

Patients with contamination-related symptoms of OCD were generally slower at responding to contamination-related material than to neutral stimuli, but did not show any approach or avoidance tendencies. One explanation for the overall slower RTs towards subtype-specific stimuli could be that patients with OCD are more distracted by or have more difficulty disengaging attention from OCD-related stimuli than healthy controls. Rather than triggering a tendency to react quickly by approaching or avoiding a stimulus, OCD-related material might trigger a tendency to stop and assess the situation or engage in cognitive avoidance strategies (Foa et al., 1986). This explanation would be in line with previous studies on attentional biases in OCD that assessed RTs in response to OCD-related material. In studies using measures such as the dot-probe paradigm, patients with OCD responded generally slower than healthy participants to OCD-related material (e.g., Moritz, Mühlenen, Randjbar, Fricke, & Jelinek, 2009; Sizino Da Victoria, Nascimento, & Fontenelle, 2012).

However, our findings are in contrast to a previous AAT study on subclinical OCD. In the study by Najmi et al. (2010), contamination-fearful participants were slower at pulling in response to contamination-related pictures than in response to neutral pictures, whereas no difference in RTs emerged across conditions when pushing. Even though our sample size should have been large enough to find an effect for pulling contamination-related compared to neutral stimuli, our results suggest that patients with contamination-related symptoms of OCD do not show implicit behavioral approach or avoidance tendencies. One difference between the Najmi et al. (2010) study and ours is that we investigated patients whereas Najmi et al. investigated a subclinical sample. In contrast, our sample only included individuals with pathological symptoms of OCD. Even though subclinical samples of OCD are highly relevant to understanding OCD, they differ in important ways from patient samples. For example, whereas individuals with OCD show both obsessions and compulsions defined as repetitive ritualistic behavior (McKay et al., 2004), subclinical samples mostly use covert rituals such as reassurance seeking or focused distraction as neutralizing behavior (for an overview see Abramowitz et al., 2014). Further, both avoidance and neutralizing behavior (such as compulsions) are more pronounced in patients with OCD compared to healthy controls (Morillo, Belloch, & Garcı, 2007).

Subtype-Specific Avoidance in Patients with Checking-Related Symptoms

Patients with checking-related symptoms of OCD showed approach-avoidance biases towards subtype-specific material. However, contrary to our hypothesis, they were faster at pulling and slower at pushing checking-related material compared to neutral stimuli. They were also faster at pulling than pushing checking-related stimuli and slower at pulling compared to pushing neutral stimuli. The healthy control group did not show any approach-avoidance tendencies. These results stand in contrast to the cognitive-behavioral models of OCD (Rachman, 2002; Salkovskis & McGuire, 2003) and the explicit measures (Hand & Büttner-Westphal, 1991) that highlight the role of avoidance behavior. One possible way to reconcile the discrepancies between results from explicit measures and our results could be based on the two-process model (Strack & Deutsch, 2004). According to the model, the execution of behavior depends on the strength of the behavioral schemata triggered in the two systems, impulsive and reflective.

The two-process model suggests that the impulsive system influences behavior by spreading activation and is fast due to its implicit precursors, whereas in the reflective system behavior is a consequence of deliberate decision processes (i.e., controlled precursors of behavior). Therefore, it is hypothesized that if the two systems interact in synergetic ways, the behavior is acted out. However, if they interact in antagonistic ways, one behavioral tendency can be stifled and therefore will not be the executed behavior. It is assumed that processes in the reflective system can be reported explicitly but that behavioral tendencies from the impulsive system may be unavailable to consciousness, although the latter are thought to be assessable using implicit measures such as the AAT. Therefore, following the assumptions of the two-process model, in our study patients with checking-related symptoms of OCD might have an approach tendency in the impulsive system and an avoidance tendency in the reflective system. This explanation is further supported by the positive correlation between the difference scores in pushing checking-related material and the explicit rating of avoidance on the Y-BOCS. The positive correlation suggests that the greater the explicit avoidance, the weaker the implicit avoidance tendency (indicated by slower pushing) of checking-related compared to neutral stimuli.

Comparison to Studies Using the AAT in Anxiety Disorders

Our results in both groups of patients differ from previous findings on anxiety disorders. In previous studies, implicit avoidance tendencies commonly occurred in response to anxiety-related pictures, but not in response to neutral pictures (see introduction). Even though anxiety disorders and OCD are closely related, our results could be explained by the differences in cognitive-emotional processing between the disorders (for an overview, see Stein et al., 2010). Individuals with an anxiety disorder or OCD typically avoid situations related to their fears. However, once confronted with an anxiety-provoking stimulus or situation, individuals with OCD most commonly show compulsions instead of avoidance as a behavioral response (Abramowitz & Jacoby, 2015). For example, an individual with checking-related symptoms might repeatedly drive back to check that no accidents had been caused at an intersection. Therefore, in OCD avoidance is present before the obsessional thought occurs. Once a stimulus has provoked anxiety, however, individuals with OCD mostly engage in actions involving the stimulus or situation, which can also involve *approaching* the stimulus (e.g., repeatedly checking if the stove is turned off or the door is locked). Both avoidance and compulsions are defined as deliberate and purposeful actions intended to reduce the distress caused by obsessions (Abramowitz & Jacoby, 2015). Therefore, the quicker RTs for pulling and the slower RTs for pushing checking-related material compared to neutral stimuli could represent an approach tendency, which is fundamental for engaging in compulsions. Hence, our results underline the differences between anxiety disorders and OCD that have recently led to the separate classification of OCD and anxiety disorders in the DSM-5 (American Psychiatric Association, 2013).

Comparison Between Contamination- and Checking-Related Symptoms

Nevertheless, the question remains of why the patients with contamination-related symptoms of OCD did not show implicit avoidance and approach biases. One explanation could be the specificity of the material. The patients with checking-related symptoms of OCD were selected according to the only specific Y-BOCS item on checking compulsions (i.e., "checking locks, stove, appliances etc."). The category for contamination-related obsessions or compulsions was broader (e.g., "Concerned will get ill because of contaminant", "excessive ritualized showering, bathing etc."). However, both groups of patients rated their subtype-specific stimuli as relevant to their symptoms and all patients with contamination-related symptoms of OCD showed both obsessions and compulsions on the Y-BOCS. Another explanation could be that checking-related stimuli pose a more immediate threat than contamination-related material (e.g., fire or injuring others vs. AIDS). The emotional processing theory claims that the fear structure serves to help individuals escape danger (Foa et al., 1986). In patients with contamination-related symptoms, the means to escape danger may be to stop and assess the situation rather than to quickly respond to the threat, which may also explain why only patients with contamination-related symptoms who do not show checking-related symptoms react more slowly to contamination-related stimuli irrespective of response direction. In patients with checking-related symptoms, more than in patients with contamination-related symptoms, approach may be the best means to escape a dangerous situation. For example, in the case of fire, approaching and extinguishing the fire prevents the harm whereas approaching a possibly blood-stained object could cause harm. Similar behaviors may also be true for healthy individuals. However, based on cognitive-behavioral models of OCD (Rachman, 2002; Salkovskis & McGuire, 2003), we would expect behavioral tendencies to differ between patients and healthy controls for two reasons. First, it can be expected that the misinterpretation of intrusive thoughts leads to perceiving checking-related stimuli as more threatening. Healthy controls may not react with approach behavior to an object such as a stove or a window, but patients might perceive these objects as dangerous, which might trigger approach behavior. This difference in perception between patients with OCD and healthy controls is supported by the explicit ratings in our study, in which patients rated OCD-related pictures as more negative than healthy controls did. Second, we would expect stronger reactions (avoidance or neutralizing behavior) to a potentially dangerous stimulus in patients with OCD compared to healthy controls (Morillo, Belloch, & Garcıa-Soriano, 2007).

Limitations and Future Studies

Our study has a number of limitations. First, we only included checking- and contamination-related stimuli. Another subtype that shows a high prevalence in people with OCD is symmetry and ordering (57%, Ruscio et al., 2010), which should be included in future studies. Second, we included only six words and six pictures as contamination- and as checking-related stimuli. Even though we did not hypothesize a different effect of the stimulus mode on behavioral tendencies in the two subtype subgroups, the number of words and pictures might not have been enough to find an effect. Furthermore, we did not have a preliminary expert rating of the level of threat the patients would perceive in response to the stimuli. However, as psychologists had rated the stimuli according to personal valence (positive to negative), we believe that we did achieve a similar rating. In addition, future studies should create an AAT using idiosyncratic material tailored to the specific symptoms of the individual.

Third, even though we did not use difference scores for our analyses, the moderate reliabilities of the difference scores may have affected our results as our analyses relied on detecting differences between the groups. Even though previous studies using RT tasks have found similar or even lower reliability scores (for an overview on the dot-probe task, see Rodebaugh et al., 2016), the moderate reliabilities of the difference scores in our study underlines the problem of relying on these tasks to test the underlying theories. Scores with low reliabilities cause difficulties, especially when the scores are used for mediation analyses or selection of individuals for personalized treatment. Future studies using the AAT should report the reliabilities and attempt to improve the reliability of the AAT. For an overview of the difficulties of unreliable measures and ways to overcome them, see Rodebaugh et al. (2016). The unacceptably low reliability of the difference score of neutral measures might be explained by the fact that we would assume consistent tendencies to push or pull OCD-related material, whereas we would not expect a difference on neutral trials. Thus, the low reliability score might even reflect the difference of behavioral tendencies between neutral and OCD-related trials. Moreover, the construct validity of the AAT is not well established. Previous studies have assessed the incremental validity of the AAT in explaining behavior above explicit measures (Rinck & Becker, 2007). It would, however, be desirable to test whether the AAT indeed assesses implicit processes (see Borsboom, 2006). Fourth, we did not include a clinical control group in our study. The inclusion of patients with anxiety disorders, in particular, might have helped to further support the differentiation between OCD and anxiety disorders in the DSM-5 (American Psychiatric Association, 2013). A group of patients with depression could have helped further understanding of whether the general slowing of the RT resulted from OCD or depression. However, as symptoms of depression did not correlate with the RTs of pushing or pulling in the different categories of the AAT, a significant effect of depression on subtype-specific RTs in our sample is unlikely. The lack of a correlation appears to indicate that depression would not explain the results. Fifth, the diagnostic sessions were not recorded. Thus, it was not possible to calculate an inter-rater reliability index for the MINI or the Y-BOCS. However, all interviewers were psychologists who had been thoroughly trained in the interviews and had previous experience in conducting them.

