Effects of cognitive and metacognitive interventions in obsessive-compulsive disorder

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Christian Rupp

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Promotionskomitee:

1. Prof. Dr. Ulrike Buhlmann
2. Prof. Dr. Nexhmedin Morina
3. Dr. Fabian Andor

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Am Ende des Wegs, wenn ich muss

Trag ich dich über den Fluss

Judith Holofernes (2005)

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Table of Contents

1. What is obsessive-compulsive disorder?

In contrast to common parlance, which usually depicts persons suffering from obsessive-compulsive disorder (OCD) as somewhat quirky neurotics who are being pushed over the edge while washing their hands or checking the stove, the real picture of this disorder is much broader and far more sophisticated. In fact, the current edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) defines OCD as being characterized by two phenomena. On the one hand, it describes the co-called obsessions, which reflect intrusive and unwanted thoughts that can also take the form of images or urges. These obsessions create unpleasant feelings of tension or discomfort, which is why the person usually tries to suppress, ignore – or neutralize, i. e., counteract them. These neutralizing behaviors represent the second part of this dualistic diagnosis, the so-called compulsions or rituals, which comprise overt behaviors, such as checking or washing, as well as mental acts, such as counting or praying. According to DSM-5, the uniting features of neutralizing behavior are their repetitiveness and the fact that they are either performed in response to an obsession or because the person feels forced to follow certain rigid rules. Furthermore, the definition of the diagnosis states that compulsions either serve to reduce anxiety or distress or to prevent some feared catastrophic event – for the prevention of which, however, the compulsion is not appropriate.

Interestingly, the DSM-5 diagnosis of OCD calls for either obsessions *or* compulsions – or both. As such, in contrast to the theoretical models discussed in the following sections, the DSM-5 diagnosis does not explicitly state that compulsions are generally preceded by obsessions in the form of a necessary condition. The "either or" formulation, however, contradicts research findings from field trials that clearly suggest that most OCD patients report both obsessions *and* compulsions (e. g., Foa & Kozak, 1995). Further criticism concerning the DSM-5 definition of OCD was for instance raised by Abramowitz and Jacoby (2014), who emphasize

among other aspects that even though they play a crucial role in OCD, the diagnostic criteria do not comprise avoidance behavior and brief, but non-repetitive covert behaviors, such as making a fist in one's pocket in response to obsessions about touching nearby children, as forms of covert but highly frequent form of resistance against obsessions.

Whereas until DSM-IV-TR (APA, 2000), OCD was still categorized as an anxiety disorder, it has been re-arranged in DSM-5 to now form the leading diagnosis in a completely new chapter termed Obsessive-Compulsive and Related Disorders (OCRD), which, beyond OCD, includes Trichotillomania, Hoarding Disorder, Skin Picking Disorder, and Body Dysmorphic Disorder (BDD). Whereas the APA (2013) justifies this re-arrangement arguing that the common thread of these disorders is the presence of both obsessional thoughts and repetitive behaviors, there is a considerable amount of controversy regarding this issue.

As shown by Mataix-Cols, Pertusa, and Lackman (2007), moving OCD away from the anxiety disorders was not based on a broad consensus among experts in the field. Following Abramowitz and Jacoby's (2014) line of argumentation, the focus on repetitiveness in DSM-5 is rather superficial, leading to an unjustified categorization of both compulsivity disorders such as OCD and BDD, which are characterized by anxiety reduction, and impulsivity disorders such as Trichotillomania and Skin Picking Disorder, which are driven by experiences of gratification. Also, they criticize that due to the focus on repetitiveness, other features of OCD, such as the non-repetitive rituals described above, receive less attention. In addition, Abramowitz and Jacoby point out that the common thread around repetitiveness is executed inconsistently within the OCRD chapter, with disorders such as hypochondriasis, substance use and gambling disorder not being part of the chapter.

1.1. Theoretical models of obsessive-compulsive disorder

Various theoretical models have been put forward in an effort to explain the mechanisms underlying OCD, so that the following section is dedicated to a summary of the most influential approaches.

1.1.1. Behavioral perspective

Drawing on traditional learning theory, i. e., classic and operant conditioning, Mowrer (1960) argued that, as anxiety disorders in general, OCD arises when normal intrusive thoughts become associated with anxiety via classic conditioning, turning these intrusions into conditioned stimuli. The development of compulsions, in turn, is explained through operant conditioning since compulsions lead to a decrease of obsessional anxiety, so that compulsions are negatively reinforced. The merits of this so-called two-factor model comprise its simplicity, its accordance with clinical impressions of OCD sufferers, and the fact that both components of the theory have been empirically confirmed. As summarized by Rachman and Hodgson (1980), there is evidence from numerous experiments showing that (a) presenting OCD patients with OCD-related stimuli causes experiences of anxiety and distress, and that (b) anxiety and distress decrease after compulsions have been performed.

Another strength of the model is that it actually assumes that the occurrence of intrusive thoughts is not a pathological phenomenon per se, since the problem only arises as soon as intrusive thoughts get associated with unpleasant emotional experiences. This is especially noteworthy given that it took some more decades until research actually demonstrated that about 90 % of all people experience intrusions on a regular basis, with intrusions exhibiting even similar content across people (Rachman & de Silva, 1978; Salkovskis & Harrison, 1984). Furthermore, as reviewed in section 2.1., a major strength of the two-factor-model is that it forms the groundwork for the most established and effective treatment approach to OCD, i. e., exposure and response prevention (ERP).

However, there are several crucial shortcomings to the two-factor-model. Most importantly, it fails to differentiate between OCD and other anxiety disorders and is unable to explain why some patients develop OCD whereas others develop agoraphobia or specific phobia (Salkovskis, 1998). This, combined with aspects concerning the shortcomings of ERP, which is based on the two-factor model, and with the fact that obsessions actually are cognitive phenomena, led to the development of cognitive theories aiming at explaining the unique features of OCD.

1.1.2. Cognitive perspective

As pointed out by Shafran (2005), the various cognitive models of OCD that have been formulated are much more similar than they are different from one another, so that this section will focus on the most influential models, which were put forward by Salkovskis (1985, 1999) and Rachman (1997, 1998).

Both Salkovkis and Rachman draw on the classic framework of cognitive therapy (e. g., Beck, 1979). Given the above-mentioned evidence that intrusive thoughts are ubiquitous phenomena, both approaches view intrusive thoughts as stimuli that are followed by evaluative cognitions, which, in turn, lead to unpleasant emotions that OCD patients try to neutralize using compulsions, thought suppression, etc. Thus, in contrast to the two-factor-model, this approach offers more of an insight into *how* intrusive thoughts actually become obsessions that provoke anxiety and discomfort. For example, in a person with OCD, the intrusive thought “Jesus is a biscuit” may be followed by the cognition “I am a dreadful sinner and deserve punishment”, leading to experiences of anxiety and guilt that the person tries to neutralize by repetitively praying the Lord’s Prayer. As a consequence, the person is unable to make any experience that could possibly disconfirm the above-mentioned appraisal, whereas performing the ritual itself works as a confirmation of the appraisal (cf., e. g., Rachman, 1998). The origin of these evaluative thoughts is assumed to derive from the person’s learning history, involving, e. g., a form

of childhood education that strongly promotes a sense of responsibility during childhood or emphasizes rigid rules concerning conduct and duty, as well as quite the opposite, i. e., having overprotective parents who prevent the child from ever being confronted with taking responsibility (Salkovskis, Shafran, Rachman, & Freeston, 1999).

Whereas Salkovkis' (1985, 1999) model and Rachman's cognitive theory of obsessions (1997, 1998) exhibit a lot of overlap, there are some differences regarding the focus of the two approaches. One minor difference concerns the wording, with Salkovskis sticking closer to classic cognitive theories by referring to those evaluative thoughts as "automatic thoughts" whereas Rachman uses the term "misinterpretations". Another difference concerns the authors' assumptions regarding the choice of cognitive distortions that they consider most relevant in OCD. In his model, Salkovskis emphasizes a lot that the main cognitive distortion driving OCD is inflated responsibility, which refers to an OCD patient's tendency to overestimate her personal responsibility concerning a certain event, and the assumption that having influence over outcome is equal to being responsible for that outcome. Take as an example that a person walks past some shards of glass on the sidewalk and starts feeling guilty because he beliefs that not putting the shards *away* is just as bad as deliberately putting them *there* in the first place.

Rachman (1997, 1998) draws on Salkovskis' model (1985) and elaborates on the aspect of inflated responsibility. However, Rachman's theory is broader in a way that it points out various other types of cognitive distortions, such as viewing an intrusion as reflecting something important about the person ("If I have thoughts like this, I must be a bad person") or as foreshadowing that something catastrophic will happen ("If I have this thought, it will happen"). Therefore, Rachman's theory is closely linked to the concept of so-called fusion beliefs, the most prominent of which is referred to as *Thought-Action-Fusion* (TAF, e. g., Shafran, Thodarson, & Rachman, 1996). TAF describes a sort of cognitive bias that regards intrusive thoughts (e. g., "I wish he was dead") as meaningful in a way that either they increase the

likelihood that something terrible, such as an accident, will happen, i. e., *Likelihood TAF*, or that having certain thoughts is just as immoral as acting in a corresponding way, i. e., *Moral TAF* (Shafran, 2005).

As summarized by Shafran (2005), both theoretical models are supported by numerous pieces of evidence, including both questionnaire-based studies and laboratory experiments that tested the predictions derived from the models. For instance, one of these experimental studies designed to test the prediction that heightened responsibility leads to increased discomfort (Ladouceur et al., 1995) demonstrated exactly the hypothesized effect in a sample of nonclinical participants who were asked to sort colored pills while being told either that (low responsibility) the researchers are only interested in the perception of color or (high responsibility) that they were participating in an important project on the development of a new pill for a virus – indicating that the association between perceived responsibility and experiences of discomfort are quite universal.

Apart from the evidence discussed in the preceding paragraph, another merit of the revised form of the Salkovskis model (1999) and Rachmans's cognitive theory of obsessions (1997) is that they account for the well-documented high comorbidity of OCD and major depression (see, e. g., Overbeek, Schruers, Vermetten, & Griez, 2002) since they describe depression both as one of the consequences resulting from distorted appraisals concerning intrusions and as a factor that promotes the occurrence of new intrusive thoughts. Similarly, another strength of Rachman's theory (1997) is that next to depression, it also succeeds at outlining the pathway connecting obsessions to stress, with stress increasing the frequency of obsessions, the misinterpretation of which, in turn, increases the level of stress. In fact, this relationship between stress and intrusions was described first in the early 1970s (Horowitz & Becker, 1971; Horowitz, Becker, Moskowitz, & Rashid, 1972) and has been replicated multiple times ever since (e. g., Parkinson & Rachman, 1981).

In contrast to the theoretic approaches provided by Rachman and Salkovskis, Purdon and Clark's (1999) theory offers a comparably new perspective by suggesting that a crucial type of belief in OCD entails the necessity of controlling one's thoughts and the assumption that losing control over one's thoughts is as detrimental as losing control over one's actions. As a consequence, persons with OCD invest enormous effort into trying to control their thoughts, which, however, rather increases the frequency of obsessions. The inefficacy and paradox effects of thought suppression attempts have been demonstrated by Wegner, Schneider, Carter, and White (1987), which is why both Rachman (1998) and Salkovskis (1999) refer to thought suppression as one of the maintaining factors in OCD. Further research highlighting the link between beliefs about thought control and OCD has been summarized by Purdon and Clark (2002).

Drawing on one of the cognitive distortions formulated by Rachman (1997, 1998), there have also been put forward theoretical accounts focusing exclusively on distorted expectancies of danger (Carr, 1974; McFall & Wollersheim, 1979) as the key element in OCD, however, these can be criticized for not being able to differentiate between OCD and other phenomena such as Generalized Anxiety Disorder (Salkovskis, 1998). The same holds for another type of cognitive distortion usually referred to as intolerance of uncertainty. While obviously playing a role in OCD, research indicates that intolerance of uncertainty is equally associated with Generalized Anxiety Disorder and Major Depression, as revealed by the meta-analysis by Gentes and Ruscio (2011). Similar to this, perfectionism has been discussed as a cognitive feature of OCD. Yet, as with the intolerance of uncertainty, the specifity of perfectionism with regard to OCD must be questioned when considering evidence that shows a similar association between perfectionism and anxiety disorders such as panic disorder with agoraphobia (Frost & Steketee, 1997).

In spite of these controversial results, in 1997, the Obsessive Compulsive Cognitions Working Group (OCCWG) proposed a set of six cognitive belief domains suggested to characterize OCD, some of which are part of the above-described theoretical models. The six domains are (1) overimportance of thoughts, (2) excessive concern about the importance of controlling one's thoughts, (3) inflated responsibility, (4) overestimation of threat, (5) intolerance of uncertainty, and (6) perfectionism.

In a study on self-report data concerning the six domains formulated by the OCCWG, Tolin, Worhunsky, and Maltby (2006) compared a sample of OCD patients with a sample of participants meeting criteria for another anxiety disorder. In sum, they arrive at the conclusion that out of all the six domains, those concerning the meaning of thoughts and the need to control them are most specific of OCD, with inflated responsibility even showing the weakest association with OCD. Note, however, that Tolin et al. used only self-report data and that participants from the OCD sample were allowed to have other comorbid anxiety disorders. Nevertheless, this result is striking regarding the cognitive models reviewed above, paving the way towards a new, i. e., metacognitive perspective centering around attitudes people with OCD hold *about* their intrusive thoughts.

