Comprehensive Insights Into Obsessive-Compulsive Disorder: Investigating Assessment, Attentional Processes, and Emotion Regulation

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General Abstract

Obsessive-Compulsive Disorder (OCD) is a heterogeneous and debilitating condition that remains frequently under- and misdiagnosed, delaying not only effective treatment but also worsening long-term outcomes. In addition to diagnostic challenges, the underlying mechanisms contributing to OCD remain insufficiently understood. This thesis addresses these gaps by enhancing symptom assessment and investigating key mechanisms implicated in the disorder's development and maintenance, specifically anger suppression and attentional biases.

To enhance assessment of OCD symptoms and diagnostic precision, *Study I* and *Study II* translated and validated the 12- and 4-item Obsessive Compulsive Inventory (OCI-12 and OCI-4, respectively), testing the factor structure, reliability, validity, and diagnostic accuracy in clinical and non-clinical samples. Participants with OCD (n = 102), anxiety-related disorders (n = 69), and non-clinical controls (n = 248) were recruited and asked to fill out several online questionnaires assessing OCD symptoms, but also other symptoms such as anxiety, depression, and worry. The German version of the OCI-12 replicated the four-factor structure representing the most common OCD symptom clusters (i.e., checking, washing, ordering, and obsessing), with a higher-order factor for general OCD symptoms accounting for their covariance and improving model fit. Both, the OCI-4 and OCI-12, showed good reliabilities, moderate-to-good construct validity, and good-to-excellent diagnostic accuracy. Thereby, the findings support these measures as resource-efficient and clinically applicable screening tools, providing standardised cut-off criteria for improved assessment in routine care and research.

To contribute to a more comprehensive understanding of underlying factors of OCD, *Study III* and *Study IV* examine the role of anger suppression and attentional biases, respectively. Considering the divergent views of psychodynamic and cognitive theories on anger suppression, *Study III* explores whether anger suppression precedes or emerges as a consequence of OCD symptoms. The temporal relationship between anger suppression, the sense of responsibility, and OCD symptoms was investigated in participants with OCD

(*n* = 48), who were recruited as part of an intervention study evaluating the effects of a metacognitive intervention for OCD. Obsessive beliefs, OCD symptoms, and anger suppression were assessed at three timepoints: pre-intervention, post-intervention, and at a six-month follow-up. Results of the structural equation models indicated that OCD symptoms predicted increased anger suppression over time, independent of depressive symptoms and medication intake. The reverse directionality, with anger suppression predicting OCD symptoms, did not yield significant results, further corroborating the cognitive perspective. The association between an inflated sense of responsibility and anger suppression was less clear and appeared to be present only in individuals with high levels of checking-related symptoms, who generally exhibit greater responsibility concerns and increased anger suppression. While OCD symptoms significantly decreased throughout the metacognitive intervention, anger suppression remained stable, indicating differential treatment effects on these mechanisms. Overall, these results provide further support for cognitive models of OCD, highlighting the role of emotion regulation processes (i.e., anger suppression) and cognitive beliefs (i.e., sense of responsibility) in OCD, with their associations differing across specific OCD symptom clusters.

Study IV tested cognitive-behavioural theories on attentional biases in OCD, addressing inconsistencies in prior research. Using a free-viewing eye-tracking paradigm, attentional processes were examined in individuals with OCD (*n* = 51), spider phobia (*n* = 50), and non-clinical controls (*n* = 64). Stimuli were individually rated for their idiosyncratic disorder relevance, allowing for a more tailored analysis. Strikingly, of those pictures deemed OCD-related on average only one-third was considered actually OCD-relevant by participants with OCD, highlighting the need for idiosyncratic material in this heterogeneous disorder. Contrary to theoretical expectations, the multilevel models did not provide evidence for a vigilance bias, as participants with OCD were neither more likely to fixate first nor did they fixate more quickly on disorder-relevant stimuli. Furthermore, no general maintenance bias (i.e., longer fixation durations) emerged for OCD-relevant images. However, attentional maintenance seemed to be

more fine-grained, as analyses revealed symptom-specific effects, with avoidance of contamination/washing-related pictures but increased maintenance on checking-related pictures in OCD. As individuals with spider phobia showed a general strategic avoidance of phobia-relevant pictures, the findings challenge that anxiety-based models on attentional biases can be transferred to OCD. Instead, the possibility of distinct underlying emotions that drive different attentional and behavioural responses is discussed. Accordingly, the importance of considering both the heterogeneity of OCD symptoms and emotional experiences in basic research to enhance the understanding of underlying mechanisms in OCD is emphasised.

Overall, this thesis advances symptom assessment for the heterogeneous nature of OCD while emphasising the need for refined theoretical conceptualisations that account for both diverse symptom presentations and underlying emotional experiences. By validating the OCI-4 and OCI-12, this thesis contributes to improving early OCD diagnosis and enabling more precise symptom assessment in both clinical and research settings. Furthermore, the findings on underlying factors of OCD challenge the assumption of universal mechanisms in its development, instead highlighting symptom-specific cognitive-affective processes, such as anger suppression in checking-related compulsions or attentional biases shaped by distinct symptoms and presumably linked to specific emotional states. The discussion underscores the need for further investigation into the interplay between cognitive, behavioural, and affective processes, considering both theoretical implications and methodological challenges. The potential for refining theoretical models and returning to basic research to investigate the emotional facets of OCD is highlighted. Moreover, as cognitive-behavioural factors addressed in the current thesis can be related to emotion regulation frameworks, the role of emotion regulation difficulties as a potential factor underlying OCD is discussed. If successfully replicated, these findings could inform clinical practice, leading to more personalised interventions that integrate emotion regulation and symptom-specific mechanisms, thereby potentially enhancing the effectiveness of OCD treatment.

Table of Contents

List of Figures

Study I

Study II

Study III

Study IV

List of Tables

Study I

Study II

Study III

Study IV

1 General Introduction

Obsessive-Compulsive Disorder (OCD) is a heterogeneous, debilitating disorder, affecting approximately 2–3% of individuals throughout their lifetime (Ruscio et al., 2010). Although effective, empirically derived treatments for OCD exist [Deutsche Gesellschaft für Psychiatrie und Psychotherapie, Psychosomatik und Nervenheilkunde (DGPPN), 2022], individuals with OCD frequently experience substantial delays between symptom onset and correct diagnosis (e.g., Ziegler et al., 2021). This widespread under- and misdiagnosis hinders timely and appropriate treatment access, leading to prolonged illness duration and associated reduced remission rates (e.g., Fineberg et al., 2013).

While diagnostic challenges pose a significant obstacle, another open question concerns the underlying factors of OCD, which are crucial not only for an adequate conceptualisation of the disorder but also for refining OCD-specific interventions. Theoretical models from psychodynamic (e.g., Freud, 1909) and cognitive-behavioural perspectives (e.g., Salkovskis & McGuire, 2003) have long sought to explain underlying mechanisms contributing to the development and maintenance of OCD. However, several key mechanisms proposed in these models still lack sufficient empirical support. Notably, anger suppression, originally emphasised in psychodynamic frameworks (Freud, 1909) and later incorporated into cognitive models (Rachman, 1993), remains poorly understood in its temporal relationship to OCD symptoms. Similarly, attentional biases have been proposed by cognitive-behavioural theorists as a core cognitive process in OCD (Salkovskis & McGuire, 2003), yet existing empirical findings remain inconsistent hindering a more fine-grained conceptualisation on the nature and extent of these biases in OCD.

In the following sections, the diagnostic challenges and the role of accurate questionnaires will be discussed in greater detail. Furthermore, theoretical models will be introduced detailing proposed underlying factors contributing to OCD. The four studies entailed in this thesis detail the validation of newly developed questionnaires to improve diagnostic accuracy, research investigating the temporal association between anger suppression and OCD

symptoms and an eye-tracking study investigating attentional biases in OCD. By integrating these findings, this thesis provides comprehensive insights into OCD, ranging from symptom assessment to underlying factors of OCD and potential implications for basic research and clinical practice.

1.1 Characteristics of OCD

In its phenomenological and clinical presentation, OCD is characterised by persistent, intrusive thoughts (i.e., obsessions) and repetitive behaviours or mental acts (i.e., compulsions; American Psychiatric Association, 2013), which significantly impair daily functioning and quality of life (Coluccia et al., 2016; Macy et al., 2013). While some individuals experience only obsessions or compulsions, most frequently both are present (Abramowitz et al., 2009; American Psychiatric Association, 2013). According to the 5th version of the Diagnostic and Statistical Manual (DSM-5; American Psychiatric Association, 2013), obsessions are characterised by two key features: (1) repetitive, persistent thoughts, urges, or images perceived as intrusive and unwanted, often causing significant anxiety or distress, and (2) attempts to ignore, suppress, or neutralise them through other thoughts or actions. The contents of obsessions may involve thoughts of harming loved ones, morally distressing or sexually disturbing thoughts, persistent doubts about whether the door is locked, or the stove is turned off, as well as intrusive thoughts on being contaminated (de Silva, 2003). On the other hand, compulsions are characterised by: (1) repetitive behaviours or mental acts that individuals feel driven to perform in response to an obsession or according to rules that must be rigidly applied, and (2) actions aimed at reducing distress, anxiety, or preventing an aversive event, which are either unrealistic in their connection to the intended outcome or are clearly excessive (American Psychiatric Association, 2013). Examples of compulsions include excessive hand-washing or cleaning rituals, repeatedly checking switches or door locks, or engaging in mental acts such as neutralising thoughts (de Silva, 2003).

While OCD is broadly defined by the presence of obsessions and compulsions, the way these symptoms manifest varies considerably among individuals. Numerous studies aimed to categorise these diverse symptoms into different clusters, of which the following four symptom-dimensions have been repeatedly been demonstrated: (1) contamination and washing, (2) responsibility for causing or preventing harm and avoid mistakes (e.g., through checking), (3) symmetry and completeness, and (4) intrusive thoughts related to taboo topics (e.g., Abramovitch et al., 2021b; Abramowitz et al., 2010). These dimensions reflect the considerable heterogeneity *between* individuals with OCD. For example, an individual with checking-related OCD symptoms may fear that he did not turn off the stove before leaving the house, which could lead to the accidental death of a loved one in a house fire, while another with contamination concerns may fear bodily excretions and potentially transferred illnesses. Further, an individual with obsessional thoughts may believe that thinking about a tragic accident could cause it to happen (de Silva, 2003). Of note, although symptom clusters can be distinguished by their content, most individuals with OCD show symptoms from multiple symptom clusters (Rufer et al., 2006), leading to considerable overlap between them (Mataix-Cols et al., 2005). Next to the heterogeneity *between* symptom clusters, there is also considerable heterogeneity *within* one cluster (Abramowitz et al., 2010). For instance, two individuals with OCD presenting symptoms of the contamination and washing cluster may consider different situations and stimuli as personally OCD-relevant: while one is primarily concerned of bodily secretions like urine or saliva, the other may be afraid of environmental contaminants, such as asbestos in the walls of public places (Jones & Krochmalik, 2003).

Regardless of the specific symptom cluster an individual with OCD presents, a diagnosis of OCD should be considered when obsessions and compulsions become time-consuming (i.e., more than one hour per day) and/or cause significant distress or impairment in daily functioning, as outlined in the DSM-5 (American Psychiatric Association, 2013). However, despite the high burden that is associated with OCD for both the individual affected (Coluccia

et al., 2016; Macy et al., 2013) and the immediate surrounding (Albert et al., 2007; Stengler-Wenzke et al., 2006), individuals with OCD frequently face significant delays in receiving a proper diagnosis and treatment. Notably, a recent study showed that, on average, already more than 12 years elapse from the onset of first OCD symptoms to the correct diagnosis of OCD (Ziegler et al., 2021). Diagnostic challenges seem to contribute to these delays, as a study on the diagnostic precision in psychiatric practices in Germany showed that around 70% of outpatients with OCD were not properly diagnosed with OCD (Wahl et al., 2010). This is particularly concerning, as longer durations between symptom onset and correct diagnosis is associated with more severe symptoms and greater functional impairment (Ziegler et al., 2021). Furthermore, a longer duration of untreated illness or a chronic course of OCD is associated with poorer response to pharmacological treatment in OCD (Albert et al., 2019; Dell'Osso et al., 2010), generally lower remission rates (Eisen et al., 2013; Fineberg et al., 2013), and worse long-term treatment outcomes (Perris et al., 2023). In summary, these findings underscore the pressing need to identify and address the challenges of current diagnostic procedures, improving the frequent under- and misdiagnosis of OCD.

1.2 Challenges in Assessment and Diagnosis of OCD

Several factors may pose obstacles to a timely and accurate diagnosis of OCD. First, patient-related difficulties, which are in OCD particularly related to shame associated with the OCD symptoms (Marques et al., 2010) and self-stigmatisation (Stengler-Wenzke et al., 2004), may generally reduce the willingness to seek help (García-Soriano et al., 2014; Schwartz et al., 2013). Furthermore, systemic healthcare-related challenges must also be considered. In the German healthcare system, constraints on resources in terms of staff, time, and money (Bundesministerium für Gesundheit, 2025) may contribute to the frequent under- or misdiagnosis of OCD. For instance, while individuals with OCD symptoms likely first present to their general practitioner (GP), the average length of a consultation session is 7.6 minutes

(Deveugele, 2002), which prohibits elaborate exploration of physical and psychological symptoms. In combination with a lack of awareness or the lack of experience in managing mental disorders (Bower et al., 2011; Brown & Wissow, 2012), these constraints could hinder correct referral to mental health-care professionals, but result in referral to other medical specialists (e.g., dermatologists; Mavrogiorgou et al., 2015).

Considering the limited resources in the healthcare system, an accurate, accessible, and time-efficient tool would be required to improve the correct referral to more specialised settings. Screening tools offer a time-efficient means of identifying individuals at risk or already suffering from OCD from those who do not. In Germany, two screening tools are currently available: the Dimensional Obsessive-Compulsive Scale – Short Form (DOCS-SF; Kühne, Paunov, Abramowitz, et al., 2021) and the Zohar-Fineberg Obsessive-Compulsive Screen (ZF-OCS; Kühne, Paunov, & Weck, 2021). Whereas both screening tools showed good validity and reliability, the assessment of diagnostic accuracy could not be established as the validation was conducted in non-clinical samples. Yet, to screen for OCD, validated cut-off criteria are required to enable quick differentiation between those with likely OCD and those without. Therefore, there is a need for a German screening tool proposing validated cut-off criteria which can ultimately contribute to improvements of the underdiagnosis of OCD.

However, beyond misreferral, additional obstacles seem to exist in specialised mental health care, as previous research showed that the interval between first professional contact and an accurate OCD diagnosis is on average two years (Stengler et al., 2013). One potential factor contributing to the difficulties in adequately assessing OCD symptoms and diagnosing the disorder is the considerable heterogeneity of OCD (Abramowitz et al., 2010). Therefore, to reduce misdiagnoses, more elaborate assessment tools should consider the heterogeneity of the disorder while effectively distinguishing it to related disorders, such as anxiety disorders. One of the most commonly used questionnaire to assess OCD symptoms is the Obsessive-Compulsive Inventory – Revised (OCI-R; Gönner et al., 2007). The OCI-R yields subscale

scores for six symptom clusters: washing, obsessing, ordering, checking, neutralising, and hoarding. Thereby, the OCI-R is able to cover the heterogeneity of symptoms by inclusion of various scales. Although the OCI-R shows good psychometric properties across a diverse range of samples (e.g., Simos et al., 2019; Solem et al., 2010; Souza et al., 2011) and can discriminate well between those with and without diagnosis of OCD (Foa, Huppert, et al., 2002), recent criticism has been raised. Specifically, since the latest update of the diagnostic criteria of the DSM-5 (American Psychiatric Association, 2013), the subscales no longer correspond to the major symptoms demarcating OCD from other disorders. Although hoarding symptoms can still occur under the diagnosis of OCD as a consequence of obsessions (American Psychiatric Association, 2013, p. 241), pathological hoarding is now regarded as separate disorder (American Psychiatric Association, 2013). Moreover, although the OCI-R is a self-report questionnaire that requires relatively few time- and staff-related resources, its administration and scoring require a license, placing additional demands on the already limited financial resources in clinical care.

In summary, the challenges in diagnosing OCD are multifaceted, encompassing patient-related factors, constraints within the healthcare system, and limitations of current assessment tools. Developing reliable and valid screening and assessment instruments that account for the heterogeneity of OCD symptoms while also considering the limited resources available in healthcare settings may be a key approach to reducing the delay between symptom onset and accurate diagnosis.

1.3 Psychodynamic and Cognitive-Behavioural Perspectives on Underlying Mechanisms of OCD

For a comprehensive assessment and effective treatment of OCD, a thorough understanding of the factors contributing to its development and maintenance is crucial. Various theoretical models have been proposed to explain the underlying mechanisms of OCD, with

first theories dating back to the early 20th century. In his analysis of obsessional neurosis ("*The Rat Man*"), Freud (1909) proposed that obsessional symptoms arise from an inner conflict between the feelings of *love* and *hate*, which is resolved by compensatory mechanisms, such as strongly supressing *hate* in favour of *love*. Freud (1926) later introduced the concepts of *undoing* and *reaction formation* as key defence mechanisms in obsessional neurosis. U*ndoing* refers to the symbolic reversal of unacceptable thoughts or actions through rituals, whereas *reaction formation* refers to transformation of repressed impulses into opposite behavioural expressions. While *undoing* is associated with compulsions, *reaction formation* has been associated with OCD-related traits, such as perfectionism and conscientiousness (Kempke & Luyten, 2007). In summary, from a psychodynamic perspective, OCD can be understood as a conflict of intolerable (e.g., aggressive) impulses sent by the *Id* and a hypermoral *Superego* (Fenichel, 1946). Whilst individuals without OCD also experience this conflict, they would be able to manage this conflict with adaptive strategies. In contrast, individuals with OCD are proposed to rely on maladaptive strategies, such as *reaction formation* (e.g., heightened conscientiousness) and *undoing* (e.g., performing checking rituals) which serve to suppress or neutralise this underlying conflict rather than resolve it effectively (Kempke & Luyten, 2007).

While psychodynamic theories do not explicitly address cognitive processes, an increasing interest emerged in the role of cognitive appraisals in the development of OCD, driven by research showing that intrusive thoughts are common in the general population and are, content-wise, similar to those of patients with OCD (Salkovskis & Harrison, 1984). This finding informed cognitive and cognitive-behavioural models on OCD, as the mere presence of obsessions alone cannot explain the development of OCD (Salkovskis & McGuire, 2003). Instead, specific cognitive and behavioural reactions to intrusive thoughts are assumed to contribute to the exacerbation of distress and the progression of OCD. In his cognitive model of OCD, Rachman (1997) proposed that while nearly all individuals experience unwanted intrusive thoughts (i.e., obsessions), individuals with OCD misinterpret the significance of these

thoughts, leading to heightened distress. Several cognitive beliefs, such as an inflated sense of responsibility (i.e., the belief that one is responsible for preventing harm), thought-action fusion (i.e., equating one's thoughts with actions), and overestimation of threat (i.e., inflated estimation of the probability of aversive events), have been associated with this misinterpretation of significance of intrusive thoughts, thereby contributing to the development of OCD symptoms (Obsessive Compulsive Cognitions Working Group, 1997; Rachman, 2002).

Among those cognitive beliefs, the inflated sense of responsibility has been proposed to be closely linked to a concept originally proposed in Freud's (1909) psychodynamic theory: anger suppression. However, while Freud (1909) viewed the suppression of immoral impulses, such as anger and aggression, as a cause of OCD, Rachman (1993) proposed that anger suppression is instead a consequence of OCD symptoms. More specifically, due to an inflated sense of responsibility, individuals with OCD regard themselves as fully responsible for preventing harm, which is an unrealistic and unattainable expectation (Ashbaugh et al., 2006). While this internal attribution of responsibility may cause feelings of frustration and anger (Radomsky et al., 2007), it further hinders the expression of anger (i.e., aggression), leading to the suppression of anger and feelings of guilt. Empirical research generally supports the role of anger and anger suppression in OCD (e.g., Cludius et al., 2021; Moritz et al., 2009, 2011), which may be particularly pronounced in individuals with checking-related OCD symptoms (Whiteside & Abramowitz, 2004). However, due to the cross-sectional design of these studies no conclusion on the temporal relationship between anger suppression and OCD symptoms can be drawn. Therefore, whether anger suppression contributes to the development of OCD, as proposed by psychodynamic theories (Freud, 1909), or arises as a consequence of OCD symptoms and an inflated sense of responsibility, as proposed by cognitive theorists (Rachman, 1993), remains to be investigated.

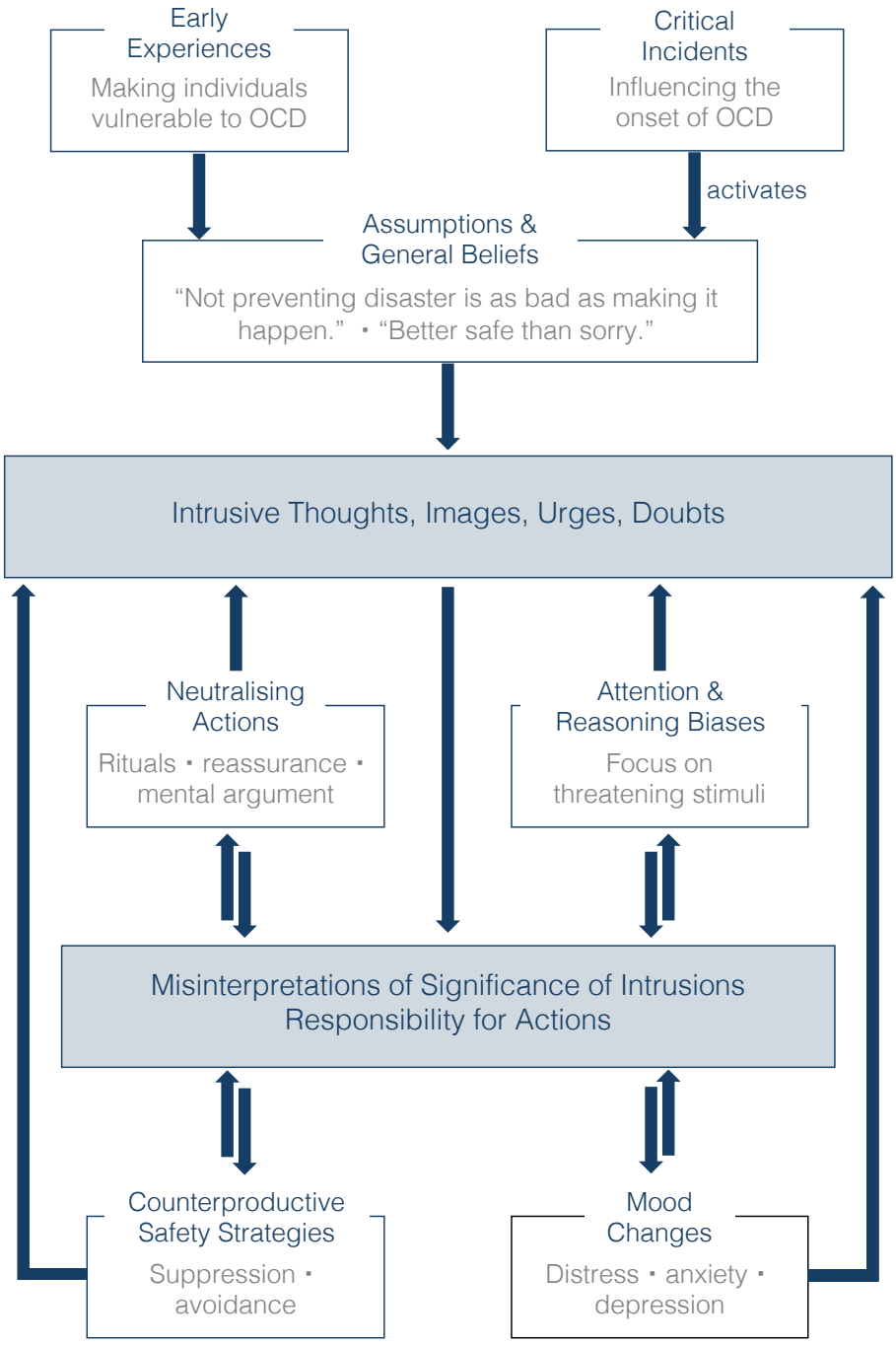
Extending the propositions of cognitive theorists, Salkovskis & McGuire (2003) incorporated cognitive, emotional, and behavioural factors in their cognitive-behavioural model

of OCD (see Figure 1). According to the model, the misinterpretation of intrusive thoughts has a number of bidirectional effects on four central mechanisms. The misinterpretation of the significance of intrusive thoughts is proposed to contribute to mood changes, including heightened distress, anxiety, and depression, which in turn reinforce maladaptive appraisals and further increase the perceived significance of intrusive thoughts. Furthermore, attention and reasoning biases are thought to play a crucial role, as heightened attentional focus on intrusive thoughts and external triggers leads to a preoccupation with OCD-related stimuli. This preoccupation, in turn, amplifies their salience and increases the likelihood of perceiving intrusive thoughts and triggers in the environment. Lastly, the model proposes that individuals with OCD increasingly rely on counterproductive safety strategies (e.g., avoidance, suppression) as well as neutralising behaviours (e.g., compulsive acts, reassurance-seeking), aimed at preventing harm or alleviating distress caused by misinterpreted intrusive thoughts. While these behaviours provide short-term relief, they ultimately reinforce maladaptive beliefs, increase the salience of intrusive thoughts, and heighten their likelihood of recurrence.

In summary, the cognitive-behavioural model (Salkovskis & McGuire, 2003) postulated a close association between cognition, emotion, and behaviour. Due to the proposed associations, the model allowed the formulation of several testable hypotheses and offered diverse targets for treatment. Since its introduction, a substantial body of research has sought to empirically test this model in basic research and translate these findings into clinical practice. Thereby, parts of the theory, such as the association between intrusive thoughts, counterproductive safety strategies and neutralising behaviour have successfully been translated into effective interventions for OCD, particularly cognitive-behavioural therapy (see Öst et al., 2015 for a meta-analysis) and exposure and response prevention (see Ferrando & Selai, 2021; Reid et al., 2021 for meta-analyses). Yet, other parts of the theory are still lacking substantial evidence from basic research. Therefore, this thesis aims to contribute to a better understanding of the factors involved in the development and maintenance of OCD.

Figure 1

Cognitive-Behavioural Model of OCD Based on Salkovskis & McGuire (2003).



Note. The figure illustrates the cognitive-behavioural model of OCD (based on Salkovskis & McGuire, 2003), depicting the occurrence of intrusive thoughts and the subsequent misinterpretation as central factors. The misinterpretation drives attention and reasoning biases, mood changes, counterproductive safety strategies, and neutralising actions, which in turn reinforce both the occurrence of future intrusions and the perceived significance of these thoughts, perpetuating the development and maintenance of OCD.

1.4 Attentional Biases in OCD: The Evidence Lags Behind the Longstanding Theory

Despite the longstanding theory that attentional biases play a crucial role in the development and maintenance of OCD symptoms (Salkovskis & McGuire, 2003), a precise characterisation of attentional processes contributing to OCD has so far not been established. Therefore, research was largely informed by theories on anxiety disorders, detailing the importance of *vigilance* and *maintenance biases* (Fox et al., 2001). Vigilance bias describes the initial fast orientation or the increased likelihood on first orienting on threatening stimuli, while maintenance bias is characterised by difficulties disengaging from threatening stimuli once attention was allocated (Basel et al., 2023; Corbetta & Shulman, 2002). Of note, these biases are not mutually exclusive, but may rather operate conjointly (Lazarov et al., 2019).

As outlined in the review of Armstrong & Olatunji (2012), research on attentional biases in anxiety largely supported the presence of a vigilance bias (i.e., biased orienting response towards threat-related stimuli). In contrast, the presence of a maintenance bias (i.e., difficulty disengaging from threat-related stimuli) appears to vary across different anxiety disorders. Whereas individuals with post-traumatic stress disorder show an increased maintenance on threat-related material (Felmingham et al., 2011; Kimble et al., 2010; Veerapa et al., 2023), individuals with spider phobia showed a vigilance-avoidance behaviour, with a quick orientation towards and subsequent avoidance of threat-related material (Pflugshaupt et al., 2005; Rinck & Becker, 2006).

Similarly to anxiety disorders, research on attentional biases in OCD initially implemented reaction-time paradigms, such as the modified Stroop-task (e.g., Kyrios & Iob, 1998; Lavy et al., 1994; van den Heuvel et al., 2005; J. M. G. Williams et al., 1996) or the dot-probe paradigm (e.g., Amir et al., 2009; MacLeod et al., 1986). While some studies supported increased allocation of attention towards threat-related material (e.g., Harkness et al., 2009; Moritz et al., 2004; Rao et al., 2010), other studies did not find any differences between

participants with and without OCD (e.g., Amir et al., 2009; Foa et al., 1993; Tata et al., 1996). Yet, as reaction-time studies (by design) cannot provide insight into the complex interplay of vigilance and maintenance biases and were criticised for their low reliability (Rodebaugh et al., 2016; Waechter et al., 2014), the inconsistent landscape of results was largely attributed to those methodological limitations. Accordingly, research shifted towards the use of eye-tracking technology, which enables assessment of diverse facets of eye-movements (e.g., fixations, saccades) as well as the dynamic unfolding of attention (i.e., from vigilance to maintenance).

However, even with the improved eye-tracking technology, the current landscape of results does not provide consistent evidence for neither vigilance nor maintenance biases. While some studies have demonstrated a biased orientation toward OCD-relevant stimuli (i.e., vigilance bias) in (sub-)clinical OCD samples (Armstrong et al., 2010, 2012; Choi & Lee, 2015), others did not yield evidence supporting this bias (Bradley et al., 2016; Cludius et al., 2019; Mullen et al., 2021). Similarly, while several studies support the presence of a maintenance bias in response to OCD-relevant material (Armstrong et al., 2010; Bradley et al., 2016; Cludius et al., 2019; Mullen et al., 2021), other studies did not find OCD-related difficulties in disengaging from OCD-relevant material (Armstrong et al., 2012; Bucarelli & Purdon, 2016; Choi & Lee, 2015).

The inconsistent findings may be related to the heterogeneity of OCD (Adamis & Olatunji, 2024), which could affect two major aspects of previous studies: the sample under investigation and the implemented stimulus material. Former eye-tracking studies frequently recruited individuals with OCD supposedly presenting only one cluster of OCD symptoms (e.g., contamination fear: Armstrong et al., 2010, 2012; e.g., checking symptoms: Bucarelli & Purdon, 2016; Choi & Lee, 2015). Yet, due to the considerable overlap between the symptom clusters (Rufer et al., 2006), classifying individuals with OCD into specific “subtypes” is somewhat arbitrary. Furthermore, previous studies relied on generic OCD-related pictures, which were deemed relevant to OCD by experts or validated picture datasets. However, given

the considerable heterogeneity even *within* OCD symptom clusters, the use of generic stimuli likely prohibits examination of attentional biases driven by OCD-relevant material, also for participants with OCD recruited based on the "subtype" (Adamis & Olatunji, 2024). More specifically, it is likely that not all pictures deemed OCD-relevant were actually relevant to the individual with OCD. Thereby, analyses on attentional biases are not solely based on OCD-relevant pictures but are influenced by effects of non-OCD-relevant but neutral, negative, or even positive pictures.

In summary, biased attention towards internal or external threat-related stimuli is, theoretically, relevant to the development and maintenance of OCD. However, more fine-grained theories on attentional biases in OCD have so far not been developed and the current landscape of results is largely inconsistent (see Basel et al., 2023), potentially due to several critical methodological limitations. Therefore, well-grounded basic research that considers the heterogeneity of OCD is needed to test or refine existing theories on attentional biases in OCD.

1.5 Aims of the Present Thesis

This thesis seeks to improve the assessment of OCD symptoms and deepen the understanding of its underlying mechanisms. Current research gaps are addressed by validating novel assessment tools and investigating cognitive and affective mechanisms while explicitly considering the heterogeneity of OCD symptoms. By integrating multiple methodologies, including a longitudinal design and an eye-tracking paradigm, this research offers a novel perspective on how symptom-specific cognitive-affective processes are associated to OCD symptoms. Specifically, the four studies in this thesis address the following aims:

First, improving diagnostic accuracy is critical to reducing delays between symptom onset and appropriate treatment. In Germany's healthcare system, brief, reliable, and freely accessible assessment tools are essential for identifying individuals with (likely) OCD. To this end, *Study I* details the translation and validation of the previously established update of the

OCI-R, the 12-item Obsessive-Compulsive Inventory (OCI-12; Abramovitch et al., 2021b). The syndromal validity, reliability, and diagnostic accuracy were investigated in clinical and non-clinical samples. Moreover, as the ultra-brief four-item version of the OCI-12 was proposed as screening tool for OCD (OCI-4; Abramovitch et al., 2021a), *Study II* details the psychometric evaluation of this ultra-brief screening tool in clinical and non-clinical samples. The inclusion of clinical and non-clinical samples enables the establishment of cut-off scores, which was previously prohibited due to validations conducted in non-clinical samples. Thereby, *Study I* and *Study II* aim to improve assessment of OCD symptoms in routine clinical care and research settings.

Second, the thesis examines the role of anger suppression in OCD. Given that psychodynamic theories emphasise the role of anger suppression in the development of OCD, while cognitive models suggest that anger suppression is a consequence of inflated sense of responsibility and general OCD symptoms, the regulation of anger in OCD is both historically significant and practically relevant. Although previous research investigated the association between anger, anger suppression, and OCD, the associations have so far only been shown cross-sectionally. Accordingly, *Study III* investigates the association between the sense of responsibility, anger suppression, and OCD symptomatology in a longitudinal design. Clarifying the temporal relationships between anger suppression, OCD symptoms, and cognitive beliefs provides critical insights for theoretical models and potential novel targets of psychotherapeutic treatment.

Lastly, this thesis aims to clarify the role of attentional biases in OCD. While cognitive-behavioural theorists suggest that attentional biases play a crucial role by fostering a preoccupation with internal and external threats in OCD, previous research could not consistently establish the presence of vigilance or maintenance biases in OCD. *Study IV* addresses and overcomes several former methodological limitations, contributing to a clearer understanding of attentional mechanisms in OCD. Using eye-tracking technology and

presenting stimuli within a free-viewing paradigm, the study aims to investigate dynamic attentional processes in a relatively natural setting. Furthermore, given the substantial heterogeneity of OCD both between and within symptom clusters, individuals with OCD regardless of their subtype were recruited while idiosyncratic disorder relevant material was used to account for individual symptoms. Furthermore, as the concepts of vigilance and maintenance biases in OCD are transferred from anxiety disorders, *Study IV* aims to identify the specificity of attentional biases to OCD. Therefore, attentional parameters in OCD were not only compared to non-clinical controls, but also to individuals with spider phobia. Thereby, this thesis aims to give a profound basis for potential replications and, ultimately, translation of these findings to clinical practice.

2 Cumulative Thesis Publications

Study I

Translation and Validation of a German Version of the 12-Item Obsessive-Compulsive Inventory (OCI-12)

This chapter is a pre-print version of an article currently in submission, before formal peer-review and publication.

Both, data and R code, have been made available online (https://osf.io/4m9x6/).

Authors: **Müller, C. L.,** Fink-Lamotte, J., Jelinek, L., Lohse, L., Berberich, G., Noll-Hussong, M. McKay, D., Abramowitz, J. S., Abramovitch, A., Ehring, T., Cludius, B.

Abstract

The Obsessive-Compulsive Inventory-Revised (OCI-R) is widely used to assess symptoms of Obsessive-Compulsive Disorder (OCD). Despite its consistent factor structure, criticism on its syndromal validity has been raised. With the recent update of the commonly used diagnostic manuals, hoarding symptoms are now better captured by the diagnosis "pathological hoarding". Furthermore, the neutralising scale suffers from relatively low psychometric properties. Consequently, a 12-item version of the scale (OCI-12), excluding hoarding and neutralising items was recently developed in English. The current study examined the psychometric properties of the German version of the OCI-12. The psychometric properties of the translated German version of the OCI-12 were investigated in a German-speaking sample, consisting of 102 participants with OCD, 69 participants with an anxiety-related disorder, and 248 non-clinical controls. The German version of the OCI-12 replicated the four-factor structure of the original English version, with a higher order factor of general OCD symptoms. In addition, similar to the original version, the German OCI-12 showed good internal consistency and test-retest reliability, moderate-to-good construct validity, and good-to-excellent diagnostic accuracy. The German version of the OCI-12 represents a syndromally valid and reliable inventory for assessing OCD symptoms. Psychometric properties are good-to-excellent and comparable to the original English version. The diagnostic sensitivity is good-to-excellent and further supports using the OCI-12 in clinical and research settings.

1. Introduction

Over the last two decades, the most common questionnaire for the assessment of Obsessive-Compulsive Disorder (OCD) symptoms has been the Obsessive-Compulsive Inventory Revised (OCI-R; Foa et al., 2002; German version: Gönner et al., 2007). Consisting of 18 items, the OCI-R assesses OCD symptoms on six dimensions (washing, checking, ordering, obsessing, neutralising, and hoarding). Yet despite its consistent factor structure demonstrated across various languages (e.g., Simos et al., 2019; Solem et al., 2010; Souza et al., 2011) and its frequent use, criticism on its syndromal validity has been raised. Particularly, although hoarding symptoms can still contribute to an OCD diagnosis when driven by obsessions (DSM-5; American Psychiatric Association, 2013, p. 241), hoarding is no longer considered a core symptom of OCD and is now classified as separate disorder (DSM-5; American Psychiatric Association, 2013; ICD-11; World Health Organization, 2019). Moreover, the subscale "neutralising" is limited to phenomena involving numeric content and suffers from low psychometric properties compared to other OCI-R subscales (Abramovitch et al., 2021; Abramowitz & Deacon, 2006; Hajcak et al., 2004).

With the aim to improve the syndromal validity of the OCI-R and adjust it to the current changes in the DSM-5 and ICD-11, Abramovitch et al. (2021) developed a 12-item English version of the OCI-R, called the OCI-12. The OCI-12 possesses good-to-excellent psychometric properties which were comparable to the original version of the OCI-R. The factor analysis evidenced that the four factors of checking, ordering, washing, and obsessing could explain the data well, with a general factor of OCD being beneficial to account for the covariances between the factors. Furthermore, the OCI-12 was able to differentiate between individuals with OCD and those with an anxiety-related disorder (ARD) or non-clinical (NC) controls. In summary, the English version of the OCI-12 represents a valuable update of the OCI-R with a syndromally valid assessment of obsessive-compulsive symptoms and symptom dimensions.

The current study aimed to assess the psychometric properties of the German version of the OCI-12 to evaluate its utility in routine care and clinical research. We translated the OCI-12 into German and examined its factor structure, internal consistency, test-retest reliability, construct validity, diagnostic accuracy, cut-off criteria, and severity benchmarks.

2. Methods

2.1. Translation Procedure

The translation process of the OCI-12 followed the translation-back-translation procedure as described in Cripps (2017) and added aspects of Beaton et al. (2000). The process is described in Appendix A1.

2.2. Study Procedure

Three groups of participants were assessed: OCD, ARD, NC. Individuals in the clinical samples (OCD and ARD) were assessed at a single timepoint (T_1). For test-retest reliability, the NC sample was assessed at two timepoints (T_1 and T_2), with email invitations sent 14 days apart. At T_1, all questionnaires were administered, whereas only the OCI-12 was administered at T_2.

All questionnaires were administered online via the survey software REDCap (Harris et al., 2009). The study was approved by the ethics committee of the Faculty of Psychology and Educational Sciences of the LMU Munich (03_Mueller_b). All participants provided informed E-consent for data collection.

2.3. Participants

For determining the target sample size, we followed the suggestions for minimum sample sizes of MacCallum (1999) and Hair (2019) to ensure that the factor analyses of the

OCI-12 could be conducted in the total sample and the subsample of participants with OCD. We also referred to previous studies that conducted analyses with similar clinical and non-clinical samples (e.g., OCD: $n = 44$, clinical control: $n = 44$, non-clinical: $n = 287$; Aydin et al., 2014; OCD: $n = 107$, anxiety disorder: $n = 30$, depression: $n = 40$; Fink-Lamotte et al., 2021). Therefore, we predefined samples sizes of 100 participants in the OCD group, 50 participants in the ARD group, and 250 participants in the NC group. The observed communalities ($h^2 = .77$ for the total sample; $h^2 = .73$ for the OCD sample) are on average larger than $h^2 = .60$, confirming that our sample sizes are adequate for conducting factor analyses in both the OCD and total samples (according to Hair et al., 2019).

Participants were recruited between April 2022 and July 2024. General inclusion criteria were: minimum age of 18 years, no history of mania or psychotic disorders, and no acute suicidality. Further group-specific inclusion criteria are described below. In- and exclusion criteria were checked with dedicated questions and questionnaires in the survey's start.

2.3.1. Clinical Samples

Participants with a primary OCD/ARD diagnosis within the previous six months, based on DSM-5 (American Psychiatric Association, 2013) or ICD-10 (World Health Organization, 1992) criteria, or those undergoing treatment due to OCD/ARD during this period, were recruited from collaborating clinics in Germany and another research project at the LMU Munich (https://osf.io/8gkjc). The diagnosis of OCD/ARD was given by healthcare providers (for participants recruited through cooperating clinics) or with a structured interview (Mini-DIPS; Margraf & Cwik, 2017; for participants recruited through another project).

For OCD participants, inclusion required a Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Hand & Büttner-Westphal, 1991) total score > 12 or a subscale score ≥ 8 for obsessions or compulsions as an indicator for clinically relevant OCD symptoms (see also Külz et al., 2014, 2019). The Y-BOCS was administered as self-rating (Y-BOCS-SR; Baer, 1993) for

participants recruited through cooperating clinics (n = 64) and as interview version (Hand & Büttner-Westphal, 1991) for participants recruited through another project (n = 38). The final sample comprised 102 participants with OCD with Y-BOCS scores indicating moderate symptoms (M = 22.14, SD = 6.08; $M_{\text{ObsessionSuscale}}$ = 11.25, $SD_{\text{ObsessionSuscale}}$ = 3.39, $M_{\text{CompulsionSubscale}}$ = 10.88, $SD_{\text{CompulsionSubscale}}$ = 3.89).

ARD participants were excluded if they had a lifetime diagnosis of OCD. In total 69 participants with ARD fulfilled the inclusion criteria and completed the assessment. The diagnoses were as follows: 28.99% social anxiety disorder, 13.04% generalised anxiety disorder, 31.88% panic disorder, 5.8% agoraphobia, 10.14% post-traumatic stress disorder, 42.03% specific phobia[1].

2.3.2. Non-Clinical Sample

Non-clinical participants were recruited via the German online panel PsyWeb (https://psyweb.uni-muenster.de). Participants were screened for major psychological disorders with the simple version of the Web Screening Questionnaire (WSQ; Donker et al., 2009) and excluded if they exceeded any cut-off. Of 906 participants that gave informed consent to participate in the study and publication of their data, 383 filled out the screening questions and fulfilled the inclusion criteria. Of those, a total of 248 participants completed the first assessment, with 163 eligible for test-retest analyses after completing both assessments.

In summary, the final sample consisted of N = 419 participants, including n = 102 in the OCD group, n = 69 in the ARD group, and n = 248 in the NC group. Sample characteristics are presented in Appendix A2.

[1] As multiple anxiety disorders could be present at the same time, the percentages exceed 100%.

2.4. Measures

The reliabilities of the questionnaires used in this study are provided in Appendix A3. The psychometric properties of the OCI-12 will be elaborated below.

2.4.1. 12-Item Obsessive-Compulsive Inventory (OCI-12)

The OCI-12 is a 12-item self-report questionnaire measuring OCD symptoms and associated distress on a five-point Likert scale [ranging from 0 (not at all) to 4 (extremely)]. Each scale is assessed by three items, such as "I get upset if objects are not arranged properly." for the ordering subscale, "I repeatedly check doors, windows, drawers, etc." for the checking subscale, "I sometimes have to wash or clean myself simply because I feel contaminated." for the washing subscale, and "I frequently get nasty thoughts and have difficulty in getting rid of them." for the obsessing subscale. The German wording of each item and the associated subscales are displayed in Appendix A4.

2.4.2. Yale-Brown Obsessive-Compulsive Scale (Y-BOCS)

The Y-BOCS was assessed as a 10-item interview (Hand & Büttner-Westphal, 1991) for participants recruited through another project and as a 10-item self-report measure (Y-BOCS-SR; Baer, 1993) for participants recruited through cooperating clinics. The Y-BOCS assesses the severity of obsessions and compulsions over the past week. Each item is rated on a five-point scale (0 to 4), with higher scores indicating higher symptom severity. While previous studies proposed that the two versions can be used interchangeably (Steketee et al., 1996), more recent investigations showed slightly higher scores in the clinician administered version (Federici et al., 2010; Hauschildt et al., 2019). In the current study, the Y-BOCS total scores did not differ significantly between the two administration modalities: Y-BOCS: $M = 22.29$, $SD = 6.44$ (completed by 38 participants recruited through another project); Y-BOCS-SR: $M = 22.05$,

SD = 5.91 (completed by 64 participants recruited through cooperating clinics); $t(71.61) = -0.19$, $p = .85$.

2.4.3. Dimensional Obsessive–Compulsive Scale (DOCS)

The DOCS (Fink-Lamotte et al., 2021) assesses OCD symptom severity over the past month across four dimensions (i.e., contamination, responsibility for harm and mistakes, symmetry, and unacceptable/taboo thoughts). Each dimension incorporates five items rated on a five-point scale (0 to 4), with higher scores representing higher symptom severity.

2.4.4. Anxiety Sensitivity Index-3 (ASI-3)

The ASI-3 (Kemper et al., 2011) assesses anxiety sensitivity with 18 items rated on a five-point Likert scale [0 (very little) to 4 (very much)], with higher scores representing higher anxiety sensitivity.

2.4.5. Penn State Worry Questionnaire (PSWQ)

The PSWQ (Glöckner-Rist & Rist, 2014) assesses excessive and unrealistic worry using 16-items that are rated on a five-point Likert scale [1 (not at all typical of me) to 5 (very typical of me)], with higher scores indicating higher worry.

2.4.6. Patient Health Questionnaire-9 (PHQ-9)

The PHQ-9 (Löwe et al., 2002) assesses the severity of depressive symptoms throughout the past two weeks with nine items rated on a four-point scale [0 (not at all) to 3 (nearly every day)]. Higher scores indicate more severe depressive symptoms.

2.4.7. Web Screening Questionnaire (WSQ)

The adapted simple version of the WSQ (Donker et al., 2009) contains 13 questions that screen for the most common psychological disorders and acute suicidality. The original version of the WSQ has been validated and deemed as an appropriate screening tool (Donker et al., 2009; Meuldijk et al., 2017).

2.5. Analytic Plan

The statistical analyses were performed in *R* Statistics (version 4.4.1; R Core Team, 2024), with significance set at $p < .05$. The R-code is available at https://osf.io/4m9x6/.

2.5.1. Confirmatory Factor Analysis

The factor structure of the OCI-12 was investigated by confirmatory factor analyses (CFA) using the *lavaan* package (version 0.6-19; Rosseel, 2012). Both, the four-factor structure (washing, checking, ordering, obsessing) and the four-factor structure including a higher-order factor of general OCD symptoms were investigated. We evaluated goodness of fit using the standardised root-mean-square residual (SRMR), root-mean-square error of approximation (RMSEA), the comparative fit index (CFI), and the Tucker-Lewis index (TLI). The following criteria as indicator for good model fit (Hu & Bentler, 1999; Schmitt, 2011): RMSEA ≤ 0.06; SRMR ≤ 0.08; CFI ≥ 0.95; TLI ≥ 0.95. As the multivariate normality assumption was violated (for mean and variance), we decided to use the “Maximum Likelihood with Robust Standard Errors and Mean-Variance Adjusted Test” in our CFAs. Therefore, all fit indices reported are robust fit indices. We further investigated in separate linear regression models whether each factor of the OCI-12 could predict the corresponding subscale of the DOCS.

2.5.2. Construct Validity

To examine construct validity, correlation analyses were conducted between OCI-12, Y-BOCS, and DOCS (convergent validity) and between OCI-12, ASI-3, PSWQ, and PHQ-9 (discriminant validity). Pearson's correlation coefficients were interpreted according to Cohen (1988).