Clinical Implications

According to the two-process model (Strack & Deutsch, 2004), behavior is controlled by both the reflective and the impulsive systems. It is assumed that the impulsive system cannot be depicted through explicit measures such as self-report questionnaires or interviews. Our results suggest that both systems could play an important role in OCD-related approach-avoidance tendencies. The AAT might be useful as a complementary diagnostic tool and in the assessment of treatment gains in OCD. The AAT has recently been employed to modify approach-avoidance tendencies and to change behavioral tendencies in various disorders (e.g., Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011; Wittekind, Feist, et al., 2015). Especially in patients with alcohol-use disorders the AAT has successfully been employed as a complementary instrument to support symptom reduction in psychotherapy (Wiers et al., 2011). In comparison to the assessment AAT used in this study, in which participants pushed and pulled an equal number of OCD-related and neutral stimuli, the training AAT involves participants pulling mainly pictures of one type (e.g., non-alcohol-related) and pushing mainly pictures of another type (e.g., alcohol-related). Furthermore, the training AAT shows positive results in subclinical individuals with contamination concerns (Amir, Kuckertz, & Najmi, 2013). This study represents an important first step in showing that training with an AAT could reduce pathological behavioral tendencies and, more importantly, overt behaviors in individuals with OCD. However, provided that our results are replicated in another study, they suggest that patients with OCD, at least those with checking-related symptoms, should be trained to avoid rather than approach OCD-related material.

Conclusion

This is the first study using the AAT to test implicit approach-avoidance tendencies in patients with two different subtypes of OCD. It is the first study to incorporate stimuli of more than one subtype, namely, checking-related and contamination-related stimuli. Contrary to our expectations, patients with contamination-related symptoms of OCD showed a generally slower response to contamination-related stimuli, irrespective of response direction, whereas patients with checking-related symptoms of OCD approached checking-related stimuli more quickly and avoided them more slowly compared to neutral stimuli. No response bias was detected in the healthy control group. These results suggest a biased approach-avoidance tendency in patients with checking-related but not contamination-related symptoms of OCD when using an implicit measure. If replicated, our results suggest that the AAT could be useful in the assessment of treatment gains as well as in developing add-on trainings for psychotherapeutic treatment of patients with OCD.

References

Abramowitz, J. S., & Deacon, B. J. (2006). Psychometric properties and construct validity of the Obsessive-Compulsive Inventory-Revised: Replication and extension with a clinical sample. *Journal of Anxiety Disorders*, *20*, 1016–1035. http://doi.org/10.1016/j.janxdis.2006.03.001

Abramowitz, J. S., Fabricant, L. E., Taylor, S., Deacon, B. J., McKay, D., & Storch, E. A. (2014). The relevance of analogue studies for understanding obsessions and compulsions. *Clinical Psychology Review*, *34*(3), 206–217. http://doi.org/10.1016/j.cpr.2014.01.004

Abramowitz, J. S., & Jacoby, R. J. (2015). Obsessive-Compulsive and Related Disorders: A Critical Review of the New Diagnostic Class. *Annual Review of Clinical Psychology*, *11*(1), 165–186. http://doi.org/10.1146/annurev-clinpsy-032813-153713

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: American Psychiatric Association.

Amir, N., Kuckertz, J. M., & Najmi, S. (2013). The effect of modifying automatic action tendencies on overt avoidance behaviors. *Emotion*, *13*(3), 478–84. http://doi.org/10.1037/a0030443

Bartoszek, G., & Winer, E. S. (2015). Spider-fearful individuals hesitantly approach threat, whereas depressed individuals do not persistently approach reward. *Journal of Behavior Therapy and Experimental Psychiatry*, *46*, 1–7. http://doi.org/10.1016/j.jbtep.2014.07.012

Baumeister, R. F., Vohs, K. D., & Funder, D. C. (2007). Psychology as the Science of Self-Reports and Finger Movements: Whatever Happened to Actual Behavior? *Perspectives on Psychological Science*. http://doi.org/10.1111/j.1745-6916.2007.00051.x

Bloch, M. H., Landeros-Weisenberger, A., Rosario, M. C., Pittenger, C., & Leckman, J. F. (2008). Meta-analysis of the symptom structure of obsessive-compulsive disorder. *American Journal of Psychiatry*, *165*(12), 1532–1542. http://doi.org/10.1176/appi.ajp.2008.08020320

Borsboom, D. (2006). The attack of the psychometricians. *Psychometrika*, *71*(3), 425–440. http://doi.org/10.1007/s11336-006-1447-6

Collins, A. M., & Loftus, E. F. (1975). A spreading-activations theory of semantic processing. *Psychological Review*, *82*(6), 407–428. http://doi.org/10.1037//0033-295X.82.6.407

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

Lawrence Erlbaum.

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. (2002). *Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Patient Edition. (SCID-I/P)*. New York: Biometrics Research, New York State Psychiatric Institute.

Fleurkens, P., Rinck, M., & Minnen, A. Van. (2014). Implicit and explicit avoidance in sexual trauma victims suffering from posttraumatic stress disorder: a pilot study. *European Journal of Psychotraumatology*, *5: 21359*. http://doi.org/10.3402/ejpt.v5.21359

Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., & Salkovskis, P. M. (2002). The Obsessive-Complusive Inventory: Development and validation of a short version. *Psychological Assessment*, *14*(4), 485–495. http://doi.org/10.1037//1040-3590.14.4.485

Foa, E. B., Kozak, M. J., Barlow, D., Cuthbert, B., Foa, U., Hallam, D., … Persons, J. (1986). Emotional Processing of Fear : Exposure to Corrective Information. *Psychological Bulletin*, *99*(1), 20–35. http://doi.org/10.1037/0033-2909.99.1.20

Gönner, S., Leonhart, R., & Ecker, W. (2008). The Obsessive-Compulsive Inventory-Revised (OCI-R): Validation of the German version in a sample of patients with OCD, anxiety disorders, and depressive disorders. *Journal of Anxiety Disorders*, *22*, 734–749. http://doi.org/10.1016/j.janxdis.2007.07.007

Hand, I., & Büttner-Westphal, H. (1991). Die Yale-Brown Obsessive Compulsive Scale (Y-BOCS): Ein halbstrukturiertes Interview zur Beurteilung des Schweregrades von Denk- und Handlungszwängen. *Verhaltenstherapie*, *1*(3), 223–225. http://doi.org/http://dx.doi.org/ 10.1159/000257972.

Heuer, K., Rinck, M., & Becker, E. S. (2007). Avoidance of emotional facial expressions in social anxiety: The Approach-Avoidance Task. *Behaviour Research and Therapy*, *45*, 2990–3001. http://doi.org/10.1016/j.brat.2007.08.010

Jelinek, L., Hauschildt, M., Hottenrott, B., Kellner, M., & Moritz, S. (2014). Further evidence for biased semantic networks in obsessive-compulsive disorder (OCD): When knives are no longer associated with buttering bread but only with stabbing people. *Journal of Behavior Therapy and Experimental Psychiatry*, *45*(4), 427–434. http://doi.org/10.1016/j.jbtep.2014.05.002

Katerberg, H., Delucchi, K. L., Stewart, S. E., Lochner, C., Denys, D. A. J. P., Stack, D. E., … Cath, D. C. (2010). Symptom dimensions in OCD: Item-level factor analysis and heritability estimates. *Behavior Genetics*, *40*(4), 505–517. http://doi.org/10.1007/s10519-010-9339-z

Kessler, R. C., Petukhova, M., Sampson, N. A., Zaslavsky, A. M., & Wittchen, H. U. (2012). Twelve-month and lifetime prevalence and lifetime morbid risk of anxiety and mood disorders in the United States. *International Journal of Methods in Psychiatric Research*, *21*, 169–184. http://doi.org/10.1002/mpr.1359

Kühner, C., Bürger, C., Keller, F., & Hautzinger, M. (2007). Reliabilität und Validität des revidierten Beck-Depressionsinventars (BDI-II). *Nervenarzt*, *78*, 651–656.