1.1.3. Metacognitive perspective

In contrast to the cognitive models and theories reviewed above, the so-called metacognitive approach to OCD does not focus an content-related belief domains such as inflated responsibility or overestimation of threat. Instead, its focus is a set of higher-order beliefs about thoughts, the so-called metacognitions, such as the belief that thoughts are generally meaningful and can and need to be controlled. Therefore, the theory provided by Purdon and Clark (1999) might equally well appear in this section as it actually suggests a metacognitive take on OCD.

Interestingly, in their account of cognitive belief domains characterizing OCD, the Obsessive Compulsive Cognitions Working Group (OCCWG) does not differentiate between cognitive and metacognitive domains (OCCWG, 1997). Out of these six domains, overimportance of thoughts and excessive concern about the importance of controlling one's thoughts can actually be thought of as reflecting attitudes *about* thoughts, i. e. metacognitions. By contrast, inflated responsibility, overestimation of threat, intolerance of uncertainty, and perfectionism can be thought of as domains regarding thought content, so that one might label them cognitive instead of metacognitive domains. This distinction is important with regard to the research that is presented in this dissertation.

A major foundation of the metacognitive perspective on emotional disorders is the Self-Regulatory Executive Function (S-REF) model put forward by Wells and Matthews (1994, 1996), which highlights the role of attentional biases, attentional deficits and metacognitive beliefs in psychological disorders in general. Regarding the maintenance of OCD in particular, Wells (2011) suggested that intrusive thoughts trigger metacognitive beliefs about the meaning of thoughts, for instance the belief that thoughts reflect or have an impact on reality (termed Thought-Action-Fusion or Thought-Event-Fusion). These metacognitive fusion beliefs intrusive thoughts turn into a threat, leading to negative emotional states that, in turn, motivate compulsions or other forms of dysfunctional neutralizing behavior. Next to fusion beliefs, Wells' theory involves metacognitions about performing rituals and about the need to engage in thought suppression as well as metacognitions about stop signals for ending rituals.

So, the metacognitive model as proposed by Wells (2011) actually differs from the established cognitive models discussed above only concerning one feature. Whereas in the latter, the crucial mediating variable between the intrusive thought and the negative emotional state is an appraisal on the content-level, e. g., regarding inflated responsibility, the mediating variable

in the metacognitive perspective is a cognition on the meta-level that assigns the intrusion un-justified meaning *in general*.

Evidence for the metacognitive model has for instance been provided by Myers, Fisher, and Wells (2009). Using a hierarchical regression approach, they were able to show that measures of metacognition (see section 3.1), e. g., fusion beliefs, accounted for incremental variance in OCD symptom measures – over and above measures of cognitive distortions and other variables such as worry. These results were replicated by Solem, Myers, Fisher, Vogel, and Wells (2010) in a Norwegian sample, further strengthening the metacognitive perspective.

2. Psychotherapeutic approaches to treating OCD

2.1. Exposure and response prevention

Derived from the two-factor model of OCD and following the principles of learning theory reviewed above, exposure and response prevention (ERP) was developed as a purely behavioral treatment approach to OCD and involves confronting the patient with stimuli that trigger obsessional anxiety or discomfort (i. e., exposure) while encouraging him to refrain from any neutralizing behavior. Following Mowrer's (1960) two-factor model, ERP was originally thought to work via extinction of the fear response because the negative reinforcement resulting from the compulsion is blocked. Nowadays, the working mechanisms behind ERP and exposure therapy in general are a subject of heated debate, with inhibitory learning evolving as one promising approach to explaining its outstanding efficacy (Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). By contrast, more traditional perspectives such as Emotional Processing Theory (Foa & Kozak, 1986), which center around fear activation and habituation, have been shown to be insufficient at explaining the efficacy of exposure-based treatments (Craske et al., 2014; Rupp, Doebler, Ehring, & Vossbeck-Elsebusch, 2017).

Regardless of the working mechanisms of ERP, which are beyond the scope and the focus of this dissertation, the great merit of ERP is its well-documented efficacy, which has been summarized by Abramowitz (1997) in a quantitative review. In a preceding meta-analysis, Abramowitz (1996) presented similar results, additionally pointing out that therapist-supervised exposure was shown to be more effective than self-controlled exposure and that complete response prevention was superior to partial response prevention in terms of efficacy.

Based on the vast amount of evidence proving its efficacy, cognitive-behavioral therapy (CBT) including ERP is regarded as gold standard treatment in official treatment guidelines, accompanied by pharmacological treatment with selective serotonin reuptake inhibitors (e. g., National Institute for Health and Clinical Excellence, 2006). Regarding medication, the overall

conclusion to be drawn from the clinical trials that have been conducted is that apparently, pharmacological treatment is effective in treating OCD, but (a) is inferior to CBT including ERP, (b) is also inferior to CBT plus medication, and (c) does not significantly enhance efficacy when being combined with CBT (Romanelli, Wu, Gamba, Mojtabai, & Segal, 2014).

However, as Schruers, Koning, Luermans, Haack, and Griez (2005) summarize, a major problem is that ERP poses a big challenge to patients due to the demanding and often debilitating procedure, so that about 25 % of patients refuse ERP treatment and another 20 % drop out of treatment. Another critical aspect about ERP is that efficacy of ERP is rather limited for patients predominantly exhibiting obsessions in the absence of overt compulsions (Rachman, 1997). Thus, in spite of the well-documented efficacy of ERP, there clearly is both room and the need for improvement.

2.2. Cognitive therapy

Cognitive approaches to the treatment of OCD are as old as the cognitive models described in section 1.1.2. and are designed to target the dysfunctional automatic thoughts, misinterpretations, and distorted beliefs attached that turn intrusive thoughts into threatening stimuli. On the one hand, following Wilhelm and Steketee (2006), cognitive therapy (CT) for OCD involves classic methods of cognitive restructuring (CR), i. e., Socratic questioning of appraisals and beliefs, aiming at correcting faulty beliefs and replacing them with more appropriate ones. Questioning cognitions may entail both collecting evidence in favor of and against cognitions and by contrasting advantages and disadvantages of cognitions. With regard to the OCD-related belief domains outlined above, OCD-specific CR strategies include for instance re-evaluating the risk of some catastrophic event in terms of overestimated threat or opening the view for other influencing factors when it comes to inflated responsibility.

On the other hand, cognitive therapy for OCD also includes so-called behavioral experiments, which offer a direct way of disconfirming an appraisal. For example, a person suffering

from checking-related OCD might be encouraged to leave the house without checking the stove and stay at some distant place for several hours in order to disconfirm the thought that the house will catch fire and burn to the ground (an example of overestimated threat). As you may have noticed, such a behavioral experiment does have a striking amount of overlap with an ERP task as the patient refrains from neutralizing behavior and is confronted with a fear-provoking situation. Hence, from a scientific point of view, it remains unclear whether the working mechanism is the disconfirmation of the fearful expectation that the house would burn to the grounds (providing corrective information) or rather the habituation or extinction of fear the person experienced while being away from her house (see e. g., Abramowitz, 1997).

Most studies that have investigated the efficacy of cognitive therapy for OCD employed complex CT programs including behavioral experiments. As such, these studies all demonstrate that CT including behavioral experiments is very effective at reducing OCD symptoms within open trials (e. g., Wilhelm et al., 2005), waitlist-controlled trials (e. g., Wilhelm et al., 2009), and effectiveness studies conducted under conditions of routine clinical practice (e. g., Belloch, Cabedo, & Carrió, 2008). Quantitative reviews such as the one by Abramowitz (1997) as well as meta-analyses (Öst, Havnen, Hansen, & Kvale, 2015; Rosa-Alcázar, Sánchez-Meca, Gómez-Conesa, & Marín-Martínez, 2008; van Balkom et al., 1994) all arrive at the conclusion that (a) CT is effective at reducing OCD symptoms, and (b) that there are no considerable differences concerning efficacy between CT and ERP.

Direct comparisons of ERP and CT within one study have yielded mixed results. Whereas Anholt et al. (2008) and Cottraux et al. (2001) report the lack of significant differences, Emmelkamp, Visser, and Hoekstra (1988) found ERP to be superior to CT, whereas CT in this study did not include behavioral experiments. By contrast, van Oppen, de Haan, et al. (1995) report results suggesting CT (including behavioral experiments) to be more effective than ERP.

The same holds for the effectiveness study by Belloch, Cabedo, and Carrió (2008), which did not include behavioral experiments.

The only study that (to the author's knowledge) investigated the efficacy of CT excluding behavioral experiments and proved its efficacy was provided by Belloch et al. (2008). Hence, little is known about the efficacy of purely "Beckian" CT, which is restricted to questioning appraisals using techniques such as Socratic questioning.

2.3. Metacognitive therapy

Metacognitive therapy (MCT) for OCD as proposed by Wells (2011) entails a number of different interventions. The common thread, however, is to challenge metacognitive beliefs such as "Thoughts are meaningful events and reflect reality" or "Thoughts equal actions". In other words, MCT is about changing OCD patients' attitude towards their intrusive thoughts or, as Wells puts it, about enabling patients to switch to the *metacognitive mode*, in which a person solely observes his thoughts from a distance.

On the one hand, the set of metacognitive interventions includes strategies that are directly derived from cognitive therapy, most of all Socratic questioning of metacognitions. For example, the metacognition "Thoughts foreshadow the future" might be challenged and changed by collecting evidence showing that events that happen are not consistent with thoughts a person experienced prior to those events. Another key technique in MCT is called *exposure and response commission* and involves having the patient perform her ritual while constantly holding the obsession in mind. According to Wells, this paradox intervention aims at shifting to the metacognitive mode by promoting what he refers to as *detached mindfulness* (DM).

DM has been described by Wells and Matthews (1994) as a strategy to arrive at metaconsciousness, which can be thought of as a state of mind in which a person is aware of her thoughts while realizing that these are nothing more than events in the mind. Teaching OCD

patients DM therefore means teaching them to solely observe their thoughts from a distance instead of getting so close to them that they feel driven to respond to them immediately. As proposed by Wells (2011), teaching DM involves imaginative exercises guided by suggestive instructions provided by the therapist.

Of course, DM exhibits considerable overlap with mindfulness-based approaches in general (e. g., Kabat-Zinn, 2005) as well with so-called defusion exercises, which are part of Acceptance and Commitment Therapy (ACT; e. g., Eifert & Forsyth, 2005). While acknowledging this conceptual proximity, reviewing these approaches would be beyond the scope of this dissertation, which is dedicated to contrasting the cognitive approach with the metacognitive perspective.

A number of clinical trials have examined and demonstrated the efficacy of complex MCT programs for OCD, most of which, however, were conducted with comparably small samples (Fisher & Wells, 2008; Rees & van Koesveld, 2008; Shareh, Gharraee, Atef-Vahid, & Eftekhar, 2010; Simons, Schneider, & Herpertz-Dahlmann, 2006). By contrast, only a small number of studies aimed at investigating single treatment components of MCT, such as DM.

Regarding DM, Firouzabadi and Shareh (2009) provided evidence for the efficacy of DM through a single case study in which one OCD patient was treated with DM, resulting in decrease of 26 points on the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989) from pre- to follow-up assessment. Moreover, Ludvik and Boschen (2015) report results from an analogue study with a non-clinical sample of students. The experiment involved the induction of memory distrust and examined the extent to which participants subsequently experienced an urge to check depending on whether they were instructed to use DM, cognitive restructuring, or no strategy at all (control group). Compared with the control condition, participants who had received one of the two "treatment" instructions were less likely to check afterwards, whereas only DM was associated

with a significant improvement in memory confidence at post-test. Note, however, that this was an analogue study with a non-clinical sample and that "treatment" only involved a written instruction.

Thus, at present, there is no study that investigated DM as a metacognitive stand-alone intervention in a clinical sample of persons with OCD. Similarly, there is hardly any literature dealing with the efficacy of purely "Beckian" cognitive restructuring without the confounding elements that accompany behavioral experiments. It is these circumstances that largely inspired the research presented within this dissertation, especially Study 1.

3. Assessment of obsessive-compulsive disorder

3.1. Retrospective rating scales

In contemporary research on OCD, retrospective rating scales, both clinician-administered and based on self-report, constitute the most prominent and established way of assessing OCD symptoms and severity. Representing the gold standard in assessing OCD symptoms, the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) is the most frequently used diagnostic instrument in outcome research. Comprising five items on obsessions and compulsions each, it offers a main score with a range of 0-40 points as each item is rated from 0 (no symptoms) to 40 (extreme symptoms). Its internal consistency and interrater reliability (Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989) as well as its validity and treatment sensitivity (Goodman, Price, Rasmussen, Mazure, Delgado, et al., 1989) have been demonstrated for the Y-BOCS main score. Even though self-report versions of the Y-BOCS (e. g., Warren, Zgourides, & Monto, 1993) have been provided and have been shown to demonstrate good convergent validity regarding the clinician-administered version (Steketee, Frost, & Bogart, 1996), they only play a minor role in OCD outcome research.

