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Implicit Approach and Avoidance in Patients With Obsessive-Compulsive Disorder

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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 with a healthy control group ($n = 30$). Participants were asked to respond to the color of a stimulus or stimulus frame by pulling a joystick toward 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 with neutral stimuli. The slower pushing (avoiding) of checking-related compared with 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.

General Scientific Summary
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.

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

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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

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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 coactivation 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 coactivation 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 and 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, & van Minnen, 2014; Heuer, Rinck, & Becker, 2007; Rinck & Becker, 2007). Furthermore, both AAT versions have yielded results implying incremental validity of the AAT compared with 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 with 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 and 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 nonaffective 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 posttraumatic 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. Nonanxious individuals commonly did not respond differently to anxiety-related compared with 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 nonclinical 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 with 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

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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, 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* (5th 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 nonclinical 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 with 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.

Method

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 with 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 semistructured 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

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Table 1
Demographic and Psychopathological Data: Mean (SD) and Frequency

Variable	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	$\chi^2(1) = .07$, $p = .79$
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)*	.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)*	.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.

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, p values $> .22$, and patients with contamination-related symptoms of OCD, p values $> .29$. 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, Erdfelder, Buchner, & Lang, 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.

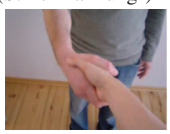
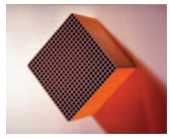
Approach-Avoidance Task

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 × 2 stimulus modes [picture and word] × 2 colors [orange and blue] × 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

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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[a]

Category	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[b])	(Simon et al., 2012)	(Simon et al., 2012)
			
	(Simon et al., 2012)	(Simon et al., 2012)	(Spülbecken[c])
Checking			
	(Simon et al., 2012)	(MacBook-Kabel[d])	(Hitzefrei from Jam1z[e])
Neutral			
	(Macbook Tasche[f])	(Lang et al., 1999)	(Lang et al., 1999)
			
	(Lang et al., 1999)	(Lang et al., 1999)	

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[a] The first author will gladly provide the remaining pictures upon request. [b] 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. [c] Spülbecken, by Thomas Renger, 2007 [https://www.flickr.com/photos/steinhobelgruen/581314019/in/photolist-pc6Sx4-jj7J7N-fmkXaa-p91awa-pqtuKe-4U1S2Y-d7bxff-eu81H4-3Cw93t-fTY2e4-Tnopv-HiQhBf-5Ytji3-9m7jHK-5A5SYz-4d2MYM-4dwrR7-gE4rA-4dst3e-f7Ls3B-7ELNdG-7ZXNZe-J3owp1-7z31C9-buzvfp-jkwajP-5EiQFr-9T9nzD-jXnEX-3SEFAA-6mpt4f-f7K6WB-dgnkCj-ofGWg7-qwWa1n-bWoCsh-e1JM9y-9kvMEn-GipQuv-a6SWvQ-4d2N4P-oeWvZe-7Ksf1o-4WSM5n-4NXvqQ-7GW1DD-3Jqbt5-fWCVSz-7Ksf5E-Fv4SX]. [d] MacBook-Kabel, zerkaut, by es-de-we, 2009, [https://www.flickr.com/photos/es-de-we/4219373089/in/photolist-7qRoBT]. [e] Hitzefrei by Jam1z, 2009, [https://www.flickr.com/photos/jam1z/3657429165/in/photolist-6zchgx]. [f] 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]. The remaining 8 pictures were taken from picture sets (IAPS and BOCD), which were created for open dissemination for academic research. See the online article for the color version of this table.

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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 alpha) 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 ($\alpha = .66$ 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 analysis of variance (ANOVA) was conducted for average RTs that compared all patients with 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) × 2 (Response direction: push, pull) × 3 (Stimulus type: contamination-related, checking-related, neutral) × 2 (Stimulus modes: picture, word) design. Second, 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 with the healthy controls.[1] 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.

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	$\alpha = .94$
Pull	Checking	$\alpha = .89$
Pull	Neutral	$\alpha = .93$
Push	Contamination	$\alpha = .79$
Push	Checking	$\alpha = .89$
Push	Neutral	$\alpha = .88$
Push – Pull	Contamination	$\alpha = .73$
Push – Pull	Checking	$\alpha = .69$
Push – Pull	Neutral	$\alpha = .30$

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

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 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-subjects 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 × Group interaction, $F(2, 90) = 24.14$, $p < .001$, $\eta_p^2 = .35$. Follow-up t tests (Bonferroni-corrected) revealed that, compared with 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.[2] Both subgroups of patients rated checking- and contamination-related stimuli as more negative than neutral stimuli, p values $< .001$. However, only patients with

[1] 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.