Külz, A. K., Landmann, S., Cludius, B., Hottenrott, B., Rose, N., Heidenreich, T., … Moritz, S. (2014). Mindfulness-based cognitive therapy in obsessive-compulsive disorder: protocol of a randomized controlled trial. *BMC Psychiatry*, *14*, 1–9. http://doi.org/10.1186/s12888-014-0314-8

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

Mataix-Cols, D., Conceicao do Rosario-Campos, M., & Leckman, J. F. (2005). A Multidimenionsal Model of Obsessive-Compulsive Disorder. *The American Journal of Psychiatry*, *162*(2), 228–238. http://doi.org/10.1176/appi.ajp.162.2.228

McKay, D., Abramowitz, J. S., Calamari, J. E., Kyrios, M., Radomsky, A., Sookman, D., … Wilhelm, S. (2004). A critical evaluation of obsessive-compulsive disorder subtypes: Symptoms versus mechanisms. *Clinical Psychology Review*, *24*(3), 283–313. http://doi.org/10.1016/j.cpr.2004.04.003

Morillo, C., Belloch, A., & Garcı, G. (2007). Clinical obsessions in obsessive – compulsive patients and obsession-relevant intrusive thoughts in non-clinical , depressed and anxious subjects : Where are the differences ?, *45*, 1319–1333. http://doi.org/10.1016/j.brat.2006.11.005

Morillo, C., Belloch, A., & Garcıa-Soriano, G. (2007). Clinical obsessions in obsessive – compulsive patients and obsession-relevant intrusive thoughts in non-clinical, depressed and anxious subjects: Where are the differences?, *45*(6), 1319–1333. http://doi.org/10.1016/j.brat.2006.11.005

Moritz, S., Von Mühlenen, A., Randjbar, S., Fricke, S., & Jelinek, L. (2009). Evidence for an attentional bias for washing- and checking-relevant stimuli in obsessive-compulsive disorder. *Journal of the International Neuropsychological Society : JINS*, *15*(3), 365–371. http://doi.org/10.1017/S1355617709090511

Najmi, S., Kuckertz, J. M., & Amir, N. (2010). Automatic avoidance tendencies in individuals with contamination-related obsessive-compulsive symptoms. *Behaviour Research and*

Therapy, *48*(10), 1058–62. http://doi.org/10.1016/j.brat.2010.06.007

Pergamin-Hight, L., Naim, R., Bakermans-Kranenburg, M. J., van IJzendoorn, M. H., & Bar-Haim, Y. (2015). Content specificity of attention bias to threat in anxiety disorders: A meta-analysis. *Clinical Psychology Review*, *35*, 10–18. http://doi.org/10.1016/j.cpr.2014.10.005

Phaf, H. R., Mohr, S. E., Rotteveel, M., & Wicherts, J. M. (2014). Approach, avoidance, and affect: A meta-analysis of approach-avoidance tendencies in manual reaction time tasks. *Frontiers in Psychology*, *5*, 1–16. http://doi.org/10.3389/fpsyg.2014.00378

Rachman, S. (2002). A cognitive theory of compulsive checking. *Behaviour Research and Therapy*, *40*(6), 625–639. http://doi.org/10.1016/S0005-7967(01)00028-6

Radke, S., Güths, F., André, J. A., Müller, B. W., & de Bruijn, E. R. A. (2014). In action or inaction? Social approach-avoidance tendencies in major depression. *Psychiatry Research*, *219*(3), 513–7. http://doi.org/10.1016/j.psychres.2014.07.011

Reinecke, A., Becker, E. S., & Rinck, M. (2010). Three Indirect Tasks Assessing Implicit Threat Associations and Behavioral Response Tendencies. *Journal of Psychology*, *218*, 4–11. http://doi.org/10.1027/0044-3409/a000002

Rinck, M., & Becker, E. S. (2007). Approach and avoidance in fear of spiders. *Journal of Behavior Therapy and Experimental Psychiatry*, *38*, 105–120. http://doi.org/10.1016/j.jbtep.2006.10.001

Rodebaugh, T. L., Scullin, R. B., Langer, J. K., Dixon, D. J., Huppert, J. D., Bernstein, A., … Lenze, A. (2016). Unreliability as a Threat to Understanding Psychopathology: The Cautionary Tale of Attentional Bias. *Journal of Abnormal Psychology*, *125*(6), 840–851. http://doi.org/10.1037/abn0000184

Roelofs, K., Putman, P., Schouten, S., Lange, W.-G., Volman, I., & Rinck, M. (2010). Gaze direction differentially affects avoidance tendencies to happy and angry faces in socially anxious individuals. *Behaviour Research and Therapy*, *48*(4), 290–4. http://doi.org/10.1016/j.brat.2009.11.008

Ruscio, A. M., Stein, D. J., Chiu, W. T., & Kessler, R. C. (2010). The epidemiology of obsessive-compulsive disorder in the National Comorbidity Survey Replication. *Psychiatry Research*, *15*(1), 53–63. http://doi.org/10.1038/mp.2008.94

Salkovskis, P. M., & McGuire, J. (2003). Cognitive-behavioural theory of OCD. In R. G. Menzies & P. De Silva (Eds.), *Obsessive-compulsive Disorder: theory, research and treatment* (pp. 59–78). Chichester: Wiley.

Schmidt, K.-H., & Metzler, P. (1992). *Wortschatztest (WST)*. Weinheim: Beltz Test GmbH.

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., … Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of Clinical Psychiatry*, *59*(SUPPL. 20), 22–33. http://doi.org/10.1016/S0924-9338(99)80239-9

Simon, D., Kischkel, E., Spielberg, R., & Kathmann, N. (2012). A pilot study on the validity of using pictures and videos for individualized symptom provocation in obsessive-compulsive disorder. *Psychiatry Research*, *198*, 81–88. http://doi.org/10.1016/j.psychres.2011.12.022

Sizino Da Victoria, M., Nascimento, A. L., & Fontenelle, L. F. (2012). Symptom-specific attentional bias to threatening stimuli in obsessive-compulsive disorder. *Comprehensive Psychiatry*, *53*(6), 783–788. http://doi.org/10.1016/j.comppsych.2011.12.005

Stein, D. J., Fineberg, N. a., Bienvenu, O. J., Denys, D., Lochner, C., Nestadt, G., … Phillips, K. A. (2010). Should OCD be classified as an anxiety disorder in DSM-V? *Depression and Anxiety*, *27*(6), 495–506. http://doi.org/10.1002/da.20699

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, *8*, 220–247. http://doi.org/10.1207/s15327957pspr0803_1

Voncken, M. J., Rinck, M., Deckers, a, & Lange, W.-G. (2012). Anticipation of Social Interaction Changes Implicit Approach-Avoidance Behavior of Socially Anxious Individuals. *Cognitive Therapy and Research*, *36*(6), 740–749. http://doi.org/10.1007/s10608-011-9408-5

Wiers, R. W., Eberl, C., Rinck, M., Becker, E. S., & Lindenmeyer, J. (2011). Retraining Automatic Action Tendencies Changes Alcoholic Patients' Approach Bias for Alcohol and Improves Treatment Outcome. *Psychological Science*, *22*(4), 490–497. http://doi.org/10.1177/0956797611400615

Wittekind, C. E., Behmer, F., Muhtz, C., Fritzsche, A., Moritz, S., & Jelinek, L. (2015). Investigation of automatic avoidance in displaced individuals with chronic Posttraumatic Stress Disorder (PTSD). *Psychiatry Research*, *228*(3), 887–893. http://doi.org/10.1016/j.psychres.2015.05.003

Wittekind, C. E., Feist, A., Schneider, B. C., Moritz, S., & Fritzsche, A. (2015). The approach-avoidance task as an online intervention in cigarette smoking: A pilot study. *Journal of Behavior Therapy and Experimental Psychiatry*, *46*, 115–120. http://doi.org/10.1016/j.jbtep.2014.08.006

Table 1
Demographic and Psychopathological Data: Mean (Standard Deviation)

	OCD patients (n = 63)	Healthy controls (n = 30)	Statistics
Demographic characteristics			
Age	39.16 (12.35)	37.30 (12.73)	$t(91) = 0.67$, $p = .50$
Education (years)	15.60 (3.29)	16.35 (2.65)	$t(91) = 1.09$, $p = .28$
Sex (m/f)	27/36	12/18	$\chi^2(1) = 0.07$, $p = .79$
Verbal intelligence (WST)	107.25 (9.70)	108.33 (8.98)	$t(91) = 0.51$, $p = .61$
Psychopathology			
OCI-R total	25.27 (11.28) *	6.97 (5.94)	$t(87) = 8.30$, $p = .001$
OCI-R washing	4.92 (4.14) *	0.70 (1.02)	$t(87) = 5.48$, $p < .001$
OCI-R obsessing	6.80 (3.56) *	1.10 (1.81)	$t(87) = 8.22$, $p < .001$
OCI-R hoarding	3.10 (3.35) *	1.00 (1.46)	$t(87) = 3.28$, $p = .002$
OCI-R ordering	3.14 (3.13) *	2.33 (2.59)	$t(87) = 1.21$, $p = .23$
OCI-R checking	5.69 (3.57) *	1.57 (1.89)	$t(86) = 5.90$, $p < .001$
OCI-R neutralizing	2.83 (3.05) *	0.53 (1.22)	$t(87) = 3.96$, $p < .001$
BDI-II total	19.68 (11.34)*	3.00 (4.32)	$t(87) = 7.76$, $p < .001$

Note: m = male; f = female; OCD = obsessive-compulsive disorder; WST = Test of Word Power; Y-BOCS = Yale-Brown Obsessive Compulsive Scale; OCI-R = Obsessive-Compulsive Inventory Revised; BDI-II = Beck Depression Inventory-II.
* based on n = 59.