2.5.3. Reliability

For internal consistency, both Cronbach's α and McDonald's ω were calculated (Dunn, 2014; McDonald, 1999) and interpreted according to Hair (2009). The test-retest reliability of the OCI-12 was investigated with correlation analyses (interpreted according to Cohen, 1988), paired *t*-tests, and the two-way mixed effect intraclass correlation coefficient (ICC; interpreted according to Koo & Li, 2016) between T_1 and T_2 in the NC sample.

2.5.4. Diagnostic Accuracy

We investigated group differences in the OCI-12 total and subscale scores by means of univariate (ANOVA) and multivariate analysis of variance (MANOVA). Furthermore, we conduced post-hoc Tukey Honest Significant Difference (Tukey HSD).

We investigated the diagnostic accuracy of the total score and each subscale with receiver operating characteristic (ROC) analyses. The area under the curve (AUC) was interpreted according to the criteria by Carter et al. (2016). Cut-off scores were established with the Youden Index (J; Youden, 1950).

3. Results

3.1 Confirmatory Factor Analysis

3.1.1. Confirmatory Factor Analysis in the OCD Sample

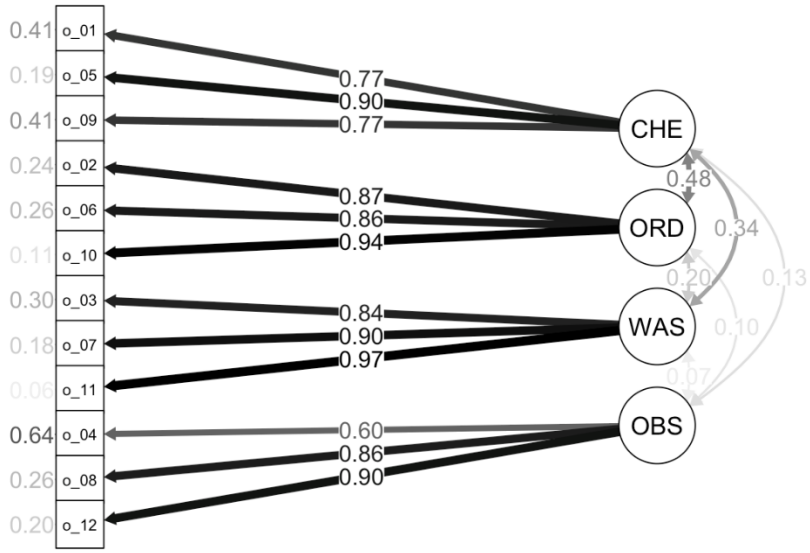
Figure 2.1A displays the CFA examining the four-factor solution. The Chi-square test, $\chi^2(48, N = 102) = 70.985$, $p = .017$, rejected the hypothesis of a perfect fit. Furthermore, the TLI (0.945) did not support a good model fit while the RMSEA indicated a marginal model fit (0.081; MacCallum et al., 1996). The remaining goodness-of-fit indices supported a good fit of the four-factor model: SRMR = 0.059; CFI = 0.960.

The four-factor model including a higher-order factor of general OCD symptoms is shown in Figure 2.1B. Aside from the Chi-square test, $\chi^2(50, N = 102) = 71.181$, $p = .026$, and the RMSEA (0.076; reasonable fit; MacCallum et al., 1996), all fit indices support a good model fit: SRMR = 0.058; CFI = 0.963; TLI = 0.951. The first-order factors loaded weakly to strongly on the higher-order factor of general OCD symptoms. The higher-order factor accounted for a significant proportion of variance in the first-order factors checking, ordering, and washing ($R^2_{Checking} = .791$, $R^2_{Ordering} = .286$, $R^2_{Washing} = .148$), but not obsessing ($R^2_{Obsessing} = .023$).

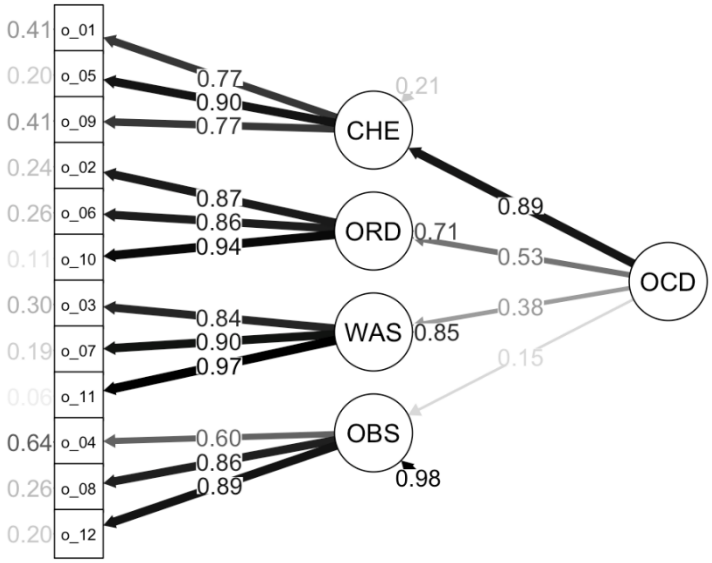
Figure 1.1

Confirmatory Factor Analyses of the OCI-12 in the OCD Sample (n = 102).

A.



B.



Note. A Path diagram of the structural equation model in the OCD sample depicting the four-factor model. **B** Path diagram of the structural equation model in the OCD sample depicting the four-factor model including a higher order factor of general OCD symptoms. The factor loadings are presented between the lines, with thicker lines being indicative of higher factor loadings. Residual variances are presented next to the observed items and factors. OCI-12 = 12-item Obsessive-Compulsive Inventory, CHE = checking subscale, ORD = ordering subscale, WAS = washing subscale, OBS = obsessing subscale, OCD = Obsessive-Compulsive Disorder.

3.1.2. Confirmatory Factor Analysis in the Total Sample

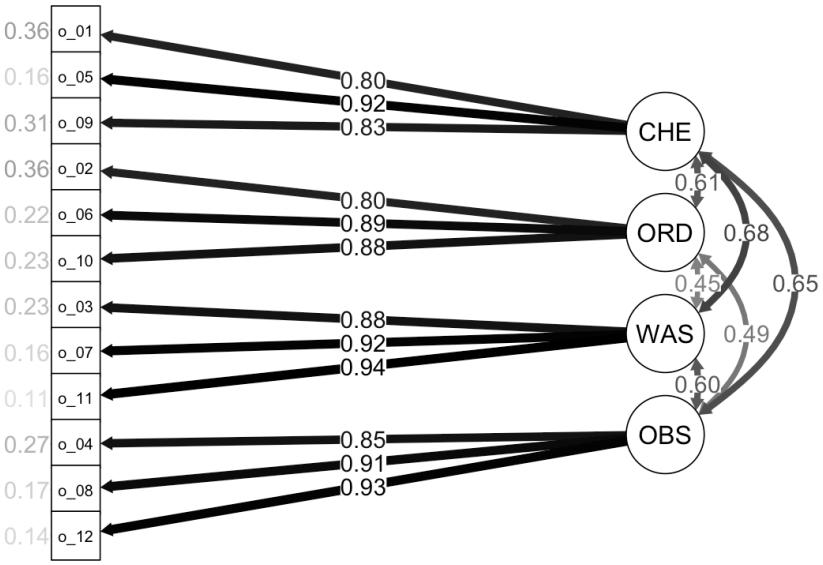
The path model of the four-factor solution in the total sample is displayed in Figure 2.2A. As in the OCD sample, the Chi-square test was significant, $\chi^2(48, N = 419) = 80.558$, $p = .002$) and the RMSEA showed only a reasonable fit (0.065; MacCallum et al., 1996). The remaining goodness-of-fit indices supported a good fit of the data: SRMR = 0.043; CFI = 0.979; TLI = 0.972.

Figure 2.2B presents the path model including the general OCD factor. Except the Chi-square test, $\chi^2(50, N = 419) = 84.168$, $p = .002$, and the RMSEA (0.065; reasonable fit; MacCallum et al., 1996), all fit indices support a good model fit: SRMR = 0.046; CFI = 0.979; TLI = 0.972. In the total sample, the first-order factors loaded strongly on the higher-order factor of general OCD symptoms. The higher-order factor accounted for a significant proportion of variance in all first-order factors ($R^2_{Checking} = .796$, $R^2_{Ordering} = .433$, $R^2_{Washing} = .588$, $R^2_{Obsessing} = .557$).

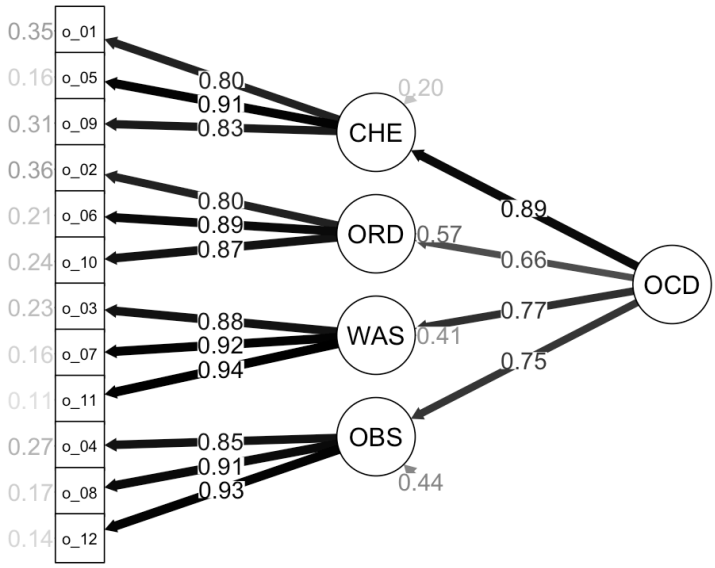
Figure 1.2

Confirmatory Factor Analyses of the OCI-12 in the Total Sample (N = 419).

A.



B.



Note. A Path diagram of the structural equation model in the total sample depicting the four-factor model. **B** Path diagram of the structural equation model in the total sample depicting the four-factor model including a higher order factor of general OCD symptoms. The factor loadings are presented between the lines, with thicker lines being indicative of higher factor loadings. Residual variances are presented next to the observed items and factors. OCI-12 = 12-item Obsessive-Compulsive Inventory, CHE = checking subscale, ORD = ordering subscale, WAS = washing subscale, OBS = obsessing subscale, OCD = Obsessive-Compulsive Disorder.

3.1.3. Correspondence of OCI-12 Subscales to DOCS Factors

The linear regression models of the four OCI-12 factors predicting each DOCS subscale are presented in Appendix A5. Each DOCS subscale significantly and strongly predicted by the corresponding OCI-12 subscale (βs ranging from β = 0.44 for checking and ordering to β = 0.84 for washing).

3.2. Reliability

3.2.1. Internal Consistency

The internal consistency for the OCI-12 subscales in the OCD group ranged from good (obsessing) to excellent (washing; see Table 1.1). The OCI-12 total showed good internal consistency. In the ARD subgroup, the internal consistency ranged from acceptable (washing) to good (ordering), while the OCI-12 total demonstrated good internal consistency. The NC group showed the lowest internal consistency, ranging from not satisfactory (checking) to acceptable (obsessing), with the OCI-12 total showing acceptable internal consistency.

Table 1.1

Internal Consistency of OCI-12 Subscales per Group.

OCI-12	OCD *n* = 102		ARD *n* = 69		NC *n* = 248	
	α	ω	α	ω	α	ω
Checking	.85	.86	.78	.83	.40	.44
Ordering	.92	.92	.87	.87	.79	.70
Washing	.93	.93	.76	.76	.60	.61
Obsessing	.82	.84	.85	.85	.77	.77
Total	.82	.74	.84	.84	.72	.71

Note. OCI-12 = 12-item Obsessive-Compulsive Inventory, OCD = Obsessive-Compulsive Disorder, ARD = Anxiety-Related Disorders, NC = Non-Clinical Controls.

3.2.2. Test-Retest Reliability

The test-retest reliability of the OCI-12 was assessed over an interval of *M* = 13.42 (*SD* = 3.64) days in the NC group. Results are displayed in Table 1.2. Results of *t*-tests indicated no significant changes over the test-retest interval for OCI-12 total and all subscales except for washing, which significantly increased from T_1 to T_2. A strong positive correlation between T_1 and T_2 was shown for the OCI-12 total and a moderate (checking) to strong (ordering, washing, obsessing) positive correlation for the OCI-12 subscales. The two-way mixed effect ICC demonstrated moderate (checking) to good (ordering, washing, obsessing) reliability for the subscales and good reliability for the OCI-12 total score.

Table 1.2

Descriptives and Test-Retest Measures of the OCI-12.

OCI-12	T_1		T_2		*t*-Test		Pearson's Correlation		ICC	
	M	*SD*	*M*	*SD*	*t*	*p*	*r*	*p*	*F*	*ICC*
Checking	0.80	0.99	0.72	0.96	-1.151	.251	.52	<.001	3.2	.69
Ordering	2.09	1.84	2.24	1.88	1.214	.227	.65	<.001	4.8	.79
Washing	0.33	0.75	0.47	0.96	2.506	.013	.67	<.001	4.7	.79
Obsessing	1.09	1.56	1.18	1.58	0.991	.323	.71	<.001	6.0	.83
Total	4.32	3.42	4.61	3.57	1.323	.188	.67	<.001	5.1	.80

Note. OCI-12 = 12-item Obsessive-Compulsive Inventory, ICC = two-way mixed effect intraclass correlation coefficient. These measures were obtained in the sample of Non-Clinical Controls (*n* = 163) only.

3.3. Construct Validity

As shown in Table 1.3, the OCI-12 correlated moderately with the Y-BOCS in the OCD sample and strongly with the DOCS in all groups. The correlations with depressive symptoms, anxiety, and worry were moderate.

Table 1.3

Correlations between OCI-12 and Measures of OCD Symptoms, Depression, Anxiety, and Worry per Group.

Measure	OCD		ARD		NC	
		OCI-12		OCI-12		OCI-12
	n	*r*	*n*	*r*	*n*	*r*
OCD Symptoms (Convergent)						
Y-BOCS $_{Total}$	102	.45	–	–	–	–
DOCS $_{Total}$	102	.74	69	.63	248	.50
Other Symptoms (Divergent)						
PHQ-9	102	.48	69	.29	248	.44
ASI-3	102	.47	69	.37	248	.39
PSWQ[1]	101	.48	65	.30	237	.46

Note. OCD = Obsessive-Compulsive Disorder, ARD = Anxiety-Related Disorders, NC = Non-Clinical Controls, OCI-12 = 12-item Obsessive-Compulsive Inventory, Y-BOCS = Yale-Brown Obsessive-Compulsive Inventory, DOCS = Dimensional Obsessive-Compulsive Scale, PHQ-9 = Patient-Health Questionnaire-9, ASI-3 = Anxiety-Sensitivity Index-3, PSWQ = Penn-State Worry Questionnaire.

[1] Missing values in the dataset.

3.4. Diagnostic Accuracy

3.4.1 Group Differences

Descriptives and group differences on the OCI-12 are presented in Table 1.4. The total scores of the OCI-12 significantly differed between groups, $F(2, 416) = 373.1$, $p < .001$, as indicated by a main effect of group in the ANOVA. Participants with OCD had significantly

higher OCI-12 scores than participants with ARD and NC, which showed significantly higher OCI-12 scores than the NC group (all p's < .001 in Tukey's HSD tests).

When considering the OCI-12 subscales, the MANOVA showed a significant main effect of group across the subscales, Pillai's Trace = 0.733, $F(8, 828) = 59.837$, $p < .001$. As for the OCI-12 total score, separate ANOVAs with post-hoc Tukey HSD tests revealed that participants with OCD had significantly higher scores on each subscale than participants with ARD, which showed significantly higher scores than the NC group (all p's < .001).

Table 1.4

Descriptives and Group Differences of the OCI-12.

OCI-12	OCD $n = 102$				ARD $n = 69$				NC $n = 248$			
	M	*SD*	*Mdn*	*IQR*	*M*	*SD*	*Mdn*	*IQR*	*M*	*SD*	*Mdn*	*IQR*
Checking	5.26	3.32	5	6	2.06	2.32	1	3	0.79	0.95	1	1
Ordering	4.90	3.52	4	5.75	3.78	3.14	3	5	1.96	1.74	2	2
Washing	5.83	4.41	6	8.75	1.59	2.16	1	3	0.34	0.85	0	0
Obsessing	7.22	3.06	8	4	3.57	2.74	3	5	1.02	1.43	1	2
Total	23.22	9.19	23	12	11.00	7.34	10	10	4.10	3.23	3	4

Note. The values for each subscale can range from 0 – 12. The possible range for the total score is 0 – 48. OCI-12 = 12-item Obsessive-Compulsive Inventory, OCD = Obsessive-Compulsive Disorder, ARD = Anxiety-Related Disorders, NC = Non-Clinical Controls, Mdn = Median, IQR = Interquartile Range.

3.4.2. Diagnostic Accuracy

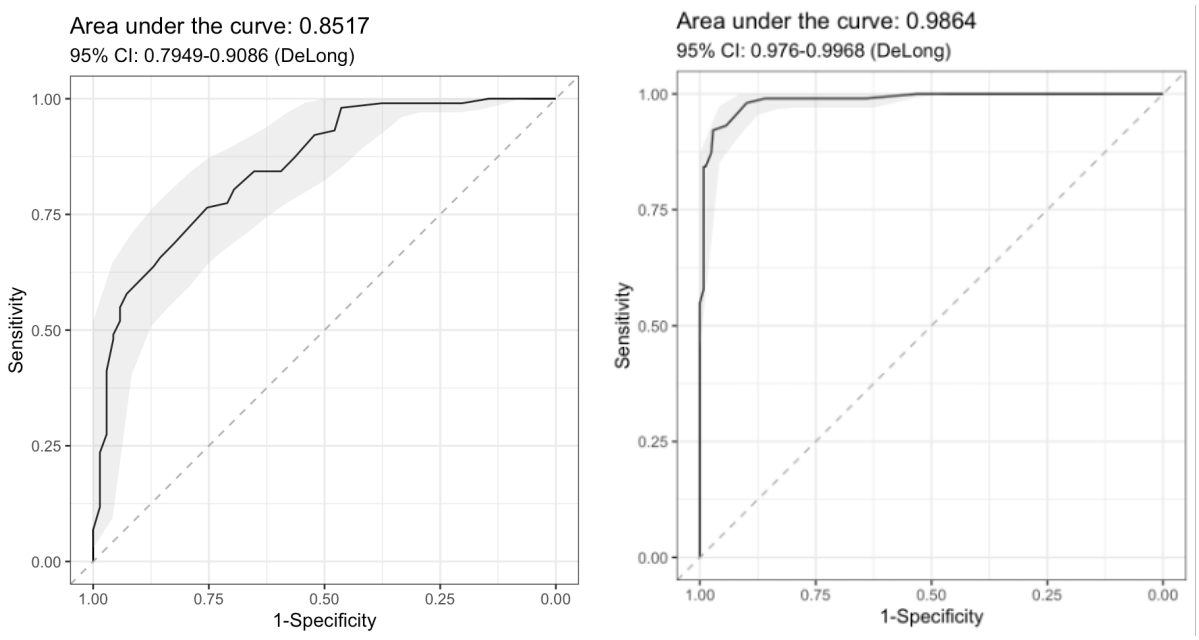
The diagnostic accuracy of the OCI-12 to discriminate participants with OCD from participants with ARD was good (AUC = .85, 95% CI [.795; .909]; see Figure 2.3A). The diagnostic accuracy for each subscale ranged from AUC = .59 (ordering) to AUC = .81 (obsessing; see Figure 2.4A).

Considering the diagnostic accuracy of the OCI-12 for distinguishing individuals with OCD from NC's, the OCI-12 total score evidenced excellent accuracy (AUC = .99, 95% CI [.976; .997]; see Figure 2.3B). The diagnostic accuracy of the subscales ranged from AUC = .75 (ordering) to AUC = .96 (obsessing). Overall, the OCI-12 total score evidenced the best diagnostic accuracy for discriminating OCD participants from both, ARD and NC (see Figure 2.4B).

Figure 1.3

Receiver Operating Characteristic Curves for the OCI-12 Total.

A **B**

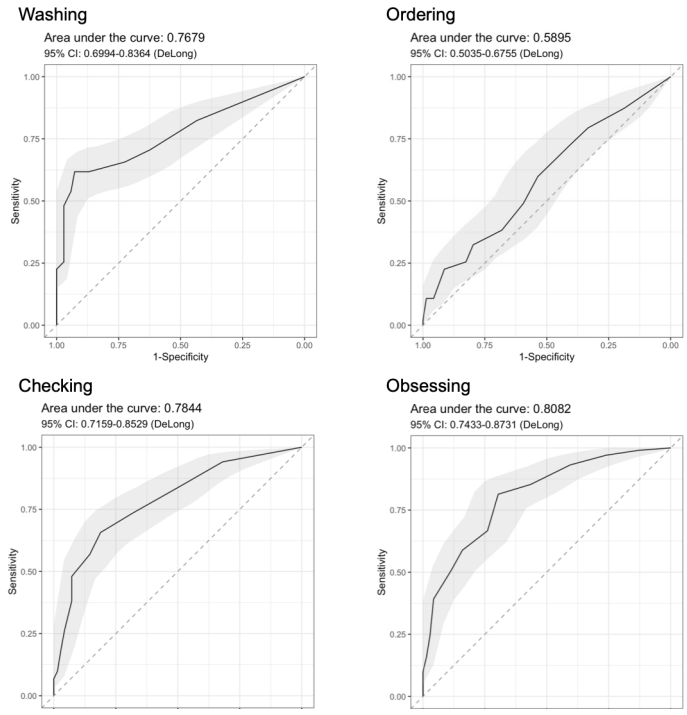


Note. A Receiver operating characteristic (ROC) curve discriminating participants with Obsessive-Compulsive Disorder (*n* = 102) from participants with Anxiety-Related Disorders (*n* = 69). **B** Receiver operating characteristic (ROC) curve discriminating participants with Obsessive-Compulsive Disorder (*n* = 102) from Non-Clinical Controls (*n* = 248).

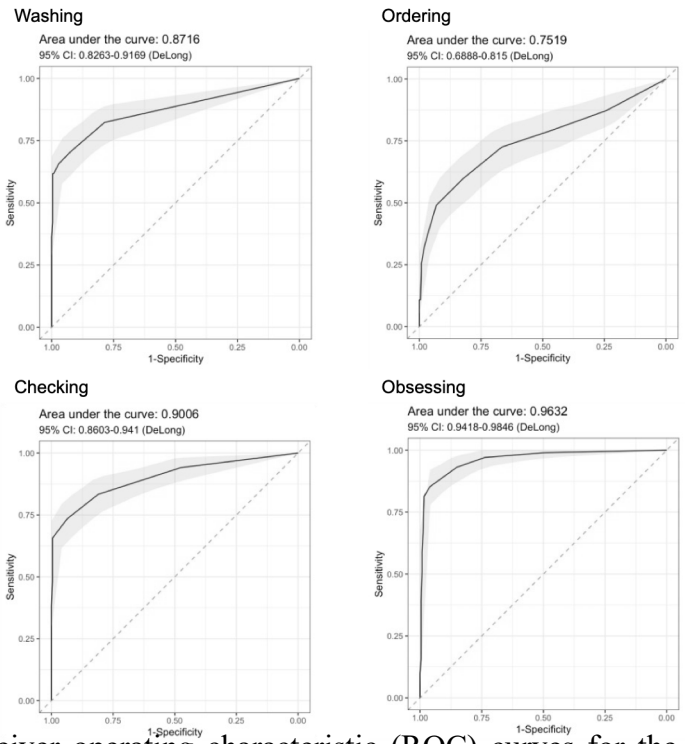
Figure 1.4

Receiver Operating Characteristic Curves for the OCI-12 Subscales.

A



B



A Receiver operating characteristic (ROC) curves for the OCI-12 subscales discriminating participants with Obsessive-Compulsive Disorder (n = 102) from participants with Anxiety-Related Disorders (n = 69). **B** Receiver operating characteristic (ROC) curves for the OCI-12 subscales discriminating participants with Obsessive-Compulsive Disorder (n = 102) from Non-Clinical Controls (n = 248).

3.4.3. Optimal Cut-Off

Table 1.5 summarises the Youden Indices, sensitivities, and specificities of the OCI-12 total and each subscale for discriminating participants with OCD from ARD and NC participants. An OCI-12 total score ≥ 17 was considered optimal to discriminate participants with OCD from participants with ARD. When discriminating participants with OCD from NC's, a score of ≥ 11 was considered optimal. Out of the subscales, the washing subscale could best discriminate OCD from ARD participants, while the obsessing subscale best discriminated OCD from NC participants. The ordering subscale was suited worst to discriminate participants with OCD from ARD and NC participants.

Table 1.5

Optimal Cut-Offs for OCI-12 Subscales.

OCI-12 Subscale	OCD vs. ARD				OCD vs. NC			
	Cut-Off	*J*	Sensitivity	Specificity	Cut-Off	*J*	Sensitivity	Specificity
Checking	4	.47	65.69%	81.16%	3	.67	73.53%	93.55%
Ordering	9	.14	22.55%	91.30%	5	.42	49.02%	93.15%
Washing	5	.55	61.76%	92.75%	2	.63	70.59%	92.34%
Obsessing	5	.51	81.37%	69.57%	4	.81	85.29%	95.97%
Total	17	.52	76.47%	75.36%	11	.89	92.16%	97.18%

Note. OCI-12 = 12-Item Obsessive-Compulsive Inventory, OCD = Obsessive-Compulsive Disorder, ARD = Anxiety-Related Disorders, NC = Non-Clinical Controls, *J* = Youden Index, Sensitivity = correct classification of OCD participants, Specificity = correct classification of non-OCD participants.

3.4.4. Severity Benchmarks

OCI-12 severity benchmarks were investigated in severity-groups based on Y-BOCS cut-offs (Storch et al., 2015; see Appendix A6 for OCI-12 descriptives per severity group). The

OCI-12 total score fairly discriminated mild from moderate cases (AUC = .73, 95% CI [.557; .900]), but only poorly distinguished moderate from moderate-severe cases (AUC = .69, 95% CI [.576; .807]) and moderate-to-severe from severe cases (AUC = .52, 95% CI [.059; .983]). Given that the severe group included only three individuals, moderate-to-severe and severe cases were combined, but discrimination from moderate cases remained poor (AUC = .69; 95% CI [.577; .801]). An optimal cut-off ≥ 12 was suggested for mild vs. moderate cases (J = 38), and a cut-off ≥ 24 for moderate vs. moderate-severe cases (J = .38). Due to small sample sizes and limited discrimination, further research with a larger sample is needed to establish OCI-12 severity benchmarks.

4. Discussion

To utilise the OCI-12 in German-speaking populations, we translated the original English version (Abramovitch et al., 2021) into German and investigated its psychometric properties. We replicated the original four-factor structure with a higher-order factor of general OCD symptoms. Furthermore, our results on the reliability, validity, and diagnostic accuracy of the OCI-12 are good-to-excellent and comparable to the original English version.

More specifically, the four-factor model (washing, checking, ordering, and obsessing) including the higher-order factor of general OCD symptoms showed a good fit to the data according to the CFAs. The higher-order factor also explained significant variance in the OCI-12 subscales. Of note, the chi-square test and the RMSEA did not support a good model fit. However, both indices are criticised for being sensitive to the sample size (Bollen, 2014; Hu & Bentler, 1999) and the degrees of freedom (Kenny et al., 2015), respectively. As most of the approximate fit indices (i.e., SRMR, CFA, TLI) supported a good fit of the data, we conclude that the four-factor structure with a higher-order factor of general OCD symptoms is also evident in the German-speaking sample. Moreover, each of the OCI-12 subscale significantly

and most strongly predicted the corresponding subscale of the well-established DOCS, providing further evidence for the four factors.

The OCI-12 total score's internal consistency and test-retest reliability was good. In terms of construct validity, the current correlation analyses showed only a moderate correlation between OCI-12 scores and the Y-BOCS. This relatively low correlation has also been shown in previous studies (see Abramovitch et al., 2021; Aspvall et al., 2020) and may be related to idiographic nature of the Y-BOCS in measuring OCD symptom severity of individually assessed obsessions and compulsions as compared to the nomothetic approach of the OCI-12. Moreover, the format of administration seems to contribute to the relatively low correlation, hinting towards the *common method bias* (Podsakoff et al., 2003). Indeed, an exploratory correlation analysis showed that the correlation between the two self-reports, OCI-12 and Y-BOCS-SR, was higher ($r = .56$, $p < .001$) than the correlation between the OCI-12 and the Y-BOCS interview ($r = .28$, $p = .090$). However, in support of convergent validity, the correlation between the OCI-12 and the DOCS is strong. Therefore, we consider the comparably weak correlation with the Y-BOCS rather as a methodological/conceptual artefact. Correlations between the OCI-12 and measures of depression, anxiety, and worry have been moderate, highlighting that the OCI-12 possesses discriminant validity but is not completely independent of these symptom measures. Given that the clinical samples present with comorbid diagnoses (e.g., depression), these results are, however, not surprising.

When comparing the OCI-12 scores between the three groups, the group of participants with OCD showed significantly higher scores than both, participants with ARD and NC. The OCI-12 can discriminate well between participants with OCD and ARD when a cut-off of ≥17 is considered and can discriminate excellently between participants with OCD and NC's when a cut-off of ≥ 11 is used. Of note, the OCI-12 should not be considered as isolated diagnostic tool (i.e., the cut-off criteria should not replace a diagnostic interview). Analyses of the severity benchmarks showed that the OCI-12 could fairly discriminate mild from moderate cases, but

only poorly discriminate between cases of mild or severe symptom severity. However, due to the small sample sizes within the severity groups, future research is needed to establish conclusive benchmarks.

5. Limitations

This study has some limitations. Although participants were recruited within cooperating clinics, structured diagnostic interviews were not always possible, risking less precise diagnoses, particularly for comorbid disorders. Likewise, the absence of structured interviews for the NC population may have allowed the inclusion of participants with undiagnosed psychological disorders, not captured by dedicated questions or the WSQ.

Furthermore, 63% of participants with OCD filled out the Y-BOCS as self-rating, whereas 37% completed the Y-BOCS interview. While both formats show strong correlations and good reliability and may be used interchangeably (Baer et al., 1993; Rosenfeld et al., 1992; Steketee et al., 1996), the weak correlation between the interview version and the OCI-12 hints towards a *common method bias,* which should be taken into consideration when interpreting the convergent validity. As the correlation between the OCI-12 and the Y-BOCS is affected by the assessment modality, it may be worthwhile in future studies to investigate the correlation between the OCI-12 and other interview-based measures.

Additionally, participants in the clinical samples presented with comorbid disorders. Although this increases the ecological validity of the current validation, comorbid information is not integrated into the psychometric analyses. Therefore, comorbid symptoms may attenuate some of the reported measures (e.g., internal validity, discriminant validity).

Lastly, the sample size of the OCD group should be increased in future studies. While the average item communalities (h^2 =.73) indicate that a sample size of n = 100 is adequate for conducting the CFA according to rules of thumb (Hair et al., 2019), a larger OCD sample may enhance the robustness of findings. The total sample size (N = 419), however, is adequate for

conducting the CFA on the OCI-12 which supports the four-factor structure, including the higher-order factor representing general OCD symptoms. A valuable next step would be recruiting a large, representative sample, which would allow the development of norms for the OCI-12.

6. Conclusion

The German version of the OCI-12 presents a syndromally valid self-report measure to assess OCD symptoms which can be used in research and clinical settings. The original four-factor structure with a higher-order factor of general OCD symptoms could be replicated and the OCI-12 possesses good-to-excellent psychometric properties in terms of internal and test-retest reliability and construct validity. Furthermore, the OCI-12 possesses good-to excellent-diagnostic accuracy for its established clinical cut-off values. To enable a wide use of the OCI-12, the German versions of this questionnaire, including the item numbering and scoring guidelines, can be found in Appendix A7 and at https://osf.io/4m9x6/. As a next step, conducting a study with larger sample sizes would be valuable to establish norms, enabling an even more meaningful and precise interpretation of scores on the OCI-12.

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Study II

Four Questions for Clarity: The German Version of the OCI-4 as an Ultra-Brief Screening Tool for Obsessive-Compulsive Disorder

This chapter is a pre-print version of an article currently in submission, before formal peer-review and publication.

Both, data and R code, have been made available online (https://osf.io/jrst9/).

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Abstract

Obsessive-Compulsive Disorder (OCD) is a prevalent and debilitating condition that is frequently under- or misdiagnosed in clinical practice, leading to significant delays between symptom onset and accurate diagnosis. To improve the diagnostic process for individuals with OCD, there is an urgent need for screening instruments that are both syndromally valid and reliable. Accordingly, the current study aims to evaluate the psychometric properties of the German version of the ultra-brief, four-item Obsessive-Compulsive Inventory (OCI-4). The psychometric properties of the OCI-4 were investigated in a German-speaking sample composed of 102 participants with OCD, 69 participants with an anxiety-related disorder, and 248 non-clinical individuals. The OCI-4 showed good test-retest reliability, moderate-to-good construct validity, and good-to-excellent diagnostic accuracy. The results support that the German version of the OCI-4 is a valid and reliable screening tool for OCD symptoms with good-to-excellent psychometric properties. The OCI-4 could be established as a screening tool in various settings to identify those with likely OCD.

1. Introduction

Obsessive-Compulsive Disorder (OCD) is a common psychological disorder, affecting 2-3% of individuals throughout their life-time (Ruscio et al., 2010), causing substantial impairment in daily functioning and quality of life (Pozza et al., 2018). Notwithstanding these severe consequences, patients presenting with OCD symptoms are frequently under- or misdiagnosed. A study in German outpatients showed that 70% of OCD patients are misdiagnosed in psychiatric practices (Wahl et al., 2010). Furthermore, even when diagnosed, some reports indicate that it may take more than 12 years from the onset of first OCD symptoms to the diagnosis of OCD (Ziegler et al., 2021). Considering that individuals with a prolonged delay between symptom onset and OCD diagnosis exhibit more severe symptoms and more functional impairments (Ziegler et al., 2021), there is an urgent need to reduce the duration between onset and diagnosis by identifying the presence of OCD as early as possible.

As patients with OCD often present at primary care institutions, a screening for OCD symptoms at this early stage would be beneficial for correct referral, increasing the potential of an early diagnosis. However, the length and complexity in administration and scoring of current tools for assessing OCD symptoms pose an obstacle to the widespread assessment of the disorder, including in non-specialised primary care settings (Blakey & Abramowitz, 2018). Accordingly, there is a need for a short and easy-to-administer empirically developed tool to assess OCD symptoms in a wide range of routine clinical care settings.

In the empirical development of screening tools, it is critical to address the heterogeneity of OCD symptoms and frequently overlapping symptom dimensions (Mataix-Cols et al., 2005). To capture the different symptom dimensions, the screening tool should be syndromally valid as well as reliable. Specifically, the tool must accurately identify OCD symptoms in alignment with the latest diagnostic criteria and symptom patterns, while effectively distinguishing individuals likely to have OCD from those who do not. Two screening tools are already available in German: the Dimensional Obsessive-Compulsive Scale - Short Form (DOCS-SF;

Kühne, Paunov, Abramowitz, et al., 2021) and the Zohar-Fineberg Obsessive-Compulsive Screen (ZF-OCS; Kühne, Paunov, & Weck, 2021). The DOCS-SF assesses which of the four symptom domains (contamination, responsibility, ordering, and unacceptable/taboo thoughts) is perceived as most distressing, and evaluates the severity of symptoms in terms of time spent, avoidance behaviours, distress, interference with daily life, and difficulty resisting symptoms in the respective domain. While it effectively screens for general distress associated with OCD symptoms, the DOCS-SF does not provide detailed information on the severity of each symptom domain. The ZF-OCS identifies the presence of symptoms across five domains (cleanliness, control, rumination, impairment in daily life, and order/symmetry) using "yes/no" questions. However, it does not assess the severity of these symptoms per domain. In terms of psychometric properties, both instruments demonstrate good test-retest reliability and construct validity. However, their validation was conducted exclusively on a German-speaking, non-clinical sample predominantly composed of students. As a result, the sensitivity and specificity of the DOCS-SF and ZF-OCS, which are essential for distinguishing individuals with likely OCD from those without, remain undetermined.

An alternative ultra-brief screening tool for assessing symptom severity across dimensions was recently introduced in English by Abramovitch et al. (2021). The four-item Obsessive-Compulsive Inventory (OCI-4), a condensed version of the syndromally valid OCI-12 (Abramovitch et al., 2021b; German version: Müller et al., submitted for publication), evaluates the most common symptom dimensions (i.e., washing, checking, ordering, and obsessing) with a single item per dimension. The OCI-4 demonstrated good-to-excellent psychometric properties in its initial validation. Due to the outlined reasons, such a screening tool would be also highly valuable in routine clinical care in Germany. Thus, the current study investigates the psychometric properties (i.e., test-retest reliability, construct validity, and diagnostic accuracy) of the German version of the OCI-4 by examining the four corresponding

items of the German version of the OCI-12 (Müller et al., submitted for publication) in clinical and non-clinical samples.

2. Methods

2.1. Participants

Recruitment took place between April 2022 and July 2024. Participants with a primary diagnosis of OCD and anxiety-related disorders (ARD) were recruited through cooperating clinics. Participants with OCD were also recruited via another project at the Ludwig Maximilians University (LMU) Munich. Non-clinical control (NCC) participants were recruited via the German online panel PsyWeb (https://psyweb.uni-muenster.de/). General inclusion criteria were: a minimum age of 18 years, no history of mania or psychotic disorders, and no acute suicidality. A description of group-specific inclusion criteria is provided below. Dedicated questions and questionnaires in the online survey were used to check for in- and exclusion criteria. The total sample consists of N = 419 participants that met the inclusion criteria and completed the study.

2.1.1. Clinical Samples

Participants in the OCD/ARD sample were included if they received a primary diagnosis of OCD/ARD within the past six months, based on DSM-5 (American Psychiatric Association, 2013) or ICD-10 (World Health Organization, 2019) criteria, or if they underwent psychotherapy due to OCD/ARD during this period. The diagnosis was given within the past six months by healthcare providers (for clinic recruits; before enrolment in the study) or with a structured interview by a trained interviewer (MINI-DIPS; Margraf & Cwik, 2017; for project recruits; at the beginning of the project). OCD participants were included with a Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Hand & Büttner-Westphal, 1991) total score > 12 or a subscale score ≥ 8 on for obsessions or compulsions, indicating clinically relevant OCD

symptoms (see also Külz et al., 2014, 2019). The Y-BOCS was administered as a self-rating measure (Y-BOCS-SR; Baer, 1993) to $n = 64$ participants recruited through cooperating clinics. Additionally, $n = 38$ participants completed the interview version of the Y-BOCS (Hand & Büttner-Westphal, 1991) as part of another project at the LMU. The final sample included $n = 102$ participants with an OCD diagnosis. Y-BOCS scores represented moderate symptoms on average ($M = 22.14$, $SD = 6.08$), with $M = 10.88$ ($SD = 3.89$) on the obsession subscale and $M = 11.25$ ($SD = 3.39$) on the compulsion subscale.

For participants with ARD, a lifetime diagnosis of OCD was defined as an exclusion criterion, that was assessed via a question in the online survey for clinic recruits ($n = 43$) and with a structured interview (MINI-DIPS; Margraf & Cwik, 2017) for project recruits ($n = 26$). In total, $n = 69$ ARD participants fulfilled the inclusion criteria and completed the assessment. The diagnoses were composed as follows: 28.99% social anxiety disorder, 13.04% generalised anxiety disorder, 31.88% panic disorder, 5.8% agoraphobia, 10.14% post-traumatic stress disorder, 42.03% specific phobia[2].

2.1.2. Non-Clinical Control (NCC) Sample

When starting the survey, non-clinical participants recruited via the German online panel PsyWeb were screened for major psychological disorders with the simple version of the Web Screening Questionnaire (WSQ; Donker et al., 2009) and excluded if any score was beyond the defined cut-off criteria. A total of $n = 248$ participants were included and completed the first assessment (T_1), whereof $n = 163$ participants completed also the second assessment (T_2) and were eligible for the test-retest analyses. Sample characteristics are presented in Appendix B1 (Table B1.1).

[2] As multiple anxiety disorders could be present at the same time, the percentages exceed 100%.

2.2. Measures

2.2.1. 4-item Obsessive-Compulsive Inventory (OCI-4)

The OCI-4 (Abramovitch et al., 2021a) was extracted from the German version of the OCI-12 (Müller et al., submitted for publication). This 4-item self-report questionnaire measures OCD symptoms and associated distress on a five-point Likert scale [ranging from 0 (not at all) to 4 (extremely)]. Each symptom dimension is assessed by one item: "I get upset if objects are not arranged properly." for the ordering subscale, "I repeatedly check doors, windows, drawers, etc." for the checking subscale, "I sometimes have to wash or clean myself simply because I feel contaminated." for the washing subscale, and "I frequently get nasty thoughts and have difficulty in getting rid of them." for the obsessing subscale. The German wording of each item and the associated subscale are displayed in Appendix B2 (Table B2.1). The psychometric properties will be elaborated below.

2.2.2. Yale-Brown Obsessive-Compulsive Scale (Y-BOCS)

The Y-BOCS was administered as interview (Hand & Büttner-Westphal, 1991) or as self-report (Y-BOCS-SR; Baer, 1993). The Y-BOCS severity scale included ten items that assess the severity of obsessions (items 1 to 5) and compulsions (items 6 to 10) over the past week. Every item is rated on a five-point scale (0 to 4) regarding the time spent on symptoms, the interference they cause, distress they induce, the effort of resistance, and the degree of control over them. The subscale sum-scores ($\text{Y-BOCS}_{\text{Obsessions}}$ and $\text{Y-BOCS}_{\text{Compulsions}}$) range from 0 to 20 and the $\text{Y-BOCS}_{\text{Total}}$ score ranges from 0 to 40, where higher scores correspond to higher symptom severity. While previous studies proposed that the two versions can be used interchangeably (Steketee et al., 1996), more recent investigations showed that the total scores produced by the clinician administered version are slightly higher (Federici et al., 2010; Hauschildt et al., 2019). However, in the current study, the Y-BOCS total scores did not differ significantly between the two administration modalities (i.e., interview completed by n = 38

project recruits and self-rating completed by n = 64 clinic recruits; Y-BOCS: M = 22.29, SD = 6.44; Y-BOCS-SR: M = 22.05, SD = 5.91; t(72.61) = -0.19, p = .85. Moreover, the Y-BOCS-SR (α = .83, ω = .81), the Y-BOCS as interview form (α = .87, ω = .88), and the overall Y-BOCS (containing both assessment forms; used for analyses; α = .85, ω = .84) evidenced good internal consistency.

2.2.3. Dimensional Obsessive–Compulsive Scale (DOCS)

The DOCS (Fink-Lamotte et al., 2021) assesses four OCD dimensions (i.e., contamination, responsibility for harm and mistakes, symmetry, and unacceptable/taboo thoughts) that are used to assess the OCD severity on throughout the past month. Each dimension contains five items assessing the amount of time that obsessions and compulsions take up, the potential avoidance behaviours, the level of distress associated with the OCD symptoms, the functional interference of obsessions/compulsions, and difficulties associated with disregarding obsessions or refraining from exerting compulsions. Items are rated on a five-point scale (0 to 4), so that each subscale ranges from 0 to 20 and the total score ranges from 0 to 80, with higher scores being indicative of higher symptom severity. In the current study, the German version of the DOCS dimensions and the DOCS total score showed acceptable to excellent internal consistency (Cronbach's αs: α_{OCD} = .87, α_{ARD} = .92, α_{NCC} = .77 and McDonald's ωs: ω_{OCD} = .72, ω_{ARD} = .92, ω_{NCC} = .77).

2.2.4. Anxiety Sensitivity Index-3 (ASI-3)

The Anxiety Sensitivity Index-3 (ASI-3; Kemper et al., 2011) is an 18-item self-report assessing anxiety sensitivity. Each item is rated on a five-point Likert scale [0 (very little) to 4 (very much)], with higher scores corresponding to higher anxiety sensitivity. The ASI-3 evidenced good to excellent internal consistency (Cronbach's αs: α_{OCD} = .87, α_{ARD} = .92, α_{NCC} = .89 and McDonald's ωs: ω_{OCD} = .87, ω_{ARD} = .92, ω_{NCC} = .89).

2.2.5. Penn State Worry Questionnaire (PSWQ)

The Penn State Worry Questionnaire (PSWQ; Glöckner-Rist & Rist, 2014) contains 16 item that assess excessive and unrealistic worry. Each item is rated on a five-point Likert scale [1 (not at all typical of me) to 5 (very typical of me)], with higher scores indicating higher symptom severity. In the current study, the PSWQ demonstrated excellent internal consistency (Cronbach's αs: α_{OCD} = .93, α_{ARD} = .95, α_{NCC} = .92 and McDonald's ωs: ω_{OCD} = .93, ω_{ARD} = .96, ω_{NCC} = .91).

2.2.6. Patient Health Questionnaire-9 (PHQ-9)

The Patient Health Questionnaire (PHQ-9; Löwe et al., 2002) contains nine items that assess the severity of depressive symptoms throughout the past two weeks. Each item is rated on a four-point scale [0 (not at all) to 3 (nearly every day)], with higher scores corresponding to higher symptom severity. In the current study, the PHQ-9 showed acceptable to good internal consistency (Cronbach's αs: α_{OCD} = .83, α_{ARD} = .87, α_{NCC} = .73 and McDonald's ωs: ω_{OCD} = .83, ω_{ARD} = .88, ω_{NCC} = .75).

2.2.Web Screening Questionnaire (WSQ)

The adapted simple version of the WSQ (Donker et al., 2009) contains 13 items that screen for the most prevalent psychological disorders (i.e., mood, anxiety, and alcohol-related diseases) and acute suicidality. The original version of the WSQ has been validated and could appropriately screen for common mental disorders (Donker et al., 2009; Meuldijk et al., 2017).

2.3. Procedure

The study incorporated three groups (OCD, ARD, NCC). Individuals in the clinical samples (OCD and ARD) were assessed at a single timepoint (T_1). To investigate test-retest reliability, individuals in the NCC sample were assessed at two timepoints (T_1 and T_2) with

invitations being sent out via e-mail 14 days apart from each other. At the first timepoint (T_1), all questionnaires were administered. At the second timepoint (T_2), NCC participants were asked to complete the OCI-4 only.

All study materials were administered online via the secured survey software REDCap (Harris et al., 2009). Participants received a link to the online survey (through cooperating clinics for the OCD and ARD samples and via PsyWeb for the NCC sample). The study was approved by the institutional ethics committee of the LMU Munich (03_Mueller_b). All participants provided informed E-consent for data collection.

2.4. Analytic Plan

All statistical analyses were performed in *R* Statistics (version 4.4.1; R Core Team, 2024). A *p*-value lower than .05 is considered significant.

2.4.1. Test-Retest Reliability

The test-retest reliability of the OCI-4 was investigated with correlation analyses between the two timepoints T_1 and T_2 in the NCC sample. Pearson's correlation coefficients were interpreted according to Cohen (1988). Further, a paired t-test was conducted to investigate potential significant differences in OCI-4 scores between T_1 and T_2. Moreover, the two-way mixed effect intraclass correlation coefficient (ICC) was calculated to determine test-retest reliability. The ICC was interpreted according to the criteria postulated in Koo & Li (2016).

2.4.2. Construct Validity

Correlation analyses were conducted to investigate the construct validity of the OCI-4. For convergent validity, correlation analyses between OCI-4, Y-BOCS, and DOCS were

conducted. For discriminant validity, correlation analyses between OCI-4, ASI-3, PSWQ, and PHQ-9 were conducted.

2.4.3. Diagnostic Accuracy

By means of univariate (ANOVA) and multivariate analysis of variance (MANOVA), we investigated group differences on the OCI-4 total and its sub-scales. To investigate potential differences more precisely, we conducted post-hoc Tukey Honest Significant Difference (Tukey HSD).

To examine the potential of using the OCI-4 to distinguish individuals with a diagnosis of OCD from individuals without such a diagnosis (i.e., NCC and ARD), we conducted receiver operating characteristic (ROC) analyses. ROC analyses were conducted for the OCI-4 total score and for each subscale, to assess the potential of individual subscales as compared to the total score. The AUC was interpreted according to the criteria proposed by Carter et al. (2016). Lastly, we calculate the Youden Index (J; Youden, 1950) to estimate a cut-off scores for distinguishing participants with OCD from those with ARD or NCC.