Moreover, a variety of self-report questionnaires have been developed over the years, which differ regarding their focus, their psychometric properties, and their factor structure (Overduin & Furnham, 2012). Among the list of the most established and current self-report questionnaires are the Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002), the Vancouver Obsessional Compulsive Inventory (VOCI; Thodarson et al., 2004), which is the successor to the Maudsley Obsessional Compulsive Inventory (MOCI; Hodgson & Rachman, 1977), and the Padua Inventory-Palatine Revision (PI-PR; Gönner, Ecker, & Leonhart, 2010), which is the most current version of the Padua Inventory, with its predecessor being the Padua Inventory-Revised (PI-R; Van Oppen, Hoekstra, & Emmelkamp, 1995). As summarized by

Overduin and Furnham (2012), all of these questionnaires exhibit good psychometric properties, and some of them, such as the OCI-R, have also been translated into various languages.

Regarding the cognitive and metacognitive models of OCD discussed above, certain specific questionnaires have been developed in order to measure the constructs that are inherent to the corresponding theory. In terms of cognitive theories, the OCCWG developed the Obsessive Beliefs Questionnaire, which originally comprised 87 items (OBQ-87; OCCWG, 1997, 2001) in order to measure the six domains of cognitive distortions described in section 1.1.2. In 2005, the OCCWG published a revised form of this questionnaire which comprises only 44 items (OBQ-44) and suggests three instead of six subscales: (1) Responsibility/Threat Estimation, (2) Perfectionism/Certainty, and (3) Importance/Control of Thoughts. This re-conceptualization was derived from the results of factor analyses, which indicated this sort of configuration.

Concerning the metacognitive model of OCD proposed by Wells (2011), a number of specific questionnaires aiming at measuring various types of metacognitions have been developed. Directly drawing on the domains of metacognition described in section 1.1.3., this set of self-report measures entails (among others) the short version of the Metacognitions Questionnaire (MCQ-30; Wells & Cartwright-Hatton, 2004), the Thought-Fusion-Instrument (TFI; Wells, Gwilliam, & Cartwright-Hatton, 2001), the Beliefs About Rituals Inventory (BARI; Wells & McNicol, 2004), and the Stop Signals Questionnaire (SSQ; Myers, Fisher, & Wells, 2009).

However, only some of the questionnaires described above have been explicitly studied with regard to their sensitivity concerning treatment effects. Out of the list of questionnaires listed above, treatment sensitivity has (to the knowledge of the author) been demonstrated for the OCI-R (Abramowitz, Tolin, & Diefenbach, 2005), for the PI-R (Van Oppen, Emmelkamp, van Balkom, & van Dyck, 1995) and for both versions of the OBQ (Anholt et al., 2010).

3.2. Real-time data capture

One major shortcoming of retrospective rating scales, either based on clinicians' ratings or on patients' self-reports, is that these data are subject to memory biases that arise automatically when persons are asked to rate the quality and quantity of their symptoms over a certain period, e. g., the last week. As a result, the validity of retrospective data is limited, with retrospective reports typically exhibiting more similarity with what the respondent experiences at the time of recall than with what concurrent reports over a certain time period indicate (Schwarz, 2007). In terms of negative and positive mood states, for instance, retrospective ratings have been shown to exhibit a tendency towards being exaggerated as compared with concurrent ratings, whereas positive mood states seem to be less affected by such bias (Sato & Kawahara, 2011).

As Schwarz (2007) points out, this sort of bias is due to the fact that the intensity of (e. g., emotional) experiences is not well represented in memory, so that persons tend to rely on inference strategies when being asked to retrospectively rate their symptoms. To be precise, according to Schwarz, respondents especially use the peak and the end of a certain episode to infer the intensity of symptoms, so that a lot of information is actually lost. As Schwarz concludes, real-time data capture provides a promising though rather difficult-to-apply means of avoiding these biases and of arriving at more valid data about respondents' experiences.

3.2.1. Traditional approaches

Various approaches have been made with regard to solving the problems associated with retrospective biases. One of them is the so-called Behavioral Avoidance Test (BAT), which involves confronting a person with aversive stimuli, such as a toilet in the case of contamination-related OCD. Although looking like an exposure task when seen from outside, BATs solely serve the purpose of diagnostic assessment, with the variables of interest being (1) how many

steps the person accomplishes in approaching the stimulus, and (2) his Subjective Units of Disturbance/Discomfort (SUDS) ratings. While the findings regarding validity of BATs are heterogeneous, there is firm evidence for BATs exhibiting good treatment sensitivity (Steketee, Chambless, Tran, Worden, and Gillis, 1996).

As such, BATs can be conceptualized as a form of real-time data capture not subject to retrospective biases. Yet, as Taylor (1995) points out, BATs are quite difficult to design in order to fit with the patient's individual set of problems, and moreover, they are usually not set in the person's natural surroundings, which limits their ecological validity. When it comes to real-time data capture, however, ecological validity is just as important as overcoming retrospective memory biases when the aim is to provide data about how patients actually *experience* symptoms of a certain disorder in their everyday lives.

In contrast to BATs, direct observation of OCD rituals by a clinician can be employed in the person's habitual surroundings, which enhances ecological validity while avoiding the caveats of retrospective ratings. As for BATs, there is evidence proving that direct observation is a form of assessment sensitive to treatment effects (e. g., Turner, Hersen, Bellack, Andrasik, & Capparel, 1980). Unfortunately, however, its use as an outcome measure in clinicial trials is limited by the fact that it is hardly applicable to outpatients, with whom most clinical research is conducted.

By contrast, diary methods, which have been applied in clinical outcome research on OCD since the 1980s, provide both ecological validity (as patients keep track of their symptoms while being in their habitual surroundings) and the advantage of overcoming retrospective biases. In terms of OCD, diary methods have been used multiple times, especially in order to measure frequency of obsessions (Taylor, 1995). Furthermore, diary methods have also been shown to exhibit good treatment sensitivity (e. g., Boersma, Den Hengst, Dekker, & Emmelkamp, 1976; Foa, Steketee, & Milby, 1980).

In spite of the advantages described above, diary methods continue to be hardly employed in outcome research, even though they provide a direct measure of symptom *frequency* – which actually would be a straightforward way of defining treatment outcome (Mavissakalian & Barlow, 1981). This discrepancy gave rise to Taylor (1995) pointing out that diary methods are urgently required to "help us understand how OCD treatments influence the patient in his or her habitual environment" (p. 265). To the author's knowledge, this discrepancy is still very much alive, which inspired the idea to apply a modern form of diary sampling, i. e. *ecological momentary assessment* (EMA), to a clinical trial comparing two different interventions for OCD.

3.2.2. Ecological momentary assessment

Since it offers a way of studying symptoms of psychological disorders under ecologically valid conditions, *ecological momentary assessment* (EMA), a term tracing back to Stone and Shiffman (1994) and often used interchangeably with *ambulatory assessment* and *experience sampling*, has become increasingly popular in clinical research (e.g., Trull & Ebner-Priemer, 2009, 2013). Providing a wide range of ways to collect data in the persons's habitual surroundings, e. g., by using a smartphone that sends random prompts several times day asking the person to rate the intensity of her symptoms, EMA comes along with a number of advantages compared to retrospective ratings scales. Not only does EMA reduce retrospective bias and enhance ecological validity due to real-life assessment, it also allows insights into the relationships between symptoms, mental events and external influences and is able to reveal dynamic processes over time (Ebner-Priemer & Trull, 2009; Shiffman, Stone, & Hufford, 2008).

As such, the EMA method has been applied to psychological disorders such as borderline personality disorder (BPD), which has contributed to a number of insights about affective instability (Ebner-Priemer & Sawitzki, 2007; Ebner-Priemer & Trull, 2009; Santangelo, Bohus,

& Ebner-Priemer, 2014). When leaving the field of BPD, however, the scope of EMA research grows more narrow, which is especially true of OCD. Gloster et al. (2008) used an EMA approach (one prompt in four hours across seven days) to study recall accuracy for OCD symptoms, whereas Purdon, Rowa, and Antony (2007) used EMA to study thought suppression attempts in OCD patients by having them keep diary of such attempts over a period of three days. To date, there are no other EMA studies dealing with OCD symptoms in patients' everyday lives.

A number of studies have demonstrated the usefulness of EMA in evaluating the efficacy of psychological interventions (mostly CBT-related), thereby demonstrating that EMA is sensitive to effects of treatment. Most of these studies have focused on substance use disorders (Morgenstern, Kuerbis, & Muench, 2014; Ruscio, Muench, Brede, & Waters, 2016; Voogt et al., 2013; Voogt, Kuntsche, Kleinjan, & Engels, 2014; Willner-Reid et al., 2016), with a few more studies dealing with sleep-restriction therapy for insomnia patients (Miller, Kyle, Marshall, & Espie, 2013), anxiety and depressive disorders in adolescents (Forbes et al., 2012) and binge eating disorder (Munsch et al., 2009). However, the designs of those studies are very heterogeneous, with sampling rates ranging from one prompt per week to five prompts per day and duration of sampling periods varying between three days and 24 weeks. Moreover, the method of data collection differs across studies, featuring smartphone-based as well as paper-pencil and phone call approaches.

All in all, EMA can be regarded as a diary sampling method that (to a large extent) rules out problems of retrospective memory biases, ensures ecological validity, allows for complex longitudinal analyses, and appears to be sensitive to effects of CBT-related treatments. To date, however, it has hardly ever been applied to OCD, neither in terms of studying symptoms nor with regard to revealing effects of treatment that especially concern the frequency of OCD-

related symptoms and behaviors. In sum, this is what gave rise to the other pieces of research that are presented within this dissertation, i. e., Study 2 and Study 3.

4. Goals of this dissertation

Taking into account the literature reviewed in Chapters 1, 2 and 3, this thesis pursued the main goal of studying the effects of key interventions of cognitive and metacognitive therapy, i. e., cognitive restructuring (CR) and detached mindfulness (DM), respectively. Thereby, my co-authors and I aimed at contributing to the literature on effective treatments beyond ERP, which, as reviewed in Chapter 2, poses a big challenge to patients and leads to considerable drop-out rates. Regarding possible operationalizations of treatment outcome, one of our major interests was to not only rely on classical retrospective rating scales, such as the Y-BOCS, but to instead study symptom changes that patients experience in their everyday lives using ecological momentary assessment (EMA) as a form of real-time data capture. The three studies presented in this dissertation all arose from the same large research project and all refer to the same sample of n = 40 women and men with OCD.

Study 1 presents the main results of the clinical trial, focusing on effect sizes based on Y-BOCS difference scores and the percentage of participants exhibiting clinical significant change. In terms of assessment methods, thus, Study 1 represents the classic approach to measuring outcome by using retrospective symptom scales. In sum, the research questions Study 1 aimed at answering were:

(1) How efficacious (in terms of the Y-BOCS) is a short intervention of purely Beckian cognitive restructuring (CR) without behavioral experiments in treating OCD when used as stand-alone intervention?

(2) How efficacious (in terms of the Y-BOCS) is a short intervention of detached mindfulness (DM) in treating OCD when used as stand-alone intervention?

By contrast, **Study 2** focuses on the application of the ecological momentary assessment (EMA) method to OCD, using the same sample as Study 1. In order to both provide an EMA-

based description of OCD symptoms and related phenomena *prior* to treatment and an EMA-based outcome measure, we conducted two EMA sampling periods of four days each both immediately before the start of treatment and right after the completion of treatment. In order to demonstrate an effect of treatment, Study 2 predominantly reports results concerning all items of the EMA questionnaire that deal with the frequency of obsessions and *dysfunctional* behaviors such as compulsions. Thus, Study 2 was designed to answer the following questions:

(3) In what way do ecologically valid data on OCD symptoms, associated behaviors and OCD-specific emotional states (as measured by EMA) reflect what theoretical models of OCD would predict?

(4) To what extent is it possible to demonstrate a treatment-related decline of OCD symptoms, associated behaviors and OCD-specific emotional states by means of the EMA method – i. e., is the EMA method sensitive to treatment effects in OCD?

Finally, **Study 3**, also referring to the same sample as Studies 1 and 2, extends the goals of Study 2 by reporting EMA data on the use of the CR and DM strategies that patients were taught during treatment. In an effort to investigate differences concerning how participants apply CR and DM strategies in their everday lives before as compared to after treatment, Study 3 pursued the goal of answering the following questions:

(5) Is there an increase from before to after treatment concerning how frequent patients apply the nearly learned strategies of either CR or DM?

(6) Is such an increase of functional coping strategies specific in a way that CR treatment only leads to an increase of CR strategies and DM treatment only leads to an increase of DM strategies?

(7) Is there a difference between CR and DM regarding how frequently the newly learned strategies are being applied by participants, to what extent participants experience these strategies as difficult to apply, and to what extent participants experience relief from using these strategies?

5. Study 1: Detached mindfulness and cognitive restructuring for treating OCD

A randomized waitlist-controlled trial comparing detached mindfulness and cognitive restructuring in obsessive-compulsive disorder

Christian Rupp[1,3¶], Charlotte Jürgens[1,3¶], Philipp Doebler[2], Fabian Andor[3], & Ulrike Buhlmann[1]*

[1] Institute of Psychology, Westfälische Wilhelms-University Münster, Fliednerstrasse 21, 48149 Münster, Germany

[2] Department of Statistics, TU Dortmund University, 44221 Dortmund, Germany

[3] Christoph-Dornier-Stiftung, Schorlemerstrasse 26, 48143 Münster, Germany

*Corresponding author

E-mail: ulrike.buhlmann@wwu.de

¶These authors contributed equally to this work.