Table 2

Overview of the Contamination-Related, Checking-Related, and Neutral Words (English Translation with German Original in Parentheses) and Pictures Used in the AAT, with Examples of the Pictures Below[6]

	Contamination	*Checking*	*Neutral*
Words			
	Touch (Berührung)	Fire (Brand)	Toy brick (Bauklotz)
	Blood (Blut)	Theft (Diebstahl)	Hole puncher (Locher)
	Dirt (Dreck)	Stove (Herd)	Bowl (Schale)
	Pathogen (Erreger)	Damage (Schaden)	Umbrella (Schirm)
	Germs (Keime)	Key (Schlüssel)	Chair (Stuhl)
	Toilet (Toilette)	Door (Tür)	Dice (Würfel)
Pictures			
	Dirty rags	Keys in the grass	Laptop case
	Blood samples	Broken Cable	Umbrella
	Clean Toilet	Open Window	Object 1
	Handshake	Stove	Object 2
	Dirty toilet	Fire	Object 3
	Sink	Fire in a pan	Basket

Contamination


(Stille Mahnung[2])


(Simon et al., 2012)


(Simon et al., 2012)


(Simon et al., 2012)


(Simon et al., 2012)


(Spülbecken[3])

Checking

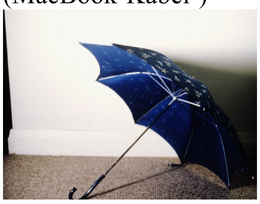

(Simon et al., 2012)

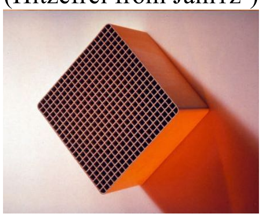

(MacBook-Kabel[4])


(Hitzefrei from Jam1z[5])

Neutral

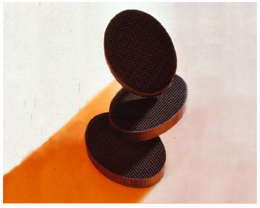

(Macbook Tasche[6])


(Lang et al., 1999)


(Lang et al., 1999)

[6] The first author will gladly provide the remaining pictures upon request.

(Lang et al., 1999)



(Lang et al., 1999)

Note. All photographs are used under Creative Commons Attribution-NonCommerical 2.0 (https://creativecommons.org/licenses/by-nc/2.0/). 1 The first author will gladly provide the remaining pictures upon request. 2 Stille Mahnung, Frankfurt/Main, 2009, by Spiegelneuronen, 2009 [https://www.flickr.com/photos/spiegelneuronen/4124744694/in/photolist-7hqrXc-7huoTQ] Used under Creative Commons Attribution-NonCommerical 2.0. 3 Spülbecken, by Thomas Renger, 2007 [https://www.flickr.com/photos/steinhobelgruen/581314019/in/photolist-pc6Sx4-jj7J7N-fmkXaa-p91awa-pqtuKe-4U1S2Y-d7bxffeu81H4–3Cw93t-fTY2e4-Tnopv-HiQhBf-5Ytji3–9m7jHK-5A5SYz4d2MYM-4dwrR7-gE4rA-4dst3e-f7Ls3B-7ELNdG-7ZXNZe-J3owp1–7z31C9-buzvfp-jkwajP5EiQFr-9T9nzD-jXnEX-3SEFAA-6mpt4f-f7K6WB-dgnkCjofGWg7-qwWa1n-bWoCsh-e1JM9y-9kvMEn-GipQuv-a6SWvQ-4d2N4P-oeWvZe-7Ksf1o-4WSM5n-4NXvqQ-7GW1DD-3Jqbt5-fWCVSz7Ksf5E-Fv4SX]. 4 MacBook-Kabel, zerkaut, by es-de-we, 2009, [https://www.flickr.com/photos/es-de-we/4219373089/in/photolist-7qRoBT]. 5 Hitzefrei by Jam1z, 2009, [https://www.flickr.com/photos/jam1z/3657429165/in/photolist-6zchgx]. 6 Macbook Tasche von Waterkant Deichkönig, by Sebastian Michalke, 2013 [https://www.flickr.com/photos/56093900@N03/10950014856/in/photolist-hFBo1X-hFCBsc-hFCdD7-hFBG1q-hFCdujhFBFVA].
The remaining 8 pictures were taken from picture sets (IAPS and BOCD), which were created for open dissemination for academic research.

Table 3

Internal Consistencies (Cronbach´s α) for Each Combination of Response Direction and Stimulus Type Used in the AAT

Response Direction	Stimulus Type	Cronbach's α
Pull	Contamination	α = .94
Pull	Checking	α = .89
Pull	Neutral	α = .93
Push	Contamination	α = .79
Push	Checking	α = .89
Push	Neutral	α = .88
Push – Pull	Contamination	α = .73
Push – Pull	Checking	α = .69
Push – Pull	Neutral	α = .30

Note: Push – Pull = internal consistencies were calculated using difference scores (push – pull) for each stimulus within each category.

Appendix C

Cludius, B., Schmidt, A. F., Moritz, S., Banse, R., & Jelinek, L. (2017). Implicit aggressiveness in patients with obsessive-compulsive disorder as assessed by an Implicit Association Test. *Journal of Behavior Therapy and Experimental Psychiatry*, *55*, 106–112.

Implicit aggressiveness in patients with obsessive-compulsive disorder as assessed by an Implicit Association Test

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Abstract

Background and objectives: Cognitive models of obsessive-compulsive disorder (OCD) highlight the role of cognitive biases for the development of the disorder. One of these biases, an inflated sense of responsibility has been associated with higher anger scores and latent aggression on self-report scales, especially in patients with compulsive checking. Validity of self-report assessment is, however, compromised by inaccuracy, social desirability, and low metacognitive awareness of traits and behaviors in patients. The aim of the present study was to extend the research on latent aggression in individuals with OCD by using an indirect, implicit measure of aggression.

Methods: Fifty-eight patients with OCD and 25 healthy controls were assessed with an Aggressiveness-Implicit Association Test (IAT), which is a reaction time task that assesses the strength of associations between the concept of "aggressiveness" and "me" compared to others.

Results: Contrary to our expectation, OCD patients with checking symptoms showed a more peaceful implicit self-concept than healthy controls. This result was corroborated by negative correlations between checking symptoms and implicit aggressiveness in the OCD sample.

Limitations: No self-report measures on aggression or anger were included in the study.

Conclusions: In comparison to previous research using self-report measures, our study indicates that implicit aspects of aggression do indeed differ from controlled aspects in patients with checking compulsions. Future research is necessary to better understand the role of aggressiveness in OCD and to derive implications for therapy.

Keywords: aggressiveness; anger; implicit association test; IAT; obsessive-compulsive disorder; checking

1. Introduction

Obsessive-compulsive disorder (OCD) is characterized by unwanted intrusive thoughts, impulses or images (obsessions), and/or repetitive, often ritualistic behaviors with the purpose of neutralizing the obsessive content or preventing an unlikely event. The content of obsessions can vary widely. Common themes of obsessions involve aggression, contamination, as well as sexual or blasphemous thoughts. Compulsions are equally diverse and involve overt behavior, for example, washing, checking as well as ordering, and/or covert behavior, for example, to actively evoke a certain phrase or image in one's mind (American Psychiatric Association, 2013).

Due to the diversity and complexity of symptoms and subtypes in OCD, it has been difficult to derive a psychological model of OCD that explains all the observed phenomenology. Freud (1909) referred to the role of love and hate with a strong repression of hate as an underlying conflict of OCD. He further claimed that hypermorality ("Übermoral") was characteristic for individuals with OCD. This concept is further pursued by psychodynamic models of OCD suggesting that hypermorality is a reaction formation to repressed aggressive and erotic impulses. This aggression is expected to be directed towards others, not openly expressed but manifests in fantasies or forms unavailable to consciousness (i.e. latent aggression). It is assumed that instead of dealing with it adaptively, individuals with OCD strongly repress aggressive impulses (for an overview see Kempke & Luyten, 2007).

More recent cognitive models posit that obsessions partly arise due to cognitive biases. One of these cognitive biases is an inflated sense of responsibility, according to which patients evaluate thoughts in terms of potential harm to themselves or others for which they are personally responsible (Obsessive Compulsive Working Group, 1997; Rachman, 1993, 1997, 2002; Salkovskis, 1985, 1989, 1996). This inflated sense of responsibility has been associated with several subtypes of OCD (Salkovskis, 1985), but has been most strongly related to checking compulsions (Foa, Sacks, Tolin, Prezworski, & Amir, 2002; Rachman, 2002). Notably, Rachman (1993) further proposed that this inflated sense of responsibility might be associated with higher anger scores as persons with OCD assign the blame for their obsessional thoughts internally rather than externally.

In line with the assumptions by Rachman (1993) and supporting the assumptions by Freud (1909), OC symptoms, especially checking, were associated with higher anger in empirical studies. College students scoring high on self-report measures of OC symptoms reported higher levels of anger compared to students without OC symptoms. These differences, however, disappeared after controlling for depression, with the exception of OC checking, which remained to be independently associated with anger (Whiteside & Abramowitz, 2004). Similar results were obtained in a clinical sample, however, in this study the relation between subtypes of OCD and anger was not directly assessed (Moscovitch, McCabe, Antony, Rocca, & Swinson, 2008). In a study that exclusively included individuals with substantial checking compulsions, “checkers” reported greater trait anger than a student control group. Surprisingly greater self-reported checking was associated with less trait anger in “checkers” (Radomsky, Ashbaugh, & Gelfand, 2007). In contrast to the results reported above, in a study by Whiteside and Abramowitz (2005) patients with OCD showed only minimally higher levels of self-reported anger, compared to a healthy control group, which were attributable to general distress. However, as general distress may be a consequence of anger, controlling for distress may have removed criterion variance. In adolescent in-patients with OCD, anger was not explicitly assessed. However, on a self-report scale of aggression no differences between patients with OCD and psychotic in-patients or healthy controls emerged (Shoval, Zalsman, Sher, Apter, & Weizman, 2006).