3. Results

3.1. Test-Retest Reliability

Results of the test-retest analyses can be found in Table 2.1. According to *t*-tests, no significant changes over the test-retest interval were evident for the total score and each subscale of the OCI-4. The Pearson's correlation coefficients showed a strong positive correlation for OCI-4 total and a moderate (washing) to strong (checking, ordering, obsessing) correlation for the OCI-4 subscales. The test-retest reliability as assessed with a two-way mixed effect ICC demonstrated moderate (checking, ordering, washing) to good (obsessing) reliability for the subscales and moderate reliability for the OCI-4 total score (according to criteria of Koo & Li, 2016).

Table 2.1

Descriptives and Test-Retest Measures of OCI-4.

OCI-4 Scales	T_1		T_2		*t*-Test		Pearson's Correlation		ICC	
	M	*SD*	*M*	*SD*	*t*	*p*	*r*	*p*	*F*	*ICC*
Checking	0.13	0.34	0.17	0.41	1.534	.127	.56	<.001	3.4	.71
Ordering	0.98	0.80	0.93	0.78	-0.833	.406	.55	<.001	3.4	.71
Washing	0.12	0.38	0.16	0.43	1.928	.305	.37	<.001	2.2	.54
Obsessing	0.27	0.56	0.30	0.60	0.780	.437	.62	<.001	4.3	.77
Total	1.50	1.26	1.56	1.34	0.664	.508	.59	<.001	3.9	.74

Note. OCI-4 = 4-Item Obsessive-Compulsive Inventory, ICC = two-way mixed effect intraclass correlation coefficient. These measures were obtained in the sample of non-clinical controls (*n* = 163) only.

3.2. Discriminant and Convergent Validity

The correlations between the OCI-4 and OCD-related measures (i.e., Y-BOCS and DOCS) as well as measures of depression (PHQ-9), anxiety (ASI-3), and worry (PSWQ) are presented in Table 2.2. Again, OCI-4 scores and the Y-BOCS correlated only in moderate magnitude in the group of participants with OCD. Correlations between the OCI-4 and the DOCS as measure of OCD symptoms were high in participants with OCD and ARD, but only moderate in the NCC group. The associations with depressive symptoms, anxiety, and worry have been shown to be moderate in all groups.

Table 2.2

Discriminant and Convergent Validity of the OCI-4.

Measure	OCD		ARD		NCC	
	n	*r*	*n*	*r*	*n*	*r*
OCD Symptoms (Convergent)						
Y-BOCS $_{Total}$	102	.41	–	–	–	–
DOCS $_{Total}$	102	.67	69	.62	248	.43
Other Symptoms (Divergent)						
PHQ-9	102	.44	69	.31	248	.39
ASI-3	102	.49	69	.33	248	.32
PSWQ[1]	101	.49	65	.27	237	.42

Note. OCD = Obsessive-Compulsive Disorder, ARD = Anxiety-Related Disorders, NCC = Non-Clinical Controls, OCI-4 = 4-Item Obsessive-Compulsive Inventory, Y-BOCS = Yale-Brown Obsessive-Compulsive Inventory, DOCS = Dimensional Obsessive-Compulsive Scale, PHQ-9 = Patient-Health Questionnaire-9, ASI-3 = Anxiety-Sensitivity Index-3, PSWQ = Penn-State Worry Questionnaire.

[1] Different sample size due to missing values in the dataset.

3.3. Diagnostic Accuracy

3.3.1. Group Differences

Descriptives and group differences of the OCI-4 total score and the four subscales can be found in Table 2.3. The total scores of the OCI-4 significantly differed between groups, as shown by a significant main effect of group in the univariate ANOVA; $F(2, 416) = 306.9$, $p < .001$, $\eta^2 = .60$. More specifically, the Tukey HSD test revealed that participants with OCD hat significantly higher OCI-4 scores as compared to participants with ARD and NCC. Furthermore, the ARD group also showed significantly higher OCI-4 scores than the NCC group.

When considering the OCI-4 subscales, a MANOVA analysis across the subscales showed a significant main effect of group across factors revealed a significant main effect; Pillai's Trace = 0.684, $F(8, 828) = 53.803$, $p < .001$, $\eta^2 = .34$. As for the OCI-4 total score,

separate univariate analyses with post-hoc Tukey HSD tests revealed that participants with OCD had significantly higher scores on each subscale than the NCC group (all p's < .001). Furthermore, OCD participants showed significantly higher scores on all subscales (all p's < .001), except for ordering (p = .606), than participants with ARD.

Table 2.3

Descriptives and Group Differences of the OCI-4.

OCI-12	OCD n = 102				ARD n = 69				NC n = 248			
	M	*SD*	*Mdn*	*IQR*	*M*	*SD*	*Mdn*	*IQR*	*M*	*SD*	*Mdn*	*IQR*
Checking	1.69	1.33	1	2	0.64	0.97	0	1	0.13	0.34	0	0
Ordering	1.67	1.2	1.5	2	1.52	1.22	1	1	0.94	0.78	1	1
Washing	2.09	1.58	2	3	0.67	0.87	0	1	0.12	0.39	0	0
Obsessing	2.37	1.27	3	2	1.12	1.08	1	2	0.24	0.51	0	0
Total	7.81	3.37	8	4	3.94	2.75	3	4	1.43	1.19	1	1

Note. The values for each subscale can range from 0 – 4. The possible range for the total score is 0 – 16. OCI-4 = 4-Item Obsessive-Compulsive Inventory, OCD = Obsessive-Compulsive Disorder, ARD = Anxiety-Related Disorders, NCC = Non-Clinical Controls, Mdn = Median, IQR = Interquartile Range.

3.3.2. Diagnostic Accuracy

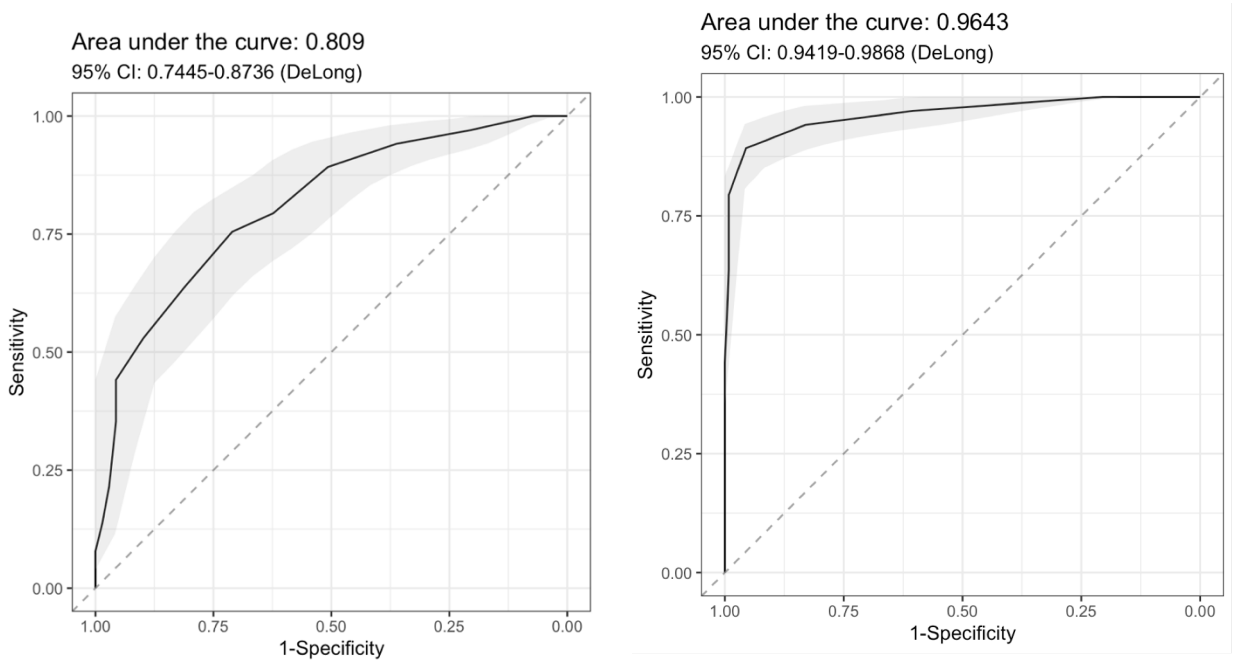
The OCI-4 had a good diagnostic accuracy in discriminating participants with OCD from participants with ARD (AUC = .81, 95% CI = [.745; .874]; see Figure 2.1A). Furthermore, ROC curves on each subscale were performed to investigate the diagnostic accuracy of each dimension. The subscale ordering showed the lowest diagnostic accuracy (AUC = .54), while the subscale obsessing could discriminate best between participants with OCD and ARD (AUC = .77; see Figure 2.2A).

When discriminating participants with OCD from NCC's, the OCI-4 total score evidenced an excellent accuracy (AUC = .96, 95% CI = [.941; .987]; see Figure 2.1B). Again, the subscale ordering showed the lowest diagnostic accuracy (AUC = .67), while the subscale obsessing evidenced the highest diagnostic accuracy (AUC = .92). The OCI-4 total score evidenced the best diagnostic accuracy for discriminating OCD participants from both, ARD and NCC (see Figure 2.2B).

Figure 2.1

Receiver Operating Characteristic Curves for the OCI-4 Total.

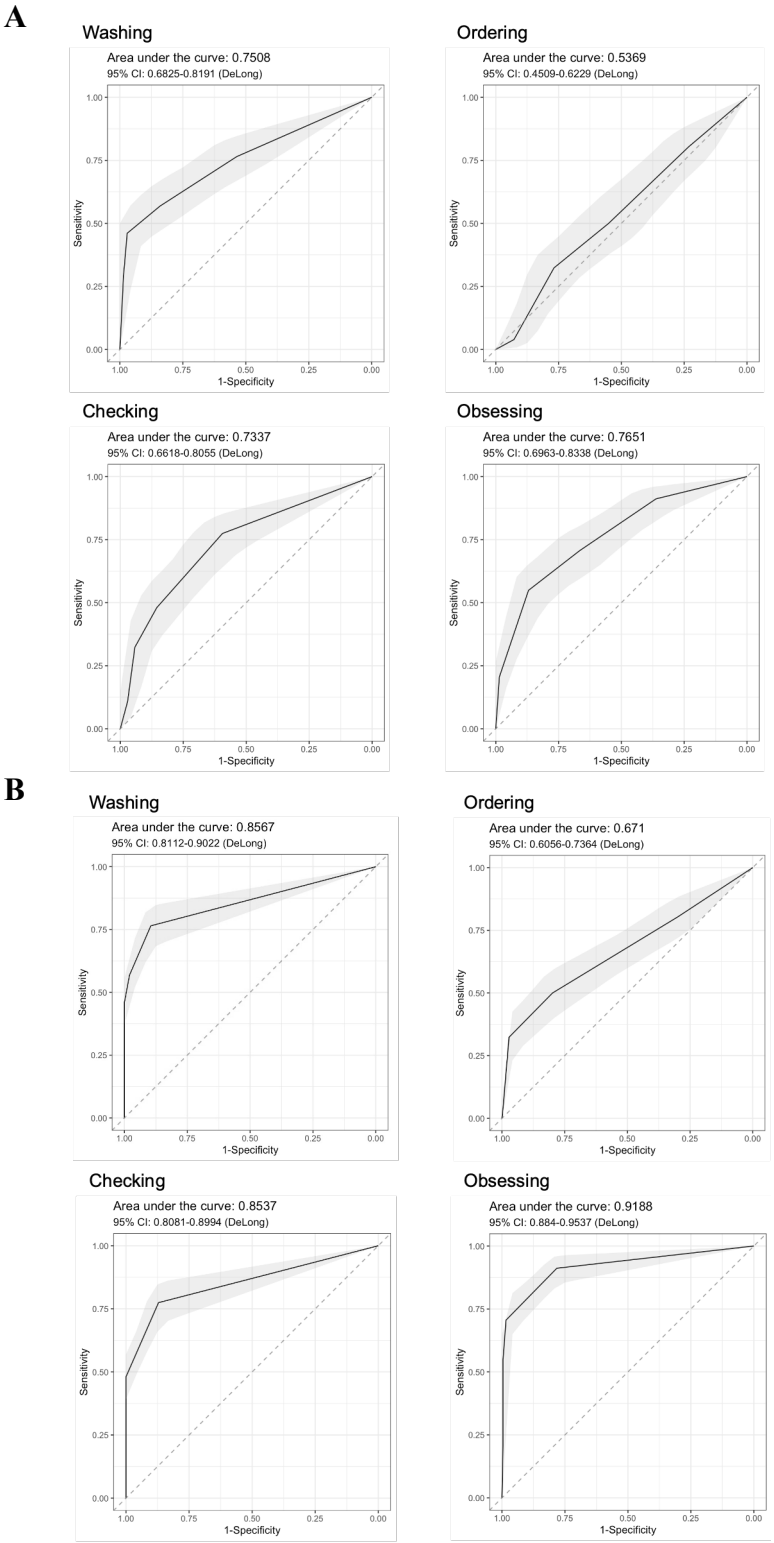
A **B**



Note. A Receiver operating characteristic (ROC) curve comparing participants with Obsessive-Compulsive Disorder from participants with Anxiety-Related Disorders. **B** Receiver operating characteristic (ROC) curve comparing participants with Obsessive-Compulsive Disorder from Non-Clinical Controls.

Figure 2.2

Receiver Operating Characteristic Curves for Each of the OCI-4 Subscales.



A Receiver operating characteristic (ROC) curves for each of the OCI-4 subscales comparing participants with Obsessive-Compulsive Disorder from participants with Anxiety-Related Disorders. **B** Receiver operating characteristic (ROC) curves for each of the OCI-4 subscales comparing participants with Obsessive-Compulsive Disorder from Non-Clinical Controls.

3.3.3. Optimal Cut-Off

The Youden Index (J = .47) for discriminating participants with OCD from participants with ARD indicated an optimal cut-off of the OCI-4 sum score of 6 or higher. This cut-off correctly classified 75.49% of participants with OCD (i.e., sensitivity) and 71.01% of participants with ARD (i.e., specificity). When discriminating participants with OCD from NCC's, the optimal cut-off according to the Youden Index (J = .85) was higher or equal to 4. This cut-off correctly classified 89.22% of participants with OCD (i.e., sensitivity) and 95.56% of NCC's (i.e., specificity).

4. Discussion

The current study aims to investigate the potential of the ultra-brief OCI-4 as a screening tool for OCD symptoms. To this end, we extracted the four items of the OCI-4 from the German version of the OCI-12 (Müller et al., submitted for publication) and investigated its psychometric properties in clinical and non-clinical samples.

The reliability of the OCI-4 was assessed with test-retest analyses. The OCI-4 total score possesses moderate-to-good test-retest reliability according to correlation analyses and the ICC. Therefore, the overall reliability of the OCI-4 can be considered moderate-to-good and is comparable to the original English version. The internal consistency for the OCI-4 was not assessed for three main reasons: First, the four items were selected to assess the different symptom dimensions of OCD, so unidimensionality, a central assumption of tests for internal consistency (McNeish, 2018), was not expected. Second, OCD patients oftentimes present with a primary theme (i.e., elevated symptoms in one or two dimensions), leading to response patterns with high scores on one or two items while relatively low scores on the other items. Third, internal consistency coefficients (e.g., Cronbach's α, McDonald's omega) are affected by the number of items (Malkewitz et al., 2023; Tavakol & Dennick, 2011). With only four

items, the internal consistency measures may therefore underestimate the reliability of the OCI-4.

When investigating the convergent validity, it is evident that the correlations between the DOCS and the OCI-4 are large, yet only moderate when considering the OCI-4 is correlated with the Y-BOCS. This relatively low correlation is, however, not surprising and has been shown in previous studies (see Abramovitch et al., 2021b; Aspvall et al., 2020). This may be related to the Y-BOCS being an idiographic measure of OCD symptom severity while the OCI-4 is considered nomothetic. Moreover, an exploratory correlation analysis hinted towards the *common method bias* (Podsakoff et al., 2003), as the correlation between the two self-reports, OCI-4 and Y-BOCS-SR, was higher ($r = .48$, $p < .001$) than the correlation between the OCI-4 and the Y-BOCS interview ($r = .28$, $p = .089$). As the correlation between the OCI-4 and the DOCS is large (according to criteria by Cohen, 1988), we assume that the moderate correlation with the Y-BOCS is rather a methodological/conceptual artefact and generally conclude that the OCI-4 possesses convergent validity. In terms of discriminant validity, moderate correlations between the OCI-4 and symptoms of depression, anxiety, and worry have been shown. Again, this highlights that the OCD symptoms assessed with this instrument may not be independent of other psychological symptoms. Overall, the German version of the OCI-4 demonstrates similar patterns of convergent and discriminant validity as the original English version.

When comparing OCI-4 total scores between the three groups, significant differences were found. Participants with OCD showed significantly higher scores as compared to both, participants with ARD and NCC. This is in line with analyses of the diagnostic accuracy of the OCI-4, which can discriminate well between participants with OCD and participants with ARD and excellent between participants with OCD and NCC participants. The optimal cut-off for discriminating the two clinical groups is an OCI-4 total score of 6 or higher. When discriminating participants with OCD from NCC participants, a cut-off of 4 or higher is considered optimal. The diagnostic accuracy of the German OCI-4 is comparable to the original

English version ($AUC_{OCD\ vs.\ ARD}$ = .76; $AUC_{OCD\ vs.\ NCC}$ = .86). While these cut-offs can be used in research setting for a screening of participants for in- and exclusion criteria, they are also of relevance in clinical care. For instance, if a person presents in routine clinical care settings and scores beyond the defined cut-off, this person is at an increased likelihood of meeting the OCD diagnostic criteria, which should motivate the clinician to administer further diagnostic questionnaires or interviews.

In summary, the OCI-4 is a promising concise screening tool that, if implemented in routine clinical care, could aid the diagnostic process and reduce the commonly observed under- and misdiagnoses in OCD. Of note, in this study the OCI-4 was extracted from the OCI-12 and needs evaluation as stand-alone screening tool. Furthermore, the OCI-4 should generally be considered a screening tool and not a diagnostic tool. Elevated scores on the OCI-4, especially if they exceed the proposed cut-offs, should be interpreted as a potential indicator of increased likelihood for OCD and should prompt further assessment to determine whether a clinical disorder is present and if treatment is warranted. Establishing the OCI-4 as standard screening tool could decrease the time from onset of first OCD symptoms to OCD diagnosis, which has been associated with more severe symptoms and worse daily functioning (Ziegler et al., 2021).

4.1. Limitations

The current study faces some limitations. Although participants were recruited within clinics, a structured interview for the diagnosis according to DSM-5 criteria was not always possible. Therefore, only a part of the participants included in the current analyses underwent a structured diagnostic interview. However, all patients were diagnosed by experienced clinicians with expertise in OCD making false diagnosed highly unlikely. Likewise, no structured interview was administered to the NCC population. The absence of any psychological disorder was assessed via the self-reported WSQ and dedicated questions only, which could potentially

lead to inclusion of some participants with undiagnosed or unrecognised psychological disorders.

Additionally, around two-thirds of the OCD participants completed the Y-BOCS as a self-report measure, while the remaining third were assessed using the interview format of the Y-BOCS. Although previous research showed that these two versions show strong correlations and may be used interchangeably (Baer et al., 1993; Rosenfeld et al., 1992; Steketee et al., 1996), the weak correlation between the Y-BOCS interview and the OCI-4 hints towards differences between the two assessment modalities.

For the sake of ecological validity, we included participants with comorbid diagnoses. Although this gives us a closer representation of clinical reality, we acknowledge that comorbid symptoms may attenuate some of the reported measures, such as internal and discriminant validity.

Lastly, it is important to note that the four items of the OCI-4 were originally embedded in the OCI-12 and were only extracted during the data analysis phase. Consequently, the context in which respondents answered these items may be different compared to when the OCI-4 would be administered as a stand-alone questionnaire. To ensure that the OCI-4 functions effectively as an independent screening tool, a future study should administer the OCI-4 on its own and evaluate its psychometric properties.

5. Conclusion

The German version of the OCI-4 presents a syndromally valid self-report measure for OCD screening with moderate-to-good reliability, good construct validity and good-to-excellent diagnostic accuracy. Based on these results, the OCI-4 is a valuable screening tool that can rapidly screen for likely OCD in clinical and non-clinical populations. The validated cut-off scores of the OCI-4 can be utilised in routine clinical care to inform subsequent diagnostic procedures, helping to address the underdiagnosis and misdiagnosis frequently observed in

OCD. Consequently, it has the potential to reduce the time required for patients to receive an accurate diagnosis and, accordingly, appropriate treatment. To enable a wide use of the OCI-4 as well as the more elaborate OCI-12, the German versions of both questionnaires, including the item numbering and scoring guidelines, are freely available under the CC BY-NC-ND 4.0 license on the Open Science Framework (https://osf.io/jrst9/). The German version of the OCI-4 can also be found in Appendix B3 (Table B3.1).

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Study III

Mediation Analyses of Longitudinal Data Investigating Temporal Associations Between Inflated Sense of Responsibility, Obsessive-Compulsive Symptoms, and Anger Suppression

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The analyses were preregistered (https://osf.io/msrxj/).

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Abstract

Cognitive theories emphasise the central role of anger and anger suppression in obsessive-compulsive disorder (OCD). According to these theories, anger suppression is seen as a consequence of OCD, whereas cognitive beliefs, such as an inflated sense of responsibility, are seen as antecedent factors. To extend the findings from cross-sectional studies, the current study investigated the temporal associations between OCD symptoms, an inflated sense of responsibility, and anger suppression. Consistent with cognitive considerations, we hypothesised that OCD symptoms mediate the association between feelings of responsibility and anger suppression. These associations were also explored in patients presenting particularly high checking-related symptoms. Further, the stability of effects beyond controlling for depressive symptoms and medication intake was explored. A total of $N = 48$ patients with OCD [50% female, M = 32.46 (SD = 10.63) years of age] completed measures on obsessive beliefs, OCD symptoms, and anger suppression at three assessment points: before and after a metacognitive intervention as well as at a follow-up six months later. Mediation models investigating symptom-associations at these three timepoints were conducted. Exploratory analyses investigating these associations in individuals presenting high checking-related symptoms ($n = 20$) and testing the stability of effects beyond controlling for depressive symptoms and medication intake were conducted. The sense of responsibility did not significantly predict the level of anger suppression. A temporal association between OCD symptoms (as assessed with the self-report measure) and anger suppression could be evidenced, which was stable beyond controlling for depressive symptoms and medication intake. Against the expectations based on cognitive theories, the sense of responsibility did not predict OCD symptoms. No mediating effect of OCD symptoms was found. In line with cognitive viewpoints, the present study shows that higher OCD symptoms predict higher levels of anger suppression in a longitudinal design, thereby contributing to the suppression of anger. This effect seems to be independent from depressive symptoms and medication intake. The effect of

sense of responsibility on OCD symptoms was less clear and could only be found in the sub-group of patients with OCD and checking-related symptoms, who generally presented higher levels of responsibility. Overall, this is the first study demonstrating temporal associations between OCD symptoms and anger suppression. Acknowledging that anger and anger suppression may be a consequence of OCD symptoms and may also affect aspects of psychotherapy can ultimately inform future adjustments to psychotherapeutic treatment.

Introduction

Obsessive-Compulsive Disorder (OCD) is a heterogeneous disorder characterised by obsessions and/or compulsions. Many emotions occur concomitant or subsequent to compulsions and/or obsessions. Among the commonly observed emotions, such as anxiety (Abramowitz et al., 2009), disgust (Bhikram et al., 2017), and guilt (Shapiro & Stewart, 2011), anger is also frequently reported by patients with OCD (Moscovitch et al., 2008). Traditionally, psychodynamic models postulated a close relationship between anger suppression and OCD. More recently, cognitive theories have also considered anger suppression to be a *consequence* of OCD symptoms. OCD symptoms are proposed to emerge from dysfunctional cognitive beliefs (Obsessive Compulsive Cognitions Working Group [OCCWG], 1997; Rachman, 1993, 1997; Salkovskis et al., 2000). One of those cognitive beliefs is an inflated sense of responsibility (Salkovskis et al., 2000). In addition to eliciting symptoms, an inflated sense of responsibility is also assumed to be responsible for increased anger suppression in OCD. As individuals with OCD feel excessively responsible for preventing harm to themselves and others (OCCWG, 1997), they take full responsibility for preventing harm, while regarding others as irresponsible (Ashbaugh et al., 2006). As it is impossible to fully prevent harm, this inflated sense of responsibility is assumed to lead to increased frustration and guilt, as well as anger (Radomsky et al., 2007). According to Rachman (1993), the internal attribution of responsibility also hinders the expression of anger (i.e., aggression) leading to anger suppression. Rachman (1993) also proposed that an inflated sense of responsibility was particularly related to checking-related symptoms of OCD.

Building upon these theoretical outlines, studies have indeed demonstrated increased anger (Cludius et al., 2021; Whiteside & Abramowitz, 2004, 2005) and sometimes even aggressiveness (Michnevich et al., 2021) in (sub-)clinical samples of OCD. Conversely, previous studies also demonstrated an association between anger suppression and symptoms of OCD. In a student sample, anger suppression was found to be increased in students with

elevated OCD symptoms compared to those with comparatively low OCD symptoms (Whiteside & Abramowitz, 2004). Moreover, patients with OCD demonstrated higher anger suppression compared to healthy controls (Cludius et al., 2021; Moritz et al., 2009, 2011). Moritz et al. (2009) further showed the relative specificity of the association between OCD symptoms and anger suppression by demonstrating that patients with OCD show higher levels of anger suppression as compared to patients with anxiety or depression. Opposingly, in a study by Whiteside and Abramowitz (2004), the differences in anger suppression between individuals with high and low symptoms of OCD disappeared when controlling for depressive symptoms. Remarkably, correlation analyses showed that only the association between anger suppression and checking symptoms was stable beyond controlling for depressive symptoms. Therefore, anger suppression may be particularly related to checking as compared to other symptom types (e.g., washing). In summary, corroborating the cognitive perspective (Rachman, 1993), these studies suggest that although individuals with OCD (symptoms) show heightened levels of anger, they are also more likely to suppress their anger. Yet, whether these effects are specific to OCD or can be explained by depressive symptoms requires further investigation.

Building upon the cognitive perspective, correlational studies (Salkovskis et al., 2000) have also corroborated the relationship between an inflated sense of responsibility and increased symptoms of OCD. Likewise, modelling studies showed that the inflated sense of responsibility (as assessed with forms of the Obsessive-Beliefs Questionnaire (OBQ); OCCWG, 2003) is related to various aspects of OCD symptomatology (Gagné et al., 2018; Taylor et al., 2010). In an experimental study, Arntz et al. (2007) induced high or low responsibility in patients with OCD and found that individuals in the high responsibility condition subsequently showed higher OCD symptomatology as well as increased checking behaviour. Foa et al. (2002) reported that individuals with high checking-related symptoms of OCD show a higher sense of responsibility (as assessed with the Obsessive Compulsive Responsibility Scale; Foa et al., 2001) as compared to individuals without checking-related symptoms. These results were also

summarised in a meta-analysis of 58 cross-sectional studies, which also highlighted the association between an inflated sense of responsibility and OCD symptoms, particularly in patients with OCD (Pozza et al., 2018).

The association between an inflated sense of responsibility and anger suppression is less well studied. A recent cross-sectional study by Cludius et al. (2021) investigated the association between an inflated sense of responsibility (assessed via the OBQ-44; Ertle et al., 2008) and anger suppression in patients with OCD as well as healthy controls. In a mediating model, it was demonstrated that the inflated sense of responsibility positively mediated the association between group membership (patients with OCD compared to healthy controls) and the level of anger suppression. In line with Rachman's (1993) propositions, these results support the theory that anger is suppressed rather than expressed, as patients with OCD take full responsibility. This association may also be of interest for intervention research and psychotherapeutic practice. While previous research on anger interventions has primarily focused on approaches like relaxation techniques, anger management strategies, or social skills training in the refinement of adaptive anger regulation (Lee & DiGiuseppe, 2018), targeting responsibility may also be promising. Based on the cognitive model by Rachman (1993), which assumes that responsibility leads to higher anger suppression, we could also assume that targeting responsibility would lead to a reduction in not only OCD symptoms but also anger suppression.

In summary, associations between an inflated sense of responsibility, OCD symptoms, and anger suppression have previously been demonstrated, lending support to Rachman's (1993) cognitive theory. However, as these associations have only been demonstrated cross-sectionally so far, inferences about temporal relationships remain tentative for now. From a clinical perspective, investigating these associations temporally is of interest as anger likely occurs throughout psychotherapy, particularly during exposure therapy. Findings that anger suppression may arise subsequent to both an inflated sense of responsibility and OCD

symptoms and may even be viable to change through adjunct changes in sense of responsibility could motivate therapists to address the importance of anger regulation throughout therapy.

Aims

The current study aims to shed light on the temporal association between the cognitive belief of an inflated sense of responsibility, symptoms of OCD, and anger suppression. We used longitudinal data with three assessment points.

First, drawing on the cognitive theory (Rachman, 1993), it is hypothesised that the inflated sense of responsibility at baseline predicts anger suppression at follow-up, and that this effect is mediated by OCD symptoms at post-intervention. This mediating effect is expected for OCD symptoms as assessed via the self-reported Obsessive-Compulsive Inventory-Revised (OCI-R; Gönner et al., 2007; Hypothesis 1A) and the standardised interview Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Hand & Büttner-Westphal, 1991; Hypothesis 1B; see Figure 4.1, Panel A).

Second, previous research has assessed whether anger can be targeted using psychotherapy. Leveraging Rachman's cognitive model (1993), which suggests that assuming responsibility heightens the suppression of anger, it's conceivable to explore how targeting responsibility might not only alleviate symptoms of OCD but also the tendency to suppress anger. Thus, a second aim of this study was to assess whether a change in responsibility would precede changes in anger suppression, mediated by a change in OCD symptoms. The data for the current study was collected as part of a project that was originally designed to investigate a novel metacognitive training for patients with OCD (MCT-OCD; Jelinek et al., 2018; Miegel et al., 2022). The MCT-OCD aims to specifically target cognitive (meta-)beliefs, including an inflated sense of responsibility. Thus, it is additionally investigated whether changes in the sense of responsibility temporally predict concomitant changes in OCD symptoms and subsequent changes in anger suppression. Specifically, it is tested whether the four-week metacognitive

training will lead to a reduction in sense of responsibility and whether this change predicts the reduction in anger suppression from baseline to follow-up. This change is expected to be mediated by a reduction in OCD symptoms from baseline to post-intervention, both measured with a self-report (OCI-R, Hypothesis 2A) and a standardised interview (Y-BOCS, Hypothesis 2B; see Figure 3.1, Panel B).

To explore the potential influence of OCD subtypes as well as the role of depressive symptoms and medication intake on the investigated associations, two exploratory analyses were conducted. First, as studies demonstrated that patients with OCD high in checking-related symptoms show higher anger suppression (Whiteside & Abramowitz, 2004), mediation models were repeated for individuals who display checking-related symptoms of OCD as indicated by a sum-score of six or higher on the checking subscale of the OCI-R at baseline (Gönner et al., 2009). Moreover, previous studies showed that the association between OCD symptoms and anger suppression may be influenced or even primarily accounted for by depressive symptoms (Cludius et al., 2021; Moscovitch et al., 2008; Whiteside & Abramowitz, 2004). Additionally, medication intake may not only affect the symptoms of OCD but may also have an effect on the occurrence and expression of anger (e.g., serotonergic and noradrenergic antidepressants likely affect the expression of anger; Bond, 2005). Therefore, the current study will conduct additional exploratory analyses to investigate the associations between sense of responsibility, OCD symptoms, and anger suppression, while controlling for depressive symptoms and medication intake. Lastly, psychodynamic models assume anger suppression to be relevant in the development of OCD symptoms (Freud, 1909). Although previous evidence is largely in line with the cognitive model, it may be that the directionality of effects between OCD and anger suppression could be reversed, with anger suppression predicting OCD symptoms. To this end, we will explore whether an inflated sense of responsibility will predict OCD symptoms, as mediated by the level of anger suppression.

Materials and Methods

Participants and Procedure

The sample of the current study consisted of 48 patients with a diagnosis of OCD. For an overview of sample characteristics see Table 3.1. Patients with OCD were recruited at the anxiety and OCD ward of the University Medical-Centre Hamburg-Eppendorf, Germany, and included in the study if they were between 18 and 70 years old and did not meet any of the following exclusion criteria: a history of any schizophrenic or affective-psychotic disorder, any neurological disorder, current alcohol or substance dependence, brain damage, or intellectual disability (i.e., IQ < 70).

This study was part of a larger project that was registered with the German Clinical Trials Register (DRKS-ID: DRKS00012531) and approved by the Ethics Committee of the German Society for Psychology (#LJ032017). Besides the measures described below, additional measures were obtained throughout data collection and analysed in other studies within the project (see e.g., Jelinek et al., 2018; Miegel et al., 2020). Following written informed consent and inclusion in the study, patients with OCD completed (among other measures within the larger project) a sociodemographic interview, a structured diagnostic interview (Mini International Neuropsychiatric Interview (M.I.N.I.), German version: Ackenheil et al., 1999), an interview on OCD symptom severity (Y-BOCS, German version: Hand & Büttner-Westphal, 1991), the two self-report measures on OCD symptoms and obsessive beliefs (OBQ-44, German version: Ertle et al., 2008; and OCI-R, German version: Gönner et al., 2007), a self-report questionnaire on anger suppression and aggression (State-Trait Anger Expression Inventory (STAXI-2), German version: Rohrmann et al., 2013), and a self-report questionnaire on depressive symptoms (Patient Health Questionnaire (PHQ-9), German version: Löwe et al., 2002). The interview on OCD symptom severity (Y-BOCS) and all self-report questionnaires were administered two more times: following the four-week metacognitive intervention period and six months later (follow-up).

Since the analyses were based on pre-existing data, no a priori power analysis was conducted. Furthermore, we refrained from conducting a post-hoc power analysis as "observed power" calculations are at risk of yielding misleading results (Hoenig & Heisey, 2001; Zhang et al., 2019). Therefore, the power of the presented analyses cannot be gauged, which will be considered in the interpretation of results.

Measures

Mini International Neuropsychiatric Interview (M.I.N.I.)

At the start of the trial, patients were interviewed with the M.I.N.I. (German version: Ackenheil et al., 1999), a structured diagnostic interview to verify the OCD diagnosis and to assess comorbid mental disorders. Our version of the interview was adapted according to the fifth version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013). The M.I.N.I. shows excellent inter-rater reliability and good to excellent test–retest reliability for both clinical and primary care populations (Sheehan et al., 1998).

Yale-Brown Obsessive-Compulsive Scale (Y-BOCS)

The Y-BOCS (German version: Hand & Büttner-Westphal, 1991), was conducted to assess OCD symptom severity at baseline, post-intervention, and follow-up. This semi-structured interview contains ten items on two subscales (obsessions and compulsions) that can be rated on a five-point Likert scale ranging from "no symptoms" (0) to "severe symptoms" (4). The Y-BOCS demonstrated good internal consistency and inter-rater reliability (Hand & Büttner-Westphal, 1991). In the current sample, Cronbach's α also indicates good internal consistency of the Y-BOCS (α = .82). The total sum score of the Y-BOCS was used for the analyses.

Obsessive-Compulsive Inventory-Revised (OCI-R)

To assess distress associated with OCD symptoms, the OCI-R (German version: Gönner et al., 2007) was conducted at baseline, post-intervention, and follow-up. The 18 items are scored on a five-point Likert scale ranging from "no symptoms" (0) to "severe symptoms" (4) and can be divided into six subscales: obsessive beliefs, washing, checking, neutralising, ordering, and hoarding. The OCI-R shows good reliability and validity (Gönner et al., 2007). A total sum score was calculated based on the subscales of washing, checking, ordering, obsessing, and neutralising. As hoarding is classified as a separate disorder according to the DSM-5 (American Psychiatric Association, 2013), the hoarding subscale was not included in the total score. The OCI-R without the hoarding subscale shows acceptable internal consistency ($\alpha = .76$) in the current sample, which is also comparable to the internal consistency for the OCI-R including all subscales ($\alpha = .78$). For exploratory analyses in the sub-sample of patients with OCD with checking-related symptoms, a sum-score cut-off of ≥ 6 was applied at the OCI-R checking subscale at baseline (Gönner et al., 2009).

Obsessive-Beliefs Questionnaire-44 (OBQ-44)

The severity of obsessive beliefs was assessed with the OBQ-44 at baseline, post-intervention, and follow-up. The OBQ-44 measures beliefs related to OCD on three subscales: responsibility and threat estimation, perfectionism and intolerance of uncertainty, and the importance of and control of thoughts. All 44 items are rated on a seven-point Likert scale ranging from "disagree very much" (1) to "agree very much" (7). The subscales showed satisfactory reliability and validity (Ertle et al., 2008). The sum score of the subscale Inflated Responsibility and Perceived Threat of Harm was used as a proxy for an inflated sense of responsibility. In the current sample, this subscale has an excellent internal consistency ($\alpha = .95$).

State-Trait Anger Expression Inventory (STAXI-2)

The STAXI-2 was conducted at baseline, post-intervention, and follow-up. This self-report measure consists of 51 items rated on a four-point Likert scale ranging from "completely disagree" (1) to "completely agree" (4). The STAXI-2 is divided into six subscales, assessing the experience of anger at state and trait levels (subscales state anger, trait anger), the suppression or outward expression of anger (subscales anger expression-in, anger expression-out), and control of anger (subscales anger control-in, anger control-out). The STAXI-2 shows good reliability and validity (Rohrmann et al., 2013). The sum score of the subscale anger expression-in was used as a proxy for anger suppression. This subscale also shows excellent internal consistency in the current sample ($\alpha = .90$).

Patient Health Questionnaire (PHQ-9)

The depression module of the PHQ-9 (German version: Löwe, Kroenke, et al., 2004) was used to assess depressive symptoms at baseline, post-intervention, and follow-up. This self-report measure consists of 9 items rated on a four-point Likert scale ranging from "not at all" (0) to "nearly every day" (3). The PHQ-9 shows good validity and sensitivity in previous studies (Löwe, Kroenke, et al., 2004; Löwe, Spitzer, et al., 2004) as well as in the current sample ($\alpha = .88$). The sum score of the PHQ-9 at post-intervention will be used in the exploratory analysis.

Intervention

All patients were inpatients at the anxiety and OCD ward of the University Medical-Centre Hamburg-Eppendorf, which offers cognitive behavioural treatment (CBT), including exposure and response-prevention in one-on-one sessions, as well as pharmacotherapy. Additionally, specialised group interventions, such as social-skills training, occupational therapies like crafts groups, and weekly ward rounds, were offered. In the context of a pilot study, the MCT-OCD was offered as an add-on intervention to all patients with OCD. The MCT-OCD used in this pilot study is a group training that consisted of four weekly training sessions. Each session lasted for 90 minutes. The aim of the MCT-OCD is to encourage patients to take a metacognitive perspective ("to think about one's thinking") and to challenge their cognitive beliefs (such as an inflated sense of responsibility) using creative and engaging exercises. The MCT-OCD sessions were attended by three to ten patients at a time and were led by a psychotherapist (in training). Each module focused on two cognitive beliefs (Module 1: Perfectionism and intolerance of uncertainty; Module 2: Thought-action fusion and control of thoughts; Module 3: Overestimation of threat and inflated responsibility; Module 4: Biased attention and biased cognitive networks). Following this pilot study, the MCT-OCD was revised and extended to eight modules. The most recent version of the MCT-OCD has been evaluated in several trials (e.g., Miegel et al., 2021) and the manual is freely available in German and English (for download see http://uke.de/ocd-mct).

Analysis Plan

Statistical Analysis: General

All statistical analyses were performed in *R* Statistics (64-bit; Version 4.2.2; R Core Team, 2021) with a *p*-value lower than .05 being considered significant. Missing values were handled by the Full Information Maximum Likelihood function (Enders & Bandalos, 2001). Considering the critique of Baron and Kenny's (1986) causal-steps approach (i.e., lack of

power, higher Type II Error rate; Hayes, 2009), the current mediation analysis implemented a bootstrapping approach with bias-corrected confidence intervals (bootstrapping index of n = 10.000). Thereby, the limitations associated with the commonly used Sobel test (Sobel, 1982) for the significance of indirect effects (*a*b*) were circumvented (Hayes, 2009; MacKinnon et al., 2004). Conclusions about the potential mediator are based on the confidence interval of the indirect effect, which is considered significant with 95% confidence if zero is not included within the lower and upper bound of the confidence interval (Hayes, 2009). The planned analyses for each individual hypothesis were pre-registered at the Open Science Framework (https://osf.io/msrxj/). Therefore, no correction of alpha error is warranted (Rubin, 2021).

Parts of the data used in the current analyses have already been analysed cross-sectionally and published in Cludius et al. (2021). Particularly, baseline assessments of OCD symptoms (Y-BOCS and OCI-R), sense of responsibility (OBQ-44), and anger suppression (STAXI-2) are part of the longitudinal analyses of this study.

To investigate the change throughout the intervention period, separate linear regression analyses were conducted for each of the relevant variables (i.e., sense of responsibility as assessed via the OBQ-44, OCD symptoms as assessed via the Y-BOCS and the OCI-R, and anger suppression as assessed via the STAXI-2). Furthermore, specific differences between the three assessment points were tested with subsequent Tukey's Honest Significant Differences (Tukey's HSD) tests (suited for tests with equally sized groups and equal variances) using the *multcomp* package (Hothorn et al., 2023).

Statistical Analysis: Hypotheses

The analyses of all hypotheses were conducted using structural equation modelling in R utilising the *lavaan* package (Rosseel, 2012). For Hypothesis 1, the relationship between the predictor (i.e., *Inflated Sense of Responsibility* at baseline) and the outcome variable (i.e., *Anger Suppression* at follow-up) as potentially mediated by *OCD Symptoms* (Hypothesis 1A: OCI-R;

Hypothesis 1B: Y-BOCS) at post-intervention was investigated with a structural equation model (see Figure 3.1, Panel A for an example).

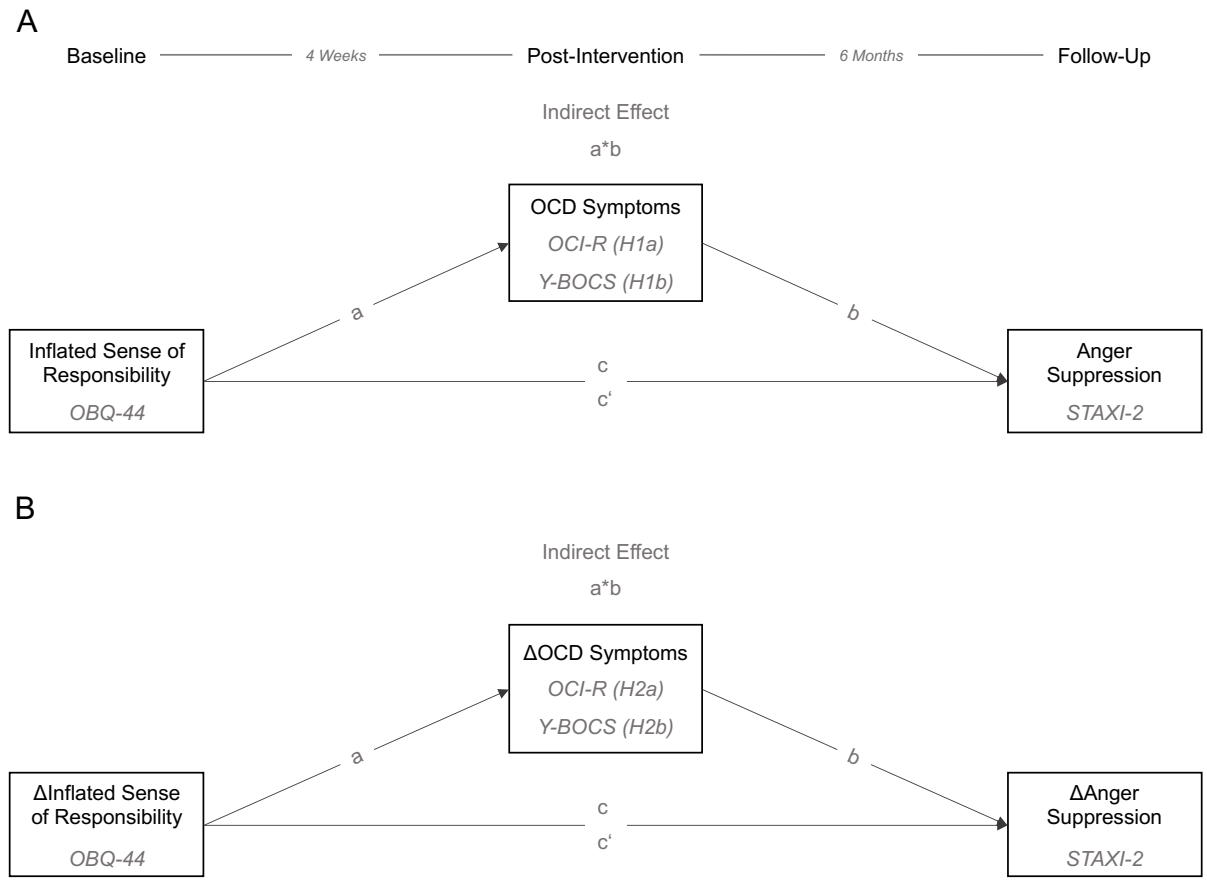
For the mediation analysis of Hypothesis 2, change scores of *Inflated Sense of Responsibility*, *OCD Symptoms* (Hypothesis 2A: OCI-R; Hypothesis 2B: Y-BOCS), and *Anger Suppression* were calculated using residualized change scores. The change as predicted by linear regression models was calculated and the difference between the predicted score by the regression and the observed score in the sample were used as the change score in the mediation analyses (i.e., $\Delta_{\text{Baseline–Post-Intervention}}$*Inflated Sense of Responsibility*; $\Delta_{\text{Baseline–Post-Intervention}}$*OCD Symptoms*; $\Delta_{\text{Baseline–Follow-Up}}$*Anger Suppression*). The residualized change scores of the OCI-R and Y-BOCS were used as indicators for change in OCD Symptoms for Hypotheses 2A and 2B, respectively (see Figure 3.1, Panel B for an example).

Statistical Analysis: Exploratory Analyses

To explore potential differences in patients with OCD and checking-related symptoms, all mediation analyses were repeated for patients with OCD presenting high checking-related symptoms according to a score of six or higher on the OCI-R checking subscale at baseline (Gönner et al., 2009). To explore whether the mediation models are stable beyond controlling for depressive symptoms and medication intake, the mediation models were extended with two variables: depressive symptoms as assessed with the PHQ-9 (Gräfe et al., 2004) at post-intervention and medication intake (0 = no medication intake, 1 = medication intake). Lastly, to explore the directionality of effects, the mediator and outcome were interchanged, so that a mediation model investigated whether an inflated sense of responsibility predicted OCD symptoms, as mediated by the level of anger suppression.

Figure 3.1

Exemplary Mediation Models.



Note. ***A.*** Mediation model tested in Hypotheses 1A and 1B with *Inflated Sense of Responsibility* assessed at baseline, *OCD Symptoms* assessed at post-intervention, and *Anger Suppression* assessed at follow-up. ***B***. Mediation model tested Hypotheses 2A and 2B. *ΔInflated Sense of Responsibility* = residualized change score of inflated sense of responsibility from baseline to post-intervention, *ΔOCD Symptoms* = residualized change scores of OCD symptoms as assessed with the OCI-R or Y-BOCS from baseline to post-intervention, *ΔAnger Suppression* = residualized change score of anger suppression from baseline to follow-up. *OBQ-44* = Obsessive Beliefs Questionnaire-44, *Y-BOCS* = Yale-Brown Obsessive-Compulsive Scale, *OCI-R* = Obsessive-Compulsive Inventory-Revised, *STAXI-2* = State-Trait Anger Expression Inventory-2. *a* = predictor regressed on the mediator, *b* = mediator regressed on the outcome, *c* = predictor regressed on the outcome without correcting for the mediator, *c*‘ = predictor regressed on the outcome correcting for the mediator, *a*b* = indirect effect.

Results

Demographics and Psychopathology

The baseline characteristics of the sample are displayed in Table 3.1.