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Abstract

Objective

Whereas research has demonstrated the efficacy of cognitive restructuring (CR) for obsessive-compulsive disorder (OCD), little is known about the efficacy of specific metacognitive interventions such as detached mindfulness (DM). Therefore, this study compared the efficacy of CR and DM as stand-alone interventions.

Design

We conducted a randomized waitlist-controlled trial. n = 43 participants were randomly assigned to either DM or CR. Out of those participants, n = 21 participants had been previously assigned to a two-week waitlist condition.

Materials and Methods

In both conditions, treatment comprised four double sessions within two weeks. Assessment took place at baseline (Pre1), after treatment (Post) and four weeks after the end of treatment (FU). There was a second baseline assessment (Pre2) in the waitlist group. Independent evaluators were blinded concerning the active condition. Adherence and competence ratings for the two therapists were obtained from an independent rater.

Results

40 patients completed the treatment. Two patients dropped out because of exacerbated depression. There were no further adverse events. Both CR and DM were shown to be superior to waitlist and equally effective at reducing OCD symptoms from pre to post assessment as measured with the Y-BOCS (CR: d = 1.67, DM: d = 1.55). In each of the two treatment conditions, eight patients (40 %) exhibited a clinical significant change at post assessment.

Conclusions

The results of this clinical trial suggest the potential efficacy of DM as a stand-alone intervention for OCD, however, our findings need to be interpreted with caution. Results indicate that both CR and DM should be considered as possible alternative treatments for OCD, whereas the working mechanisms of DM have yet to be elucidated.

Introduction

According to DSM-5, obsessive-compulsive disorder (OCD) is defined by intrusive and unwanted thoughts, images or urges (from now on referred to as obsessive thoughts or obsessions) and/or repetitive overt behaviors or mental acts used to reduce fear or distress caused by the above-named intrusive mental event [1]. Concerning treatment guidelines [2], cognitive behavioral therapy comprising exposure and response prevention (ERP), i. e., confronting patients with triggering stimuli while encouraging them to refrain from compulsions, as well as psychopharmacological treatment with selective serotonin reuptake inhibitors are considered as gold standard in treating OCD. However, around 30% of the patients treated with cognitive behavioral therapy either do not respond to this treatment [3] or decline the stressful and demanding exposure interventions. Moreover, around 20% of patients drop out of therapy [4], so that it seems crucial to further improve current treatments and to promote the development of alternative treatments.

Metacognitive therapy

Wells and Matthews [5] developed the Self-Regulatory Executive Function (S-REF) model of psychological disorders, which accentuates the role of metacognition in psychological disorders. Regarding OCD, the metacognitive model [6] emphasizes the meaning of dysfunctional metacognitive beliefs in the development and maintenance of OCD. Most importantly, it assumes that obsessive thoughts activate metacognitive beliefs concerning the meaning of thoughts, such as the assumption that thoughts represent or have an impact on reality (referred to as Thought-Action-Fusion, Thought-Object-Fusion and Thought-Event-Fusion, respectively). Based on these fusion-beliefs, obsessive thoughts are perceived as threatening, thus activating negative emotions (e.g., fear, guilt, distress) as well as metacognitive thoughts about the need to perform rituals or to engage in thought suppression. These rituals then serve to

reduce the perceived threat, while internal metacognitive criteria about stop signals serve as reference when to end the rituals.

Metacognitive therapy (MCT) of OCD based on the model mentioned above focuses on challenging metacognitive beliefs, whereas it explicitly does not include questioning of thought *content*. Instead, MCT comprises techniques such as *detached mindfulness* (DM), *exposure and response commission* and Socratic questioning of metacognitive beliefs. According to Wells [6], DM is a key technique in treating OCD as it offers an overall new approach to dealing with intrusive thoughts. Wells and Matthews [5] described DM as a technique to develop meta-consciousness, i. e., a state of mind in which the self and cognitive events are separated from one another. While in this state, the person is aware of his or her thoughts only being mental events – which s/he learns to solely observe in a passive way.

Efficacy of complex MCT treatment programs for OCD has been proven in a number of trials with, however, comparably small sample sizes [7–10]. However, only a few studies have examined the efficacy of single treatment components of MCT.

Wahl et al. [11] compared the efficacy of a mindfulness-based strategy with a distraction strategy during brief exposure to obsessive thoughts in a sample of 30 OCD patients. Significant decreases in anxiety and urge to neutralize between time of experimental manipulation and to post assessment were only found in the mindfulness-based strategy group. Firouzabadi and Shareh [12] examined the efficacy of DM in a single case study treating an OCD patient. The treatment led to a 26-point-decrease in Y-BOCS score from pre- to follow-up-assessment. Ludvik and Boschen [13] compared the efficacy of DM, cognitive restructuring (CR) and a control task (reading an unrelated scientific article) in reducing experimentally induced memory distrust and urge to check in a sample of 65 undergraduate students. Compared with the control task, participants in the control group were significantly more likely to check than participants receiving DM or CR, whereas only DM led to a significant improvement in memory confidence

at post-test. However, the experimental manipulation in this study cannot be compared to an actual treatment since it was delivered in the form of a written instruction and was limited to one single occasion.

As MCT focuses on changing one's relationship to one's own thoughts and since DM embodies a direct way of training this new way of dealing with mental events such as intrusive thoughts, it is expected to lead to a reduction in OCD symptoms according to the metacognitive model. Thus, it seems essential to examine the efficacy of DM as a stand-alone intervention in the treatment of OCD.

Cognitive restructuring

In contrast to MCT, the cognitive models of OCD proposed by Salkovskis [14, 15] and Rachman [16] emphasize the impact of distorted cognitions in the development and maintenance of OCD. Both authors suggest that not the intrusions themselves but rather the meaning attached to them (referred to as "automatic thoughts" by Salkovskis and as "misinterpretations" by Rachman) are responsible for negative emotional consequences - such as when interpreting having the intrusion as proof for being a "bad person". Evidence for this assumption comes, for example, from studies in which non-clinical samples were shown to report intrusions without being distressed [17, 18]. Salkovskis [14] suggested that these automatic thoughts are caused by specific individual beliefs about being personally responsible for harm, beliefs that having thoughts about an action is the same as accomplishing an action as well as beliefs about the need to control thoughts. Similar distortions have been described by the Obsessive Compulsive Cognitions Working Group (OCCWG) [19] who, in addition to Salkovskis, also list perfectionism, intolerance for uncertainty and overestimation of threat as relevant cognitive distortions in OCD.

Built on the cognitive model, which emphasizes that dysfunctional cognitions in response to intrusions constitute the maintaining factor in OCD, cognitive restructuring (CR) of OCD targets distorted cognitions/appraisals of obsessive thoughts primarily by using Socratic questioning. Thus, unlike DM, which teaches patients to *passively* observe and disassociate themselves from their intrusions while refraining from any sort of conceptual processing, CR provides patients with an *active* strategy of dealing with obsessive thoughts by questioning the appraisals attached to them. As such, DM and CR can be regarded as two entirely different approaches to the same problem.

Efficacy of CR in the treatment of OCD has been shown in a number of trials, of which, however, the majority comprised behavioral experiments, which can be considered as having some overlap with exposure tasks because they involve confronting patients with triggering stimuli (such as locking the door without checking if it is locked in checking-related OCD) while encouraging them to refrain from compulsions. Whereas ERP would traditionally highlight that over time, feelings of fear, disgust and tension decrease (which is often referred to as *habituation*), behavioral experiments within a CR approach would emphasize that a certain cognition has been contradicted (e. g., because the expected burglary did not occur).

The studies by Wilhelm et al. [20, 21] and Belloch et al. [22] all demonstrate the efficacy of complex cognitive treatment programs including behavioral experiments over several weeks. According to meta-analyses [4, 23, 24], CR proves to be an effective method for treating OCD - for lack of any significant differences concerning treatment efficacy of CR vs. ERP. Various other studies have investigated the efficacy of CR as compared to ERP, most of which showed no considerable differences concerning efficacy [25, 26], with one study suggesting ERP to be superior to CR in terms of recovery rates [27] and one showing the opposite result [28]. It should be noted in this context that the only one of the above-named studies whose protocol did not include behavioral experiments was the one effectiveness study by Belloch et al. [29],

so that there is little evidence for the efficacy of "purely Beckian" cognitive restructuring excluding this element. Finally, a number of meta-analyses [4, 23, 24], arrive at the conclusion that CR proves to be an effective method for treating OCD.

Given the two seemingly contradictory strategies for treating OCD, the main goal of our study was to examine the efficacy of 1) teaching patients a passively observing relation to one's own thoughts (i. e., DM) on the one hand and 2) leading them to actively question distorted appraisals and beliefs (i. e., CR) on the other hand. Since the efficacy of CR for OCD, often being compared with ERP, has been widely demonstrated (with most protocols, however, involving behavioral experiments), we regarded CR as the more established treatment approach that we decided to compare with DM, which represents a more recent and conceptually fresh take on treating OCD. In either case, our interest was to elucidate the efficacy of both approaches as stand-alone interventions, which is why we compared a purely "Beckian" form of CR with the specific intervention of DM.

Materials and Methods

Study design

The study protocol for this clinical trial was registered at ClinicalTrials.gov under the ID NCT03002753 and the title "Dealing With Intrusive Thoughts in OCD - a Comparison of Detached Mindfulness and Cognitive Restructuring" (Protocol ID: CDS-MS-JR-2016, URL: https://clinicaltrials.gov/ct2/results?cond=&term=NCT03002753&cntry=&state=&city=&dist=). The design of the study can be best described as a randomized delayed-intervention controlled trial with an underlying parallel design concerning the two active conditions (CR/DM). Participants randomized to the non-

waitlist (NWL) group started their treatment at the beginning of the week following initial assessment (Pre1) whereas participants randomized to the waitlist control group (WL) started treatment with a delay of two weeks.

The study protocol was reviewed and approved of by the ethics committee of the Department of Psychology and Sport Science at the University of Münster, Germany (approval number: 2016-37-UB). All participants provided written informed consent after the study procedure had been fully explained. The study was conducted between January 2017 (start of data collection) and July 2018 (end of data collection), whereas recruitment began in December 2016 and was completed in June 2017. The last follow-up assessment marking the end of the active phase of the study was on July 12, 2018.

Power analysis

Sample size was estimated on the basis of an a priori conducted power analysis. Importantly, we were not interested in finding differences between the two treatment conditions concerning efficacy. Thus, power analysis focused on the sample size required to find pre to post treatment effects in each of the two treatment groups. Based on the literature reviewed above it was difficult to estimate the expected effect size f for a short-term but intense stand-alone intervention of DM or CT in a clinical sample. We arrived at an estimate for f ranging from 0.25 to 0.40 for a between-within-interaction in a 2x2 repeated measures ANOVA (which corresponds to a Cohen's d of 0.5 and 0.8, respectively). Given an α level of 0.05, a power of $\beta = 0.90$ and a correlation between the two assessment points (labeled T1 and T2, respectively) of $r = 0.5$, the corresponding total sample size ranged from 46 to 20 participants. We originally planned to recruit a total of 60 participants, reduced the targeted sample size to a total of 40 participants in March 2017 due to recruitment difficulties.

Procedure

Participants were recruited via postings in social media including German OCD awareness online platforms as well as via posters in university buildings and flyers distributed in surrounding psychiatric, neurologic and dermatologic practices and outpatient departments as well as in local physicians' practices and pharmacies. Recruitment also involved repeated advertisements in local newspapers and emails to local psychotherapists. Additionally, some patients were recruited via the psychotherapeutic outpatient department at the University of Münster, which offers a weekly consultation hour for patients who, if suitable, are proposed to participate in a clinical study in order to bypass the waiting time for a regular CBT treatment.

All data were collected at the psychotherapeutic outpatient department of the Christoph-Dornier-Foundation in Münster. Participants received € 30 each for the completion of both pre- and post-assessment as well as € 40 for completing follow-up (FU) assessment. Moreover, participants in the WL were paid additional € 20 for their participation in a second pre-assessment (Pre2). Beyond that, participants received an additional amount of € 80 to € 100 for filling in questionnaires of a smartphone-based ecological momentary assessment (EMA) study that was run prior to the first treatment session and directly after the last treatment session. Results of the EMA study will be reported elsewhere.

Assessment

A two-step assessment was conducted to check inclusion/exclusion criteria. The first step involved a phone screening that was conducted by a graduate student research assistant. Second, participants meeting the criteria of the phone screening were invited to an assessment session (Pre1) which was conducted by one of six independent study evaluators. All evaluators were Master level psychologists currently participating in an advanced training to become a cognitive behavioral psychotherapist. They received special training in diagnosing OCD by the investigators. The evaluators were blind with regard to the treatment condition of the patient (DM vs.

CR). Contrary to the protocol registered at clinicaltrials.gov, however, the evaluators could not be blinded in terms of whether the patient was in the WL or the NWL condition due to aspects concerning the organization of the study process. Participants were blinded in a way that they were not told about the contents of the other treatment condition until FU assessment in order to avoid any unintended mixing of treatment strategies.

In sum, all participants underwent three assessments, i. e. Pre1, Post, and FU. Apart from that, the participants who were assigned to the WL condition during the first randomization received an additional assessment referred to as Pre2. The time span between Pre1 and Post (in the NWL group), between Pre1 and Pre2 (in the WL group) and between Pre2 and Post (in the WL group), respectively, was two weeks. The time span between Post and FU assessment was 4 weeks. Fig 1 is a a CONSORT flow diagram giving an overview of the study process and the assessment points.