Additionally, following Freud's assumptions (1909) suppressed anger (or latent aggression) has been investigated in OCD by using self-report measures that include subscales assessing “inner experience of anger vs. outward expression of anger” (State-Trait Anger Expression Inventory-Research Edition in Whiteside & Abramowitz, 2004 and in Radomsky, Ashbaugh, Gelfand, & a, 2007), “anger inwardly suppressed” (Aggression Questionnaire in Moscovitch et al., 2008), or “latent aggression” (Responsibility and Interpersonal Behaviors and Attitudes Questionnaire in Moritz et al., 2009, Moritz, Kempke, Luyten, Randjbar, & Jelinek, 2011). Students scoring high in OCD as well as patients with OCD reported a greater tendency to suppress or internalize their anger compared to healthy controls (Moscovitch et al., 2008; Whiteside & Abramowitz, 2004). Inflated latent aggression towards others was assessed in an online study in patients with OCD compared to healthy and psychiatric controls (Moritz et al., 2009). Results were replicated and extended in a study including in-person assessment; patients with OCD showed higher scores on latent aggression compared to healthy controls (Moritz et al., 2011). Moreover, in patients with OCD the suppression of anger was associated with the tendency to believe that bad thoughts have moral significance or increase the risk of harm (Whiteside & Abramowitz, 2005) and in patients with checking-related symptoms of OCD perfectionism and intolerance of uncertainty were associated with suppression of anger (Radomsky et al., 2007). Thus, suppressed anger was repeatedly found to be associated with OCD and especially checking-related symptoms of OCD.

All of the studies above used self-report questionnaires to assess anger and suppressed (latent) aggression in participants with OCD. However, one major disadvantage of self-report assessment is that it is confounded by imprecise reporting or social desirability (Greenwald & Farnham, 2000), which is especially relevant when assessing normatively disapproved dispositions, such as, trait-aggressiveness. Further, self-report measures rely on metacognitive awareness, but some traits or behaviors cannot easily be accessed by individuals themselves (Baumeister, Vohs, & Funder, 2007). To address some of the issues inherent in using self-report measures, recent research has used indirect measures. Here, instead of directly asking the participant, the implicit associations and precursors of behavior are derived from seemingly unrelated responses to stimuli (Nosek, Hawkins, & Frazier, 2011).

According to the Reflective-Impulsive Model (Strack & Deutsch, 2004), behavior is shaped by two complementary information processing systems. The impulsive system is fast requiring no attentional resources. It generates behavior through an immediate appraisal of the stimulus leading to a motivational orientation and corresponding co-activation of behavioral schemata. In the reflective system, behavior is driven by knowledge about facts and values and is a consequence of deliberate decision processes. In line with the model, research suggests that automatic (Banse, Messer, & Fischer, 2015; Richetin, Richardson, & Mason, 2010) as well as controlled (e.g., Bettencourt & Miller, 1996; Schmidt, Zimmermann, Banse, & Imhoff, 2015) precursors of reactive aggression, determine whether an individual will show overt aggressive behavior or suppress aggressive tendencies. To fully understand aggression, it is important to assess both reflective as well as impulsive precursors of aggressive behavior. While explicit self-ratings serve to reveal more reflective processes, implicit measures tap more into automatic or associative processes in the impulsive system (e.g., Asendorpf, Banse, & Mücke, 2002; Krieglmeyer, Wittstadt, & Strack, 2009).

Among various implicit measures that have been developed, the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) has shown superior psychometric properties compared to other implicit paradigms (Bar-Anan & Nosek, 2014). The IAT has previously been employed to assess implicit associations between aggressive behavior and the self (Banse et al., 2015; Grumm, Hein, & Fingerle, 2011; Richetin et al., 2010; Schmidt et al., 2015). It has been shown to predict overt and observable aggressive behavior (Banse et al., 2015), negative evaluation of an experimenter (i.e. opportunity for aggressive behavior) who provoked the participant (Richetin et al., 2010) and reactive aggression under impeded self-regulatory resources (Schmidt et al., 2015).

The aim of the present study was to shed further light onto the dynamics of (latent) aggression in OCD by using an indirect, implicit measure of aggression. To this end, patients with OCD and healthy controls were tested with a modified version of the Aggressiveness-IAT (Agg-IAT; Schmidt et al., 2015). As no previous study has used implicit measures to assess aggression in OCD, we based our hypothesis on psychodynamic and cognitive theories and previous research using self-report measures. We assumed higher implicit aggression for patients with OC checking symptoms (as assessed with the Obsessive-Compulsive Inventory Revised) compared to healthy controls when assessed with the Agg-IAT. In patients with OCD, we further expected a positive association between checking symptoms and aggression scores on the Agg-IAT.

2. Methods

2.1 Participants

The sample consisted of 58 patients with obsessive-compulsive disorder (OCD) and 25 healthy controls. Patients were recruited via the cognitive behavioral ward of the Clinic for Psychiatry and Psychotherapy of the University Medical Center Hamburg-Eppendorf, Germany, or local cognitive behavioral therapy (CBT) therapists. Healthy controls were recruited through leaflets, word of mouth, and an established subject pool. Participants were excluded if they met any of the following exclusion criteria: younger than 18 years or older than 68 years, any neurological disorder, psychotic symptoms, mania, current substance or alcohol dependence or mental retardation (IQ lower than 70). Participants were tested individually. After giving informed consent, they filled out several questionnaires (see below). After a short sociodemographic interview and psychopathological interviews (MINI and in patients also the Y-BOCS and HDRS, see below), participants were assessed with the Agg-IAT (see below) using a laptop, as well as other experimental tasks (which have been reported elsewhere; Jelinek, Hauschildt, Hottenrott, Kellner, & Moritz, 2014).

2.2. Measures

Using the Mini International Neuropsychiatric Interview (MINI; Sheehan et al., 1998), OCD diagnosis was verified in patients, whereas control participants were excluded in case of any psychological disorder. In patients, severity of OCD symptoms was assessed using the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Goodman et al., 1989; German version by Hand & Büttner-Westphal, 1991) and the Obsessive-Compulsive Inventory Revised (OCI-R; Gönner, Leonhart, & Ecker, 2008). The OCI-R is a self-report measure that consists of 18 items rated on a 5-point Likert-scale (0= not at all to 4=extremely) and comprises six subscales: washing, checking/doubting, obsessing, mental neutralizing, ordering and hoarding, measuring the distress caused by the symptoms. The recommended cutoff scores for the subtypes are: checking = 6, washing = 3, obsessions = 5, hoarding = 5, ordering = 7, neutralizing = 3 (Gönner, Leonhart, & Ecker, 2007). The inventory shows good to excellent psychometric properties (Foa, Huppert, et al., 2002; Gönner et al., 2008). Symptoms of depression were assessed using the 17-item version of the Hamilton Depression Rating Scale (HDRS; Hamilton, 1960). To estimate verbal intelligence in patients and healthy controls a multiple choice vocabulary test (MWT-B; Lehrl, 1995) was used, which correlates well with global IQ in healthy adults (Lehrl, Triebig, & Fischer, 1995). According to the MINI, 36 patients with OCD fulfilled the criteria for an additional affective disorder (major depression or dysthymia) and 36 fulfilled the criteria for an additional anxiety disorder. Written informed consent was obtained from all participants before assessment. The study was approved by the Ethics Committee of the Medical Board Hamburg, Germany.

2.3. Implicit Association Test (IAT)

The Implicit Association Test (IAT) measures automatic associations in memory. It is a reaction time task that reflects strength of associations between different concepts. The IAT was administered using the program Inquisit ("Inquisit, Version 1.32", 2001). Stimuli from the target categories "me" and "others" and the descriptor categories "peaceful" and "aggressive" were presented (stimuli are shown in Table 1). Similar to previous studies using the Agg-IAT (Banse et al., 2015; Schmidt et al., 2015), the "me" dimension consisted of German words associated to the self (me) and occupational labels (others). The occupational labels had been pre-rated as professions with medium scores on the aggressive-peaceful dimension. They were chosen for the "others" dimension in the IAT instead of the more commonly used labels of "them" and "others" to ensure that participants would not associate "others" with particularly aggressive or peaceful persons. The original version of the Agg-IAT (Banse et al., 2015) uses only male occupational labels. As we tested both male and female participants and the German language allows gendered occupational labels, we used a modified version, which includes half female and half male occupational labels (Schmidt et al., 2015). In a pre-test the peaceful-aggressive dimension had an internal consistency of α =.94 (*N*=21, male raters).

Table 1. Target and Attribute Stimuli Used in the IAT.

Target stimuli		**Attribute stimuli**	
Me	Others	Peaceful	Aggressive
Me (mir)	Architect (Architektin)	Talk (reden)	Hunt (jagen)
My (mein)	Accountant (Buchhalter)	Conciliation (Versöhnung)	Revenge (Rache)
Me (mich)	Educator (Erzieherin)	Conversation (Gespräch)	Punch (Faustschlag)
I (ich)	Famer (Landwirt)	Exchange (Austausch)	Fight (Kampf)
Self (selbst)	Cook (Köchin)	Compromise (Kompromiss)	Hit (Schlagen)
	Gatekeeper (Pförtner)	Settlement (Einigung)	Avenge (rächen)
	Cabinet Maker (Tischlerin)	Agreement (Verständigung)	Retiliate (zurückschlagen)
	Filling station attendant (Tankwart)	Counseling (Beratung)	Threat (Drohung)
	Dentist (Zahnärztin)	Agree (einigen)	Attack (Angriff)
	Carpenter (Zimmermann)	Concede (nachgeben)	Beat (hauen)

The task consisted of five blocks. The first two blocks were practice blocks with 20 trials each. First, the allocation of stimuli into attribute categories: “Aggressive” (top left) and “peaceful” (top right) and then into target categories: “others” (top left) and “me” (top right) was practiced. In the first block each stimulus appeared once, in the second block each stimulus appeared twice. The critical blocks three and five consisted of 84 trials (the first four trials were used as practice blocks and were thus discarded from the analyses) in which participants were asked to categorize stimuli into two combined categories, with a target and attribute category assigned to the same key. In block three “aggressive” and “others” were assigned to one key and “peaceful” and “me” to the respective other. In block five “aggressive” and “me” shared on response key and “peaceful” and “others” the other key.