Table 3.1

Descriptive Overview of Demographics and Relevant Variables.

	Baseline *N* = 48
Variable	% (*n*); *M* (*SD*)
Gender (female/male)	50.00% (24) / 50.00% (24)
Age (in years)	32.46 (10.63)
Education (in years)[1]	14.74 (3.82)
Illness Duration (in years)	12.17 (11.18)
Medication[2]	
None	25.00% (12)
Antidepressants	64.58% (31)
Neuroleptics	33.33% (16)
Anticonvulsants	2.08% (1)
Benzodiazepines	2.08% (1)
Current Comorbidities	
None	29.17 % (14)
Anxiety Disorder	45.84% (22)
Generalised Anxiety Disorder	27.08% (13)
Social Phobia	22.92% (11)
Panic Disorder	4.17% (2)
Post-Traumatic Stress Disorder	2.01% (1)
Depressive Disorder	45.83% (22)
Major Depressive Disorder	41.67% (20)
Dysthymia	16.67% (8)
Alcohol Dependence	6.25% (3) [3]

Note. [1]Education (in years) also includes post-graduate education. [2]Some patients also received a combination of medication groups. [3]Three patients met the M.I.N.I. diagnostic criteria for current alcohol dependence at baseline. However, according to dose indices and self-report, no alcohol was consumed during inpatient treatment.

Psychopathological data for the sample across the three measurement timepoints can be found in Table 3.2. At baseline, patients with OCD reported moderate OCD symptoms on the Y-BOCS and OCI-R (according to Abramovitch et al., 2020). Separate linear regression models with subsequent Tukey's HSD tests revealed a significant reduction in OCD symptoms from baseline to post-intervention according to the Y-BOCS ($M_{\text{baseline to post-intervention}} = -7.384$, $p < .001$, $d_z = -1.267$). No significant reduction was evident for the OCI-R ($M_{\text{baseline to post-intervention}} = -4.880$, $p = .085$, $d_z = -0.707$). Furthermore, neither the sense of responsibility ($M_{\text{baseline to post-intervention}} = -7.786$, $p = .187$, $d_z = -0.502$) nor the level of anger suppression ($M_{\text{baseline to post-intervention}} = 0.229$, $p = .983$, $d_z = 0.058$) significantly changed throughout treatment. When investigating the change from baseline to follow-up, a significant reduction of OCD symptoms was seen for both Y-BOCS ($M_{\text{baseline to follow-up}} = -7.875$, $p = .003$, $d_z = -1.016$) and OCI-R ($M_{\text{baseline to follow-up}} = -8.563$, $p < .001$, $d_z = -1.016$). No significant change was evident for the sense of responsibility ($M_{\text{baseline to follow-up}} = -12.048$, $p = .060$, $d_z = -0.526$) or the level of anger suppression ($M_{\text{baseline to follow-up}} = -1.178$, $p = .650$, $d_z = -0.267$).

Table 3.2

Descriptive Overview of Psychopathological Data.

	Baseline *N* = 48	Post-Intervention *n* = 42	Follow-Up *n* = 36
Variable		% (*n*); *Mean* (*SD*)	
OCD Symptom Severity			
OCD Symptom Severity (Y-BOCS $_{Total}$)	25.15 (6.13)	17.76 (6.68)	16.58 (7.58)
Obsession Severity (Y-BOCS $_{Obsessions}$)	12.44 (3.54)	8.93 (3.87)	8.81 (4.53)
Compulsion Severity (Y-BOCS $_{Compulsions}$)	12.71 (3.28)	8.83 (3.70)	7.78 (3.96)
OCD Symptom Severity (OCI-R $_{Total}$)*	23.32 (10.12) [1]	18.44 (10.49) [2]	15.44 (11.43)
Washing Severity (OCI-R $_{Washing}$)	4.49 (4.14) [1]	3.63 (3.95) [2]	2.64 (3.05)
Checking Severity (OCI-R $_{Checking}$)	5.36 (3.70) [1]	3.71 (3.16) [2]	3.53 (2.94)
Ordering Severity (OCI-R $_{Ordering}$)	3.77 (3.83) [1]	3.10 (3.58) [2]	2.56 (3.16)
Obsession Severity (OCI-R $_{Obsessing}$)	7.45 (3.85) [1]	6.17 (3.46) [2]	4.97 (3.53)
Neutralising Severity (OCI-R $_{Neutralising}$)	2.26 (3.46) [1]	1.83 (3.06) [2]	1.75 (3.16)
OCD-Related Beliefs			
OCD-Related Beliefs (OBQ-44 $_{Total}$)	178.38 (58.15) [1]	154.39 (49.11) [2]	149.08 (56.73)
Importance of Thoughts (OBQ-44 $_{Importance\ of\ Thoughts}$)	41.98 (18.65) [1]	33.37 (16.33) [2]	34.31 (19.50)
Responsibility (OBQ-44 $_{Responsibility}$)	67.30 (26.09) [1]	58.51 (21.00) [2]	55.25 (23.34)
Perfectionism (OBQ-44 $_{Perfectionism}$)	69.11 (23.66) [1]	62.51 (22.16) [2]	59.53 (22.07)
Anger			
Trait Anger (STAXI-2 $_{Anger\ Trait}$)	22.36 (7.35) [1]	22.15 (7.15) [2]	21.03 (7.25)
State Anger (STAXI-2 $_{Anger\ State}$)	19.70 (7.68) [1]	20.32 (7.89) [2]	20.31 (10.06)
Anger Suppression (STAXI-2 $_{Expression\text{-}In}$)	18.23 (5.82) [1]	18.46 (6.18) [2]	17.06 (6.04)
Aggression (STAXI-2 $_{Expression\text{-}Out}$)	13.02 (4.67) [1]	12.98 (4.81) [2]	13.08 (5.10)
Anger Control In (STAXI-2 $_{Control\text{-}In}$)	12.89 (3.48) [1]	12.73 (3.96) [2]	13.22 (3.51)
Anger Control Out (STAXI-2 $_{Control\text{-}Out}$)	14.62 (3.68) [1]	13.93 (4.10) [2]	14.00 (3.77)

Note. *Y-BOCS* = Yale-Brown Obsessive-Compulsive Scale with its subscales *Obsession Severity* = Subscale Obsessions of the Y-BOCS *Compulsion Severity* = Subscale Compulsions of the Y-BOCS.
OCI-R = Obsessive-Compulsive Inventory-Revised with its subscales *Washing Severity* = Subscale Washing of the OCI-R, *Checking Severity* = Subscale Checking of the OCI-R, *Ordering Severity* = Subscale Ordering of the OCI-R, *Obsession Severity* = Subscale Obsessing of the OCI-R, *Neutralising Severity* = Subscale Neutralising of the OCI-R.
OBQ-44 = Obsessive Beliefs Questionnaire-44 with its subscales *Importance of Thoughts* = Subscale Importance and Control of Thoughts of the OBQ-44, *Responsibility* = Subscale Responsibility and Threat Estimation of the OBQ-44. *Perfectionism* = Subscale Perfectionism and Intolerance of Uncertainty of the OBQ-44.
STAXI-2 = State-Trait Anger Expression Inventory-2 with its subscales *Trait Anger* = Subscale Anger Trait, *State Anger* = Subscale Anger State, *Anger Suppression* = Subscale Expression-In, *Aggression* = Subscale Expression-Out, *Anger Control In* = Subscale Control-In, *Anger Control Out* = Subscale Control Out.
***** OCI-R total score is calculated without the hoarding subscale.
[1] based on $n = 47$
[2] based on $n = 41$

Mediation Models

Intercorrelations between the predictor, mediator, and outcome variable for each hypothesis are presented in Appendix C1. Results of the separate mediation models are presented in Table 3.3. Based on Cook's distance, no influential outliers were identified (Cook, 1977). Therefore, all data were included.

Mediation Effect in Static Models

The direct effect (path c) showed that sense of responsibility did not significantly predict anger suppression. No effect of inflated sense of responsibility on the mediator OCD symptoms (path a) was found. Self-reported OCD symptoms as assessed with the OCI-R significantly predicted anger suppression (path b), with higher OCD symptoms being indicative of higher anger suppression. This association was not found for OCD symptoms as assessed with the Y-BOCS. No mediating effect of OCD symptoms (as measured by the OCI-R and Y-BOCS) for

the relationship between an inflated sense of responsibility and anger suppression was evidenced (see Table 3.3).

Mediation Effect of Change Throughout Psychotherapy

The mediation models of change showed that the change in sense of responsibility did not significantly predict the change in anger suppression (path c). The model demonstrated that a stronger reduction in the level of an inflated sense of responsibility from baseline to post-intervention significantly predicted a higher reduction in OCD symptoms as assessed with the OCI-R from baseline to post-intervention (path a). This association was not significant when OCD symptoms were assessed with the Y-BOCS. A change in OCD symptoms neither significantly predicted a change in anger suppression (path b) nor did it mediate the association between the change in sense of responsibility and the change in anger suppression (see Table 3.3).

Exploratory Analyses

Exploratory Analyses for Sub-Sample with Checking Compulsions

A comparison of the checking versus no checking sub-sample is given in Table C2.1 of Appendix C2. Results of the exploratory mediation analyses can be found in Table C2.2 of Appendix C2. The direct effect (path c) of the mediation model showed that the sense of responsibility at baseline in the sub-sample of individuals with checking-related symptoms did significantly predict anger suppression at follow-up. Similar to the analyses for the whole sample, higher OCD symptoms as assessed with the OCI-R significantly predicted higher levels of anger suppression (path b). When OCD symptoms were assessed with the Y-BOCS, higher sense of responsibility at baseline significantly predicted fewer OCD symptoms at post-intervention (path a). No mediating effect of OCD symptoms was demonstrated.

In the mediation models of change, it was shown that the change in inflated sense of responsibility significantly predicted the change in OCD symptoms (path a), but only for OCD symptoms assessed with the Y-BOCS. Likewise, the change in OCD symptoms as assessed with the Y-BOCS did significantly predict the change in anger suppression, with higher symptom reduction being associated with higher reductions in anger suppression (path b). No significant effects were demonstrated if OCD symptoms were assessed with the OCI-R.

Exploratory Analyses for Depressive Symptoms and Medication Intake

Exploratory mediation models tested whether the results of the mediation analyses were stable beyond controlling for depressive symptoms and medication intake. Results can be found in Table C3.1 in Appendix C3. A significant positive effect of OCD symptoms at baseline as assessed with the OCI-R on the level of anger suppression at follow-up was shown (path b). Furthermore, a significant total effect could be demonstrated, with higher levels of anger suppression at follow-up being predicted by higher levels of sense of responsibility at baseline (path c').

In terms of mediation models of change, results showed a significant effect of the change in sense of responsibility on the change in anger suppression. The stronger the reduction in the level of an inflated sense of responsibility from baseline to post-intervention, the higher the reduction in OCD symptoms from baseline to post-intervention (path a). This effect was evident for OCD symptoms as assessed with the OCI-R as well as with the Y-BOCS. The remaining effects did not reach significance.

Exploratory Analyses for Directionality of Effects

In an exploratory analysis, the directionality of the association between OCD symptoms and anger suppression was tested. Results are presented in Table C4.1 in Appendix C4. The sense of responsibility at baseline did significantly predict the level of anger suppression at

post-intervention (path a). Anger suppression at post-intervention could not predict OCD symptoms at follow-up (path b), nor could the level of anger suppression at baseline predict the level of OCD symptoms at follow-up (path c). No mediating effect of anger suppression on the association between sense of responsibility and OCD symptoms could be demonstrated in either model.

In the models investigating change, the change in inflated sense of responsibility significantly predicted the change in OCD symptoms as assessed with the OCI-R (path c). The remaining paths, as well as the mediation effect, remained non-significant.

Table 3.3

Mediation Models as Investigated by Separate Structural Equation Models.

Independent Variable (IV)	Dependent Variable (DV)	Mediator (M)	Effect of IV on M (a) *B*, β (*SE*), *z*, *p*	Effect of M on DV (b) *B*, β (*SE*), *z*, *p*	Indirect Effect (ab) *B*, β [95% CI]	Total Effect (c') *B*, β [95% CI]	Explained Variance (R^2)
Inflated Sense of Responsibility	Anger Suppression	OCD Symptoms $_{OCI-R}$	0.096, 0.239 (0.068), 1.425, .154	**0.183, 0.319 (0.090), 2.039, .041***	0.018, 0.076 [-0.004; 0.063]	0.074, 0.320 [-0.010; 0.144]	R^2_{OCI-R}: .057 $R^2_{Anger\ Suppression}$: .198
Inflated Sense of Responsibility	Anger Suppression	OCD Symptoms $_{Y-BOCS}$	-0.028, -0.109 (0.041), -0.678, .497	0.029, 0.031 (0.189), 0.151, .880	-0.001, -0.003 [-0.034; 0.007]	0.072, 0.310 [-0.013; 0.146]	R^2_{Y-BOCS}: .012 $R^2_{Anger\ Suppression}$: .097
ΔInflated Sense of Responsibility	ΔAnger Suppression	ΔOCD Symptoms $_{OCI-R}$	**0.165, 0.372 (0.072), 2.285, .022***	0.140, 0.221 (0.100), 1.399, .162	0.023, 0.082 [-0.008; 0.086]	-0.101, -0.360 [-0.224; 0.030]	$R^2_{\Delta OCI-R}$: .138 $R^2_{\Delta Anger\ Suppression}$: .172
ΔInflated Sense of Responsibility	ΔAnger Suppression	ΔOCD Symptoms $_{Y-BOCS}$	0.101, 0.278 (0.054), 1.889, .059$^\bullet$	0.153, 0.198 (0.164), 0.936, .349	0.016, 0.055 [-0.019; 0.047]	-0.103, -0.366 [-0.223; 0.021]	$R^2_{\Delta Y-BOCS}$: .077 $R^2_{\Delta Anger\ Suppression}$: .170

Note.

B = unstandardised regression coefficient, β = completely standardised solution.

ΔInflated Sense of Responsibility = residualized change score of inflated sense of responsibility from baseline to post-intervention, *ΔAnger Suppression* = residualized change score of anger suppression from baseline to follow-up, *ΔOCD Symptoms*$_{OCI-R}$ = residualized change scores of OCD symptoms as assessed with the OCI-R from baseline to post-intervention, *ΔOCD Symptoms*$_{YBOCS}$ = residualized change scores of OCD symptoms as assessed with the Y-BOCS from baseline to post-intervention.

* $p < 0.05$, $^\bullet$ $p < 0.10$

Discussion

Based on cognitive theories, an inflated sense of responsibility leads to symptoms of OCD and may also contribute to the development of OCD-related anger and, consequently, to the suppression of anger (Rachman, 1993). To extend previous research, the current study tested the temporal relationship between an inflated sense of responsibility, OCD, and anger suppression, and hypothesised that OCD symptoms would mediate the association between sense of responsibility and anger suppression.

Temporal Association between OCD and Anger Suppression

The current study extends previous cross-sectional research (e.g., Cludius et al., 2021; Moritz et al., 2011) by showing a significant temporal association between the level of anger suppression and OCD symptoms as assessed with a self-report measure of OCD (OCI-R). Higher OCD symptoms at post-intervention were predictive of higher levels of anger suppression at the follow-up assessment six months later. This temporal effect was replicated in the sub-sample of patients with checking-related symptoms of OCD. Additionally, a change in OCD symptoms (as assessed with the Y-BOCS) did significantly predict a change in anger suppression in patients with checking-related symptoms of OCD, with higher symptom reductions being predictive of higher reductions in anger suppression. That this effect is only visible in the sub-sample of individuals with checking-related symptoms may be related to the fact that in the current study this group not only displayed higher levels of OCD symptoms but also displayed higher levels of anger suppression. Overall, these results lend support to the concept of the cognitive theory (Rachman, 1993), as individuals with higher obsessive-compulsive symptomatology report increased internal suppression of anger.

Rachman's (1993) views are further supported by our exploratory analyses which investigated the directionality of effects. In contrast to the psychodynamic viewpoint that anger suppression is a cause of symptoms of OCD (Freud, 1909), anger suppression did not predict

the severity of OCD symptoms at a later timepoint in our exploratory analysis. Thereby, our preliminary results on directionality favour the cognitive theory over the psychodynamic perspective and are (largely) in line with Cludius et al.'s (2021) suggestion that OCD symptoms may rather occur as a consequence of anger suppression.

Moreover, OCD symptoms predicted anger suppression even after controlling for depressive symptoms and medication intake. Thereby, these exploratory results are in line with Moritz et al. (2009), who showed the relative specificity of anger suppression to OCD as compared to depression and anxiety. The current results support the assumption that the association between anger suppression and OCD symptoms may be relatively specific to OCD, and further is not primarily accounted for by medication intake.

The Role of Inflated Sense of Responsibility

Sense of Responsibility as Predictor of OCD Symptoms

Contrary to our hypotheses, the sense of responsibility did not significantly predict the level of OCD symptoms in our study. Particularly, the non-significant effect of an inflated sense of responsibility on symptoms of OCD is in stark contrast to the cognitive model (Rachman, 1993) as well as previous research proposing a causal effect between sense of responsibility and OCD symptoms (Arntz et al., 2007; Ladouceur et al., 1995).

One reason for the non-significant effect in the current study could be related to the design of the study, which assessed an inflated sense of responsibility and symptoms of OCD at different timepoints: sense of responsibility was assessed at baseline, but OCD symptoms were assessed following the four-week metacognitive intervention. The effect of the intervention could potentially mask the association between inflated sense of responsibility and OCD symptoms. Since the MCT-OCD is designed to specifically target cognitive beliefs (Jelinek et al., 2018), individuals with a higher sense of responsibility may be more responsive to this intervention, which would result in a higher reduction in sense of responsibility as well

as a higher change in OCD symptomatology. This assumption is supported by the mediation models including residualized change scores, where the change in the level of inflated sense of responsibility from baseline to post-intervention does significantly predict the concomitant change in OCD symptoms as assessed with the OCI-R. These results indicate that a sense of responsibility is indeed changed throughout the intervention and that this change is predictive of or accompanied by a change in OCD symptomatology.

In support of this, we found that higher baseline values of sense of responsibility predicted lower OCD symptoms as assessed with the Y-BOCS at post-intervention in the subgroup of patients with high checking-related compulsions. Additionally, higher reductions in sense of responsibility were also predictive of a higher reduction of OCD symptomatology in this subgroup, as assessed with the Y-BOCS. This effect may be related to the intervention itself as well as the characteristics of the checking sub-sample. In line with previous research (e.g., Foa et al., 2002) and propositions by Rachman (1993, 2002), patients primarily presenting checking-related symptoms show higher levels of sense of responsibility at baseline when compared to the rest of patients with OCD and may thus especially profit from the metacognitive training. Although promising, this suggestion remains tentative and further research is needed to investigate the predictive property of sense of responsibility for the treatment effect of a metacognitive intervention in OCD.

Sense of Responsibility as Predictor of Anger Suppression

The temporal relationship between sense of responsibility and anger suppression could not be shown in the main analyses. However, in the sub-sample of individuals with high checking-related symptoms, a significant effect of sense of responsibility at baseline on anger suppression at the follow-up was demonstrated, with higher sense of responsibility predicting higher anger suppression. Again, this effect may be related to the increased sense of responsibility characteristic in this sub-sample, as already mentioned by Rachman (1993). This

increased sense of responsibility likely results in higher anger and anger suppression. Consequently, it could be that the effect of sense of responsibility on anger suppression is only present in individuals who report a high sense of responsibility, which goes along with higher levels of anger suppression.

Furthermore, in the exploratory analysis, which tested the directionality and predicted anger suppression at post-intervention instead of follow-up, the sense of responsibility at baseline did significantly predict the level of anger suppression at post-intervention. It may be possible that the association between sense of responsibility and anger suppression is only present when measured in close proximity to each other, as the effect may, in general, be relatively small.

Mediating Effect of OCD Symptoms

Contrary to our hypotheses, none of the mediation models showed a significant mediating effect of OCD symptoms between the association of an inflated sense of responsibility and the level of anger suppression. Given the observed significant effects of OCD symptomatology on anger suppression, it seems as if OCD may rather be independently associated with anger suppression. Furthermore, reflecting upon the mixed findings on the association between sense of responsibility and anger suppression, it may be that this association is only present in individuals with a high sense of responsibility.

Additionally, particularly in the interpretation of mediation effects, the study design, including a four-week metacognitive intervention in which the sense of responsibility is specifically targeted, needs to be considered. The current study provides promising first insights into the temporal association between anger suppression and OCD symptoms but faces potential confounding effects due to the four-week metacognitive intervention. To verify the associations between sense of responsibility, anger suppression, and OCD symptoms that were observed in this study, future studies should use a longitudinal design without an intervention period.

Limitations and Future Research

This study showed several strengths such as the longitudinal design and the high ecologic validity due to the inclusion of comorbid disorders. However, it also shows several limitations. First, as the data used for the present study was part of a larger project that has already been completed (DRKS-ID: DRKS00012531), the sample size could not be increased. This is particularly relevant for the analyses on the subgroup of patients with checking-related symptoms, which was based on a sample of $n = 20$. Due to sample size restrictions, the power of the current analysis may be limited. Furthermore, the results are limited to patients with OCD that are currently undergoing inpatient psychotherapeutic treatment. Therefore, replication of the temporal associations between sense of responsibility, OCD symptoms, and anger suppression in a larger sample of inpatients and outpatients with OCD, as well as a sub-group of patients with checking-related symptoms, is advisable.

Second, the results have not always been consistent across the two measures of OCD symptoms (i.e., the self-report instrument [OCI-R] or the structured interview [Y-BOCS]). Whereas the effects in the main analyses were visible only for OCD symptoms as assessed with the OCI-R, effects in the exploratory analyses were partially only visible for the Y-BOCS. These differences may be attributed to the different underlying approaches, with the OCI-R being a nomothetic self-report questionnaire focusing on the severity of OCD symptoms in a set of symptom dimensions, whereas the Y-BOCS is considered to be a (semi-)idiographic approach seeking to identify the severity of patients' individual OCD symptoms (Abramovitch et al., 2021). Furthermore, as the remaining measures of interest (i.e., sense of responsibility and anger suppression) were also assessed via self-report (i.e., OBQ-44 and STAXI-2), the assessment type may also influence the associations of interest. Lastly, although both measures are suited to assess change throughout therapy (Abramowitz et al., 2005; Kuckertz et al., 2021), the Y-BOCS was evidenced to be more sensitive in capturing symptom changes over time (Veale et

al., 2016). Overall, these differences are likely to be at least partially accountable for the inconsistent findings in the current study.

Third, the self-report measures used in the current study face some limitations. The inflated sense of responsibility was assessed by the OBQ-44 subscale Inflated Responsibility and Perceived Threat of Harm. Even though this is the standard for assessing an inflated sense of responsibility (Cludius et al., 2021; Moritz et al., 2009, 2011; Radomsky et al., 2007), it is problematic as these two constructs load on the same dimension. Thus, a single dysfunctional belief cannot be demarcated. Although it is in line with cognitive theory, it cannot be conclusively said that the shown associations are exclusively based on the cognitive belief of inflated sense of responsibility as there may also be a relationship to the concept of perceived threat of harm. Moreover, the level of anger suppression was assessed with the self-report measure STAXI-2. As self-reports are susceptible to biases, particularly due to a lack of insight or social norms in OCD, it may be beneficial to include more objective behavioural measures (e.g., aggressiveness self-concept Implicit Association Test, Cludius et al., 2021; Implicit Relational Assessment Procedure, Michnevich et al., 2021). However, as such measures are currently not well-established, further research is needed to establish the reliability and validity of those implicit procedures for the assessment of anger suppression.

Fourth, the majority of patients with OCD in the current study reported a comorbid disorder (as assessed with the structured diagnostic interview), mostly anxiety disorders or depressive disorders. Although the effect of depressive symptoms on the relationship between OCD symptoms and anger suppression was explored in the current study, other comorbidities may potentially confound the observed relationships. Though it limits the interpretation of results to some extent, the exclusion of patients with comorbid diagnoses was not reasonable as this would not represent the population of patients with OCD and would thereby harm the ecological validity. Future research could, within a larger sample of patients with OCD,

investigate moderated mediation models to account for potential effects of comorbid diagnoses on the association between the sense of responsibility, OCD symptoms, and anger suppression.

Lastly, the model fit of the main mediation models was relatively low. This may be related to the study design, since variables of interest are liable to change over time, particularly throughout the MCT-OCD intervention. Thereby, the explained variance may be restricted, as variables measured at post-intervention and follow-up (i.e., OCD symptoms and anger suppression, respectively) changed due to the intervention, which may confound their association with baseline sense of responsibility. Moreover, the low model fit may suggest further relevant variables that could be included in future research to explain the variance in anger suppression. One particularly promising factor may be general levels of emotion regulation. Whether anger is expressed in the form of aggression or suppressed may be related to the general ability to regulate emotions (Szasz et al., 2011). Similar to other mental disorders, OCD is characterised by decreased abilities for adaptive emotion regulation, including enhanced suppression and reduced acceptance of (negative) emotions (Picó-Pérez et al., 2017; Zilverstand et al., 2017). The inclusion of a measure on general emotion regulation or the non-acceptance of emotions may potentially explain a larger proportion of variance in anger suppression and help to further explain the observed associations.

Clinical Implications

As this trial includes a metacognitive intervention adjunct to routine clinical care, specific cognitive beliefs are targeted. Analyses showed that the change in inflated sense of responsibility predicted the change in OCD symptoms. These results give an indication that changes in a cognitive belief, possibly due to the metacognitive training, may be a relevant factor for patients with OCD, and might even be particularly relevant for the subgroup of patients with a high inflated sense of responsibility.

Furthermore, this is the first study replicating the previously shown associations between OCD symptoms and anger suppression in a longitudinal design. Thereby, it corroborates theoretical outlines that anger suppression is closely associated with OCD and may even be a consequence of OCD symptoms. In a clinical setting, anger and its suppression may influence several aspects of psychotherapy, including the therapeutic alliance and the emotional expression during exposure and response prevention. Acknowledging that anger is an emotion frequently experienced by patients with OCD and that the suppression of anger is likely to be a consequence of OCD symptoms may inform future adjustments of psychotherapy. These adjustments could potentially be particularly relevant for individuals with checking-related symptoms, as also proposed in a previous review by Williams et al. (2013). Furthermore, it may be important to target emotion regulation during psychotherapy for OCD. In support of that, Fergus and Bardeen (2014) demonstrated that the emotion regulation strategy of expressive suppression is associated with each symptom dimension of OCD. Furthermore, Cludius et al. (2021) also demonstrated that aspects of emotional acceptance (i.e., non-acceptance of negative emotions) are closely related to anger suppression in OCD. Ultimately, in line with Rachman's (1993) proposition, helping patients with OCD to identify and express emotions in an adaptive way may reduce OCD symptomatology and consequently foster more adaptive emotion regulation strategies, including less suppression of anger.

Conclusion

This is, to the best of current knowledge, the first study investigating temporal associations between a sense of responsibility, OCD symptoms, and anger suppression. Although OCD symptoms did not mediate the association between a sense of responsibility and anger suppression, OCD symptoms were associated with anger suppression. In line with cognitive theories, it was demonstrated that OCD symptoms can predict the level of anger suppression and that a change in OCD symptoms may even be predictive of a change in anger

suppression. This association supports the assumption that anger suppression can develop as a consequence of OCD, where OCD symptoms themselves contribute to the suppression of anger. The association between inflated sense of responsibility and anger suppression is less clear and may only be present in patients generally presenting higher levels of responsibility and anger suppression, such as patients with checking-related symptoms. Yet, due to the outlined limitations, such as the relatively small sample size, the influence of comorbidities, and the model fit, replication of the current results is necessary. If translated into clinical practice, these results could improve psychotherapeutic treatment and motivate therapists to include anger-focused interventions for patients with OCD, particularly if they are presenting high checking-related symptoms.

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Study IV

(No) Attentional Biases in OCD? An Eye-Tracking Study Using Idiosyncratic Material

This chapter is a pre-print version of an article currently in submission, before formal peer-review and publication.

The study was preregistered and material, data and R code, have been made available online (https://osf.io/m27hc/). The pre-print is also available online at https://osf.io/preprints/osf/j6tsz.

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Abstract

Cognitive-behavioural theories propose that attentional biases contribute to the development and maintenance of obsessive-compulsive disorder (OCD). However, research findings have been inconsistent, with some studies supporting vigilance (i.e., rapid orientation toward threatening material) and/or maintenance biases (i.e., difficulty disengaging from threatening material), and others showing either one or neither of these biases. These inconsistencies may be related to several limitations of previous studies (e.g., no clinical control groups, focus on subgroups of participants with OCD, use of generic OCD-related material). Therefore, this preregistered study (https://osf.io/8gkjc) aimed to clarify attentional biases in OCD using a free-viewing eye-tracking paradigm with idiosyncratic disorder-relevant stimuli. Participants included 51 individuals with OCD, 64 non-clinical controls, and 50 individuals with spider phobia as a clinical control group. Results did not support a vigilance bias in OCD, as participants with OCD were neither faster nor more likely to fixate first on OCD-relevant stimuli. Although a maintenance bias was observed, it was driven by avoidance of negative images rather than prolonged attention to OCD-relevant stimuli. In contrast, participants with spider phobia strategically avoided spider-related images, indicating different attentional patterns compared to OCD. Exploratory analyses revealed symptom-specific attentional patterns: whereas participants with OCD avoided OCD-relevant contamination-related images, a maintenance on OCD-relevant checking-related was observed. These findings highlight the importance of considering individual symptom profiles and the emotional significance of stimuli in future research. Our study suggests that attentional processes in OCD differ from those in anxiety disorders and challenges the applicability of anxiety models of attentional biases to OCD.

1. Introduction

According to cognitive theories (Salkovskis & McGuire, 2003), attentional biases play a crucial role in the development and maintenance of OCD symptoms. However, a more fine-grained definition of attentional processes contributing to OCD has so far not been established. Therefore, previous research was largely informed by more precise theories on anxiety disorders, detailing the importance of *vigilance* and *maintenance biases* (Fox et al., 2001). *Vigilance bias* describes the initial fast orientation or the increased likelihood on first orienting on the threatening stimuli, whereas *maintenance bias* is characterised by difficulties disengaging from threatening stimuli once attention was allocated (Basel et al., 2023; Corbetta & Shulman, 2002). Of note, these biases are not mutually exclusive, but may rather operate conjointly (Lazarov et al., 2019). For instance, a person with OCD and checking-related obsessions may rapidly detect a stove knob that is not tilted completely to zero, reflecting a vigilance to threat-related material. At the same time, this person may have difficulty to disengage from the stove knob once detected, resulting in prolonged fixations, reflecting attentional maintenance.

Eye-tracking technology offers the opportunity to assess more complex and dynamic patterns of attention over a longer period of time (Armstrong & Olatunji, 2012; Fox et al., 2001). Free-viewing paradigms are particularly suited to investigate different functional and temporal components of attentional biases. In these paradigms, participants initially fixate on a central cross before freely exploring the displayed stimuli (typically two or more simultaneously) without any additional task demands (Armstrong & Olatunji, 2012). By continuously measuring an individuals' gaze throughout these paradigms, the first fixation location and first fixation latency as an indicator of vigilance bias, as well as the duration of fixations on the specific stimulus (i.e., dwell time), as a proxy for the maintenance bias, can be assessed (see Clauss et al., 2022).

Research on attentional biases in anxiety disorders is quite extensive with a recent meta-analysis giving support to the presence of attentional biases (vigilance and maintenance) across a range of anxiety disorders (Clauss et al., 2022). For example, in spider phobia as an anxiety-disorder which shares the primary emotions disgust and anxiety with OCD, research has consistently demonstrated vigilance biases and subsequent avoidance of spider-relevant material (i.e., no maintenance bias; Gerdes et al., 2009; Pflugshaupt et al., 2007; Rinck & Becker, 2006).

However, research in OCD has produced mixed results. Two studies by Armstrong and colleagues (2010, 2012) and a study by Choi & Lee (2015) investigated in undergraduate and subclinical samples with high contamination fear or high checking symptoms, respectively. Their results supported a vigilance bias in OCD, based on the first fixation location (i.e., whether the first fixation was directed at threatening/OCD-related material). However, other studies did not find any indication a vigilance bias towards OCD-related material in OCD (M. C. Bradley et al., 2016; Cludius et al., 2019; Mullen et al., 2021). Likewise, for maintenance biases, some studies showed increased fixation durations (i.e., dwell times) on threatening/OCD-related material in (sub)clinical samples with OCD (Armstrong et al., 2010; M. C. Bradley et al., 2016; Cludius et al., 2019; Mullen et al., 2021), whereas others found no evidence for a maintenance biases in OCD on OCD-related material (Armstrong et al., 2012; Bucarelli & Purdon, 2016; Choi & Lee, 2015).

The inconsistent results in previous studies may be explained by several methodological limitations. First, as recently outlined by Adamis & Olatunji (2024), phenomenological factors such as disorder heterogeneity may crucially contribute to the current landscape of inconsistent results. Indeed, a wealth of previous research restricted themselves to specific subtypes of OCD (e.g., contamination fear: Armstrong et al., 2010, 2012; e.g., checking symptoms: Bucarelli & Purdon, 2016; Choi & Lee, 2015). Whereas OCD symptoms can generally be categorised into four dimensions (i.e., checking, washing, ordering, and obsessing; Mataix-Cols et al., 2005),

these clusters are not exclusive but rather overlapping (Rufer et al., 2006). Therefore, the separation into subtypes is somewhat arbitrary. Moreover, it also remains unclear whether the results would hold for an OCD sample presenting different symptoms, limiting the generalisability of findings.

Second, and most importantly, all previous studies used generic OCD-related material. That means, that the presented stimuli were extracted from validated datasets, but participants were not asked whether the stimuli were actually relevant to their individual OCD symptoms. Due to the heterogeneity of OCD symptoms even *within* a symptom cluster this may have greatly influenced the results (e.g., whereas patient A with the contamination and washing subtype of OCD may be fearful of asbestos, patient B with the same subtype may be afraid of germs; Basel et al., 2023). Therefore, it is likely that not all pictures were relevant to the individual participants with OCD included in those studies, leading to less reliable results. To accurately capture attentional biases, it is crucial to assess the idiosyncratic disorder relevance of the stimulus material.

Third, some of the previous studies were conducted in community samples or student samples (Armstrong et al., 2010, 2012; M. C. Bradley et al., 2016; Choi & Lee, 2015). Although highly relevant in the research on OCD, analogue samples differ in important ways from patient samples (e.g., age, socioeconomic status, general functioning, disability; Abramowitz et al., 2014), which may have influenced previous results.

Fourth, most of the previous studies did not use a (clinical) control group (Armstrong et al., 2010, 2012; M. C. Bradley et al., 2016; Choi & Lee, 2015; Cludius et al., 2019; Mullen et al., 2021). However, control groups are needed to be able to distinguish attentional processes in OCD from those in the non-clinical population and establish potential specificity of these biases to OCD as compared to other psychological disorders. For the latter, a clinical control group with common features would be required. Spider phobia is particularly suited as a clinical control group for investigating attentional biases in OCD as it shares the primary emotions

disgust and anxiety and studies in spider phobia have consistently shown attentional biases (Gerdes et al., 2009; Pflugshaupt et al., 2007; Rinck & Becker, 2006). This comparison allows clarification on whether the (potentially) observed attentional biases are specific to OCD or extend to anxiety disorders (e.g., spider phobia) more broadly.

1.1. Aims

With the current study, we aimed to address and overcome limitations of previous research by investigating attentional biases in individuals with OCD irrespective of symptom clusters, including clinical and non-clinical control groups and analysing attentional biases using idiosyncratically rated stimulus material. This approach allowed us to compare attentional biases toward idiosyncratic disorder-relevant stimuli relative to neutral and negative stimuli, clarifying whether these biases are driven by disorder-specific characteristics or general aversive properties. Additionally, we examined whether OCD-related biases differ from those observed in other anxiety disorders, specifically spider phobia. Ultimately, this study aims to contribute to a deeper understanding of the attentional processes underlying the development and maintenance of OCD symptoms. Based on theoretical models and previous research, we formulate the following hypotheses:

Hypothesis 1.1.: Vigilance Bias (First Fixation Choice)[3]

a. Participants with OCD and participants with spider phobia show an increased likelihood of first attending to idiosyncratic disorder-relevant material as compared to neutral or negative material (vigilance bias), as indicated by the first fixation choice.

b. Non-clinical participants will not show a bias in first fixation choice towards disorder-relevant stimuli compared to negative or neutral stimuli.

Hypothesis 1.2.: Vigilance Bias (First Fixation Latency)

a. Participants with OCD and participants with spider phobia attend to idiosyncratic disorder-relevant material faster than they do to neutral or negative material (vigilance bias), as indicated by the first fixation latency (i.e., entry time) to the corresponding region of interest.

b. Non-clinical participants will not show a bias in first fixation latency towards disorder-relevant stimuli compared to negative or neutral stimuli.

Hypothesis 2: Maintenance Bias

a. Participants with OCD look at idiosyncratic OCD-relevant material longer compared to neutral or negative material (maintenance bias).

b. Participants with OCD will show a more pronounced maintenance bias compared to non-clinical participants and, with regard to idiosyncratic disorder-specific material, compared to participants with spider phobia.

[3] The hypothesis 1.1. regarding vigilance biases in first fixation choice was not preregistered. However, as vigilance biases can be conceptualised through both first fixation choice and first fixation latency, we aimed to provide a comprehensive analysis of vigilance biases in OCD and have included additional analyses on this hypothesis.

2. Methods

2.1. Participants

We recruited three groups of participants between October 2022 and June 2024: participants with OCD, clinical controls with spider phobia, and non-clinical controls. We aimed to create triplets of participants that were matched for age, gender, and the level of education. For age, we created age bins of 10 years (i.e., 18–27, 28–37, 38–47, 48–57, 58–70). A match for education was established if the three participants were within a range of ±3 years difference in education or if all had more than 16 years of education. As preregistered (https://osf.io/8gkjc), we conducted a simulation-based power analysis using mixed-models in the *simr* package (version 1.0.4; Green & MacLeod, 2016) with a ground-truth simulated effect size of 203 ms (approximate Cohen's *d*: 0.4) for dwell time and 22 ms (approximate Cohen's *d*: 0.3) for the first fixation latency effect. Based on these estimates, we determined that a sample size of 50 participants per group would provide 80% power to detect the expected effects.

Participants with OCD were recruited from OCD wards of cooperating clinics (Day Clinic Munich Westend, Oberberg Hospital Windach), psychotherapists in outpatient settings, as well as flyer and university-newsletters. The clinical and non-clinical control groups were recruited via online platforms (e.g., Facebook, Ebay), flyers, and the university newsletters. When interested, participants could access screening questions and questionnaires on the online platform REDCap (Harris et al., 2009), assessing the in- and exclusion screening criteria. In general, participants were excluded when they were younger than 18 or older than 70, had a lifetime diagnosis of any severe neurological disorder (e.g., stroke, epilepsy, dementia), mania, or psychotic disorder. Furthermore, participants were excluded if they had a current substance or alcohol dependence or suffered from acute suicidality. The criteria were screened with dedicated questions in the online survey and were further checked with a validated structured diagnostic interview (Diagnostic Short-Interview for Mental Disorders – Open Access; Mini-DIPS-OA; Margraf & Cwik, 2017) in the first session.

The following group specific exclusion criteria applied. Participants with *OCD* were screened with the Fear of Spiders Questionnaire (FSQ; Pössel & Hautzinger, 2002) and a cut-off of < 14 was used to include participants with low fear of spiders only. The absence of a current spider phobia and the presence of a current diagnosis of OCD according to the 5th version of the Diagnostic and Statistical Manual (DSM-5; American Psychiatric Association et al., 2015) was assessed via the Mini-DIPS-OA (Margraf & Cwik, 2017). Furthermore, to be included in the study, participants should present clinically relevant OCD symptoms, which corresponds to a total score of >12 or a score of ≥ 8 on the subscale of obsessions or compulsions (Simpson et al., 2011) on the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Hand & Büttner-Westphal, 1991). If receiving psychotropic medication, stable medication (i.e., same active ingredient) for more than four weeks was required. In total, $n = 51$ participants with OCD met the inclusion criteria and completed the study.

Participants with *spider phobia* were included if spider phobia was diagnosed according to the DSM-5 criteria with the Mini-DIPS-OA (Margraf & Cwik, 2017). Participants with spider phobia were excluded if they had any other current psychological disorder or a life-time diagnosis of OCD. In case of psychotropic drugs, a stable medication for a minimum of four weeks is required. In the later stages of the project, it became apparent that a substantial number of participants had to be excluded due to not meeting the criterion of clinically significant impairment in daily life associated with spider phobia. Therefore, to increase the sample size and to be able to match participants with OCD participants according to the defined criteria, we decided to deviate from the preregistration. Participants where thus included with high spider anxiety, as indicated by a score of ≥ 64 on the FSQ (as in Ginat-Frolich et al., 2019) even if they did not meet meeting the criterion of clinically significant impairment in daily life. A total of $n = 41$ participants with spider phobia and $n = 9$ participants with very high levels of spider anxiety according to the FSQ were included and completed the study. Participants with ($M_{\text{SpiderPhobia}} = 82.98$, $SD_{\text{SpiderPhobia}} = 12.26$) and without spider phobia but with high spider

anxiety ($M_{SpiderAnxiety}$ = 80.11, , $M_{SpiderAnxiety}$ = 11.11) did not significantly differ in their sum scores on the FSQ; $t(12.23) = -0.66$, $p = .525$. To ease the flow of reading, we will consider participants with spider phobia and those with high spider anxiety as participants with spider phobia.

Participants of the *non-clinical control group* were also screened with the FSQ (Pössel & Hautzinger, 2002) and excluded if exceeding the FSQ sum score of 14. Furthermore, participants were excluded if they met the criteria for a psychological disorder throughout their lifetime, as assessed with the Mini-DIPS-OA (Margraf & Cwik, 2017).

The study was approved by the ethics committee of the Faculty of Psychology and Educational Sciences of the LMU Munich (34_Cludius_a). All participants provided informed consent for data collection.

2.2. Procedure

The current study consisted of three phases. When interested in the study, participants filled out a screening form and, if inclusion criteria were met, were invited for two laboratory session. Prior to each laboratory session, participants completed a series of online questionnaires evaluating demographics, attentional control, and psychological symptoms (for a comprehensive overview of the measures used, please refer to the preregistration https://osf.io/8gkjc). In the first laboratory session, the diagnostic interview was conducted. If no further exclusion criterion was met, participants completed several tasks on the computer, including the free-viewing paradigm and the picture rating described below. One week later, participants were invited to the laboratory again, completing the free-viewing paradigm and picture rating with a different stimulus set.

For the sake of further analyses in the larger project, a task to assess attentional control is conducted at the first laboratory session (AX-Continuous Performance Test; Cohen et al., 1999). Additionally, a stress induction (cold-pressor test) was conducted randomly either in

session one or two prior to the free-viewing task. Results on the effect of attentional control and stress on attentional processes will be presented in a forthcoming publication.

2.3. Eye Tracking

Eye movements were recorded from the dominant eye with the EyeLink 1000 (SR Research Ltd., Ontario, Canada) throughout the free-viewing paradigm with a sampling of 1000 Hz in the "head-fixed" mode. The monitor used in the study was a 24" Dell S2419HGF gaming monitor with 1 ms reaction time, a 144Hz refresh rate, and a 298.89 mm x 521.36 mm active vertical and horizontal area, respectively. Participants were seated in front of the display computer and were instructed to place their head onto the chin rest and move as minimum as possible throughout the free-viewing paradigm. Thereby, the distance between participants' head and the display was fixed at 75.5 cm. A 9-point calibration and validation was conducted at the beginning of the free-viewing paradigm. Calibration was repeated when the validation procedure showed (weighted) accuracies above mean 0.5° and maximum 1°, as calculated by the Eyelink-Calibration/Validation procedure. Furthermore, a 9-point recalibration was conducted midway through the free-viewing paradigm. The experiment was conducted in a silent room with dimmed light. Each picture presented during the free-viewing paradigm served as a region of interest.

2.4. Free-Viewing Paradigm

The free-viewing paradigm was programmed with PsychoPy (Peirce et al., 2019). 150 trials were presented within each laboratory session, with different pictures in each session. On each trial, participants viewed two pictures presented simultaneously against a uniform grey background (RGB: 128/255, not calibrated to the monitor's luminance). The pictures were cropped to a square format with dimensions of 432 x 432 pixels, subtending a visual angle of 5.10° x 5.10°. The pictures were presented at the upper-right and lower-left to work against the

commonly observed look-up and look-left bias (Waechter et al., 2014). The centres of the pictures located at 8.57° from the display's centre (with the viewing-distance of 75.5 cm). The grey background ensured minimal visual distractions, and the free-viewing paradigm allowed participants to explore the stimuli naturally.

The pictures presented in the free-viewing paradigm were pre-selected from affective and disorder-specific picture databases [incl. EmoMadrid, Carretié et al., 2019; Geneva Affective Picture Database (GAPED), Dan-Glauser & Scherer, 2011; Disgust-Related-Images (DIRTI), Haberkamp et al., 2017; Open Affective Standardised Image Set (OASIS), Kurdi et al., 2017; International Affective Picture System (IAPS), Lang et al., 2005; Nencki Affective Picture System (NAPS), Marchewka et al., 2013; Berlin Obsessive-Compulsive Disorder Picture Set (BOCD-PS), Simon et al., 2012; Emotional Picture Set (EmoPicS), Wessa et al., 2010)] and pictures from online databases with creative commons license (incl. Flickr, Pixabay, and Pexels).

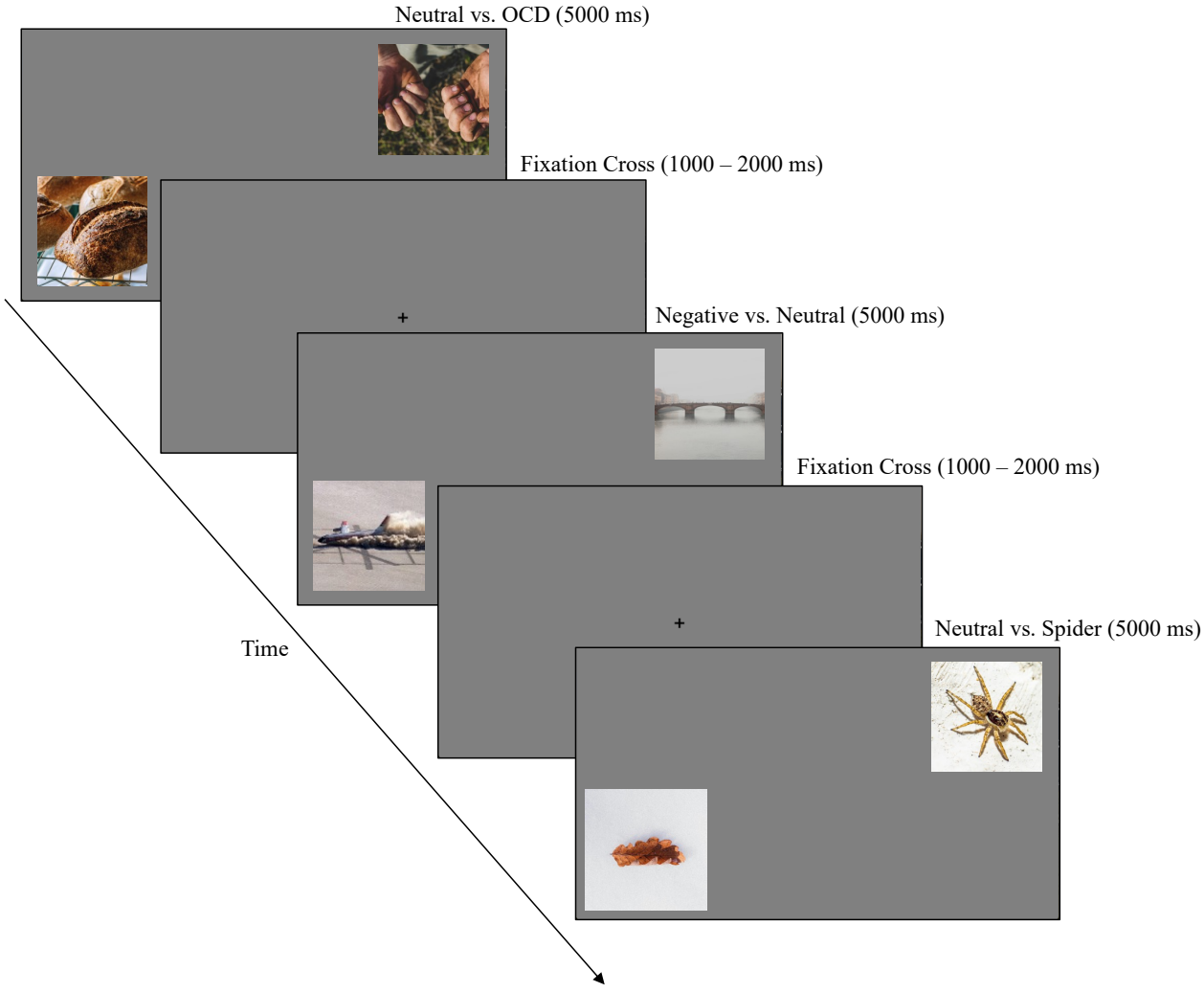
In order to present enough pictures that could be rated as personally disorder-relevant, we selected pictures which were assumed to fit different categories, namely, OCD-related pictures, spider-related pictures, negative pictures, and neutral pictures. We selected presumably OCD-related pictures that showed scenes relevant to different symptom dimensions (e.g., checking, washing, ordering). Of note, the assumed valence and relevance to OCD and spider phobia was only used for picture selection. The analyses were conducted using each participant's idiosyncratic ratings of valence and disorder relevance.