Pre1 assessment comprised about three hours and included, among others, the administration of the German versions of the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) [30] as well as the German version of Y-BOCS [31]. The level of premorbid intelligence was assessed by the Multiple-choice vocabulary intelligence test (MWT) [32]. Information about demographic variables as well as previous pharmacological or psychotherapeutic treatments was collected. At the end of the Pre 1 assessment, participants filled in a number of questionnaires, most of which they additionally filled in prior to each treatment session to obtain process measures. Among these questionnaires was the German version of the Beck Depression Inventory-Revised (BDI-II) [33] measuring the intensity of depressive symptoms.

The primary outcome measure was the Y-BOCS total score (items 1-10). The primary outcome measure was assessed at three (NWL) or four (WL) time points. Baseline measures were collected during Pre1 assessment and, in the WL group, additionally during Pre2 assessment. Post

assessment was conducted directly after the last treatment session. FU assessment was conducted 4 weeks after the end of the treatment. During the follow-up period no additional treatment was provided, but participants were told and encouraged to further practice the techniques they had learned in therapy.

Inclusion and exclusion criteria

Inclusion criteria comprised a current primary diagnosis of OCD according to DSM-5 [1], based, however, on the German version of the SCID-I [30] complemented by additional questions to confirm the DSM-5 diagnosis. Further requirements comprised a minimum total Y-BOCS score of 16, a minimum age of 18 years, fluent German language skills and a minimum IQ of 80. Exclusion criteria included current suicidality or suicidal behavior within the past six months, a current or lifetime diagnosis of bipolar and psychotic disorder, a current addictive disorder and a current borderline personality disorder. Also, participants were excluded if they were currently undergoing cognitive-behavioral therapy focusing on OCD or if they had undergone such treatment in the past 12 months. For patients under medication, it was required that the dose was stable for at least eight weeks prior to Pre1 assessment. Patients not meeting these criteria were told to contact the investigators when their medication had been stable for at least eight weeks. Similarly, patients withdrawing from medication had to be at least eight weeks off their prior medication before entering the study.

Randomization

Based on the total Y-BOCS score and the total score from the BDI-II [33] at baseline (Pre1) as well as age and sex, participants were randomized to either WL or NWL by minimization conducted with *MinimPy program 0.3* [34] using default settings. Either following Pre1 (NWL) or following Pre2 assessment (WL), participants were once more randomly allocated to the treatment group (CR/DM) using the same minimization procedure as described above. Allocation ratio was 1:1 for both randomizations. Whereas for NWL, this second randomization was based

on the Pre1 scores of Y-BOCS and BDI-II, the Pre2 scores were used for the WL. Randomization was conducted by a graduate student research assistant.

Treatment

Treatment in both conditions (DM/CR) comprised four sessions delivered within two weeks. Both therapists were Master level psychologists at an advanced stage of their clinical CBT licensing training. Supervision was provided by the fourth author (F. A.) and both therapists received special training in delivering DM and CR in the context of OCD prior to the start of the study. Participants were randomly assigned to one of the two therapists (C. R., C. J.).

Treatment consisted of two sessions per week, with a minimum of one day in-between the two weekly sessions. Each session lasted 100 min. The two treatment protocols were manualized by the first two authors drawing on the guidelines by Wilhelm and Steketee [35] for the CR group and those by Wells [6] for the DM group, respectively. The German study manuals can be provided upon request.

Based on the suggestions by the OCCWG, the CR procedure proposed by Wilhelm and Steketee [35] focuses on six cognitive domains, which are *overimportance of thoughts, control of thoughts, overestimation of danger, desire for certainty, responsibility,* and *perfectionism*. As *overimportance of thoughts* refers to thought action fusion and *control of thoughts* contains beliefs about the need to control thoughts - which both are parts of metacognitive models of OCD - these domains were explicitly excluded from the CR manual in order to avoid an overlap with metacognitive aspects and strategies. Similarly, the DM manual did not feature any references to a conceptual way of dealing with cognitions.

Adherence and competence ratings

All treatment sessions were videotaped. For adherence and competence ratings, four complete treatments from each therapist (two DM and two CR, each) were randomly selected and then rated by an independent Master level psychologist using a list of items all employing a 5-point

Likert scale, with 5 indexing the best score. The rater was at an advanced stage of his CBT licensing training and was not otherwise involved in the study. The rater had received training concerning both CR and DM prior to rating the video material.

Cognitive restructuring

The first session of the CR condition consisted of psychoeducation about characteristics of OCD (e. g., the fact that obsessive thoughts are ubiquitous and therefore do not constitute the actual problem) and comprised the development of an individual cognitive model based on the model of Salkovskis [14, 15]. Focusing on the patient's individual obsessive-compulsive symptoms, the model was designed to explain the disorder's maintenance via the distorted appraisals of intrusions, which should therefore be questioned and altered. During the second session typical cognitive distortions occurring in OCD were explained (overestimation of danger, desire for certainty, responsibility and perfectionism) and strategies to question and modify these appraisals were provided and trained, drawing from Socratic questioning and logical and hedonistic strategies of disputation. Depending on the appraisal at hand, this would for instance include techniques such as multiplication of probabilities, distribution of responsibility, cost-benefit analysis, etc., whereas the whole process of questioning was recorded in writing. Prior to and after each questioning phase, the patient was asked to rate his/her level of conviction concerning the original appraisal. Additionally, s/he was encouraged to develop an alternative cognition and to practice this new cognition in everyday life. During the third session and the first part of the fourth session, these strategies were further trained. The last part of the fourth session consisted of summarizing the new knowledge and the techniques the patient had acquired during therapy. Homework during therapeutic sessions comprised monitoring and documenting obsessive thoughts and dysfunctional appraisals as well as engaging in the active questioning of the latter and practicing alternative cognitions in everyday life.

Detached mindfulness

The first session of the DM condition comprised the same psychoeducation as in the CR treatment. Afterwards, therapist and patient developed an individual metacognitive model of the patient's obsessive-compulsive symptoms (based on Wells [6]), explaining the maintenance of the disorder via the mechanism of assigning intrusive thoughts too much importance and meaning. That is, in contrast to the CR condition, patients were taught that it is about their general attitude towards their obsessions, not about any specific appraisals in response to their obsessions. During the second session, therapist and patient developed a list of the most prominent obsessions, rating each obsession's frequency and its level of distress. This was followed by introducing the strategy of DM using different examples and metaphors and finally by training DM applying the suggestions by Wells [6]. Training DM usually involved the patients closing their eyes and following the therapist's standardized suggestive instructions to visualize an obsession, to dissociate oneself from the obsession and to switch to a mode of passive observing instead of active interaction. Each training unit was designed to comprise five to ten minutes. The third session and the first part of the fourth session consisted of further DM training. The last part of the fourth session was identical to the CR condition. Homework between therapeutic sessions comprised monitoring and documenting obsessive thoughts (only between sessions 1 and 2) and exercising DM several times per day. Patients were instructed to practice DM on the obsessions previously included in their list and to then increasingly apply DM to all kinds of triggering thoughts they encountered in everyday life.

Process measures

Prior to each treatment session, participants completed a number of questionnaires used as process measure that were presented on a tablet computer using a web-based online-survey software (www.unipark.de). Except for the results of the German version of the BDI-II [33], results of these process measures will be reported in a separate article.

Homework ratings

During each session, homework compliance was rated by the therapist on a 7-point rating scale ranging from 1 (no homework implemented) to 7 (homework done exactly as the patient was told). The first ratings were obtained in the second session, referring to homework set in the first session.

Data analysis

Data were analyzed using the *R* package *ez* [36] and *IBM SPSS Statistics (SPSS) 25.0*. Comparability of groups at baseline was analyzed by calculating independent *t*-tests for continuous variables and χ^2-test for categorical variables. In order to evaluate the efficacy of treatments, a 2x2x2 mixed ANOVA was run with the between-subjects factors *waitlist* (WL/NWL) and *treatment condition* (CR/DM) and the within-subjects factor *time* coding whether measurements were taken at *T1* or *T2:* In both groups, *T1* referred to Pre1 data, however, *T2* referred to Pre2 data in the WL group and to Post data in the NWL group, thus separating effects of time and treatment resp. waitlist. Please note that (a) this mixed ANOVA does not use the Post assessment data from participants in the waitlist group, avoiding some implicit assumptions and complexities of linear mixed models [37], and that (b) the definition of time points therefore differs between WL and NWL groups. Please also note that (c) the F-test of the *waitlist* × *time* interaction tests the global treatment effect [38]. The use of the R package *ez* involved the computation of the *generalized eta squared statistic* (η_G^2) in order to display the amount of explained variance [39].

The calculation of effect sizes (Cohen's *d*) was based on the complete data set including the Post data from WL participants, which was based on the a priori assumption of *time* not exhibiting a considerable main effect. Due to this assumption, Pre2 data were not used in the calculation of effect sizes. As the standard deviation of the outcome variable could be influenced by treatment resp. follow-up, Becker [40] recommends to use the value at the first time point.

Three effect sizes (Pre1-Post, Post-FU, and Pre1-FU) were calculated for each treatment condition as follows, using pooled standard deviations (SD_{Pre1}: 3.385; SD_{Post}: 5.789) instead of separate standard deviations for CR and DM (X = mean Y-BOCS score, SD = standard deviation): $d_1 = \frac{X_{Pre1}-X_{Post}}{SD_{Pre}}$, $d_2 = \frac{X_{Post}-X_{FU}}{SD_{Post}}$, $d_3 = \frac{X_{Pre1}-X_{FU}}{SD_{Pre}}$. Confidence intervals for Cohen's d were calculated using the formula provided by Hedges and Olkin [41].

Moreover, in order to display the *amount* of improvement, clinically significant change was assessed as proposed by Jacobson and Truax [42]. It was defined by a combination of two criteria: (I) *reliable improvement*: $RC = \frac{X_2-X_1}{S_{diff}}$, with x_1 representing a person's Y-BOCS score at Pre1 assessment, x_2 referring to a person's Y-BOCS score at Post assessment, and S_{diff} denoting being the standard error of difference scores (based on the internal consistency of the German version of the Y-BOCS (r = .80) as reported by Jacobsen et al. [43]. Based on our calculations, a decrease of 5 points or more on the Y-BOCS indicated was used as an index of reliable improvement. (II) *recovery criterion*: $a = M_1 - 2*SD_1$, with M_1 representing the mean Y-BOCS score of the sample at Pre1 assessment and SD_1 referring to the corresponding standard deviation. A post assessment Y-BOCS score of a = 17.9 or less indicated recovery. A reliable change was presumed if participants displayed a post-assessment Y-BOCS score of 17.9 or less (recovery criterion) and a minimal Pre1-Post change of 5 -points on the Y-BOCS (reliable improvement criterion).

Results

Sample description

The recruitment process and participant flow is displayed in Fig 1. As you can see from the flowchart, three participants dropped out after randomization, two of which because of exacerbated depression and one due to physical health issues. Apart from this, there were no further adverse events or unintended side effects in any of the groups. Apart from the participants who

dropped out, there was one missing data set of a CR participant concerning the process measures at FU assessment, which was due to a malfunctioning of the tablet used for data collection. There were no further missing data.

Regarding the three dropouts, an intention-to-treat (ITT) analysis was carried out under a missing at random (MAR) assumption employing multiple imputation by chained equations using predictive mean matching for the three missing continuous outcomes at T2 [44]. There were no substantial differences in any of the *p*-values of the repeated measures ANOVA in any of the 25 imputed datasets. Thus, the analyses described below are based on the completer sample ($n = 40$). By contrast, the report of the sample characteristics (Table 1) is based on the intent-to-treat (ITT) sample ($n = 43$).

Table 1 gives an overview of clinical and demographic characteristics along with between-group comparisons. We did not find any significant differences between WL and NWL and neither between CR and DM concerning any of the variables displayed (all p's > .05). Y-BOCS and BDI-II data for the different assessment points across groups (completer sample) are presented in Table 2.