Block four again served as a practice block including 20 trials in which the switched key assignment (from block 3 to block 5) of the categories “aggressive” and “peaceful” was practiced. An IAT is designed so that participants can only indicate if the stimulus belongs to a category on the right or left side of the screen by pressing one of the two keys. Thus, participants “double”-classify stimuli from four concepts into two response options utilizing corresponding response keys. Shorter response latencies are expected when the category pair matches a person's implicit association.

Participants were informed that they would perform an attention test in which they would be required to sort words into categories as quickly as possible while making as little mistakes as possible. In each block the category labels were presented and remained on the top left and top right corner of the screen. The stimulus was displayed in the middle of the screen and had to be classified into the respective category. If participants pressed the wrong key a red “X” appeared and participants were required to press the other key. Once the correct key was pressed, the stimulus disappeared. The next stimulus appeared 150 ms after the correct categorization had been made. Participants were instructed to leave their fingers on the right and left key throughout the experiment to be able to respond as quickly as possible. Response latencies were the elapsed time between the start of each stimulus presentation and the correct response. The Agg-IAT shows adequate psychometric properties. Its validity was supported by correlations with self-report measures and objective indicators of aggressive behavior in several studies (Banse et al., 2015; Gollwitzer, Banse, Eisenbach, & Naumann, 2007; Schmidt et al., 2015). Correlations with explicit (self-report) measures of aggressiveness varied across several studies (Banse et al., 2015), but were in line with results of a meta-analysis indicating a large variability of implicit-explicit measures with mean correlations of $r = .24$ (Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005). More importantly, validity of the Agg-IAT was supported by the prediction of aggressive behavior and aggressiveness by the test (Banse et al., 2015; Gollwitzer et al., 2007). Even after controlling for self-reported aggressiveness, the Agg-IAT explained substantial proportions (11-15%; Banse et al., 2015) of variance concerning aggressive behavior.

2.4 Data Analysis

2.4.1 Agg-IAT Scoring

As in previous studies using the Agg-IAT, only correct responses were used for the calculations of the Agg-IAT score (Banse et al., 2015; Schmidt et al., 2015). The scoring of the Agg-IAT followed recommendations by Greenwald, Nosek, and Banaji (2003). D_2-scores were computed by subtracting mean response latencies of the incompatible trials from mean response latencies of the compatible trials divided by the pooled standard deviation of all response latencies in these blocks. Higher D_2-scores indicate faster reactions to me + aggressive/others peaceful compared to me + peaceful/others + aggressive. Thus higher D_2-scores can be interpreted as an implicit measure of a relatively increased aggressive self-concept. Based on the D_2-scores from the first and the second half of trials of the critical blocks, the internal consistency of the Agg-IAT was computed which was excellent ($\alpha = .87$).

2.4.2. Strategy of data analysis

T-tests for independent samples (to compare OCD patients and healthy controls as well as "checkers" and healthy controls) and Pearson product-moment correlations were planned. Effect sizes for *t*-test results are expressed as Cohen's *d*, whereby $d \approx 0.2$ conventionally represents a small, $d \approx 0.5$ a medium, and $d \approx 0.8$ a large effect. An alpha level of .05 (two-tailed) was used for all statistical tests.

3. Results

No differences between patients and controls emerged for any of the sociodemographic characteristics (Table 2). Average levels of patients' OC and depressive symptoms are displayed in Table 2. Y-BOCS total scores indicate that most patients displayed moderate to severe symptoms of OCD and scored above the cutoff scores on the OCI-R subscales (Gönner et al., 2007). Twenty-seven patients scored above the cutoff of six on the OCI-R subscale for checking ($M = 9.15$, $SD = 2.07$). Checkers did not significantly differ from healthy controls in any of the sociodemographic variables (all ps > .23). Patients reported mild depressive symptoms according to the HDRS.

Table 2. Sociodemographic and Psychopathological Variables. Frequencies or Means (Standard Deviations).

Variables	Patients (n = 58)	Controls (n = 25)	Statistics
Sex (male/female)	29/29	13/12	$\chi^2(1) = 0.028$, $p = .87$
Age in years	34.21 (11.36)	38.40 (11.70)	t (81) = 1.53; p = .13
Years of education	15.13 (3.53)	15.29 (2.49) [b]	t (80) = 0.21; p = .83
Verbal intelligence	101.24 (12.41)	98.00 (8.59)[c]	t (79) = 1.14; p = .26
Duration OCD (years)	15.76 (10.32)	-	
Y-BOCS total	23.72 (5.20)	-	
Y-BOCS obsessions	12.12 (2.93)	-	
Y-BOCS compulsions	11.60 (3.13)	-	
OCI-R total	29.13 (12.04)[a]	-	
OCI-R Washing	5.13 (4.53)[a]	-	
OCI-R Checking	5.86 (3.72) [a]	-	
OCI-R Obsessing	7.85 (2.81) [a]	-	
OCI-R Neutralizing	3.23 (3.35) [a]	-	
OCI-R Ordering	4.68 (3.70) [a]	-	
OCI-R Hoarding	2.41 (3.06) [a]	-	
Depression (HDRS)	12.30 (5.82)	-	

Y-BOCS = Yale-Brown Obsessive Compulsive Scale, OCI-R = Obsessive Compulsive Inventory Revised, HDRS = Hamilton Depression Rating Scale, [a] = based on 56 participants, [b] = based on 24 participants [c] = based on 23 participants

The means and standard deviations of the Agg-IAT scores are shown in Figure 1. Patients and healthy controls did not differ in their implicit aggressiveness self-concepts according to the Agg-IAT, $t(81) = 1.01$, $p = .32$, $d = 0.24$. To examine our focal hypothesis, we compared the 27 patients who scored above the cutoff on the checking subscale of the OCI-R with healthy controls. Checkers exhibited significantly lower scores on the Agg-IAT at a medium to large effect size, than the healthy controls; $t(50) = 2.39$, $p = .021$, $d = 0.66$, suggesting that checkers have a relatively less aggressive implicit self-concept than healthy controls. The error rates differed between OCD patients (*n* = 58; *M* = 0.04, *SD* = 0.04) and healthy controls (*M* = 0.07, *SD* = 0.06; *t*(81)= 3.35, *p* = .001, *d* = 0.81) and between OCD checkers (*n* = 27; *M* = 0.04; *SD* = 0.05) and healthy controls, *t*(50) = 2.10, *p* = .04, *d* = 0.59, but did not differ between OCD patients, who were not classified as checkers (*n* = 29) [7] and OCD checkers, *t*(54) = 0.96, *p* = .34, *d* = .26. No correlation emerged between the IAT-Agg scores and the error scores in OCD patients (*r* = .03, *p* = .83) OCD checkers (*r* = .11, *p* = .59) or healthy controls (*r* = .28, *p* = .17)[8].

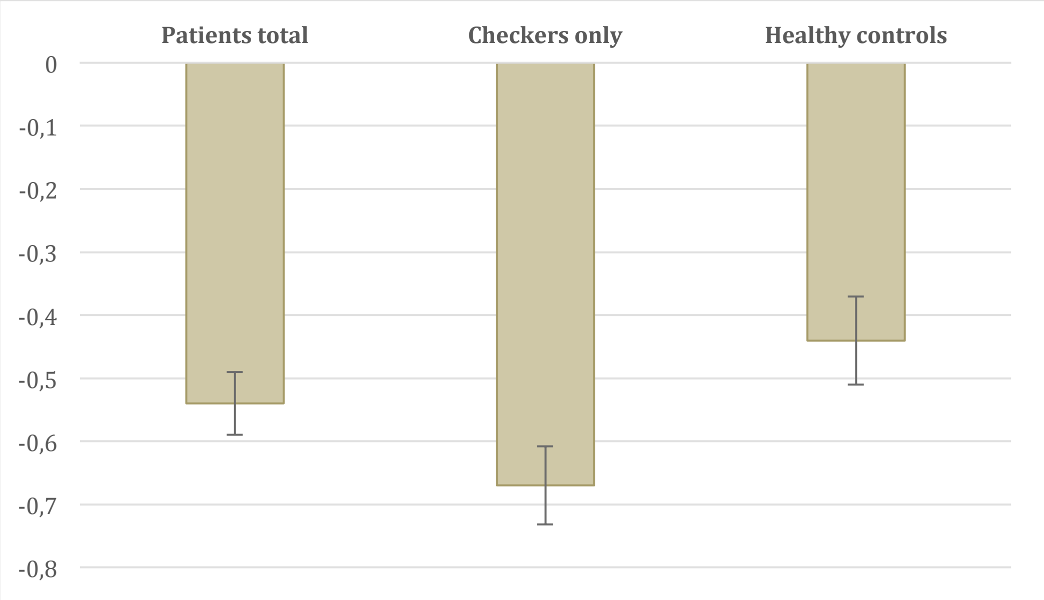

Fig. 1. D_2-scores in the Aggressiveness-IAT for all OCD patients (*n* = 58), checkers only (above cut-off score in the OCI-R subscale for checking, *n* = 27) and healthy controls (*n* = 25).