Based on the preselected pictures we created 60 trials of each of the following assumed picture combinations: 1) one *OCD-related* and one *neutral* picture, 2) one *OCD-related* and one *negative* picture, 3) one *spider-related* and one *neutral* picture, 4) one *spider-related* and one *negative* picture, 5) one *negative* and one *neutral* picture. In each laboratory session, 30 trials from each category were presented, ensuring that the two sessions presented different picture sets. Pictures occurring on one trial were matched visually based on colour and

complexity by the study team. The picture's location was counterbalanced by side, to further reduce an effect of the left-right and up-down bias. The order of trials presentation was consistent for participants within each triplet but varied randomly across triplets. Each trial was presented for 5 seconds, with an inter-trial interval varying randomly between 1 to 2 seconds during which a black fixation cross in the middle of the screen was presented. For a schematic overview of the free-viewing paradigm please see Figure 4.1.

Figure 4.1

Example Trials of the Free-Viewing Paradigm Showing Pictures of Each Category With Assumed Disorder-Relevance (OCD, Spider Phobia) and Assumed Valence.



Note. Each session, 150 trials were presented to the participant for 5000 ms, separated by a fixation cross with an intertrial interval varying randomly between 1000 and 2000 ms. Please

note that the pictures used in the actual study included licensed material. The images depicted here are license-free substitutes provided for illustrative purposes only.

Picture sources: first trial left picture: Pexels (https://www.pexels.com/de-de/foto/brot-frisch-tablett-essensfotografie-20400380/); first trial right picture: Pexels (https://www.pexels.com/de-de/foto/hande-dreckig-arbeitnehmer-arbeiter-10239293/); second trial left picture: Pixabay (https://pixabay.com/photos/plane-crash-crash-crash-landing-62883/), second trial right picture: Pexels (https://www.pexels.com/photo/dense-fog-over-bridge-in-town-25639555/); third trial left picture: Pexels (https://www.pexels.com/de-de/foto/kalt-schnee-wetter-kurve-6812372/); third trial right picture: Pixabay (https://pixabay.com/photos/zebra-spider-spider-arachnid-6272124/).

2.5. Idiosyncratic Picture Rating

Following the free-viewing paradigm, all participants rated the previously presented pictures. Each participant rated the valence of each picture, while those in the clinical groups additionally assessed its relevance to their specific disorder (i.e., OCD or spider relevance). Pictures were presented individually, and participants responded to the question: “For me personally, this picture is…” to rate valence and, for clinical groups, disorder relevance. The rating for the picture’s valence ranged from 1 (“very unpleasant”) to 9 (“very pleasant”). The rating for disorder relevance ranged from 1 (“not relevant to my obsessions or compulsions”/”not relevant to my fear of spiders”) to 4 (“very relevant to my obsessions or compulsions”/”very relevant to my fear of spiders”). For our analyses, each picture’s valence or disorder-relevance was inferred from the idiosyncratic rating. Pictures were categorised as neutral for the ratings 4 to 6 (i.e., “neutral” its gradient ratings) and as negative for the ratings 1 to 3 (i.e., “very unpleasant” to ”unpleasant”). Pictures were considered disorder relevant if they were rated as “relevant” (3) or “very relevant” (4) and as not-relevant if they were rated as “not relevant” (1) or “a bit relevant” (2).

2.6. Psychological Symptoms

2.6.1. Mini-DIPS-OA

The Diagnostic Short-Interview for Mental Disorders – Open Access (German: „Diagnostisches Kurzinterview bei psychischen Störungen – Open Access“; Mini-DIPS-OA; Margraf & Cwik, 2017) assesses current and past psychological disorders according to the DSM-5 criteria (American Psychiatric Association et al., 2015). The Mini-DIPS-OA has been validated and shows satisfactory reliability and validity (Margraf et al., 2017). In the current study, the Mini-DIPS-OA was used to assess in- and exclusion criteria in all three groups.

2.6.2. Yale-Brown Obsessive-Compulsive Scale

The Y-BOCS (Hand & Büttner-Westphal, 1991) is a semi-structured interview of which 10 item assess the severity of obsessions (items 1-5) and compulsions (items 6-10) of the past week. Items are rated on a five-point scale [ranging from 0 (none) to 4 (severe)] regarding their time, interference, distress, resistance, and control. The subscale sum-scores ($\text{Y-BOCS}_{\text{Obsessions}}$ and $\text{Y-BOCS}_{\text{Compulsions}}$) range from 0–20 and the $\text{Y-BOCS}_{\text{Total}}$ score ranges from 0–40. In the present study, the Y-BOCS evidenced good internal consistency ($\alpha = .88$, $\omega = .88$).

2.6.3. 12-Item Obsessive-Compulsive Inventory (OCI-12)

The 12-Item Obsessive-Compulsive Inventory (OCI-12; C. L. Müller et al., submitted for publication) is a 12-item self-report questionnaire measuring OCD symptoms and associated distress on four subscales (i.e., checking, ordering, washing, obsessing). The German version of the OCI-12 demonstrated good internal consistency and test-retest reliability, moderate-to-good construct validity, and good-to-excellent diagnostic accuracy (C. L. Müller et al., submitted for publication). Each item is rated on a five-point Likert scale [ranging from 0 (not at all) to 4 (extremely)]. Higher scores indicate higher symptom severity. In the present study, the OCI-12 showed excellent internal consistency ($\alpha = .92$, $\omega = .92$).

2.6.4. Obsessive Beliefs Questionnaire – German Version (OBQ-D)

The Obsessive Beliefs Questionnaire – German Version (OBQ-D; Ertle et al., 2008) measures beliefs related to OCD, including responsibility and threat estimation, perfectionism and intolerance of uncertainty, and the importance of and control of thoughts. All 24 items are rated on a seven-point Likert scale [ranging from 1 (disagree very much) to 7 (agree very much)], with higher scores indicating higher symptom severity. The OBQ-D showed excellent internal consistency in the current study (α = .96, ω = .96).

2.6.5. Fear of Spiders Questionnaire (FSQ)

The FSQ (Pössel & Hautzinger, 2002) is an 18 item self-report assessing the severity of fear of spiders. The items are rated on a seven-point Likert scale [ranging from 0 (not at all) to 6 (very much)]. Higher scores indicate higher symptom severity. In the current study, the FSQ showed excellent internal consistency (α = .99, ω = .99).

2.7. Analysis Plan

2.7.1. Pre-Processing

Eye-tracking data were exported via the interest area report functionality in the EyeLink Data Viewer software package (SR Research Ltd.). This dataset contains the features of the gaze patterns for each region of interest (i.e., lower left and upper right picture) per trial (i.e., 150 trials per session). We extracted 49500 trials (165 participants x 150 trials x 2 sessions), each with the variables first fixation location, first fixation latency (both used for analyses of vigilance bias) and dwell time (used for analyses of maintenance bias) per picture. The data were further processed with R Studio (version R 4.4.1; R Core Team, 2024). As preregistered, trials where the gaze was directed in a region of interest at the start of the trial, instead of the fixation cross, were excluded (i.e., gaze already entered a region of interest before the trial started; 727 trials, 1.47%). Furthermore, trials where the entry time into a region of interest

following the start of the picture presentation took more than 2 seconds were excluded (i.e., continued staring at the area of the previously presented fixation cross; 684 trials, 1.38%).

Furthermore, as we aim compare picture pairs (disorder-relevant vs. negative or neutral) as stated in our hypotheses, we excluded picture pairs that were not informative for our analyses (e.g., both disorder relevant, both negative, both neutral, both positive). Compared to other studies, this is necessary because the subjects individually rate the stimulus material, and thus prior balancing to relevant cases is not possible. This necessity led to exclusion of 23329 trials, 47.13%: 545 trials (1.10%), where both pictures were rated as negative (but neither was rated as disorder-relevant), 10210 trials (20.63%) where both pictures were rated as neutral (but neither was rated as disorder-relevant), 1584 trials (3.20%) where both pictures were rated as OCD relevant, 1026 trials (2.07%) where both pictures were rated as spider relevant, 621 (1.25%) where both pictures were rated as positive (but neither was rated as disorder-relevant), 9343 trials (18.87%) where one or both pictures were rated as positive (but neither was rated as disorder-relevant). In summary, 25608 trials (51.73%) were available for data analyses[4]. Of the 300 trials presented, an average of 155.20 trials per participant (*SD* = 31.06) met the criteria for inclusion in the analyses. The number of trials included per participant ranged from 63 to 225. Of note, the multilevel models used for our analyses are well-suited to account for varying numbers of trials per participant. Specifically, the pitfall of reduced reliability of estimates from participants with fewer is managed through a "shrinkage" effect, where estimates with fewer trials are partially pulled toward the group mean, ensuring more reliable and balanced results.

To compare gaze patterns within triplets (consisting of participants with OCD, spider phobia, and non-clinical controls matched for age, gender, and education), information about disorder-relevant pictures (e.g., OCD-relevant or spider-relevant) was transferred from the

[4] As overlaps in data exclusion criteria were possible (e.g., a picture was rated positive but at this trial the participant did not enter any region of interest within two seconds), the excluded trials do not exactly add up to the trials available in analyses.

clinical group participant to their triplet partners. For example, the coding of OCD-relevant pictures was inferred from the participant with OCD and applied to the corresponding participants with spider phobia and the non-clinical control within the same triplet. The dataset consisted of 28 complete triplets, 35 doublets (i.e., two participants per triplet), and 8 singlets (i.e., one participant per triplet). To address the missing data from incomplete triplets, we used random sample imputation. Values from participants in the corresponding missing groups were randomly assigned to complete the triplets, ensuring meaningful comparisons across the dataset.

2.7.2. Statistical Models Vigilance Bias

In terms of vigilance bias, we investigate two parameters of vigilance in separate multilevel models. The models were analysed with Julia (version 11.1; Bezanson et al., 2017) through *JuliaCall* (Li, 2019) in R Studio (version R 4.4.1; R Core Team, 2024). In a multilevel linear probability regression[5], we investigated the choice of first fixation (i.e., whether the right or left picture was chosen to be fixated first), with the dependent variable *Choice* as a binary variable (0 = first fixation directed at left picture, 1 = first fixation directed at right picture)[6]. In a separate multilevel linear regression, we further investigated the first fixation latency (i.e., the time from start of trial presentation to the first fixation to a region of interest).

We compared the model fit of complex models (i.e., three-level models using triplet, participant, and stimulus as random effects) with simpler models via log-likelihood ratio testing. Notably, although the more comprehensive models with a fully specified random effect structure would be preferable from a theoretical perspective, we decided to reduce the random effect structure to ensure data-driven parsimony, following the recommendations of Matuschek

[5] Following Hellevik (2009), a linear probability model rather than a logistic regression was used to facilitate interpretation of coefficients. Given most of probabilities gained from our binary data is close to 0.5, this is appropriate as we are in the linear range of the logistic function anyway.
[6] The analysis of fixation choice was not preregistered. With the analyses on choice we want to investigate whether the picture was it is also relevant which picture was in general chosen.

et al. (2017). The model described below provided the best fit, incorporating random slopes for disorder relevant (i.e., OCD-relevant and spider-relevant) stimuli and a random intercept for participant:

$$Choice_{ij} = \beta_0 + \beta_1(group_i) + \beta_2(stim\_ocd_i) + \beta_3(stim\_pho_i) + \beta_4(stim\_neg_i) + \beta_5(group_i \times stim\_ocd_i) + \beta_6(group_i \times stim\_pho_i) + \beta_7(group_i \times stim\_neg_i) + u_{0j} + u_{1j}(stim\_ocd_i) + u_{2j}(stim\_pho_i) + \epsilon_{ij}$$

With *Choice*, indicating whether the first fixation was directed to the picture or not, *group* being the indicator variable for group (OCD, spider phobia, non-clinical controls) with the reference category of non-clinical controls, *stim_ocd* representing the comparison between OCD-relevant stimuli (as rated by the participant with OCD and transferred to triplet partners) and neutral stimuli (reference category), *stim_pho* representing the comparison between spider-relevant stimuli (as rated by the participant with spider phobia and transferred to triplet partners) and neutral stimuli (reference category), *stim_neg* representing the comparison between negative stimuli and neutral stimuli (reference category), and the interactions between the different stimuli (*stim_ocd*, *stim_pho*, *stim_neg*) and the group. The stimuli (*stim_ocd, stim_pho, stim_neg*) were coded as -1 if the according stimulus was presented on the lower left, +1 if the according stimulus was presented on the upper right, and 0 if not presented or presented at both sides. This implements a pairwise probability model: the Bradley-Terry-Luce (BTL) model (R. A. Bradley & Terry, 1952; Luce, 2005), but on a linear probability scale.

Similarly, the best-fitting model was determined for the model investigating the first fixation latency. The best-fitting model including a random intercept for participant is depicted below:

$$FirstFixationLatency_{ij} = \beta_0 + \beta_1 group_i + \beta_2 looked\_at_i + \beta_3 looked\_right_i + \beta_4(group_i \times looked\_at_i) + \beta_5(looked\_right_i \times group_i) + u_{0j} + \epsilon_{ij}$$

With *FirstFixationLatency* representing the until the first fixation onset in one of the areas of interest (i.e., only one entry per trial), *group* being the indicator variable for group

(OCD, spider phobia, non-clinical controls) with the reference category of non-clinical controls, *looked_at* defines the stimulus type that is looked at [i.e., neutral (reference category), negative, OCD-relevant or spider-relevant], *looked_right* indicates whether the stimulus was presented right or left (reference category), as well as the interactions between *group* and *looked_at* and *group* and *looked_right*.

Contrasts were created for both, the model of choice and the mode of first fixation latency to directly test the hypothesised effects. An overview of the contrast coding can be found in Appendix D1 (Table D1a for first fixation choice and D1b for first fixation latency). To accommodate the complexity of the contrasts (i.e., three groups with multiple between- and within-subjects comparisons) while maintaining statistical rigor, we have chosen to deviate from the preregistered analysis plan and use Satterthwaite's method instead of likelihood ratio tests. This allowed us to use the Satterthwaite's method as implemented by the *contest* function of the *lmerTest* package (version 3.1–3; Kuznetsova et al., 2017). Using Satterthwaite's method of degrees of freedom approximation is a more conservative test of significance compared to the more liberal likelihood ratio tests, which are further restricted to pairwise model comparisons (Luke, 2017).

2.7.3. Statistical Models Maintenance Bias

For the analysis of potential maintenance biases, we conducted multilevel linear models. As dependent variable, we created a difference score for each trial, subtracting the dwell time (i.e., total fixation time) on the lower-left picture from the dwell time on the upper-right picture. Again, we compared the model fit of complex models (i.e., three-level models using participant, triplet, and stimulus as random effects) with simpler models, reducing the random effect structure. The model detailed below was shown to be the best-fitting model, with random slopes for stimulus type and a random intercept for participant:

$$dwell\_diff_{ij} = \beta_0 + \beta_1 group_i + \beta_2 stim\_ocd_i + \beta_3 stim\_pho_i + \beta_4 stim\_neg_i + \beta_5 (group_i \times stim\_ocd_i) + \beta_6 (group_i \times stim\_pho_i) + \beta_7 (group_i \times stim\_neg_i) + u_{0j} + u_{1j}(stim\_ocd_i) + u_{2j}(stim\_pho_i) + u_{3j}(stim\_neg_i) + \epsilon_{ij}$$

With *dwell_diff* representing the dwell time difference (i.e., total fixation duration) between the upper-right and lower-left picture, *group* being the indicator variable for group (OCD, spider phobia, non-clinical controls) with the reference category of non-clinical controls, *stim_ocd* representing the comparison between OCD-relevant stimuli (as rated by the participant with OCD and transferred to triplet partners) and neutral stimuli (reference category), *stim_pho* representing the comparison between spider-relevant stimuli (as rated by the participant with spider phobia and transferred to triplet partners) and neutral stimuli (reference category), *stim_neg* representing the comparison between negative stimuli and neutral stimuli (reference category), and the interactions between the different stimuli (*stim_ocd*, *stim_pho*, *stim_neg*) and the group. As in the previous model, we again use the BTL-model and conversely, the stimuli (*stim_ocd, stim_pho, stim_neg*) were coded as -1 if the according stimulus was presented on the lower left, +1 if the according stimulus was presented on the upper right, and 0 if not presented or presented at both sides.

Contrasts were created to test the hypothesised effects. An overview of the contrast coding for the maintenance bias can be found in Appendix D1 (Table D1.1c). As detailed above, the Satterthwaite's method was used for contrast analyses.

2.7.4. Sensitivity Analyses

During data inspection, we observed that some participants only looked at one of the pictures and ignored the other one presented in the same trial. Specifically, no fixation was directed on 2327 out of the 25608 pictures available for analysis (9.1%). As the biases central for our analyses may be affected if pictures are completely avoided, we conducted additional

sensitivity analyses where only the trials were analysed in which the participant looked at both pictures at least once.

2.7.5. Exploratory Analyses

Considering that previous studies primarily investigated the subtypes of OCD with washing- and checking-related symptoms (Armstrong et al., 2012; Bucarelli & Purdon, 2016; Choi & Lee, 2015; Cludius et al., 2019), we wanted to explore whether differential patterns between these two symptom types would emerge that could explain previous inconsistent results. Therefore, we decided to explore the response pattern in participants with OCD for different picture contents. We conducted two separate analyses for pictures deemed checking-related and pictures deemed washing-related according to the databases they were extracted or expert judgment. We conducted linear multilevel model to investigate dwell time, still ensuring that only the pictures deemed idiosyncratically OCD-relevant were analysed (i.e., valence and disorder-relevance were based on participants' rating), but now split up by checking-related and washing-related according to expert rating. Similar to before, the contrasts were tested using the Satterthwaite's method.

2.8. Transparency and Openness

This study's design, hypotheses, and main analyses were preregistered (https://osf.io/8gkjc). The PsychoPy code for the experiment, the original German instructions for the free-viewing paradigm, the data, and the analytic code have been made publicly available at the Open Science Framework (https://osf.io/m27hc/).

3. Results

3.1. Sample Descriptives

The sample consisted of 51 participants with OCD, 50 participants with spider phobia or high fear of spiders, and 64 non-clinical controls. We recruited more non-clinical participants since perfect matching of participants into triplets was not possible. Recruitment of further non-clinical participants enabled us to create doublets and decrease the number of singlets. The sample of participants with OCD had moderate OCD symptoms according to the Y-BOCS (M = 23.47, SD = 6.56), with an average of M = 11.56 (SD = 3.88) on the obsession subscale and M = 11.98 (SD = 3.41)[7] on the compulsion subscale. More than half of the participants with OCD showed one or more comorbid disorder (50.98%). The following comorbid disorders at the time of study participation: 41.18% anxiety disorder (but no spider phobia), 25.49% depressive disorder, 7.84% body dysmorphic disorder, 11.76% post-traumatic stress disorder, 7.84% somatic stress disorder, 5.88% eating disorder, 27.45% sleep disorder, 1.96% internet gaming disorder. An overview of sample characteristics is given in Table 4.1. Information on racial identify, gender, nativity or immigration history or socioeconomic status was not collected as the local ethics committee requires researchers to not collect this personal information unless this is strictly necessary for the study.

Table 4.1

Sample Characteristics.

	OCD n = 51	Spider Phobia n = 50	Non-Clinical Controls n = 64
Variable		*Mean* (*SD*); *n* (%)	
Gender			
Female	35 (68.63%)	48 (96.00%)	53 (82.81%)

[7] Due to technical issues during saving, one item was missing from the obsession subscale for one participant, and one item was missing from the compulsion subscale for another participant. These scores for these participants were excluded for calculation of the averages.

Male	15 (29.41%)	2 (4.00%)	11 (17.19%)
Diverse	1 (1.96%)	0 (0.00%)	0 (0.00%)
Age			
(in years)	31.45 (11.31)	26.76 (8.78)	28.67 (10.00)
Marital Status			
Single	44 (86.27%)	43 (86.00%)	55 (85.94%)
Registered life partnership	0 (0.00%)	2 (4.00%)	0 (0.00%)
Married	7 (13.73%)	5 (10.00%)	7 (10.94%)
Divorced	0 (0.00%)	0 (0.00%)	2 (3.13%)
Highest Education			
Primary school certificate	1 (1.96%)	0 (0.00%)	0 (0.00%)
Secondary school certificate	5 (9.80%)	4 (8.00%)	2 (3.13%)
High-school degree	15 (29.41%)	23 (46.00%)	15 (23.44%)
Qualification for universities and applied sciences	5 (9.80%)	1 (2.00%)	2 (3.13%)
Completed vocational training	3 (5.88%)	3 (6.00%)	6 (9.38%)
Bachelor's degree	11 (21.57%)	10 (20.00%)	16 (25.00%)
Master's degree	11 (21.57%)	9 (18.00%)	13 (20.31%)
OCD Symptoms			
$OCI\text{-}12_{Total}$	24.22 (8.30)	9.72 (6.81)	5.11 (4.61)
$OCI\text{-}12_{Checking}$	5.35 (3.21)	2.16 (2.19)	1.08 (1.48)
$OCI\text{-}12_{Ordering}$	6.00 (4.27)	1.92 (2.14)	0.48 (0.89)
$OCI\text{-}12_{Washing}$	5.45 (3.73)	3.46 (3.06)	1.86 (1.74)
$OCI\text{-}12_{Obsessing}$	7.41 (3.24)	2.18 (2.11)	1.69 (2.08)
Fear of Spiders			
FSQ_{Total}	3.78 (3.67)	82.46 (12.08)	2.41 (3.12)

Note. Participants of the three groups were matched by age, gender, and education. This resulted in 28 complete triplets, 35 doublets (i.e., two participants per triplet), and 8 singlets (i.e., one participant per triplet).

OCD = Obsessive-compulsive disorder, ARD = Anxiety-related disorders, NC = Non-Clinical Control Group, OCI-12 = 12-Item Obsessive-Compulsive Inventory, FSQ = Fear of Spiders Questionnaire.

3.2. Picture Ratings

An overview of the idiosyncratic picture rating is given in Table 4.2. Although no positive pictures were pre-selected, a substantial part of pictures was rated as positive. As

detailed above, positively rated pictures were not considered in our analyses, unless they were also rated as disorder relevant by participants of the clinical groups. Of the pictures intended to be relevant (i.e., selected from OCD-related picture sets), only about 30% were considered OCD-relevant by participants with OCD (range: 0.00% – 77.50%). The highest agreement on OCD relevance was 76.47%, meaning that 76.47% of participants with OCD rated the picture as OCD-relevant. No picture was considered OCD-relevant by all participants with OCD. In contrast, participants with spider phobia rated approximately 97% of intended spider-relevant pictures as idiosyncratically relevant (range: 62.50% – 100.00%). Full agreement on spider-relevance, meaning that all participants with spider phobia rated the picture as spider-relevant, was reached on 35 out of the 120 spider-related pictures.

Table 4.2

Percentage of Pictures Rated as Negative, Neutral, Positive and Disorder-Relevant.

	OCD		Spider Phobia[1]		Non-Clinical Control	
	Of all pictures	Of those intended	Of all pictures	Of those intended	Of all pictures	Of those intended
	Mean % (*SD*)	*Mean* % (*SD*)	*Mean* % (*SD*)	*Mean* % (*SD*)	*Mean* % (*SD*)	*Mean* % (*SD*)
Valence						
Negative	32.09 (14.54)	58.79 (21.95)	33.10 (8.75)	36.54 (22.72)	19.50 (10.21)	41.90 (20.41)
Neutral	57.33 (17.60)	67.17 (18.76)	53.59 (11.29)	66.40 (18.68)	65.23 (18.05)	66.21 (21.28)
Positive	10.58 (8.53)	–	12.80 (8.66)	–	15.27 (14.21)	–
Disorder-Relevance						
OCD-relevant / Spider-relevant	13.12 (13.16)	29.23 (19.67)	21.58 (6.27)	97.05 (7.32)	–	–

Note. OCD = Obsessive-Compulsive Disorder. Of all pictures = the percentage that was rated negative/neutral/positive or OCD-relevant / spider-relevant of all pictures presented. Of those intended = the percentage of pictures that was rated as negative/neutral/positive or OCD-relevant/spider-relevant of pictures that were initially categorised to the same category.

[1] The spider phobia group consists of $n = 41$ participants diagnosed with spider phobia according to DSM-5 criteria, and $n = 9$ participants with very high spider anxiety, though not meeting full diagnostic criteria.

3.3. Attentional Biases

Descriptive parameters of the attentional parameter analysed in the current study (i.e., first fixation choice, first fixation latency, dwell time) are displayed in Table 4.3. When investigating first-fixation latencies, a significant between-group effect across all pictures emerged, as participants with spider phobia showed significantly slower first fixation latencies, as compared to both, participants with OCD (B = 53.31, SE = 14.13, t = 3.77, p < .001) and non-clinical participants (B = 54.45, SE = 13.41, t = 4.06, p < .001). A graphic overview of raw first fixation latencies and dwell times per picture category and group is given in Figure 4.2. The complete model output of all analyses is presented in Appendix D2.

Table 4.3

Descriptives of Attentional Parameters.

	OCD		Spider Phobia[1]		Non-Clinical Control	
	M	*SD*	*M*	*SD*	*M*	*SD*
First Fixation Choice in % on Trials With…						
OCD-Relevant Pictures						
OCD-relevant (compared to neutral)	51.74	8.88	51.61	8.32	53.90	14.40
OCD-relevant (compared to negative)	50.31	12.51	51.62	13.57	50.47	18.11
Spider-Relevant Pictures						
Spider-relevant (compared to neutral)	50.02	6.13	47.21	11.27	49.32	5.21
Spider-relevant (compared to negative)	48.57	6.09	45.09	13.81	44.22	9.00
First Fixation Latency (Entry Time) in ms on Trials With … [2]						
OCD-Relevant Pictures						
OCD-relevant (compared to neutral)	343.15	86.62	385.02	123.41	340.05	61.50
Neutral (compared to OCD-relevant)	335.74	54.09	387.01	139.28	342.38	83.31
OCD-relevant (compared to negative)	317.97	42.59	363.94	97.18	336.56	91.63
Negative (compared to OCD-relevant)	350.80	121.47	379.41	96.68	354.55	118.28

Spider-Relevant Pictures						
Spider-relevant (compared to neutral)	337.55	58.73	383.73	111.03	337.20	45.94
Neutral (compared to spider-relevant)	342.85	84.12	395.50	99.10	334.36	48.47
Spider-relevant (compared to negative)	330.88	52.56	364.25	64.77	330.78	44.97
Negative (compared to spider-relevant)	331.74	55.71	383.48	106.31	339.14	56.15
Total Fixation Duration (Dwell Time) in ms on Trials With [3]						
OCD-Relevant Pictures						
OCD-relevant (compared to neutral)	1698.90	532.91	1744.89	359.07	1869.08	391.80
Neutral (compared to OCD-relevant)	1803.09	527.01	1742.48	383.21	1754.65	333.12
OCD-relevant (compared to negative)	1832.80	590.76	2181.89	584.42	1824.89	531.77
Negative (compared to OCD-relevant)	1644.08	526.63	1205.42	737.41	1833.28	544.25
Spider-Relevant Pictures						
Spider-relevant (compared to neutral)	1387.89	369.08	733.61	675.66	1726.61	372.38
Neutral (compared to spider-relevant)	2083.94	390.98	2633.27	713.86	1927.38	307.76
Spider-relevant (compared to negative)	1510.28	478.24	711.87	571.16	1697.01	424.85
Negative (compared to spider-relevant)	1929.91	532.17	2544.98	588.88	1966.86	464.31

Note. OCD = Obsessive-Compulsive Disorder. The valence, spider-relevance, and OCD-relevance is inferred from participants' idiosyncratic rating. The reported means (*M*) and standard deviations (*SD*) represent group-level values, calculated from previously computed individual participant means. The comparisons are made on the picture pairs presented per trial.

[1] The spider phobia group consists of $n = 41$ participants diagnosed with spider phobia according to DSM-5 criteria, and $n = 9$ participants with very high spider anxiety, though not meeting full diagnostic criteria.

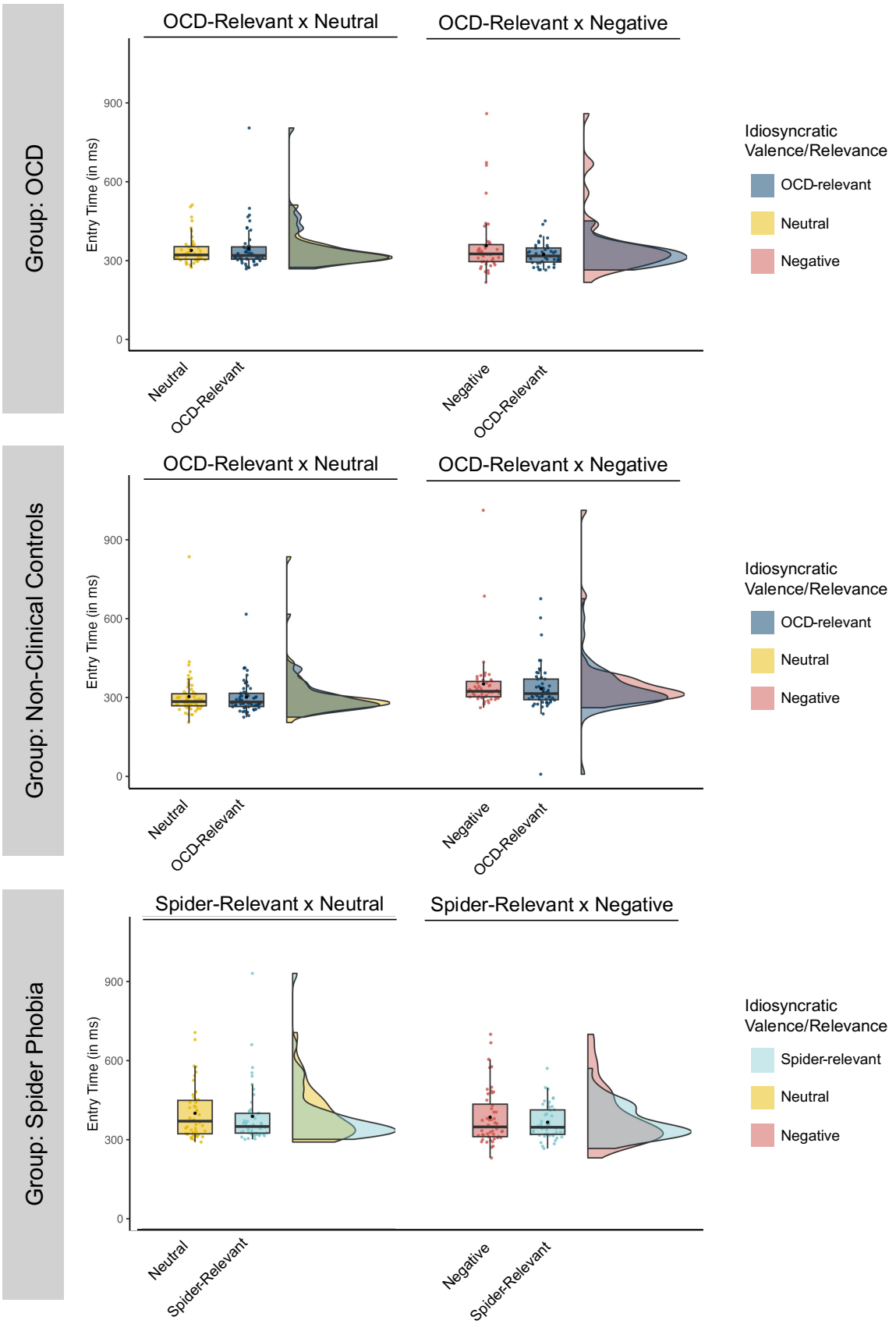
[2] The displayed first fixation latencies (entry times) are based on trials where a disorder-relevant picture (i.e., either OCD- or spider-relevant) is presented next to a negative or neutral picture.

[3] The displayed total fixation durations (dwell times) are based on trials where a disorder-relevant picture (i.e., either OCD- or spider-relevant) is presented next to a negative or neutral picture.

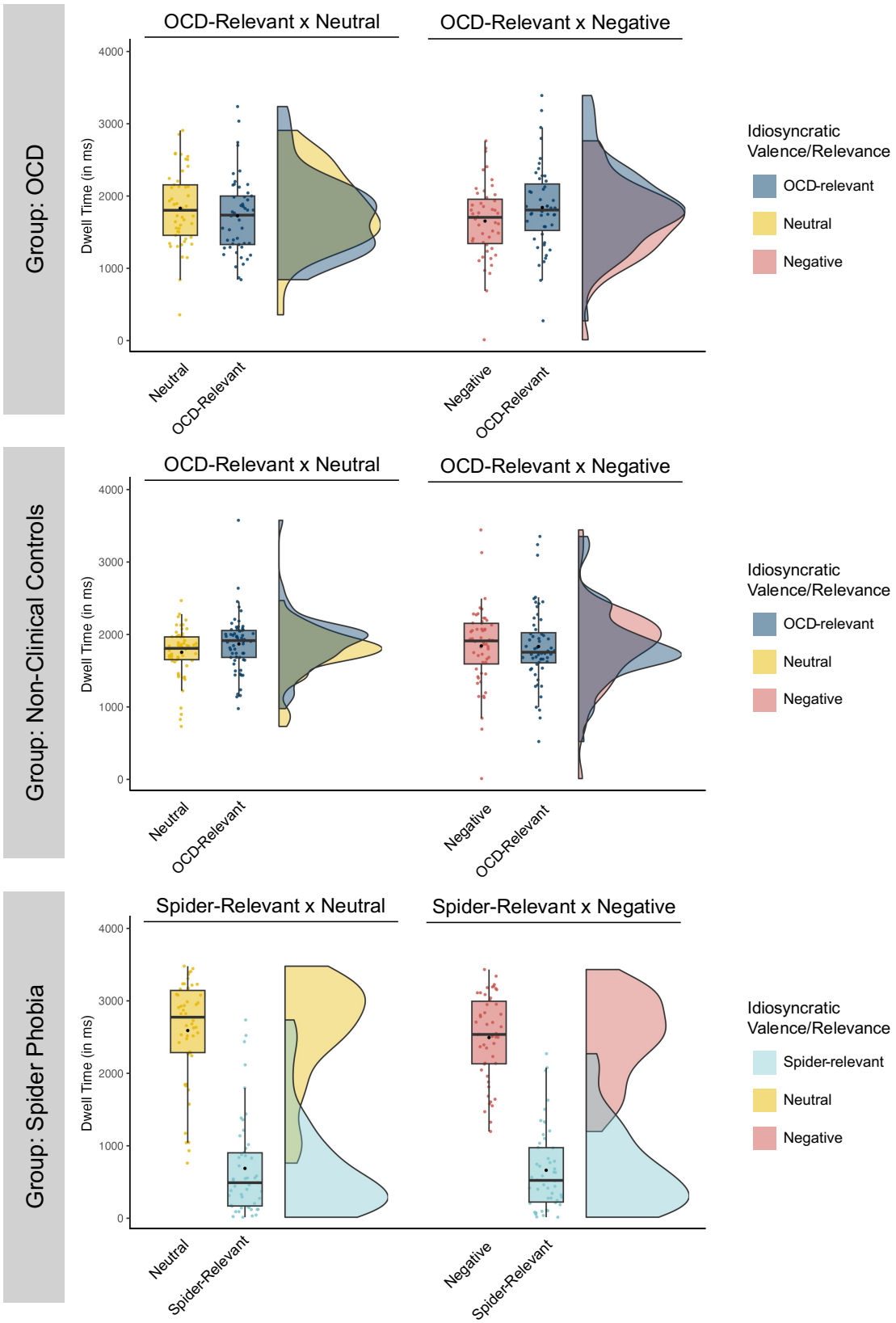
Figure 4.2

Aggregated Raw Data on Attentional Parameters Across Picture Type and Group for First Fixation Latency (A) and Dwell Time (B).

A



B


Group: OCD
OCD-Relevant x Neutral
OCD-Relevant x Negative
Dwell Time (in ms)
4000
3000
2000
1000
0
Neutral
OCD-Relevant
Negative
OCD-Relevant
Idiosyncratic Valence/Relevance
OCD-relevant
Neutral
Negative
Group: Non-Clinical Controls
OCD-Relevant x Neutral
OCD-Relevant x Negative
Dwell Time (in ms)
4000
3000
2000
1000
0
Neutral
OCD-Relevant
Negative
OCD-Relevant
Idiosyncratic Valence/Relevance
OCD-relevant
Neutral
Negative
Group: Spider Phobia
Spider-Relevant x Neutral
Spider-Relevant x Negative
Dwell Time (in ms)
4000
3000
2000
1000
0
Neutral
Spider-Relevant
Negative
Spider-Relevant
Idiosyncratic Valence/Relevance
Spider-relevant
Neutral
Negative

Note. A displays the boxplots and density plots illustrating the raw first fixation latency (i.e., entry time; in milliseconds) on disorder-relevant (OCD or spider) pictures as compared to negative and neutral pictures across groups (OCD, non-clinical controls, and spider phobia). Density plots indicate the overall distribution of entry times, with boxplots superimposed to highlight central tendencies and variability within each group. Data points in the corresponding represent person means on each picture type. The black dots in the boxplots represent the group means. **B** displays the boxplots and density plots illustrating the raw dwell time (in milliseconds) on disorder-relevant (OCD or spider) pictures as compared to negative and neutral pictures across groups (OCD, non-clinical controls, and spider phobia). Density plots indicate the overall distribution of dwell times, with boxplots superimposed to highlight central tendencies and variability within each group. Data points in the corresponding represent person means on each picture type. The black dots in the boxplots represent the group means.

3.3.1. Left-Right Bias

A left bias was shown for first-fixation choice, with a 60% probability of first fixating at lower-left pictures ($B = 0.40$, $SE = 0.04$, $p < .001$). Likewise, the first fixation latency showed a significant left bias, with 8 ms faster fixations made at the lower-left picture as compared to the upper-right picture ($B = 7.72$, $SE = 1.56$, $p < .001$). A right bias was evident for dwell time of 124 ms, with fixation durations being significantly longer on the upper-right picture ($B = 124.49$, $SE = 41.54$, $p = .003$).

3.3.2. Vigilance Bias

Results of the multilevel linear models for first fixation choice and first fixation latency are presented in Table D2.1 and Table D2.2 in Appendix D2, respectively. The corresponding contrasts testing the vigilance bias are presented in Table 4.4.

OCD. Participants with OCD did not show a significant bias for idiosyncratic OCD-relevant pictures as compared to negative or neutral pictures, neither in terms of the likelihood of fixating on these pictures first or the latency of their first fixation.

Spider Phobia. For participants with spider phobia, a significant avoidance of idiosyncratic spider-relevant pictures was seen when considering the first fixation choice, where the first fixation was less likely directed at spider-relevant pictures as compared to both negative

or neutral pictures. No significant difference in the first fixation latency emerged in the group of participants with spider phobia. Non-clinical participants also showed a significant avoidance in terms of the first fixation choice on pictures that their triplet partner considered spider-relevant as compared to pictures they consider negative, but not if compared to neutral stimuli. No significant bias was evident for the non-clinical control group when considering first fixation latency.

Valence. Participants with OCD and non-clinical participants were significantly more likely to first fixate on negative pictures as compared to neutral pictures. Participants with spider phobia showed an effect in the similar direction, but not significantly so. In terms of first fixation latency, participants with spider phobia showed a significantly faster entry time on negative as compared to neutral pictures. In the OCD group, a similar but non-significant effect could be observed.

Table 4.4

Contrasts Testing the Vigilance Hypothesis.

Contrast	Estimate	*SE*	*t*	*p*
First Fixation Choice				
Group OCD: OCD-relevant vs. neutral picture	0.005	0.008	0.568	.570
Group OCD: OCD-relevant vs. negative picture	-0.007	0.011	-0.658	.510
Group spider phobia: Spider-relevant vs. neutral picture	**-0.042**	**0.011**	**-3.748**	**<.001**
Group spider phobia: Spider-relevant vs. negative picture	**-0.056**	**0.016**	**-3.517**	**<.001**
Group non-clinical controls: OCD-relevant vs. neutral picture	0.012	0.008	1.581	.114
Group non-clinical controls: OCD-relevant vs. negative picture	-0.008	0.010	-0.838	.402
Group non-clinical controls: Spider-relevant vs. neutral picture	-0.017	0.009	-1.947	.053
Group non-clinical controls: Spider-relevant vs. negative picture	**-0.037**	**0.010**	**-3.653**	**<.001**
Group OCD: Negative vs. neutral pictures	**0.012**	**0.006**	**2.072**	**.038**

Group Spider: Negative vs. neutral pictures	0.014	0.007	1.910	.056
Group non-clinical controls: Negative vs. neutral pictures	**0.020**	**0.006**	**3.432**	**.001**
First Fixation Latency (Entry Time)				
Group OCD: OCD-relevant vs. neutral picture	2.184	6.359	0.343	.731
Group OCD: OCD-relevant vs. negative picture	7.738	6.293	1.230	.219
Group spider phobia: Spider-relevant vs. neutral picture	4.353	11.294	0.385	.700
Group spider phobia: Spider-relevant vs. negative picture	15.220	11.245	1.354	.176
Group non-clinical controls: OCD-relevant vs. neutral picture	4.677	4.177	1.120	.263
Group non-clinical controls: OCD-relevant vs. negative picture	2.504	4.355	0.575	.565
Group non-clinical controls: Spider-relevant vs. neutral picture	3.330	3.169	1.051	.293
Group non-clinical controls: Spider-relevant vs. negative picture	1.157	3.366	0.344	.731
Group OCD: Negative vs. neutral pictures	-5.554	2.889	-1.923	.055
Group Spider: Negative vs. neutral pictures	**-10.867**	**2.903**	**-3.744**	**<.001**
Group non-clinical controls: Negative vs. neutral pictures	2.173	2.938	0.740	.460

Note. Boldface values are considered significant at an α = .05. First Fixation Choice = whether the first fixation was located at the picture (0 = first fixation directed at lower-left picture, 1 = first fixation directed at upper-right picture). First Fixation Latency = the time from start of trial presentation to the first fixation to a region of interest. The valence and disorder-relevance of the pictures is inferred from the idiosyncratic rating.

3.3.3. Maintenance Bias

The results of the multilevel linear model are presented in Table D2.3 in Appendix D2. The results of the contrast analysis are presented in Table 4.5. Participants with OCD did show a significant maintenance bias on OCD-relevant pictures as compared to negative, but not as compared to neutral, pictures, which in turn were also significantly different from negative pictures to a similar extent. More specifically, OCD-relevance predicted significantly longer dwell times on these pictures as compared to pictures with a neutral valence. No significant differences in fixation duration on OCD-relevant pictures were observed between participants

with OCD and non-clinical controls. However, a significant difference on disorder-specific material was shown for the comparison between participants with OCD and participants with spider phobia. Participants with spider phobia dwelled significantly shorter on their disorder-relevant material (i.e., spider-relevant pictures) as compared to participants with OCD on their disorder-relevant material (i.e., OCD-relevant pictures). Participants with OCD and participants spider phobia showed a significant avoidance of negative as compared to neutral pictures as indicated by shorter fixation durations.

Table 4.5

Contrasts Testing the Maintenance Hypothesis.

Contrast	Estimate	*SE*	*t*	*p*
Difference in Total Fixation Duration (Dwell Time Difference)				
Group OCD:				
OCD-relevant vs. neutral picture	-10.315	62.161	-0.166	.868
Group OCD:				
OCD-relevant vs. negative picture	**214.920**	**101.195**	**2.124**	**.035**
Group OCD vs. non-clinical controls:				
Disorder-relevant pictures	-140.784	102.388	-1.375	.171
Group OCD vs. group spider phobia:				
Disorder-relevant pictures	**1580.476**	**135.490**	**11.665**	**<.001**
Group OCD:				
Negative vs. neutral pictures	**-225.235**	**91.696**	**-2.456**	**.015**
Group Spider:				
Negative vs. neutral pictures	**-363.189**	**95.517**	**-3.802**	**.001**
Group non-clinical controls:				
Negative vs. neutral pictures	47.100	84.265	0.559	.577

Note. Boldface values are considered significant at an $\alpha = .05$. Difference in Total Fixation Duration = difference in fixation duration comparing the upper-right with the lower-left picture (i.e., Fixation $\text{Duration}_{\text{uperr-right}}$ − Fixation $\text{Duration}_{\text{lower-left}}$). The valence and disorder-relevance of the pictures is inferred from the idiosyncratic rating.

3.4. Sensitivity Analyses

On average, only one picture was fixated on 4.54% of trials (OCD: 1.53%, spider phobia: 8.01%, non-clinical controls: 4.58%). The results of the sensitivity analyses, including only trials in which both pictures were fixated at least once, are shown in Appendix D3. Table D3.1 depicts the contrasts investigating the vigilance biases. Alike in the main analyses, no

significant vigilance bias on disorder-relevant pictures was demonstrated when considering the first fixation latencies. Furthermore, when considering first fixation choice, non-clinical participants showed a bias towards first fixating on spider-relevant pictures as compared to negative pictures. In contrast to the main analyses, a significant bias towards first fixating spider-relevant pictures as compared to neutral pictures in the group of participants with spider phobia was evident. A trend in the similar direction was shown for spider-relevant pictures as compared to negative pictures, yet not reaching significance. The remaining effects on disorder-relevant stimuli remained non-significant.

The contrasts testing the maintenance bias are shown in Table D3.2. The sensitivity analyses were in line the main analyses, showing a significant maintenance bias on OCD-relevant stimuli as compared to negative stimuli in the OCD group, while also showing a significant avoidance of negative pictures as compared to neutral pictures. Participants with OCD also showed a significantly longer maintenance on OCD-relevant pictures as compared to participants with spider phobia on spider-relevant pictures.

3.5. Exploratory Analyses

Descriptives of the attentional parameters divided by checking- and washing-related pictures can be found in Table D4.1 with visualisations of raw dwell times provided in Figure D4.1 in Appendix D4. The results of the exploratory analyses on potential vigilance biases on checking- or washing-related pictures are presented in Table D4.2 and Table D4.3 in Appendix D4. No significant effect was observed for first fixation choice, suggesting that participants with OCD were neither significantly more likely nor significantly faster to fixate on checking- or washing-related pictures compared to neutral or negative pictures.

The results of the exploratory analyses on dwell times for checking-related and washing-related pictures are presented in Table D4.4 in Appendix D4. Participants with OCD showed a significant maintenance bias for idiosyncratic OCD-relevant pictures with checking-related

content. Specifically, their dwell times on checking-related pictures were significantly longer compared to both neutral and negative pictures. On a between-subject level, however, no significant differences were found when comparing these dwell times to those of non-clinical controls or participants with spider phobia.

In contrast, participants with OCD dwelled significantly shorter on OCD-relevant washing-related pictures as compared to neutral pictures. No significant difference was observed between the dwell times on washing-related as compared to negative pictures. On a between-subject level, participants with OCD showed significantly shorter dwell times on washing-related OCD-relevant pictures as compared to non-clinical controls on the same pictures. No significant differences in dwell times were evident when comparing the dwell times of participants with OCD on washing-related disorder-relevant pictures to those of participants with spider phobia on spider-relevant pictures. Alike in the main analyses, a significant avoidance of negative pictures as compared to neutral pictures was consistently seen in the two clinical groups (i.e., participants with OCD and participants with spider phobia).