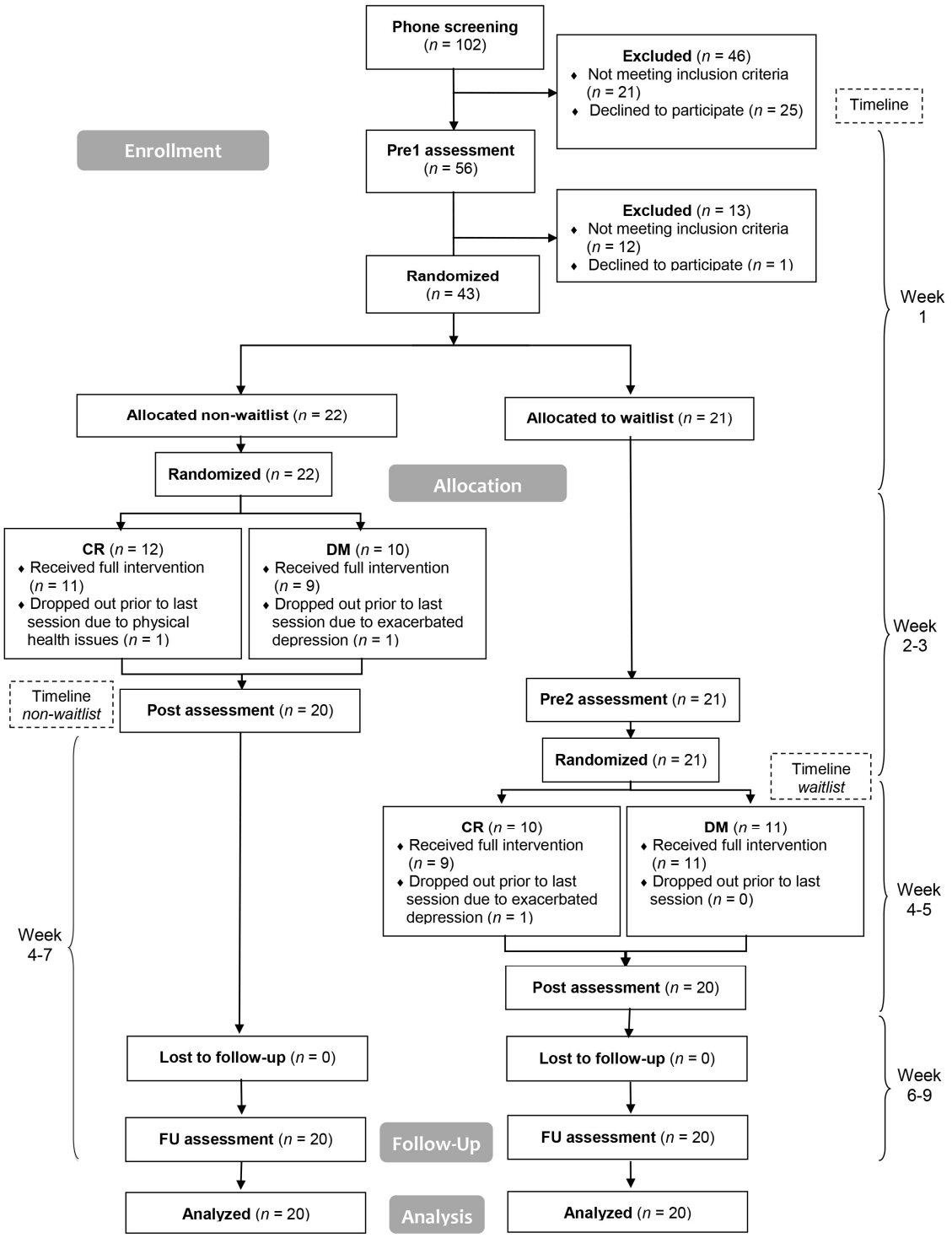

Fig 1. CONSORT flowchart describing the study process and participant flow. The reasons for exclusion after Pre1 assessment were as follows: OCD at subclinical level (n = 5), other than OCD being the primary diagnosis (n = 2), therapy focusing on OCD within the past 12 months (n = 2), history of psychosis (n = 1), recent change of medication (n = 1), acute Borderline Personality Disorder (n = 1), declined because experienced study protocol as too stressful (n = 1). *Abbreviations:* CR = cognitive restructuring, DM = detached mindfulness.

Table 1. Demographic and clinical characteristics at Pre1 assessment (intention-to-treat sample).

Variable	NWL (*n*=22)	WL (*n*=21)	*p*	CR (*n*=22)	DM (*n*=21)	*p*
Age, mean (*SD*)	31.59 (11.73)	30.43 (8.42)	0.710	31.23 (10.96)	30.81 (9.48)	0.894
Sex, *n* (*%*)						
Male	9 (40.91)	9 (42.86)	1.000	12 (54.54)	6 (28.57)	0.124
Female	13 (59.09)	12 (57.14)		10 (45.45)	15 (71.43)	
Family status						
Single, *n* (*%*)	17 (77.27)	19 (90.48)	0.535	18 (81.82)	18 (85.74)	1.000
Married, *n* (*%*)	4 (18.18)	2 (9.52)		3 (13.63)	3 (14.29)	
Widowed, *n* (*%*)	1 (4.55)	0 (0.00)		1 (4.55)	0 (0.00)	
Employment						
Working full-time, *n* (*%*)	9 (40.91)	7 (33.33)	0.405	10 (45.45)	6 (28.57)	0.550
Working part-time, *n* (*%*)	6 (27.27)	10 (47.62)		7 (31.82)	9 (42.86)	
Not working, *n* (*%*)	7 (31.82)	4 (19.05)		5 (22.73)	6 (28.57)	
Years of school education, mean (*SD*)	13.11 (1.09)	13.07 (3.14)	0.954	12,57 (1.03)	13.64 (3.06)	0.139
Clinical characteristics						
Mean persistence of OCD, years (*SD*)	10.32 (8.45)	12.19 (9.77)	0.506	10.36 (8.81)	12.14 (9.45)	0.527
Mean age of onset, years (*SD*)	18.41 (10.57)	16.41 (10.59)	0.538	18.61 (11.99)	16.190 (8.80)	0.453
Number of comorbid disorders, mean (*SD*)	1.00 (1.51)	0.57 (0.93)	0.268	0.68 (1.36)	0.90 (1.18)	0.568
Number of previous inpatient & outpatient treatments, mean (*SD*)	2.86 (3.09)	2.52 (3.04)	0.718	2.82 (3.10)	2.57 (3.04)	0.793
Participants under psychopharmacological medication, number (*%*)	8 (36.36)	11 (52.38)	0.364	11 (50.00)	8 (38.10)	0.543
Participants experienced in the intervention delivered, number (*%*)	1 (4.54)	3 (14.29)	0.345	3 (13.64)	1 (4.76)	0.607

The number of participants experienced in the intervention delivered was determined by the therapists who asked participants during treatment whether they are familiar with the strategy, e. g. due to previous therapies. Fisher's exact test was used for calculating comparisons for the variables *sex*, *family status*, *employment*, *Participants under psychopharmacological medication*, and *Participants experienced in the intervention delivered*, with the *p* value referring to a two-sided test. *t*-test for independent samples were computed for the remaining variables. All

p values refer to comparisons between the groups listed in the two columns to the left, respectively.
Current comorbid disorders of the intention-to-treat sample were (percentage in brackets): Specific Phobia: 5 (11.63%), Alcohol Dependence Syndrome, in remission: 3 (6.98%), Major Depressive Disorder: 3 (6.98%), Social Anxiety Disorder: 3 (6.98%), Dysthymia: 2 (4.65%), Generalized Anxiety Disorder: 2 (4.65%), Post-traumatic Stress Disorder: 2 (4.65%), Body Dysmorphic Disorder: 2 (4.65%), Somatization Disorder: 2 (4.65%), Cannabinoid Dependence Syndrome, in remission: 1 (2.33%), Panic Disorder with Agoraphobia: 1 (2.33%), Panic Disorder without Agoraphobia: 1 (2.33%), Agoraphobia without Panic Disorder: 1 (2.33%), Undifferentiated Somatoform Disorder: 1 (2.33%), Persistent Somatoform Pain Disorder: 1 (2.33%), Trichotillomania: 1 (2.33%), Dermatillomania: 1 (2.33%), Overeating: 1 (2.33%), Attention Deficit Hyperactivity Disorder: 1 (2.33%). *Abbreviations:* NWL= non-waitlist, WL = waitlist, CR = cognitive restructuring DM = detached mindfulness.

Table 2. Y-BOCS data, BDI-II data, and Cohen's d (completer sample).

Variable	**NWL (*n*=20)**	**WL (*n*=20)**	***p***	**CR (*n*=20)**	**DM (*n*=20)**	***p***
Y-BOCS (items 1-10), mean (*SD*)						
Pre1	25.50 (3.82)	23.85 (2.74)	0.125	25.05 (2.69)	24.30 (4.00)	0.491
Pre2	-	23.60 (2.39)	-	-	-	-
Post	20.40 (6.71)	18.05 (4.57)	0.204	19.40 (5.38)	19.05 (6.30)	0.851
FU	-	-	-	16.35 (9.11)	17.05 (7.92)	0.797
BDI-II, mean (*SD*)						
Pre1				17.65 (9.29)	16.55 (10.66)	
Post				16.30 (10.39)	14.55 (12.71)	
FU (DM: *n*=20, CR: *n*=19)				12.00 (8.49)	13.10 (13.04)	
Cohen's *d* (95% confidence intervals in square brackets)			**CR**	(*n*=20)	**DM**	(*n*=20)
Pre1-Post			**1.67**	[0.95; 2.39]	**1.55**	[0.84; 2.26]
Post-FU			**0.53**	[-0.10; 1.16]	**0.35**	[-0.28; 0.98]
Pre1-FU			**2.57**	[1.73; 3.41]	**2.14**	[1.36; 2.92]

Cohen's *d* is based on the Y-BOCS data (items 1-10). The calculation of *M* and *SD* for the BDI-II at FU in the CR condition was based on 19 instead of 20 participants due to one missing data set. The *p* values refer to *t*-tests for independent samples between the groups listed to the left. *Abbreviations:* NWL= non-waitlist, WL = waitlist, CR = cognitive restructuring DM = detached mindfulness.

Homework ratings

The results of the homework ratings can be retrieved from Table 3.

Table 3. Homework ratings.

	CR (*n*=20)	DM (*n*=20)
Second session, mean (*SD)*	5.85 (1.39)	6.50 (0.69)
Third session, mean (*SD)*	5.45 (1.39)	5.45 (1.32)
Fourth session, mean (*SD)*	4.90 (1.68)	5.50 (1.43)

There are no homework ratings for the first session because the first homework was set at the end of the first session. *Abbreviations:* CR = cognitive restructuring DM = detached mindfulness.

Efficacy of treatment

Mixed ANOVA

The mixed 2x2x2 ANOVA used the Y-BOCS score as dependent variable since this was the a priori-defined outcome measure. The results of the mixed ANOVA are displayed in Table 4, whereas mean Y-BOCS-scores are displayed in Fig 2. The significant main effect for *time* ($p < .001$) indicates a global change in mean Y-BOCS scores across all combinations of *waitlist* and *treatment condition*s, while the non-significant main effects for *waitlist* and *treatment condition*s as well as the non-significant interaction of these two factors are interpreted as no difference at T1 (=Pre1), as expected by randomization and confirmed by Fig 2. The significant *waitlist* x *time* interaction ($p = 0.001$) indicates that mean Y-BOCS scores change from T1 to T2 when treatment is immediate (see upper panel of Fig 2), while the non-significant *treatment condition* x *time* and *waitlist* x *treatment condition* x *time* interactions correspond to parallel mean Y-BOCS score changes (see upper panel of Fig 2) for both treatment types, i. e., no change for waiting participants (see lower panel of Fig 2). In sum, the results are in line with our hypotheses, indicating no considerable effect of the time spent waiting in the waitlist condition and showing both treatment conditions to be similarly effective.

Table 4. Results of the mixed 2x2x2 ANOVA.

	df_1	df_2	F	p	η_G^2
Time	1	36	15.82	< 0.001	0.097
Treatment condition	1	36	0.26	0.611	0.005
Waitlist	1	36	0.50	0.486	0.010
Waitlist × *Time*	1	36	12.89	0.001	0.081
Waitlist × *Treatment condition*	1	36	1.65	0.208	0.033
Treatment condition × *Time*	1	36	0.001	0.979	< 0.001
Waitlist × *Treatment Condition* × *Time*	1	36	<0.001	0.991	< 0.001

The dependent variable for this ANOVA was the Y-BOCS score which served as the primary outcome measure. The degrees of freedom for the numerator of the *F* test are referred to as df_1, whereas the degrees of freedom for the denominator of the F test are referred to as df_2. The *generalized eta squared statistic* (η_G^2) is used to display the amount of explained variance.