[2] Because of the high overlap between the subgroups, t tests instead of a repeated measures ANOVA were calculated.

Table 4
Means and SDs of Explicit Picture Ratings as a Function of Group and Stimulus Type

Stimulus type	Group		Statistics
	OCD	Healthy controls	
Neutral	2.96 (.36)	3.12 (.16)	$t(90) = 2.31, p = .023$
OCD checking-relevant	2.08 (.55)	2.90 (.19)	$t(90) = 7.96, p < .001$
OCD contamination-relevant	2.16 (.59)	2.76 (.17)	$t(90) = 5.41, p < .001$

Note. OCD = obsessive-compulsive disorder. One healthy participant was excluded because there was no variance in her picture ratings.

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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 × Response Direction × Mode × Instruction × 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 values $> .20$), indicating that the instructions did not influence the main results. Thus, instruction was not included as a between-subjects factor in the following analyses to increase power.

The ANOVA analyzing RTs from all patients combined revealed a significant interaction of Response Direction × Mode of stimulus, $F(1, 88) = 17.28$, $p = .001$, $\eta_p^2 = .16$, and a significant interaction of OCD-Relevance × Response Direction × 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 values $> .15$, suggesting that patients with OCD did not exhibit general avoidance tendencies to OCD-related stimuli compared with 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 with neutral material, an ANOVA analyzing average RTs from patients with contamination-related symptoms of OCD and healthy controls revealed a significant Stimulus Type × 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 × Group × Response Direction was significant (p values $> .11$). 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 with 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.[3]

The ANOVA analyzing average RTs from patients with checking-related symptoms of OCD and healthy controls revealed a significant Stimulus Type × Response Direction interaction, $F(1, 56) = 4.67$, $p = .035$, $\eta_p^2 = .08$. Most importantly, the expected Stimulus Type × Response Direction × 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 with 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 values $> .63$). 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

[3] 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.

Table 5
Reaction Times for Each Combination of Group (Patients With Checking-Related Symptoms and Healthy Controls), Stimulus Type (Checking and Neutral), and Response Direction (Pull [Approach] and Push [Avoidance]): Means (SDs)

Group	Direction	Stimulus type: Checking	Stimulus type: Neutral	Statistics
Checkers	Pull	747.95 (174.01)	793.67 (224.34)	$t(27) = 2.52$, $p = .02$, $d = .49$
	Push	790.87 (171.12)	743.70 (131.63)	$t(27) = 3.25$, $p = .003$, $d = .63$
Healthy	Pull	634.22 (72.78)	643.43 (82.27)	$t(29) = 1.17$, $p = .25$, $d = .22$
	Push	620.72 (76.80)	641.78 (78.68)	$t(29) = 0.81$, $p = .42$, $d = .15$

Note. Checkers = patients with checking-related symptoms of OCD; healthy = healthy controls.

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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 × Subtype × 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 × 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 with 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 with neutral stimuli, $t(11) = 0.48$, $p = .64$, $d = 0.14$. This shows that the interaction of Subgroup × 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 with neutral stimuli, $t(15) = 2.25$, $p = .04$, $d = 0.56$, and slower at pushing in response to checking-related compared with 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 with 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 values $< .19$, p values $> .32$, or healthy controls, r values $< .14$, p values $> .46$. 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 values $< .22$, p values $> .28$, nor for healthy controls, r values $< .19$, p values $> .33$. 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 × Stimulus Type (contamination-related, checking-related, and neutral) and Pull × 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 values $> .06$).

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 with neutral stimuli and compared with healthy controls.

General Avoidance

The overall sample of patients with OCD (not differentiated according to subtype) did not show avoidance tendencies toward

OCD-related material (contamination- and checking-related) compared with 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 nonspecificity 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 toward 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 with 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. (2010) 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 with healthy controls (Morillo, Belloch, & Garcıa-Soriano, 2007).

Subtype-Specific Avoidance in Patients With Checking-Related Symptoms

Patients with checking-related symptoms of OCD showed approach-avoidance biases toward subtype-specific material. However, contrary to our hypothesis, they were faster at pulling and slower at pushing checking-related material compared with neutral stimuli. They were also faster at pulling than pushing checking-related stimuli and slower at pulling compared with 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 with 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

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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 with 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 with healthy controls (Morillo et al., 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

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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 interrater 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 with 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.

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