4. Discussion

Given that previous research yielded mixed results on attentional biases in OCD, the current study aimed to address several methodological limitations and provide a more precise understanding of attentional biases in OCD. Using a free-viewing eye-tracking paradigm, we examined the gaze patterns of participants when viewing idiosyncratically disorder-relevant stimuli. Specifically, we investigated within-group differences by comparing fixation patterns on OCD-relevant stimuli versus negative and neutral stimuli. Additionally, we explored potential between-group differences to determine whether attentional biases in OCD differed from those observed in non-clinical individuals and participants with spider phobia.

4.1. Vigilance Biases

Our results demonstrated that participants with OCD did not exhibit a significant vigilance bias toward idiosyncratic disorder-relevant material. Specifically, they did not fixate more quickly on OCD-relevant stimuli (first fixation latency), nor were they more likely to fixate first on OCD-relevant pictures compared to negative or neutral pictures (first fixation choice). This is in line with various previous studies (first fixation latency: Armstrong et al., 2012; Choi & Lee, 2015; Cludius et al., 2019; Mullen et al., 2021; first fixation choice: Armstrong et al., 2010, 2012; Choi & lee, 2015). Thus, considering our results in the context of previous evidence, this suggests that a vigilance bias toward OCD-relevant material is not a characteristic feature of OCD.

Whereas vigilance biases in spider phobia have been relatively consistently observed, the present findings suggest a more complex attentional pattern in this group. Contrary to previous studies (Mogg & Bradley, 2006; Pflugshaupt et al., 2007; Rinck & Becker, 2006), participants with spider phobia in the current study did not show a faster initial orientation towards spider-relevant stimuli. Instead, our main analyses revealed an initial avoidance pattern, as they were less likely to first fixate on spider-relevant pictures. Although unexpected, similar early overt attentional avoidance has been reported by Huijding et al. (2011). Moreover, our sensitivity analyses investigating attentional biases on trials where both pictures were at least fixated once revealed that participants with spider phobia were indeed significantly more likely to first fixate on spider-relevant images compared to negative or neutral images. The results for the two other groups remained unchanged. Therefore, it appears that participants with spider phobia employed a specific strategy: while keeping their gaze at the display's centre, they likely covertly attended to the presented the stimuli, even though the pictures were presented relatively far in the visual periphery. Upon detecting a spider, they shifted overt attention to the alternative image, effectively avoiding spider-related pictures altogether as, by design, only one spider-related picture was presented at a time. The role of covert attention in

this design is further supported by the generally slower first fixation latencies compared to reflexive attention allocation (e.g., H. J. Müller & Rabbitt, 1989), as well as the significantly slower first fixation latencies in spider phobia relative to the other two groups. However, the free-viewing paradigm is inherently limited to measuring overt attentional processes via eye movements. Since covert attentional processes are associated with overt responses (Amir et al., 2016), future research could complement the free-viewing paradigm with visual search tasks or cueing paradigms (Price et al., 2019) incorporating idiosyncratic disorder-relevant stimuli.

4.2. Maintenance Biases

In terms of maintenance bias, participants with OCD dwell longer on OCD-relevant material as compared to negative but non-OCD-relevant material. However, this effect requires careful interpretation, as participants with OCD also showed a significant avoidance of negative as compared to neutral pictures in general. Rather than reflecting an attentional maintenance on OCD-relevant pictures, the observed differences in dwell times on OCD-relevant pictures as compared to negative pictures is more likely driven by a general avoidance of negative pictures.

When comparing attentional biases across groups, a significant difference in attentional maintenance emerged between participants with OCD and those with spider phobia. However, this effect appears to be primarily driven by the avoidance of spider-relevant images in individuals with spider phobia rather than an increased maintenance on OCD-relevant images in participants with OCD. This interpretation is further supported by the finding that attentional maintenance on OCD-relevant images did not significantly differ between participants with OCD and non-clinical controls. These findings suggest that when using idiosyncratic stimuli, attentional biases are not observable in individuals with OCD.

4.3. No Attentional Biases in OCD?

As the rationale for investigating attentional biases in OCD was based on the theoretical outlines on attentional biases in anxiety disorders, the current study questions whether these theories are really generalisable to OCD or rather anxiety-specific. Whereas our results supported an avoidance of spider-related pictures in participants with spider phobia, we could not demonstrate any attentional bias in participants with OCD. This is contradicting some of the previous findings (Armstrong et al., 2010, 2012; M. C. Bradley et al., 2016; Choi & Lee, 2015; Cludius et al., 2019; Mullen et al., 2021), however, in the interpretation of our findings several factors need to be considered.

Our study differs from previous studies in various ways. First, in contrast to previous studies that analysed gaze patterns using generic OCD-related material, our study examined gaze patterns in response to idiosyncratically disorder-relevant pictures. Notably, only approximately 30% of the pictures categorised as OCD-relevant based on established OCD-specific picture databases were actually rated as idiosyncratically relevant by participants with OCD. This discrepancy highlights a key limitation of previous studies, as the use of generic OCD-related material does likely fail to accurately capture individual disorder relevance in this highly heterogeneous disorder. Consequently, attentional parameters analysed in prior studies (e.g., Armstrong et al., 2010, 2012; Choi & Lee, 2015; Mullen et al., 2021) may be confounded by general valence effects rather than effects due to the stimulus' OCD-relevance. By disentangling the effects of valence from the idiosyncratic disorder relevance, the present study provides a more precise assessment of attentional biases in OCD.

Second, we included participants with OCD regardless of their specific symptom dimension, to allow an ecologically valid representation of the attentional biases in OCD. This also allowed us to explore attentional biases within the different symptom dimensions of OCD, that potentially contributed to the non-findings in the current study. Since vigilance biases were not differentially affected by symptom-specific content, we conclude that vigilance biases may

be generally absent in OCD. This is in line with previous studies failing to demonstrate the presence of vigilance biases in OCD (M. C. Bradley et al., 2016; Cludius et al., 2019; Mullen et al., 2021). However, our exploratory analyses revealed a maintenance bias depending on symptom dimension. Specifically, participants with OCD who rated checking-related pictures as disorder relevant dwelled longer on these pictures compared to negative and neutral pictures, whereas those for whom washing-related pictures were disorder relevant showed an avoidance of these pictures. Further supporting this content-specific pattern, a significant between-group effect showed that participants with OCD showed a more pronounced avoidance of washing-related images compared to non-clinical controls.

Our explorative finding of maintenance on and avoidance of pictures with checking- or washing-related content, respectively, could be related to the differing emotional experiences and phenomenological presentations across OCD symptom clusters. Particularly, individuals with contamination concerns and washing compulsions frequently report heightened disgust, which often leads to avoidance of places that provoke such feelings (e.g., public toilets). This is in line with a previous qualitative review, which suggested that disgust is linked to attentional avoidance (Knowles et al., 2019). In contrast, individuals with checking symptoms tend to experience excessive fear, feeling compelled to engage with fear-inducing stimuli (e.g., a stove) and finding it difficult to disengage from checking behaviours. The findings of our exploratory analyses therefore suggest that that attentional biases in OCD should not be considered solely in terms of disorder relevance but should also be examined in relation to content-specific symptoms and emotions. Future research should therefore aim to consider even more idiosyncratic information on the presented stimulus material, as this could help to detect specific attentional biases in patients with distinct symptom profiles and emotional experiences.

4.4. The Complexity of Assessing Attentional Biases

Overall, our study highlights that the assessment of attentional biases in OCD, but also in spider phobia, is more complex than oftentimes assumed. Of note, not only the OCD-relevance shows considerable idiosyncrasy, but also the valence ratings show individual variation from the valences originally derived within the validated picture sets. Given that the validated datasets frequently relied on the rating of undergraduate students (Balsamo et al., 2020; Carretié et al., 2019; Dan-Glauser & Scherer, 2011), this finding is not surprising but underscores that the perceived valence of pictures may vary depending on the sample under investigation as well as the context in which these pictures are presented.

Additionally, we see a considerable avoidance (i.e., reduced dwell time) of negative as compared to neutral pictures in both clinical groups, but not in the non-clinical control group. This finding shows that, even without disorder-relevance, negatively valenced stimuli elicit a specific pattern of avoidance in these two clinical groups. This highlights the necessity to disentangle effects that are due to a pictures' valence from those that arise due to its relevance. This distinction is only possible with idiosyncratic ratings and the appropriate coding of the stimuli.

Lastly, the heterogeneity of OCD and the inclusion of idiosyncratic OCD-relevant stimuli causes a considerable variation in trials that were used for analyses. As our study further suggests variation within OCD depending on the symptom dimensions depicted on the images, the trial number needs to be comparably large, to allow reliable assessment of attentional biases even for those with relatively specific OCD symptoms.

In summary, our study is, to the best of our knowledge, the first to specifically investigate attentional biases while delineating the effects of idiosyncratic disorder relevance from emotional valence. Furthermore, the power was increased by increasing the number of participants (e.g., 28 participants with OCD and 22 non-clinical controls in Cludius et al., 2019; 16 participants with OCD and 16 non-clinical controls in Mullen et al., 2021) as well as the

number of presented stimuli (e.g., 32 pictures in Armstrong et al., 2010, 52 pictures in 2012; 40 pictures in Cludius et al., 2019) as compared to previous studies. However, given that the idiosyncratic rating introduced heterogeneity in the number of trials used for analyses, future research should ensure larger or more consistent trial numbers across participants. Thereby, the influence of OCD symptom heterogeneity on attentional biases and the interplay between valence and disorder relevance can be further explored.

4.5. Limitations

The present study has several strengths, including its preregistered design, the use of advanced methods (i.e., eye-tracking) allowing for continuous assessment of attentional processes, the inclusion of both clinical and non-clinical control groups, an increased sample size, and the consideration of symptom heterogeneity in OCD as well as idiosyncratic ratings. However, despite these strengths, our findings must be interpreted considering certain limitations:

First, relying on individual ratings for valence and disorder-relevance is, as also shown by our results, an important step to capture individual attentional processes. However, in our study we also see there is a considerable heterogeneity of number of trials used for analyses. Although our models can account for varying trial numbers, the power for some estimates may be limited. Notably, the picture with the highest agreement was rated as OCD-relevant by three-quarters of the participants with OCD, demonstrating that no single image was universally perceived as OCD-relevant. Potentially, future research could profit from determining idiosyncratic disorder relevant stimuli beforehand to ensure an equal amount of trials for each participant. Second, we did not exclude participants with OCD that showed comorbid disorders. Although defining comorbidities as an exclusion criterion would reduce the potential of confounding effects, we would considerably decrease the ecological validity of our study. This is particularly striking considering that a comorbidity rate of 69% for OCD was shown in a

recent systematic review and meta-analysis (Sharma et al., 2021). Third, although we did not put constraint on our sample with regard to demographic characteristics other than age, our sample was primarily female and relatively young. Therefore, we must consider this constraint on generality when interpreting our results. Fourth, as outlined above, we at one point decided to not only consider participants with spider phobia, but also participants with very high spider anxiety not meeting the full diagnostic criteria. Since the FSQ scores did not significantly differ between these two groups and the majority of individuals met the diagnostic criteria of spider phobia, this change is likely to only have a minimal effect on the current results. Yet, we cannot rule out that the effects for the subgroup of participants with very high spider anxiety may be slightly different from those with spider phobia. Lastly, our exploratory analyses investigating differential attentional biases depending on the picture content (checking-related and washing-related) were conducted on a considerable smaller dataset, affecting the power of our results. As this finding is particularly intriguing, future research is needed to investigate the seemingly diverging attentional biases within OCD.

5. Conclusion

When using idiosyncratic OCD-relevant material, participants with OCD do not show attentional biases on OCD-relevant material beyond those observed for negative material. As participants with spider phobia show a strategic avoidance of spider-relevant pictures, that may be driven by covert attentional processes, we conclude that attentional processes in OCD may differ from those observed in other anxiety disorders. Our study further highlights the importance of considering the heterogeneity of OCD. Strikingly, only ~30% of pictures that were intended to be OCD-related were considered as OCD-relevant by participants with OCD. Furthermore, our exploratory analyses on attentional processes by the OCD symptom dimensions contamination and washing as well as checking revealed diverging effects. Whereas an avoidance of washing-related pictures was seen, a trend towards attentional maintenance on

checking-related OCD-relevant pictures was observed. Therefore, future studies should consider the use of idiosyncratic material and further investigate whether the attentional processes in OCD may be moderated by emotion type (e.g., disgust, anxiety, shame) or picture content. Understanding these underlying mechanisms in OCD can not only contribute to a more comprehensive theory on attentional biases in OCD but also contribute to improvements of psychotherapeutic interventions that are inherently working with attentional processes, particularly exposure therapy.

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3 General Discussion

The overarching goal of this thesis is to advance the understanding of OCD by improving symptom assessment and examining key processes implicated in its development and maintenance. To achieve this, the thesis systematically addresses two major challenges in OCD research: the need for syndromally valid and reliable assessment tools to improve diagnostic accuracy (*Study I* and *Study II*) and the necessity of investigating core mechanisms underlying OCD symptomatology through advanced basic research (*Study III* and *Study IV*). The following sections synthesise the findings of the four studies incorporated in the current thesis, integrate them into the broader research context, and discuss their implications for future research and clinical practice.

3.1 Symptom Assessment in OCD

Current tools for screening and assessing OCD symptoms often lack clearly interpretable cut-off scores, fail to capture the disorder's heterogeneity, or are misaligned with the latest diagnostic criteria. To address these limitations, *Study I* and *Study II* evaluated the psychometric properties of the translated German OCI-12 (original English version: Abramovitch et al., 2021b) and the OCI-4 as an ultra-brief four-item screener for OCD (original English version: Abramovitch et al., 2021a). Both studies assessed reliability, validity, and diagnostic accuracy to ensure these tools provide clinically meaningful assessments in research and practice. *Study I* also examined the factor structure of the OCI-12 to evaluate whether the items represent the four most common symptom clusters in OCD: checking, ordering, washing, and obsessing. Overall, these studies aim to address the diagnostic challenges of OCD, particularly the frequent under- and misdiagnosis contributing to long durations of untreated illness (Ziegler et al., 2021).

3.1.1 Summary of Results in Study I and Study II

The translated German version of the OCI-12 was examined in a sample of 102 participants with OCD, 69 participants with an anxiety-related disorder, and 248 non-clinical participants (*Study I*). The factor analysis supported the original four-factor structure, consisting of checking, ordering, washing, and obsessing, with a higher-order factor representing general OCD symptoms accounting for their covariance. This structure effectively captures the heterogeneous symptomatology of OCD. Furthermore, the OCI-12 demonstrated good test-retest reliability over a 14-day interval in nonclinical participants. Construct validity was largely supported, although the *common method bias* (Podsakoff et al., 2003) may have influenced the measures of convergent validity, as the OCI-12 showed stronger correlations with self-reports than with the interview version of the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Hand & Büttner-Westphal, 1991). Lastly, the OCI-12 exhibited good-to-excellent diagnostic accuracy in distinguishing participants with OCD from those with anxiety-related disorders and non-clinical controls. Cut-off scores for the OCI-12 total score and its subscales were established, providing valuable thresholds for both research and clinical practice. However, severity benchmarks could not be established, as the sample sizes per severity category were too small.

Following the translation and validation of the OCI-12 (*Study I*), the ultra-brief four-item version (OCI-4) was examined in the same sample (*Study II*). The OCI-4 demonstrated good reliability and construct validity, though *common method bias* (Podsakoff et al., 2003) likely influenced measures of convergent validity, as also observed in the OCI-12. Through inclusion of participants with OCD, clinical and non-clinical control groups, this is the first study offering validated cut-off criteria. Based on the validated cut-off criteria, OCI-4 showed goo-to-excellent diagnostic accuracy in discriminating participants with OCD from those with anxiety-related disorders and non-clinical controls. However, as the four questions were embedded within the OCI-12 and only extracted at the data analysis stage, it remains to be

investigated how the OCI-4 performs as a stand-alone tool for screening for OCD symptoms. Taken together, the OCI-12 and OCI-4 have been demonstrated as valid and reliable tools to assess and screen for OCD symptoms in clinical and non-clinical samples. However, since normative data are lacking, recruiting a large, representative sample of individuals with OCD would be beneficial to further enhance the utility and clinical applicability of these assessment tools.

3.2 A Step Towards Accurate and Fast Diagnosis of OCD

Reflecting upon the diagnostic challenges outlined in *Chapter 1*, the OCI-4 and OCI-12 play a crucial role in addressing the frequent under- and misdiagnosis of OCD for three key reasons. First, both tools have been validated in clinical and non-clinical populations, ensuring their ability to accurately screen for and assess OCD symptoms across diverse samples. As participants in the clinical groups were included even with comorbid disorders, the studies aimed to increases ecological validity. Considering the high comorbidity rates of 69% among individuals with OCD (Sharma et al., 2021), the finding that OCD severity can be reliably assessed even in the presence of comorbid conditions supports the applicability of these tools in real-world settings.

Second, both tools contribute to resource efficient assessment of OCD symptoms, which is a critical factor in routine clinical care. More specifically, the OCI-4 and OCI-12 are made publicly available and freely accessible (OCI-4: https://osf.io/jrst9/; OCI-12: https://osf.io/4m9x6/), enabling their use despite potentially scarce monetary resources. Moreover, in contrast to clinician-administered assessments, such as the Y-BOCS (Hand & Büttner-Westphal, 1991), these tools require no trained rater, making them easy to implement in diverse clinical settings even for non-specialised professionals. By minimising demands on staff-, time-, and monetary-related resources, these tools offer a practical solution to the common constraints faced in the healthcare system (Bundesministerium für Gesundheit, 2025),

ensuring that OCD symptoms can be effectively screened and monitored even in resource-limited settings.

Third, by assessing symptom severity across the most common OCD symptom dimensions (i.e., checking, washing, ordering, obsessing), the OCI-4 and OCI-12 provide a comprehensive and nuanced evaluation of the heterogeneous nature of OCD symptoms. Unlike idiographic tools such as the Y-BOCS (Hand & Büttner-Westphal, 1991), which focus on individualised symptom presentations, or screening instruments like the DOCS-SF (Kühne, Paunov, Abramowitz, et al., 2021), that assess the severity of the most pronounced symptom cluster only, the OCI-4 and OCI-12 offer a broader, standardised assessment. Although especially useful for an efficient and reliable assessment of OCD symptoms across a variety of contexts, the limits of the OCI-4 and OCI-12 must also be considered.

The OCI-4 and OCI-12 are both nomothetic tools, which can give information on the severity of each symptom cluster that can be reliably assessed in a standardised manner. However, in line with calls for personalisation of psychotherapeutic treatment (Cohen & DeRubeis, 2018), these tools should be complemented with idiographic approaches, such as the Y-BOCS (Hand & Büttner-Westphal, 1991), which are essential for assessing the individual symptoms in detail. Such an idiosyncratic assessment of symptoms is particularly necessary in the context of exposure and response prevention, where identification of individual triggers in the external (e.g., situations, objects) and internal (e.g., thoughts) worlds is a crucial prerequisite for adequate treatment (Gillihan et al., 2012; Hezel & Simpson, 2019).

In summary, the OCI-4 and OCI-12 are highly effective for screening, symptom assessment, and research applications, playing a key role in overcoming diagnostic challenges in OCD. However, assessment alone does not inform us about how these symptoms emerge or persist over time. To develop and provide individually tailored effective interventions, it is essential to understand the mechanisms that drive OCD symptoms and maintain the disorder.

Therefore, another key question needs to be addressed: What factors contribute to the development and maintenance of this heterogeneous disorder?

3.3 Beyond Symptoms: Investigating Underlying Mechanisms of OCD

While research on OCD increased throughout the last years (Tang et al., 2023), crucial questions remain regarding its underlying mechanisms. In line with the translational research framework proposed by Ehring et al. (2022), basic research is fundamental for identifying and enhancing the understanding of processes involved in the development and maintenance of psychopathology. As a critical first step in the translational process, it generates insights that can ultimately inform the development of new, empirically developed treatment interventions. The selection of the processes investigated in basic research is guided by theoretical frameworks, empirical findings, and phenomenological observations (Ehring et al., 2022). Theoretical models are central as they guide the formulation of testable hypotheses, providing a structured framework for understanding clinical phenomena, and enabling the empirical evaluation of proposed mechanisms through statistical testing (Fried, 2020). Although long-standing theoretical models on OCD propose various underlying factors, empirical support remains mixed. Therefore, in *Study III* and *Study IV*, a theory-driven approach with improved methodology was adopted to examine two key mechanisms, anger suppression and attentional biases, as potential contributors to OCD symptomatology.

Study III is informed by psychodynamic (Freud, 1909) and cognitive (Rachman, 1993) theories and investigated the role of anger suppression, particularly its relationship with inflated responsibility beliefs and OCD symptoms, within a longitudinal design in a sample of patients with OCD undergoing a metacognitive intervention. Additionally, it was explored whether OCD symptoms are a consequence or an antecedent of anger suppression, directly drawing on the open debate between cognitive (Rachman, 1993) and psychodynamic perspectives (Freud, 1909).

Study IV, grounded in cognitive-behavioural models (Salkovskis & McGuire, 2003), addressed the proposition that attentional biases toward threat-relevant stimuli contribute to the development and maintenance of OCD. To overcome methodological limitations of prior research, such as reliance on reaction-time paradigms, constrained OCD samples, and the use of generic stimuli, *Study IV* employed a free-viewing eye-tracking paradigm. By incorporating idiosyncratically relevant stimuli and both clinical and non-clinical control groups, this study aimed to provide a more precise assessment of attentional biases specific to OCD. Together, *Study III* and *Study IV* aimed to strengthen the empirical foundation of OCD research by conducting rigorous, replicable, and theoretically informed basic research.

3.3.1 Summary of Results in Study III and Study IV

Study III utilised a longitudinal design to examine the relationships between sense of responsibility, OCD symptoms, and anger suppression in 48 patients with OCD who had undergone a four-week metacognitive intervention. In line with cognitive theories (Rachman, 1993), higher OCD symptom severity was associated with greater anger suppression at the subsequent timepoint, supporting a temporal relationship that remained stable even after controlling for depressive symptoms and medication intake. This finding supports the relative specificity of this association to OCD. In contrast, the reverse directionality, where anger suppression would predict subsequent OCD symptoms, was not supported, further reinforcing the cognitive perspective (Rachman, 1993) over psychodynamic viewpoints (Freud, 1909). Surprisingly, despite a strong theoretical basis and previous research suggesting that an inflated sense of responsibility contributes to OCD symptoms (Pozza et al., 2018), this association was not as robust in the current study, as it emerged only in an exploratory analysis of a sub-sample with high checking-related symptoms. Similarly, the link between an inflated sense of responsibility and anger suppression was observed only in an exploratory analysis on individuals with high checking-related symptoms or when both measures were assessed in close

temporal proximity. This suggests that the overall effect may be small, symptom-specific, or sensitive to timing effects. These findings should be interpreted in light of the sample characteristics and study design. As participants were undergoing a structured metacognitive intervention, it is possible that treatment effects influenced the observed relationships, for instance by affecting the investigated cognitive-affective mechanisms. Notably, while OCD symptoms significantly decreased throughout the intervention, the levels of anger suppression remained stable, suggesting that the intervention had differential effects on the mechanisms under investigation. Moreover, as the explained variance in the models was relatively small, it is possible that other factors, such as general emotion regulation abilities, contribute to the relationship between sense of responsibility, OCD symptoms, and anger suppression.

In *Study IV*, attentional biases were investigated using eye-tracking within a free-viewing paradigm in three groups: 51 participants with OCD, 50 participants with spider phobia, and 64 non-clinical controls. Despite methodological improvements, no general attentional bias was observed in individuals with OCD, contradicting theoretical predictions (Salkovskis & McGuire, 2003). Specifically, participants with OCD did not exhibit vigilance biases (i.e. faster or a more probable initial orientation) or maintenance biases (i.e., prolonged fixation durations) toward idiosyncratic OCD-relevant pictures, neither when compared to neutral pictures nor relative to non-clinical control groups. While longer dwell times (i.e., fixation durations) have been observed on OCD-relevant as compared to negative material or as compared to the biases on disorder-relevant material in the spider phobia group, these findings were rather explained by an avoidance of negative and spider-related material than by a maintenance bias in OCD. Interestingly, exploratory analyses revealed content-specific attentional biases, suggesting that attentional processes in OCD are more complex and symptom-dependent than previously assumed. Specifically, participants exhibited a maintenance bias toward checking-related OCD-relevant pictures, whereas an avoidance pattern emerged for contamination/washing-related OCD-relevant pictures. Furthermore,

substantial heterogeneity was observed in the OCD-relevance of pictures. Fewer than one-third of the pictures originally classified as OCD-related were actually rated as OCD-relevant by individuals with OCD. Moreover, no picture was universally rated as OCD-relevant by all participants with OCD. Likewise, the idiosyncratic valence rating differed substantially from the assumed valence based on validated datasets. Overall, the results challenge the applicability of anxiety-based models of attentional biases to OCD and underscore the importance of considering idiosyncratically symptom-specific attentional patterns in future research.

3.4 A Problem of Translating Ill-Defined Theories?

Although *Study III* and *Study IV* were guided by theoretical models of OCD (Freud, 1909; Rachman, 1993; Salkovskis & McGuire, 2003) and incorporated methodological advancements, such as the use of longitudinal data and eye-tracking, the results were largely not in line with the theory-driven hypotheses. One possible explanation for these inconsistencies lies in the heterogeneous nature of OCD, which manifests not only in overlapping symptom clusters observed in the validated questionnaires (*Study I* and *Study II*) but also in the symptom-specific effects identified in the studies examining basic cognitive-affective processes underlying OCD (*Study III* and *Study IV*). The divergence between expected and observed results suggests that mechanisms theorised to underlie OCD, such as an inflated sense of responsibility or attentional biases, may not operate uniformly across individuals but are affected by the disorders' heterogeneous symptom structure. Therefore, while methodological improvements remain crucial, these findings highlight the need to critically reflect on current theoretical frameworks of OCD. More specifically, the current theoretical models of OCD seem to face two critical challenges: (1) a lack of precision in defining key constructs and (2) an oversimplification that fails to account for the disorder's heterogeneity.

3.4.1 Lack of Precise Definitions of Underlying Mechanisms

For theories to be translated into research, the proposed constructs should be clearly defined, reliably measured, and allow generation of testable predictions (Cludius & Ehring, 2023; Fried, 2020). In this process, the vagueness of key concepts of the theories considered in the current thesis may contribute to the difficulty to yield reliable results in empirical research.

While acknowledging the historical significance of early psychodynamic theories (Fenichel, 1946; Freud, 1909, 1926) in the development of an understanding of OCD, the issue of loosely defined constructs is particularly evident in psychodynamic frameworks. This aligns with Popper's (1963) broader critique of unfalsifiable theories that lack precise construct definitions. For example, anger suppression is proposed to arise from a conflict between the *Id*, generating intolerable (e.g., aggressive) impulses, and the hypermoral *Superego*, enforcing rigid moral responses (Fenichel, 1946; Kempke & Luyten, 2007). The suppression of anger or aggressive impulses was proposed to happen outside of conscious awareness (Bertolucci et al., 2023) and the process underlying the automatic suppression remains ambiguous. Thereby, it remains challenging to measure anger suppression with currently available assessment tools, contributing to difficulties in determining whether anger suppression is a causal factor in OCD or a secondary consequence of other processes. In the context of *Study III*, where anger suppression was assessed through self-report measures, the findings may be restricted to conscious aspects of anger suppression, inherently constraining direct empirical tests of the psychodynamic perspective.

Beyond psychodynamic theories, the challenge of imprecise conceptualisation of phenomena also extends to aspects outlined in cognitive-behavioural models. Although Shafran (2005) highlighted that the cognitive-behavioural model of Salkovskis & McGuire (2003) allows the formulation of testable predictions, increasing the translation into empirical research, some concepts remain only vaguely defined. For instance, attentional biases are defined as the preoccupation with internal and external triggers in the environment (Salkovskis & McGuire,

2003). However, the specific operationalisation of "preoccupation" as an observable phenomenon remains unclear. Consequently, research on attentional biases in OCD has been guided by more precise theories on attentional biases in anxiety disorders (Fox et al., 2001). This led to the hypotheses that individuals with OCD show a heightened vigilance towards threat (i.e., vigilance bias) as well as difficulties to disengage from threat once attended (i.e., maintenance bias). Yet, the results of *Study IV* challenge that this transfer is valid and call for more precise and tailored theories on attentional biases in OCD.

3.4.2 Oversimplification of Current Models of OCD

Beyond imprecise definitions, a major limitation of current OCD theories is their tendency to assume generic underlying factors for the disorder's heterogeneous symptomatology. Empirical findings (e.g., Basel et al., 2023; McKay et al., 2004), including these from this thesis, challenge this assumption and underscore the necessity of considering the heterogeneity of OCD in theoretical models.

More specifically, *Study III* demonstrated a temporal relationship between OCD symptoms and anger suppression, with OCD symptoms preceding anger suppression. However, the hypothesised role of inflated responsibility (Rachman, 1993) in anger suppression was observed only in individuals with high checking-related symptoms. Although not explicitly addressed in the cognitive-behavioural model of OCD (Salkovskis & McGuire, 2003), these findings align with propositions that specific cognitive beliefs are differentially associated with OCD symptom clusters (Rachman, 2002). For instance, while the inflated sense of responsibility seems to be specifically associated with checking-related OCD symptoms, as outlined in *Study III* but also previous research (e.g., Foa, Sacks, et al., 2002), perfectionism has been linked to symmetry and ordering-related OCD symptoms (Hellberg et al., 2020).

Similarly, *Study IV* supported more nuanced, symptom-specific attentional patterns that varied by stimulus content rather than a general attentional vigilance or maintenance biases

across individuals with OCD. While a maintenance bias on OCD-relevant checking-related pictures was shown, OCD-relevant washing-related pictures predicted attentional avoidance. Intriguingly, these attentional patterns appear to align with the phenomenological expression of OCD symptoms, an association also demonstrated by Armstrong et al. (2012), who found that attentional vigilance towards contamination-related images was predictive of the behavioural avoidance of a public restroom. As discussed in *Chapter 1*, individuals with checking-related OCD tend to engage more prolongedly with threat-related stimuli and experience difficulties disengaging from checking rituals (e.g., repeatedly ensuring that the stove is turned off before leaving the house). Conversely, individuals with contamination concerns frequently show anticipatory avoidance behaviours of disgust-related stimuli, such as actively planning to avoid public restrooms due to feared bodily excretions. Interestingly, Rachman (1976) categorised both behaviours as avoidance but distinguished between two types: *passive avoidance*, which can be described as scenarios where one is "punished if s/he does", like going to public restrooms, and *active avoidance*, where one is "punished s/he does not", like leaving the kitchen without checking the stove. Of note, when *passive avoidance* fails, individuals with contamination/washing-related symptoms also show forms of *active avoidance* and act upon the feeling of being contaminated by engaging in compulsive washing. Although behavioural observations support these distinctions (Bucarelli & Purdon, 2016; McKay & Carp, 2017), research on attentional parameters remains inconsistent.

Thereby, the results of the current thesis explicitly underscore the need for a more nuanced understanding of symptom-specific mechanisms rather than assuming uniform processes across OCD. A more fine-grained approach may not only enhance theoretical models but also provide deeper insights into how distinct OCD symptom dimensions manifest and persist. Therefore, to refine our understanding of underlying mechanisms and integrate these insights into theoretical models, basic research must leverage the heterogeneity of OCD.

Identifying symptom-dependent mechanisms is critical for advancing theory, which can drive further research and ultimately inform optimised intervention strategies.

3.5 Leveraging the Heterogeneity of OCD in Basic Research

So far, the considerable heterogeneity of OCD symptoms was considered a major challenge in identifying underlying mechanisms of OCD. Therefore, previous studies investigated potential underlying mechanisms in subgroups of individuals with OCD, presenting pronounced symptoms of one symptom cluster (e.g., contamination fear: Armstrong et al., 2010, 2012; e.g., checking symptoms: Bucarelli & Purdon, 2016; Choi & Lee, 2015). However, the substantial overlap between symptom clusters makes defining strict subgroups arbitrary and potentially limiting. While *Study III* also investigated effects in a subgroup of patients with particularly high checking-related OCD symptoms, this thesis highlights the advantages of leveraging the heterogeneity of OCD by including individuals regardless of symptom cluster while systematically assessing and accounting for symptom heterogeneity with dedicated analyses, as exemplified in *Study IV*. Therefore, future research may assess the symptom heterogeneity, for instance by utilising the OCI-12, rather than restricting investigations to predefined subgroups. This would allow researchers to identify patterns in symptom expression and associated cognitive-emotional processes during the data analysis phase, rather than imposing rigid inclusion and exclusion criteria and investigation of processes in specific subgroups only.

Additionally, when using stimuli to evoke OCD symptoms or specific emotions, it is crucial to assess their idiosyncratic valence and disorder relevance. The present findings of *Study IV* indicate significant variability in how individuals with OCD perceive disorder-relevant stimuli. Strikingly, no picture presented within this study was universally rated as OCD-relevant by every participant with OCD. Moreover, only on average one-third of those pictures assumed to be relevant were actually rated as OCD-relevant by participants with OCD. Beyond disorder-

relevance, a considerable mismatch between subjectively perceived valence and originally assigned picture valence was observed in all groups. Therefore, assuming that certain stimuli are inherently OCD-relevant, negative, or neutral without assessing their subjective relevance or valence may lead to misleading conclusions. . This includes drawing inferences about OCD-related processes that, due to the disorder-irrelevance of the presented stimuli, may instead be primarily driven by general valence effects. Future research should therefore prioritise idiosyncratic assessments of stimulus relevance and valence to enhance the reliability and validity of experimental paradigms.

These improvements may contribute to an enhanced understanding of processes that drive the phenomenological heterogeneity of OCD. However, beyond advancing basic research, it may be crucial expand the focus beyond cognitive-behavioural aspects. Given that individuals with OCD experience a broad range of emotions (see e.g., Abramowitz & Jacoby, 2015; Bhikram et al., 2017; Moscovitch et al., 2008), incorporating affective processes into OCD research may allow for a more comprehensive perspective on OCD. Examining the emotional basis of OCD symptoms, as well as the relationship between emotional experiences and other factors proposed to be involved in the development and maintenance of OCD, may be a valuable next step toward enhancing the understanding of the inconsistent landscape of results.

3.6 Beyond Anxiety: The Emotional Complexity of OCD

OCD has long been associated with the experience of anxiety and fear (Abramowitz et al., 2009), which was also reflected in its initial classification as anxiety disorder (American Psychiatric Association, 2000). However, accumulating evidence suggests that a broader range of emotions, such as disgust (Bhikram et al., 2017), guilt (Shapiro & Stewart, 2011), shame (Marques et al., 2010), and anger (Moscovitch et al., 2008), is closely associated with OCD symptomatology. These emotional experiences are, however, not randomly distributed across OCD symptoms but rather show distinct associations with specific symptom clusters, as

outlined below. Therefore, the heterogeneity of OCD seems to extend beyond symptom presentation and cognitive processes to its underlying emotional processes.

Early psychodynamic theories suggested that anger and its suppression contribute to the development of OCD in general (Freud, 1909). However, Rachman (1993) later proposed that anger may arise as a consequence of an inflated sense of responsibility, which is particularly pronounced in individuals with checking-related OCD symptoms (Foa, Sacks, et al., 2002; Salkovskis et al., 2000). In line with that, the experience of anger, which is rather suppressed than expressed, was shown to be particularly associated with checking-related symptoms in previous studies (Radomsky et al., 2007; Whiteside & Abramowitz, 2004). *Study III* supports this perspective, showing that the associations between sense of responsibility, OCD symptoms, and anger suppression were most consistently observed in individuals with high checking-related OCD symptoms.

While anger appears to arise as a consequence of internal processes, such as cognitive responsibility beliefs, two additional emotions discussed in the context of *Study IV* are particularly observed in response to specific OCD-related external situations: disgust and fear of harm. The experience of disgust is closely associated with symptoms of contamination and washing (Ludvik et al., 2015) and may be provoked by external contamination-related stimuli such as dirty toilets or unclean fingernails. In contrast, the fear of harm or guilt is commonly seen in individuals with checking-related OCD symptoms, often driven by an exaggerated sense of responsibility and elicited by checking-related stimuli such as a lit stove or a candle placed near a wall (Rachman, 2003; M. T. Williams et al., 2013). While fear can also be experienced by individuals with contamination concerns, those with checking symptoms rarely report disgust as a dominant emotion (Sieg & Scholz, 2001).

The heterogeneity of emotional experiences in OCD may be associated to other factors proposed to underlie OCD symptomatology. More specifically, the results of *Study IV* suggest that distinct emotional experiences may be reflected in attentional processes. On an emotional

level, pictures related to contamination- and washing as well as spider-related pictures may both elicit disgust. Therefore, the attentional avoidance observed for both, spider-relevant and OCD-relevant washing-related pictures, could be attributed to disgust-related avoidance behaviour, an association previously outlined in a qualitative review (Knowles et al., 2019). In contrast, checking-related images may be fear inducing, which could further lead to a prolonged attentional engagement and difficulty disengaging from checking-related stimuli. As outlined above, these attentional phenomena appear to be reflected at a phenomenological level through passive and active avoidance (Rachman, 1976), respectively, though further empirical investigation is required to substantiate this relationship.

The phenomenon that different emotional experiences may drive diverging attentional processes was also observed in spider phobia. As summarised in a meta-analysis by Armstrong & Olatunji (2012), the tendency to avoid maintaining gaze on spider pictures is reversed when individuals with high spider anxiety are exposed to real spiders, which was associated with increased maintenance of gaze. The authors argued that this may be related to the different urgencies elicited by the stimuli. While a spider picture is a low-urgency, potentially disgust-inducing cue that can be ignored without consequences, a real spider is a high-urgency, potentially fear-inducing cue that demands immediate attentional engagement and action. This aligns with Cole et al. (2013), who proposed that while both fear and disgust are intense and aversive emotions, they differ in their urgency of taking behavioural actions, potentially related to the perceived imminence of threat.

These findings suggest that perceptual biases and behavioural responses in spider phobia and OCD are driven by specific underlying emotions, such as disgust and fear of harm, rather than by negative emotions in general. Given that these emotions are associated with varying levels of urgency, they likely shape attentional and behavioural patterns differently. However, as research on the role of distinct emotional experiences in OCD remains limited, the influence of emotions such as disgust and fear on attentional and behavioural processes requires further

investigation. Therefore, a valuable next step would be a translation of these phenomenological observations on emotional experiences to basic research.

3.6.1 Take one Step Back to Move Forward: Basic Research on the Emotional Landscape of OCD

While distinct emotions appear to be associated with different OCD symptom clusters, no study to date has systematically investigated the specific emotions experienced by individuals with OCD as a function of their symptom profiles. To gain deeper insights into the emotional landscape of OCD, basic research is needed to clarify how different symptom dimensions correspond to distinct emotional experiences. Assessing emotional experiences is particularly challenging, both in the general population and in individuals with OCD, due to the inherently dynamic nature of emotions (Gross, 2002; Kuppens & Verduyn, 2017) and potential limitations in emotional awareness associated with OCD (See et al., 2022). Qualitative verbal reports from individuals describing the emotions associated with their symptoms may serve as a valuable starting point to get a deeper understanding of the emotional unfolding in OCD and generate testable hypotheses (Bazen et al., 2021). However, structured, validated assessment methods are necessary in research to ensure reliability and precision. Recent advances in assessment methods have provided more precise tools to capture emotional variability. For instance, the Discrete Emotions Questionnaire has been developed as a state measure of discrete emotions such as anger, disgust, and fear (Harmon-Jones et al., 2016). This instrument may be particularly well-suited for laboratory (experimental) research, as it allows for the assessment of discrete emotional states in response to diverse stimuli (e.g., idiosyncratically OCD-relevant pictures). Additionally, Ecological Momentary Assessment (EMA) protocols offer a valuable approach to measuring psychological states in (nearly) real-time and in real-world contexts (Ebner-Priemer & Trull, 2009). Thereby, EMA aims to minimise recall bias commonly associated with trait questionnaires (Shiffman et al., 2008) and allows the assessment of

emotions that are associated with currently experienced OCD symptoms or even specific OCD-relevant situations, as already implemented in recent studies (e.g., Bischof et al., 2024). By leveraging these methodological advancements, future research can comprehensively assess both the laboratory-based and real-world emotional dynamics of OCD, providing deeper insights into the interplay between symptomatology and emotional experiences.

While an understanding of the emotions underlying OCD is a crucial first step, another key question arises given individuals' tendency to downregulate aversive emotions and upregulate positive emotions (Tamir, 2009): How do individuals with OCD regulate the intense aversive emotions experienced in the context of their disorder?

3.6.2 Emotion Regulation Difficulties at the Core of OCD?

While a wide range of emotions play a central role in OCD, research has only recently begun to focus on how these emotions are regulated. Emotion regulation refers to cognitive-behavioural processes that modulate the timing, intensity, and expression of emotions (Gross, 2002). According to Gross' (1998, 2014) process model of emotion regulation, the emotional experience can be influenced by several regulatory processes: (1) *situation selection*, where individuals actively influence which situation they will encounter to modify the generation of emotions, (2) *situation modification,* which involves altering relevant aspects of a situation to modify its emotional impact, (3) *attentional deployment,* determining which aspects of the situation are being attended to modify an emotional response, (4) *cognitive change*, where the interpretation or appraisal of a situation is altered to influence its emotional impact, and (5) *response modulation*, which involves directly influencing some aspects of a generated emotion and emotion-related actions.

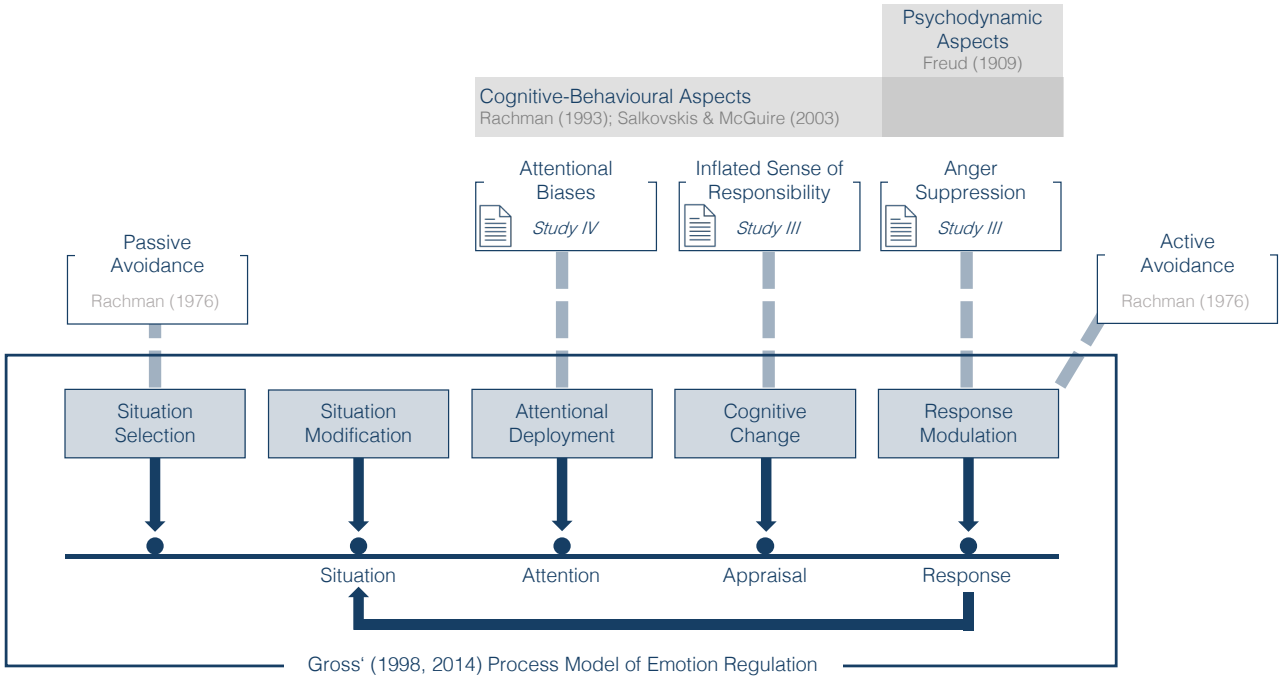
Although so far not explicitly addressed, several mechanisms described within the psychodynamic (Freud, 1909) and cognitive/cognitive-behavioural models (Rachman, 1993; Salkovskis & McGuire, 2003) can be integrated into Gross' (1998, 2014) framework of emotion

regulation (see Figure 2 for an schematic integration of these concepts). Attentional biases, proposed as a crucial underlying factor in Salkovskis & McGuire's (2003) cognitive-behavioural model and investigated in *Study IV*, could be seen as a form of emotion regulation at the stage of *attentional deployment*. Individuals with contamination-related concerns may exhibit an avoidance response to washing-related stimuli as a way to avoid intensification of feelings of disgust. In contrast, those with checking compulsions may perceive a higher urgency for action and thereby maintain their attention on OCD-relevant stimuli in an attempt to engage with feelings of fear and pre-empt potential harm, affecting the emotional unfolding of fear of harm and guilt. Similarly, cognitive beliefs such as the inflated sense of responsibility investigated in *Study III* and seen especially in those with high checking-related symptoms (Foa, Sacks, et al., 2002; Salkovskis et al., 2000), can be viewed as a maladaptive form of *cognitive change*, as they alter the appraisal of a situation (e.g., whether the stove was turned off) in a way that exaggerates its perceived consequences. More specifically, the rigid, exaggerated responsibility beliefs characteristic of OCD (e.g., "I must be absolutely certain that the stove is off because otherwise, I would be responsible for any harm") intensify aversive emotions (e.g., fear of harm), thereby reinforcing compensatory action-taking aimed at preventing or mitigating perceived threats. Moreover, anger suppression, outlined in both psychodynamic (Freud, 1909) and cognitive models of OCD (Rachman, 1993) and investigated in *Study III*, aligns with expressive suppression, a form of *response modulation*. Moreover, behavioural avoidance patterns (Rachman, 1976) addressed in the discussion of results can be reflected as emotion regulation processes. Passive avoidance frequently seen in individuals with contamination concerns (e.g., avoiding public restrooms), can be understood as a counterproductive safety strategy to prevent the emergence of aversive emotions within the stage of *situation selection* (Starcevic et al., 2011). In contrast, active avoidance, such as performing checking compulsions to actively reduce the fear of harm and feelings of guilt, can be understood as a form of *response modulation* (Calkins et al., 2013). Therefore, several mechanisms proposed to underlie the

development and maintenance of OCD symptoms, as investigated in this thesis, may be viewed as forms of emotion regulation that modulate aversive emotions experienced in the context of OCD.

Figure 2

Schematic Overview of the Integration of OCD-Related Cognitive-Behavioural and Affective Mechanisms Into Gross' (1998, 2014) Process Model of Emotion Regulation



Note. The process model of emotion regulated is based on Gross (2014) and has been adapted for the current discussion. The figure illustrates how cognitive-behavioural and psychodynamic aspects of OCD, examined in *Study III* and *Study IV* (i.e., attentional biases, inflated sense of responsibility, and anger suppression) or discussed in relation to the findings (i.e., active and passive avoidance), could align with Gross' (1998, 2014) process model of emotion regulation. Please note that the depicted dashed associations have not yet been empirically tested.

Despite the theoretical overlap between cognitive-behavioural processes and emotion regulation, to the best of current knowledge, no prior research has systematically examined how these factors (e.g., attentional biases, maladaptive cognitive beliefs, avoidance behaviours)

function as regulatory mechanisms that modulate the diverse emotions experienced in OCD. Furthermore, it remains unclear whether emotion regulation difficulties contribute to the emergence of cognitive-behavioural factors outlined in theoretical models (Rachman, 1993; Salkovskis & McGuire, 2003), serve as maintaining mechanisms, or represent a predisposing vulnerability for the disorder. While *Study III* suggests that anger suppression as a form of emotion regulation may be a consequence of OCD symptoms, findings indicate that emotion regulation difficulties may (potentially over time) become independent from OCD symptoms, as symptom improvement did not correspond with reduced levels of anger suppression. This highlights the need to consider emotion regulation difficulties as a distinct factor in the context of OCD.