Pearson product-moment correlations were calculated between OCI-R subscales and the Agg-IAT scores. Negative correlations were found between the Agg-IAT and the checking (*r* = -.36, *p* = .007) and washing (*r* = -.27, *p* = .04) subscales of the OCI-R. The negative correlation between the total score of the OCI-R and the Agg-IAT was marginally significant (*r* = -.26, *p* = .05). No significant correlations were found for any other subscale of the OCI-R. This further indicates that higher OCD symptoms for checking are associated with lower implicit aggressiveness self-concepts. No significant correlation between Agg-IAT scores and

[7] Two patients were not included in this analyses due to missing OCI-R scores.
[8] No interactions were found on the error rates between the within-factor IAT Block and all possible contrast groups (healthy controls, OCD patients and OCD checkers, *ps* > .13). This suggests that the order effects of the IAT did not differentially influence results in the three groups.

depression according to the HRDS ($r = .04$; $p = .75$) emerged, suggesting no relation between aggressiveness self-concepts and depression in patients with OCD.

4. Discussion

This study is the first to examine automatic/implicit aspects of aggression in patients with OCD. Based on psychodynamic (Freud, 1909; Kempke & Luyten, 2007) and cognitive models of OCD (Obsessive Compulsive Working Group, 1997; Rachman, 1997; Salkovskis, 1985, 1989, 1996) as well as research on anger and aggression in OCD (Moritz et al., 2009, 2011; Moscovitch et al., 2008; Radomsky et al., 2007; Whiteside & Abramowitz, 2004), we expected that particularly patients who showed symptoms of compulsive checking would display increased implicit aggressiveness self-concepts compared to healthy controls. We further expected a positive association between compulsive checking and aggression scores on the Agg-IAT. Unexpectedly, differences in automatic aspects of aggression were contrary to our prediction. Patients with symptoms of compulsive checking showed a less aggressive implicit self-concept than healthy controls. This result was corroborated by negative correlations between the subscale for checking of the OCI-R and the Agg-IAT in the total OCD sample which again runs into the opposite direction as hypothesized. In a self-report study on anger control in OCD, higher anger scores disappeared after controlling for depression (Whiteside & Abramowitz, 2004).Contrary the association between automatic aspects of aggression and compulsive checking in the present study was not attributable to depression. Depression scores and scores on the Agg-IAT did not correlate in patients with OCD. The findings in our study stand in contrast to significant group differences when using self-report measures of anger and aggressiveness (Moritz et al., 2011, 2009; Moscovitch et al., 2008; Radomsky et al., 2007; Whiteside & Abramowitz, 2004). While a negative strength of association of checking scores and aggressiveness is in line with the study by Radomsky et al. (2007) in which the same pattern was observed when assessing anger using self-report measures.

Firstly, the discrepancy between our and previous results on aggressiveness in OCD could be attributed to differences in personal appraisal of aggressiveness in OCD patients and healthy controls. Based on our results, it is conceivable, that although individuals with compulsive checking symptoms generally have less aggressive implicit self-concepts than healthy controls, they might explicitly evaluate themselves as relatively more aggressive. This could be explained by OC checkers' high moral and/or religious standards and their strong urge to behave correctly (Rachman, 1993), once they become frustrated or angry. In addition, aggressive intrusions may be more frightening in such individuals as they run counter their less aggressive self-concepts and question the moral values of the holder. This explanation is supported by a study on emotion regulation in OCD patients that suggests that OCD is associated with a high emotional awareness paired with a low emotional clarity (Fergus & Bardeen, 2014), potentially leading to feelings of anger and aggression.

Secondly, considering cognitive models of OCD (Obsessive Compulsive Working Group, 1997; Rachman, 1993, 1997, 2002; Salkovskis, 1985, 1989, 1996), another explanation may have to do with an inflated sense of responsibility. Compulsive "checkers" often feel responsible for the safety of themselves and others (Ashbaugh, Gelfand, & Radomsky, 2006) and try to neutralize obsessive content related to harm to themselves or others (Shafran, 1997). Frustration and anger could be caused as obsessive content cannot be (fully) neutralized through checking compulsions which, in turn, would lead to increased self-reports of aggressiveness. Therefore, the patients' aggression would be a consequence of OCD and not a cause for the disorder. This would be in contrast to Freud's theories (1909) and psychodynamic models (see Kempke & Luyten, 2007) suggesting that aggressive impulses were the cause for "hypermorality" which would consequently lead to OCD (i.e. hypermorality as mechanism to cope with perceived aggressiveness). The present study, using a cross sectional design was not conducted to shed light on the question whether aggression is as a cause or consequence of OCD. Future studies with a longitudinal design could test this hypothesis, using indirect and self-report aggressiveness measures concurrently.

Cognitive and psychodynamic theories also differ in their specificity of defining aggression in OCD. Freud's theories incorporate the concept of latent aggression, which is defined as a repressed form of overt aggression. However, cognitive models are less elaborate in the definition of aggression in OCD and could also incorporate acts of covert aggression (e.g., lying, stealing). As the Agg-IAT consists of words depicting mainly acts of overt aggression, the Agg-IAT may not fully represent the concept of aggressiveness in OCD. The focus on different aspects of aggressiveness and anger in OCD is perhaps another reason for the inconsistency between our and previous results. Furthermore, due to the inflated sense of responsibility others could be perceived as irresponsible, which is especially evident in patients with compulsions (Ashbaugh et al., 2006). This mechanism should be particularly triggered in a performance task with error feedback such as the Agg-IAT during which participants are asked to react as fast and correctly as possible. This could also explain why

OCD patients showed lower error rates than healthy controls.

The current study shows a number of limitations that should be addressed in future research. First, differences in aggression scores could be due to differences in test motivation. Error rates, as an indicator for test motivation differed between patients and healthy controls. While error rates for the healthy controls are similar to results obtained by Schmidt et al. (2015), OCD patients made fewer errors. However, as the differences in aggressiveness self-concepts were not associated with the errors on the IAT, differences in aggression scores are not attributable to motivational differences. Second, we did not include self-report measures on aggression in the study. As indirect measures benefit from being less transparent to the participant and tap into automatic associations it is not unexpected that our results are in contrast to previous research on aggression in OCD. However, both indirect and self-report measures should be included in future studies to be able to compare implicit as well as explicit concepts of aggression simultaneously. Third, the Agg-IAT only delivers difference scores. Single-category data cannot be validly interpreted, as the IAT relies on comparisons between sets of conditions (Nosek & Banaji, 2001). Therefore, it is theoretically possible, for example, that individuals with checking behavior did not associate themselves more strongly with peaceful attributes but others more strongly with aggressive attributes. The occupational labels, however, had been rated as professions with medium scores on the aggressive-peaceful dimension in a pilot study, that, however, was based on a convenience sample that very likely did not include a large number of OCD patients. Hence, although it cannot be completely ruled out that OC “checkers” differ from healthy controls in their perception of aggressiveness in several professions, it is not very plausible.

Future research is necessary to further elucidate aggressiveness in OCD, for example, whether the putative dissociation between implicit and explicit aggressiveness may mirror higher moral standards in OCD patients and thus aggressive impulses are over reported because they are judged as abnormal and incongruent with one's personality, and to give implications for psychodynamic and cognitive-behavioral interventions. Thus, future studies should aim for replications of our results based on implicit measure while incorporating explicit measures of aggressiveness and OCD related cognitive biases as well.

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References

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5)*. *Diagnostic and Statistical Manual of Mental Disorders 4th edition TR.* doi:10.1176/appi.books.9780890425596.744053

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*(2), 380–393. doi:10.1037//0022-3514.83.2.380

Ashbaugh, A. R., Gelfand, L. A., & Radomsky, A. S. (2006). Interpersonal Aspects of Responsibility and Obsessive Compulsive Symptoms. *Behavioural and Cognitive Psychotherapy*, *34*(02), 151. doi:10.1017/S1352465805002699

Banse, R., Messer, M., & Fischer, I. (2015). Predicting aggressive behavior with the aggressiveness-IAT. *Aggressive Behavior*, *41*, 65–83. doi:10.1002/AB.21574

Bar-Anan, Y., & Nosek, B. a. (2014). A comparative investigation of seven indirect attitude measures. *Behavior Research Methods*, *46*(3), 668–688. doi:10.3758/s13428-013-0410-6

Baumeister, R. F., Vohs, K. D., & Funder, D. C. (2007). Psychology as the Science of Self-Reports and Finger Movements: Whatever Happened to Actual Behavior? *Perspectives on Psychological Science*. doi:10.1111/j.1745-6916.2007.00051.x

Bettencourt, B. a, & Miller, N. (1996). Gender differences in aggression as a function of provocation: a meta-analysis. *Psychological Bulletin*, *119*(3), 422–447. doi:10.1037/0033-2909.119.3.422

Fergus, T. A., & Bardeen, J. R. (2014). Emotion regulation and obsessive–compulsive symptoms: A further examination of associations. *Journal of Obsessive-Compulsive and Related Disorders*, *3*(3), 243–248. doi:10.1016/j.jocrd.2014.06.001

Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., & Salkovskis, P. M. (2002). The Obsessive-Complusive Inventory: Development and validation of a short version. *Psychological Assessment*, *14*(4), 485–495. doi:10.1037//1040-3590.14.4.485

Foa, E. B., Sacks, M. B., Tolin, D. F., Prezworski, A., & Amir, N. (2002). Inflated perception of responsibility for harm in OCD patients with and without checking compulsions: a replication and extension. *Journal of Anxiety Disorders*, *16*(4), 443–453. doi:10.1016/S0887-6185(02)00128-7

Freud, S. (1909). Notes upon a case of obsessional neurosis. In J. Strachey (Ed.), *The* *standard edition of the complete psychological works of Sigmund Freud.* London: Hogarth Press.