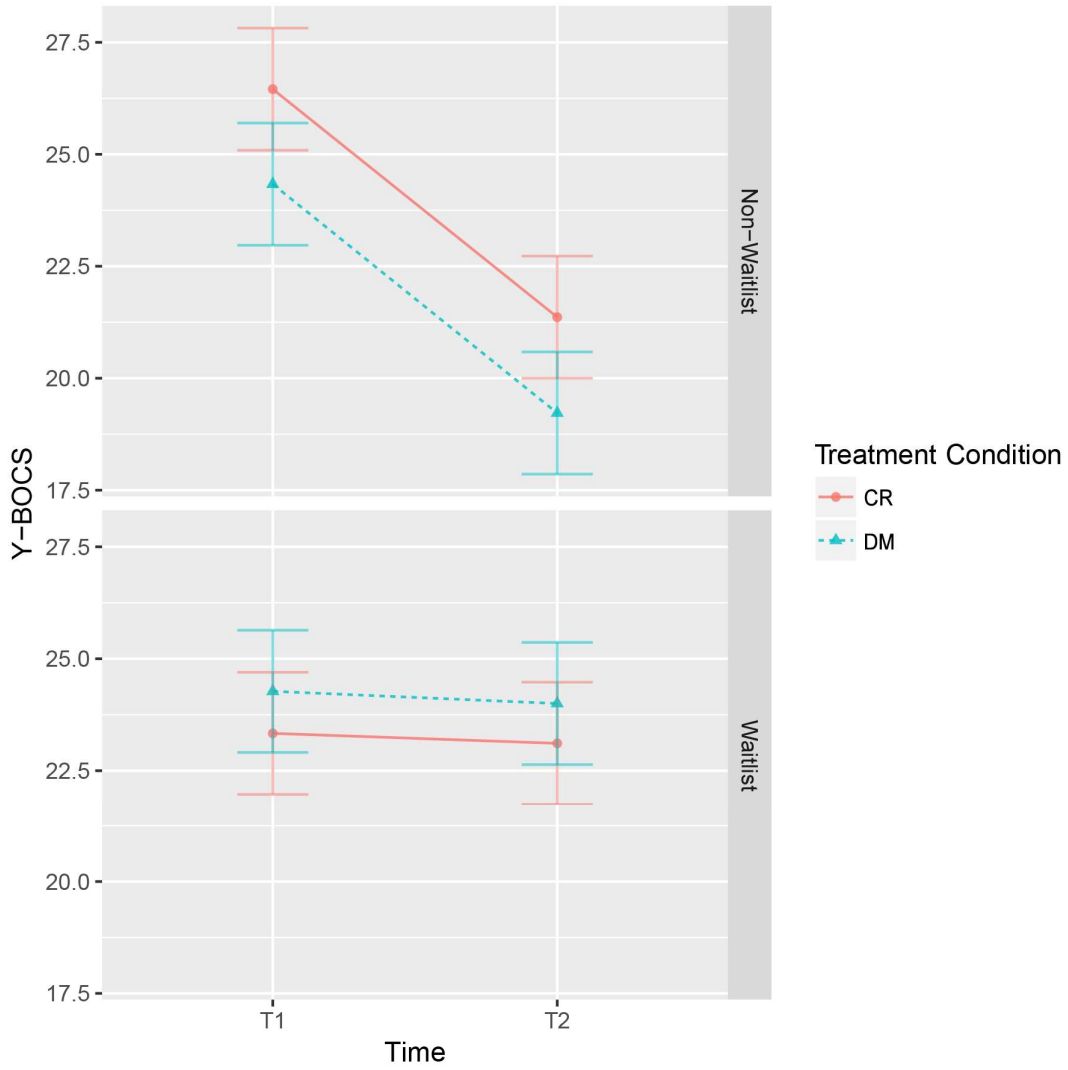

Fig 2. Line graph showing the results of the mixed ANOVA with 95% confidence intervals. The upper graph visualizes the results from the non-waitlist group of completers (total *n* = 20; CR: *n* = 11; DM*: n* = 9), whereas the lower graph displays the results from the waitlist group of completers (total *n* = 20; CR: *n* = 9; DM*: n* = 11). In both graphs, T1 refers to the Pre1 assessment. In the upper graph, T2 refers to the Post assessment, whereas in the lower graph, T2 refers to the Pre2 assessment, thus separating the effects of time and treatment. *Abbreviations:* CR = cognitive restructuring, DM = detached mindfulness.

Effect sizes

As one can see from Table 2, we found large Pre to Post effect sizes concerning the Y-BOCS score for both treatment conditions, with a non-significant trends towards symptom severity even further decreasing between Post and FU assessment.

Clinical significant change

At Post assessment, a clinical significant change based on the criteria described above was evident in 8 (40%) patients from the DM group and in 8 (40%) patients from the CR group – based on the Y-BOCS score.

Adherence and competence ratings

Across sessions and therapists, the mean adherence ratings were 4.78 (*SD* = 0.11) in the CR condition and 4.99 in the DM condition (*SD* = 0.02). Also across sessions and therapist, mean competence ratings were 4.70 (*SD* = 0.11) in the CR condition and 4.67 (*SD* = 0.05) in the DM condition.

Discussion

Our results demonstrate that, in line with our expectations, both treatment conditions were superior to the waitlist condition concerning clinical improvement on the gold standard Y-BOCS. As the interaction effect for *time* and *waitlist* indicates, there was a significant symptom reduction in both treatment conditions relative to the WL condition. Regarding the effect sizes in both treatment conditions (DM: $d = 1.55$, CR: $d = 1.67$) and the fact that in both conditions, 40 % of the patients exhibited a clinical significant change, our results are promising, especially in the light of the short treatment period. As such, our results confirm and extend the findings of Firouzabadi and Shareh [12], Ludvik and Boschen [13] and Wahl et al. [11] suggesting the efficacy of DM when intensely delivered as a stand-alone intervention in a clinical sample and under randomized controlled conditions. Also, the results concerning BDI-II point to a slight reduction of depressive symptoms across time (from Pre1 to Post to FU) in both the DM and the CR condition.

Moreover, it is worth mentioning that our findings concerning effect sizes and percentage of patients exhibiting a clinical significant change are not as different from those by Fisher and Wells [7], Rees and van Koesveld [8], Shareh et al. [9] and Simons et al. [10] as one might

expect taking into account that treatment in those studies comprised between 10 and 20 weekly sessions and a large variety of metacognitive interventions beyond DM. In sum, our findings concerning the CM condition confirm the theoretical assumptions of the model put forward by Wells [6] and underline the crucial role of altering patients' attitudes towards their inner events in reducing OCD symptoms.

Also with regard to the CR condition, our results contribute to the issue of whether behavioral experiments are necessary for making CR for OCD effective. Since we designed the CR condition analogously to the DM condition by limiting treatment to the purely Beckian elements, i. e., questioning of thoughts and beliefs and developing alternative cognitions, our findings offer the possibility of isolating those cognitive principles from the exposure-associated confounds of behavioral experiments, demonstrating that even within a very limited time frame, cognitive restructuring can lead to clinical significant change. Hence, the findings for the CR condition correspond to and extend those by Belloch et al. [29] showing that CR excluding behavioral experiment can also lead to considerable effect sizes in the treatment of OCD. Finally, our results further confirm the cognitive models of OCD developed by Salkovskis [14, 15] and Rachman [16].

However, this study only partly addressed the question which working mechanisms underlie the *detached mindfulness* technique and to what extent the two treatment conditions share common working mechanisms. The results concerning process measures of cognition and metacognition collected in this study will be reported elsewhere. Yet, our clinical experience while delivering treatment in the DM condition raised some hypotheses concerning underlying working mechanisms beyond those proposed by Wells [6]. Based on the observation that several patients reported heightened and decreasing feelings of distress and tension while applying DM to their obsessions, future research should focus on the question to what extent DM is actually similar to in sensu exposure, sharing, e. g., the working mechanisms of habituation, fear extinction,

inhibitory learning and expectancy violation [45–47]. Moreover, future research should address the question whether DM can also be compared to a relaxation-based coping skill, since a large number of participants also reported experiencing the DM technique as relaxing and pleasant. Conceptually, this would place DM close to systematic desensitization [48]. What is yet to be investigated is the effectiveness of DM when applied in a non-randomized, uncontrolled clinical setting, since generalizability and external validity of our findings is clearly limited by factors such as the manualized treatment procedure and the short and intense treatment setting.

Besides, we would like to emphasize the conceptual overlap between DM and mindful-acceptance-based techniques, e.g., cognitive defusion, which form an important part of Acceptance and Commitment Therapy (ACT) [49]. To date, however, there are no studies on the efficacy of specific elements of ACT, whereas the efficacy of complex ACT treatment protocols has been demonstrated for OCD, e. g., [50]. Indeed, our results suggest that other techniques aiming at increasing a person's distance to his or her thoughts, such as cognitive defusion, might also be effective as stand-alone techniques. Further research should therefore examine the relevance of these single treatment components within mindful-acceptance based therapies such as ACT to further clarify its relevance in the treatment of OCD.

All in all, this study exhibits a number of strengths. First, this trial was, to our knowledge, the first examining the efficacy of detached mindfulness as a stand-alone intervention, while comparing it to a purely cognitive treatment condition excluding any confounding elements such as behavioral experiments. Second, our sample can be regarded as representative of the clinical population with regard to e. g., symptom severity, disorder persistence, comorbidity, age and percentage of males/females, which are factors enhancing external validity. Third, adherence to the detailed protocol was ensured and shown to be very high in both conditions, just as competence ratings yielded very high scores, indicating a high quality of treatment. Fourth, our

findings are useful for clinicians in a way that two interventions other than exposure and response prevention were shown to actually reduce OCD symptoms – including compulsions as measured with the Y-BOCS – without targeting the reduction of compulsions in the first place. We therefore would suggest to consider both DM and CR as strategies to pave the way for subsequent exposure treatment since they arguably mean less stress for the patient, thus having a lower risk of being refused.

Yet, the interpretation of our results is limited by various factors. First, the sample size was comparably small, so that statistical power was insufficient with regard to finding efficacy differences between the two treatment conditions, which, however, was not the goal of the study. It is a common phenomenon in psychotherapy outcome research that two active conditions are similarly effective, e. g. [51], however, the interpretation of our results is limited in a way that of course, they do not allow any conclusions concerning superiority or non-inferiority due to power issues. Second, the clinicians in charge of the diagnostic assessment were, due to organizational reasons, only blinded concerning the treatment condition, but not with regard to whether the participant was in the WL or in the NWL condition. Therefore, a certain bias towards the assumption of symptom improvement cannot be ruled out. Third, our study lacked a placebo condition, which is why the amount of change due to unspecific working mechanisms such as a good working alliance or gaining insight, e. g., [52], cannot be quantified. Similarly, both treatment conditions comprised psychoeducation and the development of an idiosyncratic maintenance model, which probably added to the treatment's efficacy, as well. Fourth, it has to be taken into account that the treatment was delivered by only two therapists (i. e. the first two authors), which reduces the generalizability of our results. Last, our results are limited by the fact that, due to the FU time frame only comprising four weeks for organizational reasons, we are unable to make any statements about long-term efficacy.

Conclusions

In sum, we were able to show that two conceptually very different treatment concepts relying on the intense training of a single technique within a limited time frame were effective at reducing OCD symptoms. As such, this study adds to the development of alternative effective treatment strategies for OCD. Taking all limitations into account, this study was the first to suggest that DM as a stand-alone intervention may be similarly effective as cognitive restructuring in treating OCD within a limited amount of time. However, future research is urgently needed to replicate our results, possibly in a larger sample, to address the underlying working mechanisms and to elucidate to what extent DM shares working mechanisms with other interventions such as ERP, relaxation and cognitive restructuring.

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6. Study 2: Ecological momentary assessment in obsessive-compulsive disorder

A study on treatment sensitivity of ecological momentary assessment in obsessive-compulsive disorder

Christian Rupp[a,c], Charlotte Jürgens[a,c], Daniela Gühne[b], Philipp Doebler[b], Fabian Andor[c], & Ulrike Buhlmann[a]

[a] Institute of Psychology, Westfälische Wilhelms-University Münster, Fliednerstrasse 21, 48149 Münster, Germany

[b] Department of Statistics, TU Dortmund University, 44221 Dortmund, Germany

[c] Christoph-Dornier-Stiftung, Schorlemerstrasse 26, 48143 Münster, Germany

Corresponding author:

Prof. Dr. Ulrike Buhlmann

Westfälische Wilhelms-University Münster

Institute of Psychology

Fliednerstrasse 21

48149 Münster

Germany

Phone: +49-251-8334112 | Fax: +49-251-8331331 | Email: ulrike.buhlmann@wwu.de

Conflict of Interest Statement

The authors declare no conflict of interest.

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Abstract

As part of a larger clinical trial, this ecological momentary assessment (EMA) study pursued the main goal of demonstrating that the EMA method is sensitive to treatment effects of detached mindfulness (DM) and cognitive restructuring (CR) for obsessive-compulsive disorder (OCD). A second goal was to provide a descriptive analysis of OCD symptoms and influencing factors in participants' everyday lives. 39 participants were included in the final analyses. EMA sampling involved a smartphone and comprised four days with 10 random prompts per day both before (Pre-Treatment EMA) and after the completion of a 2-week clinical intervention of either DM or CR (Post-Treatment EMA) that participants had been randomly allocated to. The EMA questionnaire included items on the frequency of obsessions, subjective burden due to obsessions, perceived current stress, emotions, and on the frequency of compulsions and other dysfunctional behaviors. Descriptive Pre-Treatment EMA results highlight the importance of compulsions and emotional states of tension/discomfort in OCD. Pre-Post comparisons showed a significant reduction of avoidance behavior, obsessions, and burden due to obsessions, with a non-significant trend also indicating a reduction of compulsions. There was no pre to post effect concerning emotions. This study adds to the existing research on OCD symptoms and offers further evidence in confirmation of established theoretical models of OCD. Also, our results can be taken as evidence for treatment sensitivity of the EMA method in OCD. Further research is needed to replicate, broaden and generalize our results.

Key Practitioner Message:

- This ecological momentary assessment (EMA) study examined symptoms of obsessive-compulsive disorder (OCD) and the extent to which the EMA method is sensitive to treatment effects.
- EMA sampling took place both before and after an intervention of either detached mindfulness (DM) or cognitive restructuring (CR).
- Pre-treatment results highlight the importance of compulsions and emotional states of tension/discomfort in OCD.
- Pre-Post comparisons show a reduction of avoidance behavior, obsessions, and burden due to obsessions, with a non-significant trend also indicating a reduction of compulsions.
- Results can be taken as evidence in confirmation of contemporary models of OCD and as proof of treatment sensitivity of the EMA method in OCD.

Keywords: Obsessive-compulsive disorder; OCD; ecological momentary assessment; EMA; treatment sensitivity; cognitive restructuring; detached mindfulness

A study on treatment sensitivity of ecological momentary assessment in obsessive-compulsive disorder

DSM-5 defines obsessive-compulsive disorder (OCD) by intrusive and unwanted thoughts, images or urges (i.e., obsessions) followed by repetitive overt behaviors or mental acts (i.e., compulsions) that patients employ to reduce fear and tension caused by the above-named obsessions (American Psychiatric Association, 2013). The link between obsessions that are followed by compulsions to reduce distress forms the core of contemporary models of OCD proposed by Rachman (1998), Salkovskis (1985, 1999), and Wells (2011).