Growing evidence suggests that individuals with OCD in general exhibit widespread emotion regulation difficulties. More specifically, a recent meta-analysis demonstrated that individuals with OCD show general deficits in engaging in goal-directed behaviours and accessing effective emotion regulation strategies (See et al., 2022). These findings are in line with previous studies showing that OCD is characterised by an imbalance between goal-directed and habitual learning systems, contributing to the habitual reliance on and persistence of compulsive behaviours (Gillan et al., 2016; Yu et al., 2024). This supports the notion that compulsive acts could be characterised as a habitually used, maladaptive strategy to manage aversive emotions, offering short-term relief while perpetuating the disorder (Calkins et al., 2013). Furthermore, a recent study on emotion regulation in daily life found that individuals with OCD perceive their regulation strategies as significantly less effective than those of healthy controls (Bischof et al., 2024). Thereby, the reliance on compulsions to regulate aversive emotions may be further reinforced, as alternative emotion regulation strategies may not yield the same regulatory success. Therefore, individuals with OCD may generally demonstrate difficulties in the flexible use of a diverse repertoire of emotion regulation strategies, which would otherwise be characteristic of effective emotion regulation (e.g., Bonanno & Burton,

2013; Sheppes et al., 2014). While these findings highlight universal emotion regulation difficulties across individuals with OCD, some results also reflect the disorder's heterogeneity, as specific regulatory difficulties are particularly linked to distinct symptom clusters. For instance, non-acceptance of emotions has been specifically associated with heightened responsibility for harm and intrusive, morally unacceptable thoughts (See et al., 2022). These cognitive patterns are particularly characteristic of the checking and obsessing symptom clusters (Abramowitz et al., 2010), respectively. Therefore, next to the diverging cognitive-affective processes observed in *Study III* and *Study IV*, these findings highlight that specific emotion regulation difficulties are associated with specific OCD symptom clusters.

Thereby, the current thesis highlights the central role of emotions and emotion regulation in OCD, while at the same time emphasising the need for further research to clarify how cognitive-behavioural mechanisms (e.g., attentional biases, cognitive beliefs) outlined in theoretical models of OCD (Rachman, 1993; Salkovskis & McGuire, 2003) function as emotion regulation strategies. As the current studies (*Study III* and *Study IV*) did not incorporate analyses of direct measures of emotional experience or emotion regulation alongside the main outcomes, future research could benefit from systematically investigating these associations. For instance, inclusion of standardised assessments, such as the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2003), could aid in better understanding the association between cognitive-behavioural factors, general emotion regulation difficulties, and OCD symptoms. Ultimately, investigating the interplay between cognitive-behavioural and affective mechanisms offers a novel perspective on OCD and could inform basic research, laying the foundation for its potential future translation into clinical practice.

3.7 Implications for Clinical Practice

The thesis has several implications for clinical practice. First and foremost, the OCI-4 and OCI-12 are syndromally valid, reliable, and resource efficient tools to screen for and assess

OCD symptoms. Therefore, they can contribute to a faster and more accurate diagnostic process in OCD. Furthermore, although the sensitivity to treatment still needs to be formally established, the evidence of good test-retest reliability and time efficiency of the OCI-12 makes this tool already valuable in the continuous assessment of symptoms throughout the psychotherapeutic process. Its brevity allows for frequent administration, such as weekly assessments, which is, in accordance with DGPPN (2022) recommendations, particularly valuable during the first four weeks of treatment. Tracking the symptom trajectories throughout psychotherapy allows to assess the treatment success, potential complications or worsening of symptoms, which can inform adjustments in treatment planning. In particular, the validated cut-off scores can help determine whether symptoms remain above the clinical OCD threshold or have decreased to a subclinical level, thereby offering valuable insights into treatment progress.

Moreover, the thesis highlights the need to consider the heterogeneity in OCD not only during the symptom assessment, but also for planning of psychotherapeutic interventions. For instance, during exposure and response prevention patients are exposed to feared situations or stimuli (i.e., *exposure*), while refraining from compulsive responses (i.e., *response prevention*; Abramowitz, 1996). In this context, it is fundamental that the patient should be exposed to stimuli that are idiosyncratically relevant and that ultimately address the "core fear" (Gillihan et al., 2012). Crucially, as outlined in *Study IV*, only a fraction of stimuli deemed OCD-related were actually rated as OCD-relevant by participants with OCD, with some participants indicating that none of the 120 pictures was relevant to their obsessions or compulsions. This underscores the importance of dedicating time to accurately assessing individual symptoms and identifying specific situations and stimuli that are particularly relevant to a patient's OCD symptoms. Only when an adequate assessment of idiosyncratically relevant internal and external stimuli was conducted, exposure therapy can be planned accordingly, and the individual can expose him or herself to individually OCD-relevant situations and stimuli.

Furthermore, although replication is needed, the results of *Study IV* suggest that it may be relevant to investigate which emotions a patient experiences in association with situations and stimuli relevant to their OCD symptoms. As diverging attentional but also behavioural processes were proposed to be associated with fear as compared to disgust, the knowledge on underlying emotions could be relevant to tailor exposure therapies more to the individual participant. For instance, the instructions during exposure therapy could be adapted. While someone with disgust-related washing compulsions may be asked to actively engage with the disgust-eliciting stimulus, to work against the OCD-related avoidance of disgust-related stimuli, a patient who is afraid of causing harm by not turning off the stove may be asked to disengage and leave the symptom-provoking situation early to avoid the OCD-related maintenance on these stimuli. Notably, the call to tailor exposure interventions to underlying emotions has recently been supported by a meta-analytic review demonstrating that disgust is more resistant to extinction than fear, underscoring the potential advantage of disgust-specific interventions (Mitchell et al., 2024).

Lastly, the cognitive-behavioural-affective processes outlined in the current thesis suggest that emotion regulation may be an important process associated with OCD symptoms. *Study III* demonstrated that individuals with OCD show increased use of anger suppression, which can be considered as maladaptive emotion regulation strategy if used habitually. Crucially, these regulatory difficulties persisted even when OCD symptoms improved, indicating that difficulties in emotion regulation are not sufficiently addressed by symptom-focused interventions. As a result, improving abilities to regulate emotions may be a valuable therapeutic target. Difficulties in emotion regulation may also affect central aspects of exposure and response prevention, as compulsive responses, that usually provide short-term relief from aversive emotions, should be omitted after exposure to OCD-relevant stimuli (Abramowitz, 1996). Considering that individuals with OCD perceive their emotion regulation strategies as less effective (Bischof et al., 2024) and report limited access to presumably adaptive emotion

regulation strategies (See et al., 2022), it may be beneficial, or even essential, to address alternative ways to regulate aversive emotions occurring in this context. Expanding the repertoire of emotion regulation strategies may not only reduce reliance on otherwise habitually used compulsions, but at the same time enhance the ability of flexible emotion regulation depending on situational demands, a hallmark of adaptive emotion regulation (e.g., Bonanno & Burton, 2013; Sheppes et al., 2014). Moreover, the experience of aversive emotions is not confined to exposure and response prevention sessions, but also arises before (e.g., anticipatory anxiety driving avoidance and safety behaviours) and after exposure (e.g., residual anxiety reinforcing delayed engagement in compulsive acts; Kyrios, 2003). At these stages, heightened emotional distress may hinder engagement in therapeutic interventions (Mancebo et al., 2011) or, if regulated through safety behaviours or late compulsive acts, reduce treatment success (Blakey & Abramowitz, 2016; Jacoby & Abramowitz, 2016). Considering currently observed attrition rates of 18% (Ong et al., 2016) and the fact that more than half of the individuals with OCD that initially showed remission relapsed within five years (Eisen et al., 2013), enhancing general emotion regulation could potentially reduce drop-out rates and improve long-term therapeutic success. Yet, it remains to be empirically investigated whether promoting more flexible and adaptive emotion regulation, potentially serving as a form of *response substitution* for compulsive acts, provides additional benefits to traditional exposure and response prevention approaches. While robust basic research is essential for developing individually tailored, OCD-specific emotion regulation treatments (in line with Ehring et al., 2022), integrating existing transdiagnostic protocols may offer a valuable interim approach. Given that emotion regulation is considered a transdiagnostic factor (Sloan et al., 2017), the *Unified Protocol for Transdiagnostic Treatment of Emotional Disorders* (Barlow et al., 2017) could be a valuable addition to currently available treatment options. As this approach also enables personalisation through the selection of individual modules (Sauer-Zavala et al., 2017), it may

be adequately suited to account for the heterogeneity in OCD, which extends beyond symptom presentation to the emotional underpinnings and regulatory difficulties.

3.8 General Strengths and Limitations

The studies incorporated in the present thesis add a valuable contribution to the assessment and understanding of the heterogeneous symptom structure in OCD. First, the translation and validation of the OCI-4 and OCI-12 in clinical and non-clinical samples allowed to establish psychometric properties but also cut-off values that can be implemented in clinical care and research (*Study I* and *Study II*). Both questionnaires, along with the data and code used for validation, are freely accessible. Next to improved assessment, *Study III* and *IV* provided more comprehensive insights into factors proposed to be underlying OCD. Drawing upon longitudinal data, *Study III* allowed for investigation of temporal associations between the sense of responsibility, OCD symptoms, and anger suppression. Thereby, the longstanding debate of psychodynamic (Freud, 1909) and cognitive theorists whether anger suppression is a cause or consequence of OCD symptoms was addressed. Moreover, *Study IV* investigated dynamic attentional processes in an eye-tracking paradigm, where idiosyncratic stimulus material was used in a free-viewing paradigm. Next to the design, the coding scheme in the multilevel models allowed to disentangle valence from disorder relevance and comparisons between the three groups. Thereby, this study provided important insights into potential diverging attentional biases in OCD. Furthermore, inclusion of a clinical and non-clinical control group allowed the comparison between common attentional biases and biases specific to OCD. To enable replication of results, the preregistration, experimental setup, instructions, data, code, and analysis script are made publicly available.

Despite these strengths, several limitations must be considered in the interpretation of current results. One potential limitation concerns the sample composition. In *Study I* and *Study II*, participants were not explicitly recruited to represent the general OCD population,

preventing the establishment of population norms. Future research should aim to replicate these findings in larger and more representative samples. Moreover, participants of *Study III* were undergoing a metacognitive intervention. As aspects of treatment specifically target the sense of responsibility, it cannot be ruled out that the temporal associations between responsibility, OCD symptoms, and anger suppression are affected by the treatment. Furthermore, an intervention effect cannot be ruled out in the sample of *Study IV*, as participants were recruited in clinical settings and were undergoing treatment at the time of the study. This raises the possibility that psychotherapeutic interventions, such as exposure therapy, may have influenced their attentional engagement with OCD-relevant material, potentially affecting the observed attentional patterns.

Furthermore, while depressive symptoms were controlled for in *Study III* and *Study IV* included a clinical control group to distinguish attentional biases in OCD from those observed in spider phobia, the role of other comorbid disorders was not systematically examined. Given the high prevalence of comorbidities in OCD (Sharma et al., 2021), it remains unclear whether the observed effects are truly specific to OCD or influenced by co-occurring conditions, such as generalised anxiety disorder which was highly prevalent in both samples. Future research should consider a more comprehensive assessment of comorbidities to determine whether the reported findings reflect disorder-specific mechanisms or potential transdiagnostic processes.

Moreover, *Study IV* demonstrated symptom-specific attentional biases, likely influenced by distinct emotional experiences of disgust and fear of harm. However, while the idiosyncratic disorder relevance of stimuli was assessed, the associated emotional responses were not explicitly measured. A more detailed analysis of emotion-related attentional biases is therefore warranted. Clarifying how different emotional responses are associated to OCD symptoms and investigating their potential moderating effect on underlying mechanisms, such as attentional biases, would be a valuable next step toward a more comprehensive understanding of OCD.

Lastly, *Study III* and *Study IV* investigated symptom-specific effect by investigating subsets of the collected data. Although relevant to further investigate potential heterogeneous effects depending on symptom profiles, the exploratory analyses are based on relatively small samples reducing the statistical power. Furthermore, the current thesis had a strong focus on checking-related and washing-related symptoms, while not elaborating on ordering- and obsessing-related symptoms. Therefore, future research should increase the sample size to allow for more statistically powered analyses on diverging effects considering the heterogeneous nature of OCD, including all symptom clusters.

In summary, while this thesis provides important advancements in the assessment and understanding of OCD, future research should aim to expand sample representativeness, systematically control for comorbid conditions, incorporate direct measures of emotional experiences and emotion regulation processes, and investigate the full spectrum of OCD symptom dimensions to further refine theoretical models and clinical interventions.

3.9 General Conclusion

To conclude, the present thesis aimed to improve symptom assessment and diagnostic accuracy as well as deepen the understanding of factors contributing to the development and maintenance of OCD. To achieve this, it focused on validating novel assessment tools and examined cognitive-affective processes underlying OCD symptoms.

By validating the OCI-12 and OCI-4, this thesis introduces a resource-efficient and standardised approach to OCD symptom assessment. These instruments can facilitate earlier detection of OCD, reduce misdiagnosis, and enhance clinical decision-making. While both, the OCI-12 and OCI-4, demonstrated good-to-excellent psychometric properties, future research should establish normative data and sensitivity to treatment changes to maximise their clinical applicability.

Beyond diagnostic advancements to assess the heterogeneous OCD symptoms, this thesis highlights the critical role of the heterogeneity of cognitive-affective processes in OCD, particularly in anger suppression and attentional biases. The findings emphasise the role of anger suppression in OCD, which may be particularly relevant in individuals with heightened responsibility beliefs and checking-related compulsions. While anger suppression is more likely a consequence rather than a cause of OCD symptoms, high levels of anger suppression persisted even if OCD symptoms improved. Therefore, these findings suggest that beyond OCD-focused treatments, integrating targeted emotion-focused interventions may provide additional benefits by addressing associated emotion-regulation difficulties.

Similarly, findings on attentional biases underscore the need to consider both cognitive and affective processes in understanding attentional mechanisms and the development of OCD. Attentional biases appear to be symptom-dependent, with contamination- and washing-related pictures eliciting attentional avoidance and checking-related pictures driving attentional maintenance. These differences likely reflect distinct emotional states, with attentional avoidance being associated with disgust, whereas a fear of harm likely drives attentional maintenance. This suggests that anxiety disorder models used as proxies for OCD-related attentional biases may not be directly transferable, as attentional biases in OCD are not universal but rather closely intertwined with heterogeneous symptom-specific cognitive-affective processes.

As highlighted throughout this thesis, strengthening basic research on the mechanisms underlying OCD is a crucial next step. Given the overlap between cognitive-behavioural mechanisms and emotion regulation processes, future research should leverage the heterogeneity of OCD and examine the interplay between cognitive, behavioural, and affective processes. Ultimately, these insights could contribute to the development of more fine-grained theoretical models and foster translation of basic research into clinical practice, such as

integrating emotion-focused symptom-specific interventions to improve treatment effectiveness for OCD.

4 Deutsche Zusammenfassung

Umfassende Einblicke in die Zwangsstörung:

Untersuchung von Symptomerfassung, Aufmerksamkeitsprozessen und Emotionsregulation

Die Zwangsstörung (englisch: Obsessive-Compulsive Disorder; OCD) ist eine heterogene, den Alltag einschränkende Störung, von der etwa 2-3 % der Menschen im Laufe ihres Lebens betroffen sind (Ruscio et al., 2010). Gemäß den Kriterien der fünften Version des Diagnostischen und Statistischen Manuals Psychischer Störungen (DSM-5; American Psychiatric Association, 2013) ist die Zwangsstörung durch Zwangsgedanken und/oder Zwangshandlungen gekennzeichnet. Zwangsgedanken sind wiederholt auftretende, intrusive Gedanken, Bilder, oder Triebe, die sich gegen den Willen aufdrängen und meistens erhebliche Angst oder Unbehagen auslösen. Betroffene versuchen daher häufig diese Zwangsgedanken zu ignorieren, zu unterdrücken oder zu neutralisieren. Zwangshandlungen, auf der anderen Seite, sind wiederholte Verhaltensweisen oder mentale Vorgänge, zu deren Ausführung sich die Betroffenen gezwungen fühlen. Diese können unabhängig von Zwangsgedanken auftreten, sind jedoch häufig als Reaktion auf diese zu sehen (Abramowitz et al., 2009; American Psychiatric Association, 2013).

Die Inhalte von Zwangsgedanken und Zwangshandlungen wurden in vorheriger Forschung wiederholt in vier übergreifende Symptomcluster eingeordnet: (1) Kontaminationsgedanken und Waschzwänge, (2) Verantwortlichkeit für das Verursachen oder Verhindern von Schaden und das Vermeiden von Fehlern (z.B. durch Kontrollverhalten), (3) Symmetrie und Vollständigkeit sowie (4) aufdringliche Gedanken zu tabuisierten Themen (z.B. Abramovitch et al., 2021b; Abramowitz et al., 2010). Durch die Symptomcluster wird bereits deutlich, dass die Symptome der Zwangsstörung eine erhebliche Heterogenität aufweisen. Während eine Person mit Kontrollzwang beispielsweise befürchtet, dass sie den Herd nicht ausgeschaltet hat, bevor sie das Haus verließ, was zum versehentlichen Tod eines geliebten Menschen bei einem Hausbrand führen könnte, fürchtet sich eine andere Person mit Kontaminationsängsten vor Körperausscheidungen und möglicherweise übertragene Krankheiten (de Silva, 2003). Die meisten Menschen mit Zwangsstörungen weisen Symptome

aus mehreren Symptomclustern auf (Rufer et al., 2006), wodurch sich die Symptomcluster stark überschneiden (Mataix-Cols et al., 2005).

Neben der Heterogenität *zwischen* den Symptomclustern gibt es auch eine erhebliche Heterogenität *innerhalb* eines jeden Clusters (Abramowitz et al., 2010). So können sich die Inhalte der Zwangsgedanken und Zwangshandlungern zweier Personen, die Symptome des Clusters Kontamination und Waschen aufweisen, grundlegend unterscheiden: Während sich die eine Person vor allem um Körpersekrete wie Urin oder Speichel sorgt, fürchtet sich die andere vor Umweltschadstoffen wie Asbest in den Wänden öffentlicher Gebäude (Jones & Krochmalik, 2003). Unabhängig der spezifischen Inhalte gilt, dass sofern die Zwangsgedanken und/oder Zwangshandlungen zeitaufwendig sind (d.h. mehr als eine Stunde am Tag einnehmen) und/oder klinisch bedeutsames Leiden auslösen, die Diagnose einer Zwangsstörung in Erwägung gezogen werden sollte (American Psychiatric Association, 2013).

Obwohl Betroffene (Coluccia et al., 2016; Macy et al., 2013) und ihr nahes Umfeld (Albert et al., 2007; Stengler-Wenzke et al., 2006) eine erhebliche Belastung durch die Zwangsstörung erleben, zeigt sich in der klinischen Praxis, dass die Diagnosestellung oft erst nach erheblicher Verzögerung erfolgt. So vergehen im Durchschnitt 12 Jahre zwischen dem Beginn der Symptomatik bis zur korrekten Diagnose der Zwangsstörung (Ziegler et al., 2021). Zudem wird die Zwangsstörung häufig unter- oder fehldiagnostiziert. Demnach zeigte eine Studie in deutschen Facharztpraxen für Psychiatrie, dass 70% der Patient:innen mit Zwangsstörung keine korrekte Diagnose erhielten (Wahl et al., 2010). Diese Faktoren tragen zu einer längeren Krankheitsdauer bei, welche wiederum ein Prädiktor für niedrigere Remissionsraten (Eisen et al., 2013; Fineberg et al., 2013) und schlechtere langfristige Behandlungsergebnisse ist (Perris et al., 2023). Die diagnostischen Herausforderungen sind durch verschiedene Faktoren bedingt. Neben Charakteristika der Betroffenen, wie beispielsweise Scham (Marques et al., 2010) und Selbststigmatisierung aufgrund der Zwangssymptome (Stengler-Wenzke et al., 2004), sind die knappen zeitlichen, personellen und

monetären Ressourcen des Gesundheitssystems (Bundesministerium für Gesundheit, 2025) ein potenziell weiterer zentraler Faktor. Daher sind zeitökonomische, kostengünstige und personalschonende Screeningverfahren mit validierten Grenzwerten, die Hinweis auf das Vorliegen einer möglichen Zwangsstörung liefern, nötig. Neben Screening-Instrumenten sind umfangreichere Instrumente, die auf die aktuellen Diagnosesysteme angepasst sind, die Heterogenität der Störung adäquat abfragen und Zwangssymptome gut von deren anderer Störungen abgrenzen können, essenziell.

Um die Erfassung von Zwangssymptomen und die diagnostische Genauigkeit bisheriger Instrumente zu verbessern, wurden daher in *Studie I* und *Studie II* das 12- und 4-Item Zwangsinventar [12-Item Obsessive-Compulsive Inventory (OCI-12); Abramovitch et al., 2021b, 4-Item Obsessive-Compulsive Inventory (OCI-4); 2021a] aus dem Englischen übersetzt und auf die Faktorenstruktur, Reliabilität, Validität und diagnostische Genauigkeit in klinischen und nicht-klinischen Stichproben getestet. Teilnehmer:innen mit Zwangsstörungen (n = 102), angstbezogenen Störungen (n = 69) und nicht-klinische Kontrollpersonen (n = 248) wurden rekrutiert und füllten mehrere Online-Fragebögen aus, in denen Zwangssymptome, aber auch andere Symptome wie Angst, Depression und Sich-Sorgen erfasst wurden. Die deutsche Version des OCI-12 replizierte die vier-Faktoren-Struktur, die die häufigsten Symptom-Cluster der Zwangsstörung (d.h. Kontrollieren, Waschen, Ordnen und Zwangsgedanken) repräsentiert, wobei ein Faktor höherer Ordnung für allgemeine Zwangssymptome deren Kovarianz berücksichtigt, und die Modellanpassung verbessert. Sowohl das OCI-4 als auch das OCI-12 zeigten gute Reliabilitäten, eine mäßige bis gute Konstruktvalidität und eine gute bis hervorragende diagnostische Genauigkeit. Damit unterstützen die Ergebnisse diese Maße als ressourceneffiziente und klinisch anwendbare Screening-Instrumente, die standardisierte Grenzwerte (cut-off Kriterien) für eine verbesserte Bewertung in der Routineversorgung und in der Forschung bieten. Auch wenn die Veränderungssensitivität des OCI-12 noch separat getestet werden muss, gibt *Studie I* erste Hinweise darauf, dass dieses Instrument auch für die

Verlaufsdiagnostik im Rahmen der psychotherapeutischen Versorgung geeignet ist. Den Empfehlungen der Deutschen Gesellschaft für Psychiatrie und Psychotherapie, Psychosomatik und Nervenheilkunde (DGPPN, 2022) folgend könnten so, zumindest innerhalb der ersten vier Wochen der Therapie, die Symptome der Zwangsstörung wöchentlich mit dem OCI-12 erfasst werden. Während das OCI-4 und OCI-12 als nomothetische Maße eine strukturierte Erfassung der Zwangssymptome ermöglichen, ist eine Ergänzung idiographischer Methoden, wie beispielsweise die Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Hand & Büttner-Westphal, 1991), für die genauere Therapieplanung ratsam. So kann die Heterogenität der Zwangsstörung vollumfänglich erfasst und in der psychotherapeutischen Versorgung berücksichtigt werden, sodass beispielsweise Expositionstherapien auf die personalisierten zwangsrelevanten Situationen angepasst werden können. Während *Studie I* und *Studie II* die adäquate Erfassung von Zwangssymptomen adressieren, widmet sich diese Dissertation einer weiteren zentralen Frage: Welche Faktoren tragen zur Entstehung und Aufrechterhaltung der Zwangsstörung bei?

Bereits seit dem frühen zwanzigsten Jahrhundert werden erste Theorien zur Entstehung der Zwangsstörung formuliert. Freud (1909) postulierte, dass ein innerer Konflikt von *Liebe* und *Hass*, welcher durch eine starke Unterdrückung des *Hasses* zugunsten der *Liebe* bewältigt wird, der Zwangsstörung zugrunde liegt. Dieser Konflikt kann als Konflikt zwischen dem *Es*, welches unmoralische (beispielsweise aggressive) Impulse sendet, und dem überstrengen *Über-Ich*, konzeptualisiert werden (Fenichel, 1946). Die Rolle der Ärgerunterdrückung wurde auch von kognitiven Konzepten aufgegriffen, jedoch nicht als Ursache der Zwangsstörung, sondern eher als Folge kognitiver Verzerrungen. Genauer postulierte Rachman (1997), dass Ärgerunterdrückung als Folge eines überhöhten Verantwortungsgefühls zu betrachten sei, bei dem sich Personen mit Zwangsstörungen als vollständig verantwortlich dafür ansehen Schaden zu verhindern, was jedoch eine unrealistische und unerreichbare Erwartung ist (Ashbaugh et al., 2006). Diese interne Zuschreibung von Verantwortung kann zu Frustration und Ärger führen

(Radomsky et al., 2007), erschwert jedoch gleichzeitig den Ausdruck dieses Ärgers (z.B. durch aggressives Verhalten), was wiederum zu Unterdrückung von Ärger und der Entstehung von Schuldgefühlen führt. Bisherige Querschnittstudien zeigen einen Zusammenhang zwischen Ärgerunterdrückung und Zwangssymptomen (z.B. Cludius et al., 2021; Moritz et al., 2009, 2011), jedoch bleibt offen, ob Ärgerunterdrückung eine Ursache oder eine Folge der Symptomatik ist.

In den darauffolgenden Jahren wurden kognitive Modelle um weitere kognitive, emotionale und verhaltensbezogene Faktoren erweitert. In ihrem kognitiv-behavioralen Modell der Zwangsstörung stellen Salkovskis & McGuire (2003) heraus, dass die Fehlinterpretation aufdringlicher Gedanken in Wechselwirkung mit anderen Prozessen steht. Zum einen sind in Folge der Missinterpretation Stimmungsveränderungen zu beobachten, insbesondere verstärkte Angst und Stresserleben. Zudem sind Aufmerksamkeits- und Denkverzerrungen ein zentraler Faktor, da Betroffene intrusiven Gedanken und auslösenden Reizen übermäßige Aufmerksamkeit schenken, was ihre Fehlinterpretation verstärkt und die Wahrscheinlichkeit von weiteren Zwangsgedanken erhöht. Um Unbehagen zu reduzieren, greifen Personen mit Zwangsstörung häufig auf kontraproduktive Sicherheitsstrategien (z.B. Vermeidung, Unterdrückung) und Neutralisierungsverhalten (z.B. zwanghaftes Kontrollieren, Waschen oder Rückversicherungssuchen) zurück. Diese Strategien bieten zwar kurzfristige Erleichterung, verstärken jedoch langfristig maladaptive Überzeugungen und erhöhen die Wiederkehr intrusiver Gedanken. Dieses Modell erlaubte die Formulierung mehrerer überprüfbarer Hypothesen (Shafran, 2005). Dennoch bleibt die Rolle einzelner Aspekte, wie die der Aufmerksamkeitsverzerrungen, empirisch bislang unzureichend geklärt (siehe Basel et al., 2023).

Mit Hinblick auf die offenen Fragen hinsichtlich der Rolle von Ärgerunterdrückung und der Präsenz von Aufmerksamkeitsverzerrungen in der Zwangsstörung, zielten *Studie III* und *Studie IV* darauf ab, das Verständnis für die Entstehung und Aufrechterhaltung von

Zwangsstörungen durch fundierte Grundlagenforschung zu vertiefen und mit neuen Erkenntnissen zu erweitern. In Anbetracht der unterschiedlichen Annahmen psychodynamischer (Freud, 1909) und kognitiver Theorien (Rachman, 1993) zur Rolle der Ärgerunterdrückung in der Zwangsstörung wurde in *Studie III* untersucht, ob die Ärgerunterdrückung eher eine Ursache oder eine Folge von Zwangssymptomen ist. Daher wurde die zeitliche Beziehung zwischen Ärgerunterdrückung, übersteigertem Verantwortungsgefühl und Zwangssymptomen bei Teilnehmer:innen mit Zwangsstörung (n = 48) untersucht. Die Teilnehmer:innen wurden im Rahmen einer Interventionsstudie rekrutiert, in der die Effekte eines metakognitiven Trainings bei Zwangsstörungen untersucht wurden. Kognitive Verzerrungen wie ein übersteigertes Verantwortungsgefühl, Zwangssymptome und Ärgerunterdrückung wurden zu drei Zeitpunkten untersucht: vor der Intervention, nach der Intervention und bei einer sechsmonatigen Nachuntersuchung. Die Ergebnisse der Strukturgleichungsmodelle zeigten, dass Zwangssymptome, unabhängig von depressiven Symptomen und Medikation, eine verstärkte Ärgerunterdrückung im Laufe der Zeit vorhersagten. Die umgekehrte Prädiktion, bei der das Niveau der Ärgerunterdrückung Zwangssymptome vorhersagt, ergab hingegen keine signifikanten Ergebnisse, was die kognitive Perspektive (Rachman, 1993) weiter stützt. Die Verbindung zwischen dem übersteigerten Verantwortungsgefühl und der Ärgerunterdrückung war weniger eindeutig und scheint nur bei Patient:innen mit generell erhöhten Werten in beiden Bereichen, insbesondere bei solchen mit Symptomen der Kontrollzwänge, vorhanden zu sein. Diese Ergebnisse sollten unter Berücksichtigung der Stichprobencharakteristika und des Studiendesigns interpretiert werden. Da die Teilnehmer:innen eine strukturierte metakognitive Intervention erhielten, könnten Behandlungseffekte die beobachteten Zusammenhänge beeinflusst haben, beispielsweise durch Veränderungen in den untersuchten kognitiv-affektiven Mechanismen. Dass die Intervention unterschiedliche Auswirkungen auf die untersuchten Mechanismen hatte, wird dadurch bestärkt, dass sich die Zwangssymptome während der Intervention signifikant

verringerten, während das Niveau der Ärgerunterdrückung stabil blieb. Demnach scheint es so, als wären dysfunktionale Emotionsregulationsmechanismen wie die Ärgerregulation nicht durch gängige störungsspezifische Behandlungsmethoden zu reduzieren, was die Frage nach alternativen, emotionsfokussierten Behandlungsoptionen als wertvolle Ergänzung bestehender Verfahren aufwirft.

Wie in *Studie III*, wurde auch in *Studie* IV ein theoriebasierter Ansatz gewählt. Basierend auf dem kognitiv-behavioralen Modell der Zwangsstörung (Salkovskis & McGuire, 2003) wurde die Rolle von Aufmerksamkeitsverzerrungen in der Zwangsstörung untersucht. Angesichts inkonsistenter Befunde in vorherigen Studien (siehe Basel et al., 2023) verfolgte *Studie IV* das Ziel, methodische Schwächen früherer Forschung (z.B. keine klinische Kontrollgruppe, generisches Bildmaterial) zu verbessern und somit präzisere Erkenntnisse über Aufmerksamkeitsprozesse in der Zwangsstörung zu gewinnen. Mithilfe eines „Free-Viewing" Paradigmas wurden daher die Blickbewegungen bei Personen mit Zwangsstörungen (n = 51), Spinnenphobie (n = 50) und nicht-klinischen Kontrollpersonen (n = 64) mithilfe eines Eye-Trackers untersucht. Die Teilnehmer:innen bewerteten alle Bilder hinsichtlich ihrer individuellen Valenz und Krankheitsrelevanz. Bemerkenswerterweise wurde deutlich, dass im Durchschnitt nur ein Drittel der Bilder, die als zwangsbezogen eingestuft wurden, für die Betroffenen mit Zwangsstörung tatsächlich zwangsrelevant sind. Die individuelle Bewertung erlaubte eine gezieltere Analyse von Aufmerksamkeitsverzerrungen auf idiosynkratisch krankheitsrelevante Bilder im Vergleich zu negativen und neutralen Bildern. Die Ergebnisse zeigten, dass entgegen den theoretischen Erwartungen keine *Vigilance Bias* beobachtet wurde, da Teilnehmer:innen mit Zwangsstörungen weder wahrscheinlicher zuerst noch schneller auf störungsrelevante Stimuli fixierten. Ebenfalls zeigte sich auf zwangsrelevanten Bilder keine *Maintenance Bias* (d.h. eine längere Fixationsdauer). Jedoch zeigten sich in explorativen Analysen differenziertere Effekte hinsichtlich der Fixationsdauer auf zwangsrelevante Bilder bei Teilnehmer:innen mit Zwangsstörung. Diese Analysen zeigten, dass Bilder zu

Kontaminations- und Waschzwängen eher vermieden, während solche zu Kontrollzwängen intensiver betrachtet wurden (*Maintenance Bias*). Im Kontrast hierzu zeigten Teilnehmer:innen mit Spinnenphobie eine allgemeine strategische Vermeidung phobierelevanter Bilder. Daher stellen die Ergebnisse in Frage, dass angstbasierte Modelle zu Aufmerksamkeitsverzerrungen auf Zwangsstörungen übertragen werden können. Ein möglicher Erklärungsansatz sind die zugrundeliegenden Emotionen der verschiedenen Symptomcluster: Während bei Kontaminations- und Waschzwängen sowie bei der Spinnenphobie empfundener Ekel im Vordergrund steht und mit Vermeidungsverhalten einhergeht, führt Furcht vor potenziellem Schaden bei Kontrollzwängen eher zu einer verstärkten Aufmerksamkeitsbindung an potenziell bedrohliche Reize. Daher unterstreichen die Ergebnisse die Notwendigkeit, die Heterogenität der Zwangsstörung in der Grundlagenforschung zu berücksichtigen, sowohl in der Ausprägung von Aufmerksamkeitsverzerrungen als auch in den damit zusammenhängenden Emotionen, um ein besseres Verständnis der zugrundeliegenden Mechanismen zu fördern.

Zusammenfassend trägt diese Dissertation durch die Validierung des OCI-4 und des OCI-12 einen Beitrag zur Verbesserung der frühzeitigen Diagnosestellung von Zwangsstörungen bei und ermöglicht eine präzisere Symptomerfassung in klinischen und wissenschaftlichen Kontexten. Darüber hinaus stellen die Erkenntnisse zu den zugrunde liegenden Faktoren der Zwangsstörung die Annahme universeller Mechanismen in ihrer Entstehung infrage und heben stattdessen symptomabhängige kognitiv-affektive Prozesse hervor, wie die Unterdrückung von Ärger bei Kontrollzwängen oder Aufmerksamkeitsverzerrungen, die sich auf spezifische Inhalte und möglicherweise zugrundeliegende emotionale Zustände, unterschiedlich ausprägen. Zudem werden Emotionsregulationsschwierigkeiten als möglicher weiterer Faktor diskutiert, da sowohl Ärgerunterdrückung als auch Aufmerksamkeitsverzerrungen als Prozesse der Emotionsregulation betrachtet werden können. Insgesamt trägt diese Dissertation dadurch zur Verbesserung der Symptomerfassung der heterogenen Symptome der Zwangsstörung bei und

betont gleichzeitig die Notwendigkeit verfeinerter theoretischer Konzeptualisierungen. Demnach sind Erkenntnisse aus der Grundlagenforschung nicht nur essenziell für die Entwicklung neuer Interventionen, sondern sollten auch theoretische Modelle informieren, da sie zur präziseren Differenzierung kognitiver, behavioraler und affektiver Mechanismen beitragen können.

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Appendices

List of Appendices

Appendix A: Study I

Appendix A1: Translation Procedure

Two native German speakers, who are also proficient in English (Z. I. S. compound bilingual and M. A. coordinate bilingual), translated the English version of the OCI-12 into German and wrote a short report on the translation and critical terms during the translation. These two German versions were synthesised into one version and proved for adequacy by an expert committee (consisting of B. C., J. F.-L., L. J., L. L., and C. M.). This synthesised version was then back-translated by two native English speaker (coordinate bilinguals T. F. and X. S.) who had not been involved in the prior translation process. Finally, these two back-translated English versions were proved for adequacy in an expert meeting including the first author of the English OCI-12 version (A. A., B. C., C. M.; Abramovitch et al., 2021b). Some minor adjustments of the German version were made and ultimately proved for adequacy by the German expert panel. Thereby, the final German version of the OCI-12 was established and is freely available online on the Open Science Framework (https://osf.io/4m9x6/).

Appendix A2: Sample Characteristics

Table A2.1

Sample Characteristics.

	OCD *n* = 102	ARD *n* = 69	NC *n* = 248
Variable		*Mean* (*SD*); *n* (%)	
Gender			
Female	73 (71.57%)	56 (81.16%)	135 (54.44%)
Male	27 (26.47%)	13 (18.84%)	113 (45.56%)
Diverse	2 (1.96%)	0 (0.00%)	0 (0.00%)
Age			
(in years)	30.34 (8.98)	30.93 (10.07)	56.06 (14.23)
Highest Education			
No school diploma	0 (0.00%)	1 (1.45%)	0 (0.00%)
Basic secondary school diploma	0 (0.00%)	1 (1.45%)	7 (2.82%)
General certificate of secondary education	10 (9.80%)	5 (7.25%)	22 (8.87%)
High-school degree	28 (27.45%)	17 (24.64%)	20 (8.06%)
Completed vocational training	16 (15.69%)	9 (13.04%)	44 (17.74%)
College of applied sciences degree	9 (8.82%)	8 (11.59%)	40 (16.13%)
Bachelor’s degree	20 (19.61%)	18 (26.09%)	21 (8.47%)
Master’s degree	19 (18.63%)	9 (13.04%)	72 (29.03%)
Doctorate degree	0 (0.00%)	1 (1.45%)	22 (8.87%)
Comorbidities			
Depressive disorder	9 (8.82%)	22 (31.88%)	–
Eating disorder	2 (1.96%)	3 (4.35%)	–
Substance use disorder	0 (0.00%)	0 (0.00%)	–
Anxiety disorder	13 (12.75%)	–	–
OCD Symptoms			
$OCI\text{-}12_{Total}$	23.22 (9.19)	11.00 (7.34)	4.10 (3.23)
$OCI\text{-}12_{Checking}$	5.26 (3.32)	2.06 (2.32)	0.79 (0.95)
$OCI\text{-}12_{Ordering}$	4.90 (3.52)	3.78 (3.14)	1.96 (1.74)
$OCI\text{-}12_{Washing}$	5.83 (4.41)	1.59 (2.16)	0.34 (0.85)
$OCI\text{-}12_{Obsessing}$	7.22 (3.06)	3.57 (2.74)	1.02 (1.43)
$DOCS_{Total}$	29.32 (12.59)	11.33 (10.52)	2.53 (3.00)
$DOCS_{Contamination}$	8.44 (5.59)	1.99 (2.68)	0.56 (1.17)
$DOCS_{Responsibility}$	8.28 (5.27)	3.36 (3.96)	0.77 (1.29)
$DOCS_{TabooThoughts}$	7.46 (5.07)	3.65 (4.36)	0.74 (1.29)
$DOCS_{Symmetry}$	5.65 (5.01)	2.54 (3.42)	0.48 (0.97)

Note. OCD = Obsessive-Compulsive Disorder, ARD = Anxiety-Related Disorders, NC = Non-Clinical Controls,

OCI-12 = 12-item Obsessive-Compulsive Inventory, $OCI\text{-}12_{Total}$ = OCI-12 total sum score, $OCI\text{-}12_{Checking}$ = sum score of the OCI-12 "checking" subscale, $OCI\text{-}12_{Ordering}$ = sum score of the OCI-12 "ordering" subscale, $OCI\text{-}12_{Washing}$ = sum score of the OCI-12 "washing" subscale, $OCI\text{-}12_{Obsessing}$ = sum score of the OCI-12 "obsessing" subscale, $DOCS_{Total}$ = DOCS sum score, $DOCS_{Contamination}$ = sum score of the DOCS "contamination" subscale, $DOCS_{Responsibility}$ = sum score of the DOCS "responsibility for harm and mistakes" subscale, $DOCS_{TabooThoughts}$ = sum score of the DOCS "unacceptable/taboo thoughts" subscale, $DOCS_{Symmetry}$ = sum score of the DOCS "symmetry" subscale.

Appendix A3: Internal Consistencies of Questionnaires

The internal consistencies of the assessment methods used in the current study are presented in Table C1. In the present study, the Y-BOCS-SR, the Y-BOCS as interview form, and the overall Y-BOCS (containing both assessment forms; used for analyses) evidenced good internal consistency. The DOCS and the ASI-3 both showed acceptable to excellent internal consistency. The PSWQ demonstrated excellent internal consistency. Lastly, the PHQ-9 showed acceptable-to-good internal consistency.

Table B3.1

Internal Consistencies of Administered Questionnaires.

Interview/ Questionnaire	OCD *n* = 102		ARD *n* = 69		NC *n* = 248	
	α	ω	α	ω	α	ω
Y-BOCS	.85	.84	–	–	–	–
$Y\text{-}BOCS_{Interview}$	.87	.88	–	–	–	–
Y-BOCS-SR	.83	.81	–	–	–	–
DOCS	.87	.72	.92	.92	.77	.77
ASI-3	.87	.87	.92	.92	.89	.89
PSWQ	.93	.93	.95	.96	.92	.91
PHQ-9	.83	.83	.87	.88	.73	.75

Note. OCD = Obsessive-Compulsive Disorder, ARD = Anxiety-Related Disorders, NC = Non-Clinical Controls, Y-BOCS = Yale-Brown Obsessive-Compulsive Inventory (Combined Y-BOCS Interview and Y-BOCS SR), $Y\text{-}BOCS_{Interview}$ = Yale-Brown Obsessive-Compulsive Inventory Interview, Y-BOCS-SR = Yale-Brown Obsessive-Compulsive Inventory Self-Rating, DOCS = Dimensional Obsessive-Compulsive Scale, ASI-3 = Anxiety-Sensitivity Index-3, PSWQ = Penn-State Worry Questionnaire, PHQ-9 = Patient-Health Questionnaire-9.

Appendix A4: Formulation of OCI-12 Items

Table A4.1

Formulation of German OCI-12 Items.

	German OCI-12 Items	Subscale
1	Ich kontrolliere Dinge öfter als nötig.	Checking
2	Es stört mich, wenn Gegenstände nicht richtig angeordnet sind.	Ordering
3	Es fällt mir schwer, einen Gegenstand zu berühren, wenn ich weiß, dass er von fremden oder bestimmten Personen berührt wurde.	Washing
4	Es fällt mir schwer, meine eigenen Gedanken zu kontrollieren.	Obsessing
5	Ich kontrolliere immer wieder Türen, Fenster, Schubladen usw.	Checking
6	Es belastet mich, wenn andere etwas daran ändern, wie ich die Dinge angeordnet habe.	Ordering
7	Manchmal muss ich mich waschen oder reinigen, einfach weil ich mich kontaminiert/beschmutzt fühle.	Washing
8	Mich belasten unangenehme Gedanken, die mir gegen meinen Willen in den Sinn kommen.	Obsessing
9	Ich kontrolliere immer wieder Gas- und Wasserhähne und Lichtschalter, nachdem ich sie abgedreht/ausgeschaltet habe.	Checking
10	Für mich müssen Dinge in einer bestimmten Art und Weise angeordnet sein.	Ordering
11	Ich wasche mir die Hände öfter und länger als nötig.	Washing
12	Ich habe oft schlechte Gedanken und habe Schwierigkeiten, sie loszuwerden.	Obsessing

Appendix A5: OCI-12 Subscales Predicting DOCS Factors

Table A5.1

OCI-12 Subscales Predicting Scores on the DOCS Factors (N = 419).

OCI-12 Subscale	β	*t*	*p*
Predicting DOCS Responsibility for Harm and Mistakes			
Checking	0.44	9.87	<.001*
Ordering	-0.01	-0.37	.714
Washing	0.07	1.78	.077
Obsessing	0.38	9.35	<.001*
Predicting DOCS Symmetry			
Checking	0.29	6.09	<.001*
Ordering	0.44	11.43	<.001*
Washing	0.10	2.26	.025
Obsessing	0.10	2.39	.018
Predicting DOCS Contamination			
Checking	0.03	1.02	.833
Ordering	0.07	3.00	.003*
Washing	0.84	29.78	<.001*
Obsessing	0.02	0.67	.506
Predicting DOCS Unacceptable/Taboo Thoughts			
Checking	0.11	2.38	.018*
Ordering	-0.04	-1.02	.309
Washing	-0.01	-0.23	.816
Obsessing	0.71	16.51	<.001*

Note. OCI-12 = 12-item Obsessive-Compulsive Inventory, DOCS = Dimensional Obsessive-Compulsive Scale, β = standardised regression coefficient. Those subscales of the OCI-12 that should predict the subscale of the DOCS most strongly are highlighted in boldface.

Appendix A6: Severity Benchmarks

Table A6.1

OCI-12 Descriptives by Y-BOCS Severity Benchmarks.

	N	OCI-12									
Benchmarks[1]		Total		Checking		Ordering		Washing		Obsessing	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Mild (0-13)	10	15.50	6.93	4.00	2.25	3.80	3.99	2.40	3.71	5.30	2.91
Moderate (14-25)	65	22.32	8.95	4.88	3.37	4.78	3.57	5.40	4.23	7.26	3.03
Moderate-to-Severe (26-34)	24	28.21	7.73	6.79	2.92	5.67	3.41	7.75	4.10	8.00	2.70
Severe (35-40)	3	28.33	11.68	5.67	5.69	5.00	0.00	11.33	0.58	6.33	5.51

Note. Y-BOCS = Yale-Brown Obsessive-Compulsive Scale, OCI-12 = 12-item Obsessive-Compulsive Inventory

[1]The severity benchmarks of the Y-BOCS are derived from (Storch et al., 2015).

12-Item Zwangsinventar / 12-Item Obsessive-Compulsive Inventory (OCI-12)

Die folgenden Aussagen beziehen sich auf Erfahrungen, die viele Menschen in ihrem Alltag machen. Markieren Sie die Zahl, die am besten beschreibt, **WIE SEHR** diese Erfahrung im **LETZTEN MONAT** bei Ihnen Unbehagen ausgelöst oder Sie **BELASTET** hat.
Die Zahlen beziehen sich auf die folgenden Abstufungen:

		0 Überhaupt nicht	1 Ein wenig	2 Mäßig	3 Stark	4 Extrem
1.	Ich kontrolliere Dinge öfter als nötig.	0	1	2	3	4
2.	Es stört mich, wenn Gegenstände nicht richtig angeordnet sind.	0	1	2	3	4
3.	Es fällt mir schwer, einen Gegenstand zu berühren, wenn ich weiß, dass er von fremden oder bestimmten Personen berührt wurde.	0	1	2	3	4
4.	Es fällt mir schwer, meine eigenen Gedanken zu kontrollieren.	0	1	2	3	4
5.	Ich kontrolliere immer wieder Türen, Fenster, Schubladen usw.	0	1	2	3	4
6.	Es belastet mich, wenn andere etwas daran ändern, wie ich die Dinge angeordnet habe.	0	1	2	3	4
7.	Manchmal muss ich mich waschen oder reinigen, einfach weil ich mich kontaminiert/beschmutzt fühle.	0	1	2	3	4
8.	Mich belasten unangenehme Gedanken, die mir gegen meinen Willen in den Sinn kommen.	0	1	2	3	4
9.	Ich kontrolliere immer wieder Gas- und Wasserhähne und Lichtschalter, nachdem ich sie abgedreht/ausgeschaltet habe.	0	1	2	3	4
10	Für mich müssen Dinge in einer bestimmten Art und Weise angeordnet sein.	0	1	2	3	4
11	Ich wasche mir die Hände öfter und länger als nötig.	0	1	2	3	4
12	Ich habe oft schlechte Gedanken und habe Schwierigkeiten, sie loszuwerden.	0	1	2	3	4

Subskalen

Kontrollieren:	1, 5, 9
Ordnen:	2, 6, 10
Waschen:	3, 7, 11
Zwangsgedanken:	4, 8, 12

Auswertungsregeln

Für die Auswertung wird ein Summenwert über die 12 Items gebildet (Skala erstreckt sich von 0 – 48). Für die Subskalen wird ein Summenwert über die jeweiligen Items der Skala gebildet (pro Subskala erstreckt sich die Skala von 0 – 12).