Gollwitzer, M., Banse, R., Eisenbach, K., & Naumann, A. (2007). Effectiveness of the Vienna social competence training on explicit and implicit aggression: Evidence from an aggressiveness-IAT. *European Journal of Psychological Assessment*, *23*(3), 150–156. doi:10.1027/1015-5759.23.3.150

Gönner, S., Leonhart, R., & Ecker, W. (2007). The German version of the obsessive - compulsive inventory-revised: A brief self-reportmeasure for the multidimensional assessment of obsessive -compulsive symptoms. *Psychotherapie, Psychosomatik,Medizinische Psychologie*, *57*, 395–404.

Gönner, S., Leonhart, R., & Ecker, W. (2008). The Obsessive-Compulsive Inventory-Revised (OCI-R): Validation of the German version in a sample of patients with OCD, anxiety disorders, and depressive disorders. *Journal of Anxiety Disorders*, *22*, 734–749. doi:10.1016/j.janxdis.2007.07.007

Goodman, W. K., Price, L. H., Rasmussen, S. A., Mazure, C., Fleischmann, R. L., Hill, C. L., … Charney, D. S. (1989). The Yale-Brown Obsessive Compulsive Scale. I. Development, use, and reliability. *Archives of General Psychiatry*, *46*, 1006–1011. doi:10.1001/archpsyc.1989.01810110048007

Greenwald, A. G., & Farnham, S. D. (2000). Using the Implicit Association Test to Measure Self-Esteem and Self-Concept. *Journal of Personality and Social Psychology*, *79*(6), 1022–1038. doi:10.1037//0022-3514.79.6.I022

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* (Vol. 74). doi:10.1037/0022-3514.74.6.1464

Greenwald, A., Nosek, B., & Banaji, M. (2003). Understanding and using the Implicit Association Test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology*. Retrieved from http://briannosek.com/papers/IATalgorithm.pdf\npapers2://publication/uuid/6802C570-4727-4E64-8F8F-C6F4A8D3639C

Grumm, M., Hein, S., & Fingerle, M. (2011). Predicting aggressive behavior in children with the help of measures of implicit and explicit aggression. *International Journal of Behavioral Development*, *35*(4), 352–357. doi:10.1177/0165025411405955

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

Hand, I., & Büttner-Westphal, H. (1991). Die Yale-Brown Obsessive Compulsive Scale (Y-BOCS): Ein halbstrukturiertes Interview zur Beurteilung des Schweregrades von Denk- und Handlungszwängen [The Yale-Brown Obsessive Compulsive Scale (Y-BOCS): A semistructured interview for assessing severity of . *Verhaltenstherapie*, *1*(3), 223–225. doi:http://dx.doi.org/ 10.1159/000257972.

Hofmann, W., Gawronski, B., Gschwendner, T., Le, H., & Schmitt, M. (2005). A Meta-Analysis on the Correlation Between the Implicit Association Test and Explicit Self-Report Measures. *Personality and Social Psychology Bulletin*, *31*(10), 1369–1385. doi:10.1177/0146167205275613

Inquisit (Version 1.32). (2001). Seattle, WA: Millisecond Software.

Jelinek, L., Hauschildt, M., Hottenrott, B., Kellner, M., & Moritz, S. (2014). Further evidence for biased semantic networks in obsessive-compulsive disorder (OCD): When knives are no longer associated with buttering bread but only with stabbing people. *Journal of Behavior Therapy and Experimental Psychiatry*, *45*(4), 427–434. doi:10.1016/j.jbtep.2014.05.002

Kempke, M. a, & Luyten, P. (2007). Psychodynamic and cognitive-behavoiural approaches of obsessive-compulsive disorder: Is it time to work through our ambivalence? *Bulletin of the Menninger Clinic*, *71*(4), 291–311.

Krieglmeyer, R., Wittstadt, D., & Strack, F. (2009). How attribution influences aggression: Answers to an old question by using an implicit measure of anger. *Journal of Experimental Social Psychology*, *45*(2), 379–385. doi:10.1016/j.jesp.2008.10.003

Lehrl, S. (1995). *Mehrfachwahl-Wortschatz-Intelligenztest: MWT-B [Multiple choice vocabulary test: MWT-B]* (3rd ed.). Balingen: PERIMED-spitta.

Lehrl, S., Triebig, G., & Fischer, B. (1995). Multiple choice vocabulary test MWT as a valid and short test to estimate premorbid intelligence. *Acta Neurologica Scandinavica*, *91*(5), 335–345. doi:10.1111/j.1600-0404.1995.tb07018.x

Moritz, S., Kempke, S., Luyten, P., Randjbar, S., & Jelinek, L. (2011). Was Freud partly right on obsessive-compulsive disorder (OCD)? Investigation of latent aggression in OCD. *Psychiatry Research*, *187*(1-2), 180–184. doi:10.1016/j.psychres.2010.09.007

Moritz, S., Wahl, K., Ertle, A., Jelinek, L., Hauschildt, M., Klinge, R., & Hand, I. (2009).

Neither saints nor wolves in disguise: ambivalent interpersonal attitudes and behaviors in obsessive-compulsive disorder. *Behavior Modification*, *33*(2), 274–292. doi:10.1177/0145445508327444

Moscovitch, D. a., McCabe, R. E., Antony, M. M., Rocca, L., & Swinson, R. P. (2008). Anger experience and expression across the anxiety disorders. *Depression and Anxiety*, *25*(2), 107–113. doi:10.1002/da.20280

Nosek, B. a., & Banaji, M. R. (2001). The Go/No-Go Association Task. *Social Cognition*, *19*(6), 625–666. doi:10.1521/soco.19.6.625.20886

Nosek, B. a., Hawkins, C. B., & Frazier, R. S. (2011). Implicit social cognition: From measures to mechanisms. *Trends in Cognitive Sciences*, *15*(4), 152–159. doi:10.1016/j.tics.2011.01.005

Obsessive Compulsive Working Group. (1997). Cognitive assessment of obsessive-compulsive disorder. *Behaviour Research and Therapy*, *35*(7), 667–81. doi:10.1016/S0005-7967(97)00017-X

Rachman, S. (1993). Obsessions, responsibility and guilt. *Behaviour Research and Therapy*, *31*(2), 149–154. doi:10.1016/0005-7967(93)90066-4

Rachman, S. (1997). A cognitive theory of obsessions. *Behaviour Research and Therapy*, *35*(9), 793–802. doi:10.1016/S0005-7967(97)00040-5

Rachman, S. (2002). A cognitive theory of compulsive checking. *Behaviour Research and Therapy*, *40*(6), 625–639. doi:10.1016/S0005-7967(01)00028-6

Radomsky, A. S., Ashbaugh, A. R., & Gelfand, L. a. (2007). Relationships between anger, symptoms, and cognitive factors in OCD checkers. *Behaviour Research and Therapy*, *45*(11), 2712–2725. doi:10.1016/j.brat.2007.07.009

Richetin, J., Richardson, D. S., & Mason, G. D. (2010). Predictive validity of IAT aggressiveness in the context of provocation. *Social Psychology*, *41*(1), 27–34. doi:10.1027/1864-9335/a000005

Salkovskis, P. M. (1985). Obsessional-compulsive problems: A cognitive-behavioural analysis. *Behaviour Research and Therapy*, *23*(5), 571–583. doi:10.1016/0005-7967(85)90105-6

Salkovskis, P. M. (1989). Cognitive-behavioural factors and the persistence of intrusive thoughts in obsessional problems. *Behaviour Research and Therapy*, *27*(6), 677–682.

doi:10.1016/0005-7967(89)90152-6

Salkovskis, P. M. (1996). Cognitive-behavioural approaches to the understanding of obsessional problems. In R. M. Rapee (Ed.), *Current controversies in the anxiety disorder* (pp. 100–134). New York: Guilford Press.

Schmidt, A. F., Zimmermann, P. S., Banse, R., & Imhoff, R. (2015). Ego Depletion Moderates the Influence of Automatic and Controlled Precursors of Reactive Aggression. *Social Psychology*, *46*(3), 132–141. doi:10.1027/1864-9335/a000233

Shafran, R. (1997). The manipulation of responsibility in obsessive-compulsive disorder. *The British Journal of Clinical Psychology / the British Psychological Society*, *36 (Pt 3)*, 397–407. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/20153459

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., … Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. In *Journal of Clinical Psychiatry* (Vol. 59, pp. 22–33). doi:10.1016/S0924-9338(99)80239-9

Shoval, G., Zalsman, G., Sher, L., Apter, A., & Weizman, A. (2006). Clinical characteristics of inpatient adolescents with severe obsessive-compulsive disorder. *Depression and Anxiety*, *23*(2), 62–70. doi:10.1002/da.20135

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review : An Official Journal of the Society for Personality and Social Psychology, Inc*, *8*, 220–247. doi:10.1207/s15327957pspr0803_1

Whiteside, S. P., & Abramowitz, J. S. (2004). Obsessive-compulsive symptoms and the expression of anger. *Cognitive Therapy and Research*, *28*(2), 259–268. doi:10.1023/B:COTR.0000021544.64104.29

Whiteside, S. P., & Abramowitz, J. S. (2005). The expression of anger and its relationship to symptoms and cognitions in obsessive-compulsive disorder. *Depression and Anxiety*, *21*(3), 106–111. doi:10.1002/da.20066