Grenzwerte

Grenzwert zur Unterscheidung von Patient:innen mit Zwangsstörungen (OCD) von nicht-klinischen Personen:

OCI-12 Gesamtscore ≥ 11

Grenzwert zur Unterscheidung von Patient:innen mit Zwangsstörungen (OCD) von Patient:innen mit angstbezogenen Störungen:

OCI-12 Gesamtscore ≥ 17

Lizenz

Müller, C. L., Fink-Lamotte, J., Jelinek, L., Lohse, L., Ehring, T., Noll-Hussong, M., Berberich, G., Wahl-Kordon, A., Borgelt, J., McKay, D., Abramowitz, J. S., Abramovitch, A., & Cludius, B. (2025). Translation and validation of the German 12-item Obsessive-Compulsive Inventory (OCI-12) in clinical and non-clinical samples. *Clinical Psychology in Europe*, *7*(4), e16165. https://doi.org/10.32872/cpe.16165

Appendix B: Study II

Appendix B1: Sample Characteristics

Table B1.1

Sample Characteristics.

	OCD *n* = 102	ARD *n* = 69	NC *n* = 248
Variable		*Mean* (*SD*); %(*n*)	
Gender			
Female	73 (71.57%)	56 (81.16%)	135 (54.44%)
Male	27 (26.47%)	13 (18.84%)	113 (45.56%)
Diverse	2 (1.96%)	0 (0.00%)	0 (0.00%)
Age			
(in years)	30.34 (8.98)	30.93 (10.07)	56.06 (14.23)
Highest Education			
No school diploma	0 (0.00%)	1 (1.45%)	0 (0.00%)
Basic secondary school diploma	0 (0.00%)	1 (1.45%)	7 (2.82%)
General certificate of secondary education	10 (9.80%)	5 (7.25%)	22 (8.87%)
High-school degree	28 (27.45%)	17 (24.64%)	20 (8.06%)
Completed vocational training	16 (15.69%)	9 (13.04%)	44 (17.74%)
College of applied sciences degree	9 (8.82%)	8 (11.59%)	40 (16.13%)
Bachelor’s degree	20 (19.61%)	18 (26.09%)	21 (8.47%)
Master’s degree	19 (18.63%)	9 (13.04%)	72 (29.03%)
Doctorate degree	0 (0.00%)	1 (1.45%)	22 (8.87%)
Comorbidities			
Depressive disorder	9 (8.82%)	22 (31.88%)	–
Eating disorder	2 (1.96%)	3 (4.35%)	–
Substance use disorder	0 (0.00%)	0 (0.00%)	–
Anxiety disorder	13 (12.75%)	–	–
Other	15 (14.71%)	1 (1.15%)	–

Note. OCD = Obsessive-Compulsive Disorder, ARD = Anxiety-Related Disorders, NC = Non-Clinical Controls

Appendix B2: Formulation of German OCI-4 Items

Table B2.1

Formulation of German OCI-4 Items.

	German OCI-4 Items	Subscale
1	Es stört mich, wenn Gegenstände nicht richtig angeordnet sind.	Ordering
2	Ich kontrolliere immer wieder Türen, Fenster, Schubladen usw.	Checking
3	Manchmal muss ich mich waschen oder reinigen, einfach weil ich mich kontaminiert/beschmutzt fühle.	Washing
4	Ich habe oft schlechte Gedanken und habe Schwierigkeiten, sie loszuwerden.	Obsessing

4-Item Zwangsinventar / 4-Item Obsessive-Compulsive Inventory (OCI-4)

Die folgenden Aussagen beziehen sich auf Erfahrungen, die viele Menschen in ihrem Alltag machen. Markieren Sie die Zahl, die am besten beschreibt, **WIE SEHR** diese Erfahrung im **LETZTEN MONAT** bei Ihnen Unbehagen ausgelöst oder Sie **BELASTET** hat.
Die Zahlen beziehen sich auf die folgenden Abstufungen:

		0 Überhaupt nicht	1 Ein wenig	2 Mäßig	3 Stark	4 Extrem
1.	Es stört mich, wenn Gegenstände nicht richtig angeordnet sind.	0	1	2	3	4
2.	Ich kontrolliere immer wieder Türen, Fenster, Schubladen usw.	0	1	2	3	4
3.	Manchmal muss ich mich waschen oder reinigen, einfach weil ich mich kontaminiert/beschmutzt fühle.	0	1	2	3	4
4.	Ich habe oft schlechte Gedanken und habe Schwierigkeiten, sie loszuwerden.	0	1	2	3	4

Subskalen

Ordnen: 1

Kontrollieren: 2

Waschen: 3

Zwangsgedanken: 4

Auswertungsregeln

Für die Auswertung wird ein Summenwert über die 4 Items gebildet (Skala von 0 – 16).

Grenzwerte

Grenzwert zur Unterscheidung von Patient:innen mit Zwangsstörungen (OCD) von nicht-klinischen Personen:

OCI-4 Gesamtscore ≥ 4

Grenzwert zur Unterscheidung von Patient:innen mit Zwangsstörungen (OCD) von Patient:innen mit angstbezogenen Störungen:

OCI-4 Gesamtscore ≥ 6

Lizenz:

Müller, C. L., Jelinek, L., Fink-Lamotte, J., Scheunemann, J., McKay, D., Abramowitz, J. S., Abramovitch, A., & Cludius, B. (2025). Four questions for clarity: A first investigation of the German version of the OCI-4 as an ultra-brief screening tool for Obsessive-Compulsive Disorder. *Journal of Obsessive-Compulsive and Related Disorders*, *45*, 100953. https://doi.org/10.1016/j.jocrd.2025.100953

Appendix C: Study III

Appendix C1: Correlation Tables for Mediation Models

Table C1.1

Means, standard deviations, and correlations with confidence intervals for variables relevant to mediation models of Hypothesis 1A and 1B.

Variable	*M*	*SD*	1	2	3
1. Inflated Sense of Responsibility $_{\text{Baseline}}$	67.30	26.09			
2. OCI-R$_{\text{Post-Intervention}}$	18.44	10.49	.22 [-.09, .49]		
3. Y-BOCS$_{\text{Post-Intervention}}$	17.76	6.68	-.10 [-.39, .21]	**.50**** **[.23, .70]**	
4. Anger Suppression$_{\text{Follow-Up}}$	17.06	6.04	.29 [-.04, .57]	**.38*** **[.04, .64]**	-.01 [-.35, .34]

Note. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014).
* $p < .05$. ** $p < .01$.

Table C1.2

Means, standard deviations, and correlations with confidence intervals for variables relevant to mediation models of Hypothesis 2A and 2B.

Variable	*M*	*SD*	1	2	3
1. ΔInflated Sense of Responsibility	0.00	14.91			
2. ΔOCD Symptoms$_{OCI-R}$	0.00	6.61	**.37*** **[.07, .61]**		
3. ΔOCD Symptoms$_{Y-BOCS}$	0.00	5.42	.28 [-.04, .54]	**.47**** **[.19, .68]**	
4. ΔAnger Suppression	0.00	4.21	**-.38*** **[-.64, -.04]**	.01 [-.34, .36]	.01 [-.33, .35]

Note. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). *ΔInflated Sense of Responsibility* = residualized change score of inflated sense of responsibility from baseline to post-intervention , *ΔAnger Suppression* = residualized change score of anger suppression from baseline to follow-up, *ΔOCD Symptoms$_{OCI-R}$* = residualized change scores of OCD symptoms as assessed with the OCI-R from baseline to post-intervention, *ΔOCD Symptoms$_{YBOCS}$* = residualized change scores of OCD symptoms as assessed with the Y-BOCS from baseline to post-intervention.

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

Appendix C2: Exploratory Analyses on Sub-Sample with Checking Compulsions

Table C2.1

Descriptives of High- versus Low-Checking Samples.

	Baseline		Post-Intervention		Follow-Up	
	Low-Checking (n = 27)	High-Checking (n = 20)	Low-Checking (n = 25)	High-Checking (n = 17)	Low-Checking (n = 19)	High-Checking (n = 17)
Variable	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
OCD Symptoms (Y-BOCS$_{Total}$)	23.63 (7.06)	27.10 (4.17)	17.08 (7.68)	18.76 (4.92)	16.11 (8.35)	17.12 (6.84)
OCD Symptoms (OCI-R$_{Total}$)	18.15 (7.51)	30.30 (9.06)	14.88 (8.18)	24.00 (11.49)	13.00 (8.83)	18.18 (13.53)
Inflated Sense of Responsibility (OBQ-44$_{Responsibility}$)	58.26 (24.39)	79.50 (23.69)	52.68 (20.62)	67.63 (18.70)	48.21 (19.90)	63.12 (24.94)
Anger Suppression (STAXI-2$_{Expression-In}$)	17.78 (5.24)	18.85 (6.61)	16.64 (5.69)	21.31 (5.97)	15.89 (5.96)	18.35 (6.04)

Note. *Low-Checking* = patients with OCD that present low checking-related symptoms as defined via a sum score of < 6 on the OCI-R subscale checking at baseline. *High-Checking* = patients with OCD that present high checking-related symptoms as defined via a sum score of ≥ 6 on the OCI-R subscale checking at baseline. Cut-off was based on Gönner et al. (2009).

Table C2.2

Mediation models for exploratory analyses in OCD checking sub-sample as investigated by separate structural equation models.

Independent Variable (IV)	Dependent Variable (DV)	Mediator (M)	Effect of IV on M (a) *B*, β (*SE*), *z*, *p*	Effect of M on DV (b) *B*, β (*SE*), *z*, *p*	Indirect Effect (ab) *B*, β [95% CI]	Total Effect (c') *B*, β [95% CI]	Explained Variance (R^2)
Inflated Sense of Responsibility	Anger Suppression	OCD Symptoms $_{OCI-R}$	0.037, 0.075 (0.201), 0.186, .852	**0.284, 0.537 (0.116), 2.445, .014***	0.011, 0.040 [-0.104; 0.159]	**0.154, 0.583 [0.044; 0.353]***	$R^2_{OCI-R:}$ .006 $R^2_{Anger\ Suppression:}$ .627
Inflated Sense of Responsibility	Anger Suppression	OCD Symptoms $_{Y-BOCS}$	**-0.128, -0.574 (0.056), -2.285, .022***	0.519, 0.439 (0.364), 1.427, .154	-0.066, -0.252, [-0.202; 0.019]	**0.147, 0.557 [0.026; 0.341]***	$R^2_{Y-BOCS:}$ .329 $R^2_{Anger\ Suppression:}$ .439
ΔInflated Sense of Responsibility	ΔAnger Suppression	ΔOCD Symptoms $_{OCI-R}$	0.159, 0.269 (0.224), 0.710, .477	0.077, 0.240 (0.121), 0.634, .526	0.012, 0.065 [-0.066; 0.119]	0.015, 0.078 [-0.040; 0.170]	$R^2_{\Delta OCI-R:}$ .072 $R^2_{\Delta Anger\ Suppression:}$ .060
ΔInflated Sense of Responsibility	ΔAnger Suppression	ΔOCD Symptoms $_{Y-BOCS}$	**0.175, 0.542 (0.085), 2.048, .041***	**0.400, 0.686 (0.197), 2.027, .043***	0.070, 0.371, [-0.023; 0.171]	0.026, 0.138 [-0.024; 0.180]	$R^2_{\Delta Y-BOCS:}$ .293 $R^2_{\Delta Anger\ Suppression:}$ .352

Note. Sample consists of $n = 20$ Patients with OCD that present checking-related symptoms as defined via a sum score of ≥ 6 on the OCI-R subscale checking (Gönner et al., 2009).

B = unstandardised regression coefficient, β = completely standardised solution.

ΔInflated Sense of Responsibility = residualized change score of inflated sense of responsibility from baseline to post-intervention , *ΔAnger Suppression* = residualized change score of anger suppression from baseline to follow-up, *ΔOCD Symptoms*$_{OCI-R}$ = residualized change scores of OCD symptoms as assessed with the OCI-R from baseline to post-intervention, *ΔOCD Symptoms*$_{YBOCS}$ = residualized change scores of OCD symptoms as assessed with the Y-BOCS from baseline to post-intervention.

* $p < 0.05$. $^{\bullet}$ $p < 0.10$

Appendix C3: Sensitivity Analyses

Table C3.1

Mediation models as investigated by separate structural equation models controlled for depressive symptoms and medication intake.

Independent Variable (IV)	Dependent Variable (DV)	Mediator (M)	Effect of IV on M (a) *B*, β (*SE*), *z*, *p*	Effect of M on DV (b) *B*, β (*SE*), *z*, *p*	Indirect Effect (ab) *B*, β [95% CI]	Total Effect (c') *B*, β [95% CI]	Explained Variance (R^2)
Inflated Sense of Responsibility	Anger Suppression	OCD Symptoms $_{OCI-R}$	0.096, 0.238 (0.068), 1.420, .155	**0.232, 0.391 (0.101), 2.299, .021***	0.022, 0.093 [-0.005; 0.079]	**0.090, 0.378 [0.000; 0.182]**	R^2_{OCI-R}: .057 $R^2_{Anger\ Suppression}$: .301
Inflated Sense of Responsibility	Anger Suppression	OCD Symptoms $_{Y-BOCS}$	-0.028, -0.110 (0.041), -0.682, .495	0.048, 0.054 (0.232), 0.207, .836	-0.001, -0.006 [-0.040; 0.009]	0.077, 0.331 [-0.028; 0.163]	R^2_{Y-BOCS}: .012 $R^2_{Anger\ Suppression}$: .109
ΔInflated Sense of Responsibility	ΔAnger Suppression	ΔOCD Symptoms $_{OCI-R}$	**0.166, 0.373 (0.069), 2.287, .017***	0.166, 0.260 (0.085), 1.943, .052•	0.027, 0.097 [-0.001; 0.080]	-0.093, -0.326 [-0.205; 0.019]	$R^2_{\Delta OCI-R}$: .139 $R^2_{\Delta Anger\ Suppression}$: .205
ΔInflated Sense of Responsibility	ΔAnger Suppression	ΔOCD Symptoms $_{Y-BOCS}$	**0.102, 0.280 (0.046), 2.218, .027***	0.182, 0.234 (0.160), 1.142, .254	0.019, 0.066 [-0.017; 0.052]	-0.094, -0.330 [-0.201; 0.012]	$R^2_{\Delta Y-BOCS}$: .078 $R^2_{\Delta Anger\ Suppression}$: .199

Note.

Depressive symptoms as assessed with the PHQ-9 and medication intake (0 = no medication, 1 = medication) are added as covariates in the mediation model.

B = unstandardised regression coefficient, β = completely standardised solution.

ΔInflated Sense of Responsibility = residualized change score of inflated sense of responsibility from baseline to post-intervention , *ΔAnger Suppression* = residualized change score of anger suppression from baseline to follow-up, *ΔOCD Symptoms*$_{OCI-R}$ = residualized change scores of OCD symptoms as assessed with the OCI-R from baseline to post-intervention, *ΔOCD Symptoms*$_{YBOCS}$ = residualized change scores of OCD symptoms as assessed with the Y-BOCS from baseline to post-intervention. Controlled for depressive symptoms as assessed with the PHQ-9 at post-intervention and for medication intake (0 = no medication intake, 1 = medication intake).

* $p < 0.05$, • $p < 0.10$

Appendix C4: Exploratory Analyses on the Directionality of Effects

Table C4.1

Mediation models with interchanged mediator and dependent variable as investigated by separate structural equation models.

Independent Variable (IV)	Dependent Variable (DV)	Mediator (M)	Effect of IV on M (a) *B*, β (*SE*), *z*, *p*	Effect of M on DV (b) *B*, β (*SE*), *z*, *p*	Indirect Effect (ab) *B*, β [95% CI]	Total Effect *B*, β [95% CI]	Explained Variance (R^2)
Inflated Sense of Responsibility	OCD $\text{Symptoms}_{OCI\text{-}R}$	Anger Suppression	**0.119, 0.494 (0.034), 3.519, <.001***	0.667, 0.367 (0.443), 1.506, .132	0.079, 0.181 [-0.021; 0.215]	0.060, 0.136 [-0.098; 0.225]	$R^2_{\text{Anger Suppression:}}$ .224 $R^2_{\text{OCI-R:}}$ .120
Inflated Sense of Responsibility	OCD $\text{Symptoms}_{Y\text{-}BOCS}$	Anger Suppression	**0.118, 0.489 (0.034), 3.429, .001***	0.194, 0.161 (0.204), 0.948, .343	0.023, 0.079 [-0.023; 0.075]	0.020, 0.069 [-0.069; 0.120]	$R^2_{\text{Anger Suppression:}}$ .239 $R^2_{\text{Y-BOCS:}}$ .025
ΔInflated Sense of Responsibility	ΔOCD $\text{Symptoms}_{OCI\text{-}R}$	ΔAnger Suppression	-0.069, -0.267 (0.044), -1.542, .123	-0.184, -0.093, (0.447), -0.411, .681	0.013, 0.025 [-0.052; 0.127]	**0.177, 0.349 [0.032; 0.314]**	$R^2_{\Delta\text{Anger Suppression:}}$ .071 $R^2_{\Delta\text{OCI-R:}}$ .130
ΔInflated Sense of Responsibility	ΔOCD $\text{Symptoms}_{Y\text{-}BOCS}$	ΔAnger Suppression	-0.069, -0.267 (0.044), -1.541, .123	-0.245, -0.131 (0.438), -0.560, .575	0.017, 0.035 [-0.077; 0.094]	0.071, 0.148 [-0.025; 0.313]	$R^2_{\Delta\text{Anger Suppression:}}$ .071 $R^2_{\Delta\text{Y-BOCS:}}$ .038

Note. *B* = unstandardised regression coefficient, β = completely standardised solution.

ΔInflated Sense of Responsibility = residualized change score of inflated sense of responsibility from baseline to post-intervention , *ΔAnger Suppression* = residualized change score of anger suppression from baseline to post-intervention, *ΔOCD* $\textit{Symptoms}_{OCI\text{-}R}$ = residualized change scores of OCD symptoms as assessed with the OCI-R from baseline to follow-up, *ΔOCD* $\textit{Symptoms}_{YBOCS}$ = residualized change scores of OCD symptoms as assessed with the Y-BOCS from baseline to follow-up.

* $p < 0.05$, • $p < 0.10$

Appendix D: Study IV

Appendix D1: Contrast Coding of Multilevel Modelling

Table D1.1

Overview of Contrast Coding Used for Hypothesis Testing.

Contrast	Contrast Coding	Part of Hypothesis Tested
a) First Fixation Choice		
Group OCD: OCD-relevant vs. neutral picture	stim_ocd + groupocd:stim_ocd >= 0	Patients with OCD are more likely to first fixate on OCD-relevant material compared to neutral material (choice bias within OCD group)
Group OCD: OCD-relevant vs. negative picture	(stim_ocd + groupocd:stim_ocd) - (stim_neg + groupocd:stim_neg) >= 0	Patients with OCD are more likely to first fixate on OCD-relevant material compared to negative material (choice bias within OCD group)
Group spider phobia: Spider-related vs. neutral picture	stim_pho + groupspider:stim_pho >= 0	Patients with spider phobia are more likely to first fixate on spider-relevant material compared to neutral material (choice bias within spider group)
Group spider phobia: Spider-related vs. negative picture	(stim_pho + groupspider:stim_pho) - (stim_neg + groupspider:stim_neg) >= 0	Patients with spider phobia are more likely to first fixate on spider-relevant material compared to negative material (choice bias within spider group)
Group non-clinical controls: OCD-relevant vs. neutral picture	stim_ocd = 0	Non-clinical controls will not show a bias towards OCD-relevant stimuli compared to neutral stimuli (choice bias within non-clinical control group)
Group non-clinical controls: OCD-relevant vs. negative picture	stim_ocd - stim_neg = 0	Non-clinical controls will not show a bias towards OCD-relevant stimuli compared to negative stimuli (choice bias within non-clinical control group)
Group non-clinical controls: Spider-related vs. neutral picture	stim_pho = 0	Non-clinical controls will not show a bias towards spider-relevant stimuli compared to neutral stimuli (choice bias within non-clinical control group)
Group non-clinical controls: Spider-related vs. negative picture	stim_pho - stim_neg = 0	Non-clinical controls will not show a bias towards spider-relevant stimuli compared to negative stimuli (choice bias within non-clinical control group)
Group OCD: Negative vs. neutral picture	stim_neg + groupocd:stim_neg = 0	Participants with OCD will not show a bias towards negative compared to neutral stimuli (choice bias within OCD group)
Group spider phobia: Negative vs. neutral picture	stim_neg + groupspider:stim_neg = 0	Participants with spider phobia will not show a bias towards negative compared to neutral stimuli (choice bias within spider phobia group)

Group non-clinical controls: Negative vs. neutral picture	stim_neg = 0	Non-clinical controls will not show a bias towards negative compared to neutral stimuli (choice bias within non-clinical control group)

b) First Fixation Latency (Entry Time)

Group OCD: OCD-relevant vs. neutral picture	looked_atocd + groupocd:looked_atocd <= 0	Patients with OCD fixate faster on idiosyncratic OCD-relevant material as compared to neutral material (entry time bias within OCD group)
Group OCD: OCD-relevant vs. negative picture	(looked_atocd + groupocd:looked_atocd) - (looked_atneg + groupocd:looked_atneg) <= 0	Patients with OCD fixate faster on OCD-relevant material as compared to negative material (entry time bias within OCD group)
Group spider phobia: Spider-related vs. neutral picture	looked_atpho + groupspider:looked_atpho <= 0	Patients with spider phobia fixate faster on idiosyncratic spider-relevant material as compared to neutral material (entry time bias within spider group)
Group spider phobia: Spider-related vs. negative picture	(looked_atpho + groupspider:looked_atpho) - (looked_atneg + groupspider:looked_atneg) <= 0	Patients with spider phobia fixate faster on spider-relevant material as compared to negative material (entry time bias within spider group)
Group non-clinical controls: OCD-relevant vs. neutral picture	looked_atocd = 0	Non-clinical controls will not show a bias towards OCD-relevant stimuli compared to neutral stimuli (entry time bias within non-clinical group)
Group non-clinical controls: OCD-relevant vs. negative picture	looked_atocd - looked_atneg = 0	Non-clinical controls will not show a bias towards OCD-relevant stimuli compared to negative stimuli (entry time bias within non-clinical group)
Group non-clinical controls: Spider-related vs. neutral picture	looked_atpho = 0	Non-clinical controls will not show a bias towards spider-relevant stimuli compared to neutral stimuli (entry time bias within non-clinical group)
Group non-clinical controls: Spider-related vs. negative picture	looked_atpho - looked_atneg = 0	Non-clinical controls will not show a bias towards spider-relevant stimuli compared to negative stimuli (entry time bias within non-clinical group)
Group OCD: Negative vs. neutral picture	looked_atneg + groupocd:looked_atneg = 0	Participants with OCD will not show a bias towards negative compared to neutral stimuli (entry time bias within OCD group)
Group spider phobia: Negative vs. neutral picture	looked_atneg + groupspider_looked_atneg = 0	Participants with spider phobia will not show a bias towards negative compared to neutral stimuli (entry time bias within spider phobia group)
Group non-clinical controls: Negative vs. neutral picture	looked_atneg = 0	Non-clinical controls will not show a bias towards negative compared to neutral stimuli (entry time bias within non-clinical control group)

c) Difference in Total Fixation Duration (Dwell Time Difference)

Group OCD: OCD-relevant vs. neutral picture	stim_ocd + groupocd:stim_ocd >= 0	Patients with OCD look at idiosyncratic OCD-relevant material longer compared to neutral material (maintenance bias within OCD group)
Group OCD: OCD-relevant vs. negative picture	(stim_ocd + groupocd:stim_ocd) - (stim_neg + groupocd:stim_neg) >= 0	Patients with OCD look at idiosyncratic OCD-relevant material longer compared to negative material (maintenance bias within OCD group)
Group OCD vs. group non-clinical controls: Disorder-relevant pictures	groupocd + groupocd:stim_ocd >= 0	Patients with OCD will show a more pronounced maintenance bias compared to Non-clinical controls (maintenance bias between OCD and non-clinical group)
Group OCD vs. group spider phobia: Disorder-relevant pictures	(groupocd + stim_ocd + groupocd:stim_ocd) - (groupspider + stim_pho + groupspider:stim_pho) >= 0	Patients with OCD will show a more pronounced maintenance to idiosyncratic disorder-specific material compared to patients with spider phobia (maintenance bias between OCD and spider group)
Group OCD: Negative vs. neutral picture	stim_neg + groupocd:stim_neg = 0	Participants with OCD will not show a bias towards negative compared to neutral stimuli (maintenance bias within OCD group)
Group spider phobia: Negative vs. neutral picture	stim_neg + groupspider:stim_neg = 0	Participants with spider phobia will not show a bias towards negative compared to neutral stimuli (maintenance bias within spider phobia group)
Group non-clinical controls: Negative vs. neutral picture	stim_neg = 0	Non-clinical controls will not show a bias towards negative compared to neutral stimuli (maintenance bias within non-clinical control group)

Note. First Fixation Choice = whether the first fixation was located at the picture (0 = first fixation directed at lower-left picture, 1 = first fixation directed at upper-right picture); First Fixation Latency = the time from start of trial presentation to the first fixation to a region of interest; Difference in Total Fixation Duration = difference in fixation duration comparing the upper-right with the lower-left picture (i.e., Fixation Durationuperr-right – Fixation Durationlower-left); group = indicator variable for participant group (OCD, spider phobia, non-clinical controls, with non-clinical controls as the reference category); stim_ocd = comparison between OCD-relevant stimuli (as rated by participants with OCD and transferred to triplet partners) and neutral stimuli (reference category); stim_pho = comparison between spider-relevant stimuli (as rated by participants with spider phobia and transferred to triplet partners) and neutral stimuli (reference category), stim_neg = comparison between negative stimuli and neutral stimuli (reference category); looked_at = stimulus type that is looked at (neutral as the reference category, negative, OCD-relevant, or spider-relevant); looked_right = indicator of whether the stimulus was presented on the right (left as the reference category).

Appendix D2: Output of Multilevel Models

Table D2.1

Model Output of the Model Testing the Effect of Stimulus Type and Group on the First Fixation Choice.

	First Fixation Choice		
Predictors	Estimates	95% CI	*p*
(Intercept)	0.40	0.32 – 0.47	**<.001**
group [ocd]	-0.03	-0.14 – 0.08	.582
group [spider]	-0.02	-0.13 – 0.09	.691
stim ocd	0.01	-0.00 – 0.03	.114
stim pho	-0.02	-0.03 – 0.00	.052
stim neg	0.02	0.01 – 0.03	**.001**
group [ocd] × stim ocd	-0.01	-0.03 – 0.01	.507
group [spider] × stim ocd	-0.01	-0.03 – 0.01	.467
group [ocd] × stim pho	0.01	-0.01 – 0.04	.403
group [spider] × stim pho	-0.02	-0.05 – 0.00	.084
group [ocd] × stim neg	-0.01	-0.02 – 0.01	.310
group [spider] × stim neg	-0.01	-0.02 – 0.01	.506
Random Effects			
σ^2	0.14		
$\tau_{00\ participant}$	0.09		
$\tau_{11\ participant.re1.stim\_ocd}$	0.00		
$\tau_{11\ participant.re1.stim\_pho}$	0.00		
ρ_{01}	-0.82		
	-0.07		
ICC	0.38		
$N_{\ participant}$	165		
Observations	25608		
Marginal R^2 / Conditional R^2	0.003 / 0.382		

Note. First Fixation Choice = whether the first fixation was located at the picture (0 = first fixation directed at lower-left picture, 1 = first fixation directed at upper-right picture); group = indicator variable for participant group (OCD, spider phobia, non-clinical controls, with non-clinical controls as the reference category); stim_ocd = comparison between OCD-relevant stimuli (as rated by participants with OCD and transferred to triplet partners; coding: -1 = OCD-relevant stimulus presented left, +1 = OCD -relevant stimulus presented right, 0 = OCD-relevant stimulus not presented or presented on both sides; reference = neutral stimulus); stim_pho = spider-relevant stimulus (as rated by participants with spider phobia and transferred to triplet partners; coding: -1 = spider-relevant stimulus presented left, +1 = spider-relevant stimulus presented right, 0 = spider-relevant stimulus not presented or presented on both sides; reference = neutral stimulus) and neutral stimuli (reference category); stim_neg = negative stimulus (coding: -1 = negative stimulus presented left, +1 = negative stimulus presented right, 0 = negative stimulus not presented or presented on both sides; reference = neutral stimulus), σ^2 = Residual variance; τ_{00} = Variance of the random intercept across participants, reflecting individual differences in overall first fixation probabilities; τ_{11} (stim_ocd, stim_pho, stim_neg) = Variances of random slopes for OCD-relevant, spider-relevant, and negative stimuli, indicating individual variability in how these stimuli influence the probability of a first fixation; ρ_{01} = Correlation between random intercepts and random slopes, showing the relationship between participants' overall fixation tendencies and their sensitivity to specific stimuli types; *ICC* = Intraclass correlation coefficient, representing the proportion of variance in first fixation choice attributable to differences between participants; $N_{\text{participant}}$ = Number of participants included in the analysis; Observations = Total number of analysed trials; Marginal R^2 = Proportion of variance explained by fixed effects only; Conditional R^2 = Proportion of variance explained by both fixed and random effects.

Table D2.2

Model Output of the Model Testing the Effect of Stimulus Type and Group on the First Fixation Latency.

	First Fixation Latency (Entry Time)		
Predictors	Estimates	95% CI	*p*
(Intercept)	335.86	318.43 – 353.29	**<.001**
group [ocd]	5.27	-20.88 – 31.43	.693
group [spider]	63.02	36.72 – 89.32	**<.001**
looked at [neg]	2.17	-3.59 – 7.93	.460
looked at [ocd]	4.68	-3.51 – 12.86	.263
looked at [pho]	3.33	-2.88 – 9.54	.293
looked right [TRUE]	7.72	4.66 – 10.79	**<.001**
group [ocd] × looked at [neg]	-7.73	-15.80 – 0.35	.061
group [spider] × looked at [neg]	-13.04	-21.13 – -4.94	**.002**
group [ocd] × looked at [ocd]	-2.49	-17.41 – 12.42	.743
group [spider] × looked at [ocd]	-9.33	-21.54 – 2.87	.134
group [ocd] × looked at [pho]	-9.65	-18.95 – -0.35	**.042**
group [spider] × looked at [pho]	1.02	-21.97 – 24.02	.930
group [ocd] × looked right [TRUE]	-6.45	-11.03 – -1.86	**.006**
group [spider] × looked right [TRUE]	2.26	-2.04 – 6.55	.303
Random Effects			
σ^2	12942.16		
$\tau_{00\ participant}$	4806.25		
ICC	0.27		
$N_{\ participant}$	165		
Observations	25608		
Marginal R^2 / Conditional R^2	0.036 / 0.297		

Note. First Fixation Latency = the time from start of trial presentation to the first fixation to a region of interest; group = indicator variable for participant group (OCD, spider phobia, non-clinical controls; reference = non-clinical controls); looked_at = stimulus type that is looked at (negative, OCD-relevant, or spider-relevant; reference = neutral); looked_right = indicator of whether the stimulus was presented on the right (reference = left); σ^2 = Residual variance; τ_{00} = Variance of the random intercept across participants, reflecting individual differences in overall first fixation latency; $N_{\text{participant}}$ = Number of participants included in the analysis; Observations = Total number of analysed trials; Marginal R^2 = Proportion of variance explained by fixed effects only; Conditional R^2 = Proportion of variance explained by both fixed and random effects.

Table D2.3

Model Output of the Model Testing the Effect of Stimulus Type and Group on the Dwell Time Difference.

	Difference in Total Fixation Duration (Dwell Time Difference)		
Predictors	Estimates	95% CI	*p*
(Intercept)	124.49	43.07 – 205.90	**.003**
group [ocd]	-74.25	-195.79 – 47.29	.231
group [spider]	-32.13	-155.09 – 90.83	.608
stim ocd	56.22	-55.74 – 168.17	.325
stim pho	-225.29	-392.68 – -57.89	**.008**
stim neg	47.10	-118.06 – 212.26	.576
group [ocd] × stim ocd	-66.53	-232.00 – 98.93	.431
group [spider] × stim ocd	21.63	-146.56 – 189.82	.801
group [ocd] × stim pho	-353.09	-603.95 – -102.22	**.006**
group [spider] × stim pho	-1407.62	-1664.92 – -1150.33	**<.001**
group [ocd] × stim neg	-272.34	-516.43 – -28.24	**.029**
group [spider] × stim neg	-410.29	-659.95 – -160.63	**.001**
Random Effects			
σ^2	2455518.61		
$\tau_{00\ participant}$	93055.80		
$\tau_{11\ participant.stim\_ocd}$	115653.29		
$\tau_{11\ participant.stim\_pho}$	433817.92		
$\tau_{11\ participant.stim\_neg}$	396223.66		
ρ_{01}	-0.07		
	0.06		
	0.06		
ICC	0.20		
$N_{\ participant}$	165		
Observations	25608		
Marginal R^2 / Conditional R^2	0.193 / 0.357		

Note. Dwell Time Difference = difference between the dwell times on the picture presented on the upper-right as compared to the picture presented on the lower-left; group = indicator variable for participant group (OCD, spider phobia, non-clinical controls, with non-clinical controls as the reference category); stim_ocd = comparison between OCD-relevant stimuli (as rated by participants with OCD and transferred to triplet partners; coding: -1 = OCD-relevant stimulus presented left, +1 = OCD -relevant stimulus presented right, 0 = spider OCD-relevant stimulus not presented or presented on both sides; reference = neutral stimulus); stim_pho = spider-relevant stimulus (as rated by participants with spider phobia and transferred to triplet partners; coding: -1 = spider-relevant stimulus presented left, +1 = spider-relevant stimulus presented right, 0 = spider-relevant stimulus not presented or presented on both sides; reference = neutral stimulus) and neutral stimuli (reference category); stim_neg = negative stimulus (coding: -1 = negative stimulus presented left, +1 = negative stimulus presented right, 0 = negative stimulus not presented or presented on both sides; reference = neutral stimulus),
σ^2 = Residual variance; τ_{00} = Variance of the random intercept across participants, reflecting individual differences in overall first fixation probabilities; τ_{11} (stim_ocd, stim_pho, stim_neg) = Variances of random slopes for OCD-relevant, spider-relevant, and negative stimuli, indicating individual variability in how these stimuli influence the probability of a first fixation; ρ_{01} = Correlation between random intercepts and random slopes, showing the relationship between participants' overall fixation tendencies and their sensitivity to specific stimuli types; *ICC* = Intraclass correlation coefficient, representing the proportion of variance in first fixation choice attributable to differences between participants; $N_{\text{participant}}$ = Number of participants included in the analysis; Observations = Total number of analysed trials; Marginal R^2 = Proportion of variance explained by fixed effects only; Conditional R^2 = Proportion of variance explained by both fixed and random effects.

Appendix D3: Sensitivity Analyses

Table D3.1

Sensitivity Analysis Testing the Vigilance Hypothesis.

Contrast	Estimate	*SE*	*t*	*p*
First Fixation Choice				
Group OCD: OCD-relevant vs. neutral picture	0.003	0.008	0.405	.685
Group OCD: OCD-relevant vs. negative picture	-0.007	0.011	-0.652	.514
Group spider phobia: Spider-relevant vs. neutral picture	**0.058**	**0.011**	**5.032**	**<.001**
Group spider phobia: Spider-relevant vs. negative picture	0.030	0.016	1.875	.061
Group non-clinical controls: OCD-relevant vs. neutral picture	0.014	0.008	1.869	.062
Group non-clinical controls: OCD-relevant vs. negative picture	-0.006	0.010	-0.596	.551
Group non-clinical controls: Spider-relevant vs. neutral picture	-0.017	0.009	-1.854	.066
Group non-clinical controls: Spider-relevant vs. negative picture	**-0.037**	**0.010**	**-3.547**	**<.001**
Group OCD: Negative vs. neutral pictures	0.010	0.006	1.834	.067
Group Spider: Negative vs. neutral pictures	**0.027**	**0.007**	**3.646**	**<.001**
Group non-clinical controls: Negative vs. neutral pictures	**0.020**	**0.006**	**3.400**	**.001**
First Fixation Latency (Entry Time)				
Group OCD: OCD-relevant vs. neutral picture	2.808	5.744	0.489	.625
Group OCD: OCD-relevant vs. negative picture	7.870	5.686	1.384	.166
Group spider phobia: Spider-relevant vs. neutral picture	4.684	10.427	0.449	.653
Group spider phobia: Spider-relevant vs. negative picture	10.818	10.344	1.046	.296
Group non-clinical controls: OCD-relevant vs. neutral picture	5.774	3.881	1.488	.137
Group non-clinical controls: OCD-relevant vs. negative picture	4.409	4.057	1.087	.277
Group non-clinical controls: Spider-relevant vs. neutral picture	1.354	2.954	0.458	.647
Group non-clinical controls: Spider-relevant vs. negative picture	-0.011	3.143	-0.004	.997
Group OCD: Negative vs. neutral pictures	-5.062	2.610	-1.939	.052
Group Spider: Negative vs. neutral pictures	**-6.135**	**2.855**	**-2.148**	**.032**
Group non-clinical controls: Negative vs. neutral pictures	1.365	2.744	0.498	.619

Note. Boldface values are considered significant at an α = .05. First Fixation Choice = whether the first fixation was located at the picture (0 = first fixation not directed at picture, 1 = first fixation directed at picture). First Fixation Latency = the time from start of trial presentation to the first fixation to a region of interest. The valence and disorder-relevance of the pictures is inferred from the idiosyncratic rating.

Table D3.2

Sensitivity Analysis Testing the Maintenance Hypothesis.

Contrast	Estimate	*SE*	*t*	*p*
Difference in Total Fixation Duration (Dwell Time Difference)				
Group OCD: OCD-relevant vs. neutral picture	-16.004	59.766	-0.268	.789
Group OCD: OCD-relevant vs. negative picture	**233.960**	**98.426**	**2.377**	**.019**
Group OCD vs. non-clinical controls: Disorder-relevant pictures	-142.867	95.994	-1.488	.139
Group OCD vs. group spider phobia: Disorder-relevant pictures	**1491.951**	**131.670**	**11.331**	**<.001**
Group OCD: Negative vs. neutral pictures	**-249.964**	**91.212**	**-2.740**	**.007**
Group Spider: Negative vs. neutral pictures	**-348.205**	**95.785**	**-3.635**	**<.001**
Group non-clinical controls: Negative vs. neutral pictures	-12.115	85.083	-0.142	.887

Note. Boldface values are considered significant at an $\alpha = .05$. Difference in Total Fixation Duration = difference in fixation duration comparing the upper-right with the lower-left picture (i.e., $\text{Fixation Duration}_{\text{uperr-right}} - \text{Fixation Duration}_{\text{lower-left}}$). The valence and disorder-relevance of the pictures is inferred from the idiosyncratic rating.

Appendix D4: Exploratory Analyses

Table D4.1

Descriptives of Attentional Parameters by Checking- and Washing-Related Pictures.

	OCD		Spider Phobia[1]		Non-Clinical Control	
	M	*SD*	*M*	*SD*	*M*	*SD*
First Fixation Choice in % on Trials With…						
Checking-Related OCD-Relevant Pictures						
OCD-relevant$_{checking}$ (compared to neutral)	50.94	9.27	52.65	8.64	52.28	8.25
OCD-relevant$_{checking}$ (compared to negative)	48.87	12.78	55.28	13.49	47.58	21.08
Washing-Related OCD-Relevant Pictures						
OCD-relevant$_{washing}$ (compared to neutral)	50.66	9.38	51.63	8.58	52.62	8.58
OCD-relevant$_{washing}$ (compared to negative)	49.66	17.76	49.72	17.40	48.52	13.49
First Fixation Latency (Entry Time) in ms on Trials With … [2]						
Checking-Related OCD-Relevant Pictures						
OCD-relevant$_{checking}$ (compared to neutral)	357.85	130.92	408.60	264.09	355.70	129.47
Neutral (compared to OCD-relevant$_{checking}$)	335.52	68.28	383.74	143.91	328.32	61.64
OCD-relevant$_{checking}$ (compared to negative)	325.34	101.44	352.86	80.84	298.70	76.03
Negative (compared to OCD-relevant$_{checking}$)	339.28	117.37	487.18	300.27	329.93	43.01
Washing-Related OCD-Relevant Pictures						
OCD-relevant$_{washing}$ (compared to neutral)	324.23	68.72	380.16	126.54	337.48	62.00
Neutral (compared to OCD-relevant$_{washing}$)	335.21	93.41	383.69	146.99	333.48	58.29
OCD-relevant$_{washing}$ (compared to negative)	312.31	38.85	366.25	126.68	343.29	71.08
Negative (compared to OCD-relevant$_{washing}$)	357.29	188.19	376.85	115.56	365.11	132.95
Total Fixation Duration (Dwell Time) in ms on Trials With [3]						
Checking-Related OCD-Relevant Pictures						
OCD-relevant$_{checking}$ (compared to neutral)	1706.84	550.46	1722.55	460.84	1742.77	532.45
Neutral (compared to OCD-relevant$_{checking}$)	1710.85	540.47	1762.32	574.06	1838.73	483.39
OCD-relevant$_{checking}$ (compared to negative)	1988.10	815.63	1496.55	679.37	1765.34	719.65
Negative (compared to OCD-relevant$_{checking}$)	1496.55	679.37	1871.62	776.42	1781.76	674.86

Washing-Related OCD-Relevant Pictures						
OCD-relevant$_{washing}$ (compared to neutral)	1494.94	644.61	1589.90	459.44	1695.30	570.34
Neutral (compared to OCD-relevant$_{washing}$)	2077.94	646.05	1912.59	450.48	1983.19	572.59
OCD-relevant$_{washing}$ (compared to negative)	1554.69	576.16	1910.15	727.28	2007.01	542.21
Negative (compared to OCD-relevant$_{washing}$)	1916.97	596.36	1650.64	740.99	1716.50	605.42

Note. OCD = Obsessive-Compulsive Disorder. The valence, spider-relevance, and OCD-relevance is inferred from participants' idiosyncratic rating. OCD content (i.e., checking- or washing-related) is inferred from the original database or expert rating. The reported means (*M*) and standard deviations (*SD*) represent group-level values, calculated from previously computed individual participant means. The comparisons are made on the picture pairs presented per trial.

[1] The spider phobia group consists of $n = 41$ participants diagnosed with spider phobia according to DSM-5 criteria, and $n = 9$ participants with very high spider anxiety, though not meeting full diagnostic criteria.

[2] The displayed first fixation latencies (entry times) are based on trials where a disorder-relevant picture (i.e., either OCD- or spider-relevant) is presented next to a negative or neutral picture.

[3] The displayed total fixation durations (dwell times) are based on trials where a disorder-relevant picture (i.e., either OCD- or spider-relevant) is presented next to a negative or neutral picture.

Table D4.2

Exploratory Analysis Investigating the First Fixation Choice on Checking- and Washing-Related Pictures.

	Contrast	Estimate	*SE*	*t*	*p*
First Fixation Choice					
Pictures with Checking-Related Content	Group OCD: OCD-relevant vs. neutral picture	-0.020	0.019	-1.068	.290
	Group OCD: OCD-relevant vs. negative picture	-0.005	0.029	-0.162	.871
	Group non-clinical controls: OCD-relevant vs. neutral picture	-0.014	0.018	-0.767	.446
	Group non-clinical controls: OCD-relevant vs. negative picture	-0.022	0.027	-0.807	.420
	Group OCD: Negative vs. neutral picture	-0.015	0.019	-0.829	.407
	Group non-clinical controls: Negative vs. neutral picture	0.008	0.022	0.365	.715
Pictures with Washing-Related Content	Group OCD: OCD-relevant vs. neutral picture	-0.006	0.019	-0.292	.771
	Group OCD: OCD-relevant vs. negative picture	-0.020	0.031	-0.666	.506
	Group non-clinical controls: OCD-relevant vs. neutral picture	**0.047**	**0.017**	**2.870**	**.005**
	Group non-clinical controls: OCD-relevant vs. negative picture	0.030	0.025	1.197	.232
	Group OCD: Negative vs. neutral picture	0.015	0.018	0.846	.398
	Group non-clinical controls: Negative vs. neutral picture	0.017	0.016	1.064	.288

Note. Boldface values are considered significant at an α = .05. First Fixation Choice = whether the first fixation was located at the picture (0 = first fixation directed at lower-left picture, 1 = first fixation directed at upper-right picture). The valence and disorder-relevance of the pictures is inferred from the idiosyncratic rating. The content of the picture is based on databases or expert-judgment. A total of 1979 was used for analyses of checking-related pictures and 2576 trials were used for analyses on washing-related pictures.

Table D4.3

Exploratory Analysis Investigating the First Fixation Latency on Checking- and Washing-Related Pictures.

	Contrast	Estimate	*SE*	*t*	*p*
First Fixation Latency (Entry Time)					
Pictures with Checking-Related Content	Group OCD: OCD-relevant vs. neutral picture	19.148	14.369	1.333	.183
	Group OCD: OCD-relevant vs. negative picture	14.336	14.560	0.985	.325
	Group non-clinical controls: OCD-relevant vs. neutral picture	17.164	11.448	1.499	.134
	Group non-clinical controls: OCD-relevant vs. negative picture	16.257	14.292	1.138	.255
	Group OCD: Negative vs. neutral picture	4.812	10.736	0.448	.654
	Group non-clinical controls: Negative vs. neutral picture	0.906	12.488	0.073	.942
Pictures with Washing-Related Content	Group OCD: OCD-relevant vs. neutral picture	1.677	17.595	0.095	.924
	Group OCD: OCD-relevant vs. negative picture	-2.469	17.354	-0.142	.887
	Group non-clinical controls: OCD-relevant vs. neutral picture	3.261	10.320	0.316	.752
	Group non-clinical controls: OCD-relevant vs. negative picture	-1.409	10.257	-0.137	.891
	Group OCD: Negative vs. neutral picture	4.146	8.128	0.510	.610
	Group non-clinical controls: Negative vs. neutral picture	4.670	8.390	0.557	.578

Note. Boldface values are considered significant at an $\alpha = .05$. First Fixation Latency = the time from start of trial presentation to the first fixation to a region of interest. The valence and disorder-relevance of the pictures is inferred from the idiosyncratic rating. The content of the picture is based on databases or expert-judgment. A total of 1979 was used for analyses of checking-related pictures and 2576 trials were used for analyses on washing-related pictures.

Table D4.4

Exploratory Analysis Investigating the Maintenance Bias on Checking- and Washing-Related Pictures.

	Contrast	Estimate	*SE*	*t*	*p*
Difference in Total Fixation Duration (Dwell Time Difference)					
Pictures with Checking-Related Content	**Group OCD: OCD-relevant vs. neutral picture**	**226.721**	**104.283**	**2.174**	**.032**
	Group OCD: OCD-relevant vs. negative picture	**488.544**	**142.099**	**3.438**	**.001**
	Group OCD vs. non-clinical controls: Disorder-relevant pictures	300.318	168.733	1.780	.078
	Group OCD vs. group spider phobia: Disorder-relevant pictures	-394.772	421.503	-0.937	.353
	Group OCD: Negative vs. neutral pictures	**-261.823**	**108.742**	**-2.408**	**.018**
	Group Spider: Negative vs. neutral pictures	**-335.317**	**137.198**	**-2.444**	**.015**
Pictures with Washing-Related Content	**Group OCD: OCD-relevant vs. neutral picture**	**-292.081**	**106.653**	**-2.739**	**.007**
	Group OCD: OCD-relevant vs. negative picture	78.397	161.833	0.484	.629
	Group OCD vs. non-clinical controls: Disorder-relevant pictures	**-453.473**	**172.008**	**-2.636**	**.009**
	Group OCD vs. group spider phobia: Disorder-relevant pictures	-40.508	249.888	-0.162	.871
	Group OCD: Negative vs. neutral pictures	**-370.479**	**114.589**	**-3.233**	**.002**
	Group Spider: Negative vs. neutral pictures	**-411.403**	**122.969**	**-3.346**	**.001**

Note. Boldface values are considered significant at an $\alpha = .05$. Difference in Total Fixation Duration = difference in fixation duration comparing the upper-right with the lower-left picture (i.e., Fixation $\text{Duration}_{\text{uperr-right}}$ − Fixation $\text{Duration}_{\text{lower-left}}$). The valence and disorder-relevance of the pictures is inferred from the idiosyncratic rating. The content of the picture is based on databases or expert-judgment. A total of 1979 was used for analyses of checking-related pictures and 2576 trials were used for analyses on washing-related pictures.