Clinical assessment of OCD in adults typically entails clinician-administered rating scales, with the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Goodman et al., 1989) constituting the gold standard in terms of measuring changes through treatment (i. e., treatment sensitivity) in clinical research, and a number of self-report scales such as the Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002), the Vancouver Obsessional Compulsive Inventory (VOCI, Thodarson et al., 2004), and the Padua Inventory-Palatine Revision (Gönner et al., 2010). As Overduin and Furnham (2012) point out, most self-report scales show good psychometric properties while exhibiting differences concerning the facets of OCD being measured. In terms of treatment sensitivity, however, there is only little evidence concerning self-report scales, with the OCI-R being the exception (Abramowitz, Tolin, & Diefenbach, 2005).

When it comes to direct in vivo measures of OCD symptoms that rule out retrospective biases naturally attached to the above-named rating scales, a traditional yet less contemporary approach is the so-called Behavioral Avoidance Test (BAT), which measures a person's avoidance behavior and his or her subjective units of distress (SUDs) when being confronted with a feared object or situation. Although BATs exhibit good treatment sensitivity, as

shown by Steketee, Chambless, Tran, Worden, and Gillis (1996), for example, they are usually not set in the person's personal environment and are also difficult to design given a wide range of feared situations within and across individuals with OCD (Taylor, 1995).

By contrast, direct observation of OCD rituals can be considered as more ecologically valid than BATs since measures are taken in the person's personal surroundings. As such, direct observation has been shown to be sensitive to treatment effects (e. g., Turner, Hersen, Bellack, Andrasik, & Capparel, 1980), yet, this method is hardly applicable to outpatients which restricts its practical meaning for clinical trials. On the contrary, as pointed out by Taylor (1995), diary methods, which involve having patients keep track of their symptoms in everyday life (e. g., by means of a self-observation form) have been used since the 1980s for assessing frequency and other features of obsessions in a way that is ecologically valid and minimizes retrospective bias. Also, this approach has been used for assessing outcome to behavioral treatment in OCD patients and shows good treatment sensitivity (e. g., Boersma, Den Hengst, Dekker, & Emmelkamp, 1976; Foa, Steketee, & Milby, 1980).

Yet, this approach remained the exception in outcome research, which is why Mavissakalian and Barlow noted back in 1981 that frequency measures of OCD behaviors are under-represented in outcome research, leading Taylor (1995) to conclude that diary methods are urgently needed to shed light on how OCD-specific treatments lead to changes in the patients' personal environment. The fact that as far as we know little has changed regarding this circumstance is what gave rise to our idea of using a modern form of diary method, i. e. *ecological momentary assessment* (EMA), to measure treatment effects in a sample of OCD patients.

EMA, a term originally coined by Stone and Shiffman (1994), has gained heightened attention within the past ten years (e.g., Trull & Ebner-Priemer, 2009, 2013). Offering many

possibilities of collecting data in people's everyday lives, e. g., via a smartphone sending random prompts throughout the day asking the patient to rate his or her mood, major advantages of EMA as compared to retrospective symptom scales are the reduction of retrospective bias and the enhancement of ecological validity (Ebner-Priemer & Trull, 2009; Shiffman, Stone, & Hufford, 2008).

However, to date, there is hardly any EMA research in OCD, and not a single study that used EMA as a measure of outcome with regard to an intervention. Gloster et al. (2008) used an EMA approach (one prompt in four hours across seven days) to study recall accuracy for OCD symptoms, whereas Purdon, Rowa, and Antony (2007) asked OCD sufferers to keep diary of their attempts to suppress their thoughts over three days, revealing that thought suppression is a frequently used but ineffective strategy among OCD sufferers.

There are a few studies that used EMA to evaluate clinical trials dealing with psychological disorders other than OCD. The study that most inspired our design was provided by Munsch et al. (2009), who used two EMA sampling periods of one week each before and after treatment to demonstrate the efficacy of a CBT intervention on binge eating. EMA sampling in this study was smartphone-based and featured five fixed prompts per day.

The EMA study that this publication deals with was part of a larger clinical trial (Rupp, Jürgens, Doebler, Andor, & Buhlmann, 2019), which compared two different approaches to dealing with obsessions, i. e., detached mindfulness (DM) and cognitive restructuring (CR). The latter draws on the theoretical models by Salkovskis (1985, 1999) and Rachman (1998) and teaches patients to question their distorted appraisals of intrusive thoughts and to develop alternative attitudes towards them, e. g., by re-evaluating risk and the amount of personal responsibility. DM, by contrast, was based on Wells's (2011) metacognitive model of OCD and, instead of teaching patients to *actively* deal with their cognitions, educates them to *passively* observe their obsessions from a distance instead of experiencing them

as important events that require immediate action. Both interventions comprised four double sessions of 100 minutes each within two weeks. As expected, both interventions were similarly effective at reducing OCD symptoms as measured with the German version of the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Hand & Büttner-Westphal, 1991). Theoretical background, treatment procedure and results of the clinical trial have been described elsewhere (Rupp et al., 2019).

Our first aim in applying EMA to our OCD sample was to provide a brief descriptive analysis of OCD symptoms as well as related emotions, behaviors and influencing variables. Next to this, the main reason for why we complemented our clinical trial by a Pre and Post EMA assessment was to address the above-described lack of ecologically valid outcome data and to hence demonstrate that the EMA method is sensitive to treatment effects in OCD.[1]

In EMA research it is crucial to ensure that participants are not overwhelmed by too many items in the questionnaire. Thus, the design of an EMA questionnaire always means a tradeoff between informative content and practicability. Our decisions regarding the items that were finally included in the questionnaire were based on the current state of the scientific literature on OCD that we will briefly summarize in the following paragraphs.

Drawing on the model by Salkovskis (1985), the first phenomena to study in an EMA study with OCD patients should be obsessions, compulsions and avoidance behavior. Taking into account the ubiquity of thought suppression attempts in OCD (e. g., Purdon et al., 2007) and the evidence pointing towards both a lack of memory confidence (Hermans, Martens, De Cort, Pieters, & Eelen, 2003; McNally & Kohlbeck, 1993) and a lack of attention confidence (Hermans et al., 2008), we decided to also study thought suppression attempts and forms of compulsive action monitoring aiming at keeping track of one's potential mistakes.

[1] The EMA-based comparison of the two interventions we studied (DM and CR), which will focus on aspects such as general and specific working mechanisms as well as applicability of DM vs. CR, will be reported elsewhere.

With regard to OCD-related emotions, Salkovskis's model (1985) lists anxiety, dysphoria and discomfort as predecessors of compulsions. Further emotions assigned an important role regarding OCD are guilt (e. g., Shafran, Watkins, & Charman, 1996), disgust (e. g., Berle & Phillips, 2006), and shame (e. g., Weingarden & Renshaw, 2015). Given the large body of evidence showing that intolerance of uncertainty is a common feature of OCD (e. g., Gentes & Ruscio, 2011), we also added the experience of uncertainty to our EMA questionnaire. Also, Salkovskis's model (1985) assumes that what leads to negative emotions in OCD is a certain form of misinterpretation of obsessions – which is what actually lends obsessions their burdensome character. Therefore, apart from a reduced frequency of compulsions and obsessions, an effect of treatment could also consist in a decrease of perceived *burden* regardless of the frequency of obsessions – since both of our interventions aimed at teaching patients a novel way of dealing with obsessions.

In terms of variables influencing the occurrence and severity of OCD symptoms, our first choice was stress since it is the most studied construct, with evidence demonstrating the link between stress and OCD symptoms (especially obsessions) dating back to the 1970s (summarized by Horowitz, 1975). Further evidence showing that stress has an impact on OCD symptom severity, drawing both on cross-sectional and longitudinal designs, has e. g. been provided by Findley et al. (2003) and Lin et al. (2007). The crucial influencing role that stress appears to play regarding OCD symptoms led us to include this variable as covariate in all regression models described below. Given our main goal to demonstrate treatment sensitivity and the different ways in which an effect of treatment may be reflected in OCD, we hypothesized that:

(1) all dysfunctional behaviors, i. e. compulsions, avoidance, thought suppression, and action monitoring should decrease from Pre-Treatment EMA to Post-Treatment EMA in both treatment conditions,

(2) all negative emotions associated with OCD should decrease from Pre-Treatment EMA to Post-Treatment EMA in both treatment conditions,

(3) both treatments should lead to a decrease of obsessions from Pre-Treatment EMA to Post-Treatment EMA,

(4) across treatments, during Pre-Treatment EMA, the burden resulting from obsessions should correlate higher with the frequency of obsessions than during Post-Treatment EMA since patients learn to deal with obsessions in a different way.

Methods

The study was conducted between January 2017 and July 2018. The study protocol was approved of by the ethics committee of the Department of Psychology and Sport Science at the University of Münster, Germany. Also, it was registered at ClinicalTrials.gov under the ID NCT03002753. All participants provided written informed consent after the study procedure had been fully explained.

Participants

Our 40 participants were the same OCD patients (completer sample) as those in the clinical trial (Rupp et al., 2019). Please see Rupp et al. for data concerning the intention-to-treat sample and for information on recruitment, inclusion and exclusion criteria as well as diagnostic assessment. All participants fulfilled the DSM-5 criteria for OCD and had a minimum Y-BOCS score of 17. Table 1 gives a detailed description of the sample with separate data for each of the two treatment groups. Participants were randomly assigned to the two treatment conditions (DM/CR).

Treatment, assessment and introduction into the EMA smartphone procedure took place at the psychotherapeutic outpatient clinic of the Christoph-Dornier-Foundation in Münster. Participants received € 80 for completing the smartphone-based EMA questionnaires and

were paid an additional € 10 per sampling period if they had answered a minimum of 80 % of all prompts.

Design and procedure

Like Munsch et al. (2009), we compared a Pre-Treatment EMA sampling period with a Post-Treatment EMA sampling period. We chose a sampling period of four days with ten randomly presented prompts per day, separated from each other by a minimum of 30 minutes. Both sampling periods comprised Friday through Monday and were conducted immediately before the start and after the completion of treatment.

EMA sampling was done using a smartphone (Motorola Moto G2) and the software *movisensXS* (App Version: 1.0.0). Each day, random sampling started at 9 am and ended at 9 pm, applying either an acoustic alert (preferably) or a vibrating alert. Participants were able to produce fixed prompts, e. g., by switching the phone to inactive mode during the day. Participants were given the opportunity to irrevocably dismiss or to postpone prompts for a maximum of five times.

Items in the EMA questionnaire

The items presented in the questionnaire were derived from the literature reviewed above, whereas items on the emotions sadness, frustration, and helplessness were added following conversations with experts and drawing e. g. on the circumplex model of emotions (Russell, 1980). For the purpose of completeness, Table 2 lists all items included in the EMA questionnaire, with Screens 1 and 2 presenting the preliminary items on stress, relaxation, frequency of obsessions and perceived (i. e., subjective) burden, Screens 3 through 5 listing all emotion items and Screens 6 through 10 showing all behavior items, i. e., dysfunctional behaviors (Hypothesis 1) and behaviors related to what patients are taught in treatment (DM vs. CR). Since the comparison of DM and CR and participants' application of the associated strategies (Screen 11) will be the subject of a different publication, the list of behavior items

relevant for the study at hand only comprises *Suppression*, *Compulsion*, *Monitoring*, and *Avoidance*. This publication will not present results for the remaining behavior items and the items presented on Screen 11.

All EMA items were rated on a Likert scale ranging from 1 (*not at all*) to 7 (*very much*). Except for three additional items on the use of the strategies learned during treatment (Screen 11), the questionnaires for Pre-Treatment EMA and Post-Treatment EMA were identical. The original questionnaire was in German, however, Table 2 lists English translations of all items. Following the pathway implied by Salkovskis's (1985) model, the programming of the software involved that when participants rated the frequency of obsessions as "not at all", they were instantly redirected to the end of the questionnaire, thereby skipping all items on emotional states and behaviors. Items belonging to one category (e. g., emotions or behaviors) were randomly allocated to screens presenting a maximum of three items each. Please note that the variable *Relaxation* only served as a control variable to detect implausible response patterns.

Feasibility and reactivity to EMA.

Feasibility of and reactivity to EMA were assessed via a post-monitoring questionnaire that participants filled in a couple of days following each of the two sampling periods. The questionnaire comprised 23 items that were rated on a Likert scale from 1 (*not at all*) to 5 (*absolutely*). These items were designed to measure representativeness ("To what extent were the days you carried the smartphone with you representative of your everyday life?"), practicability (e. g., "Would you say that the frequency of prompts was too high?"), acceptability (e. g., "How unpleasant was it for you to fill in the questionnaires?") and reactivity to EMA (e. g., "To what extent did you respond differently to obsessions because of the EMA study?").

Preliminary data analysis and cleansing of data

All analyses were conducted via multilevel modeling using the statistical software R (R Core Team, 2018), especially the packages *lme4* (Bates, Mächler, Bolker, & Walker, 2015), *nlme* (Pinheiro, Bates, DebRoy, & Sarkar, 2018), *lmerTest* (Kuznetsova, Brockhoff, & Christensen, 2017), and *MuMIn* (Barton, 2018). All Likert-scales items were centered at 0, which required a transformation of data from 1-7 to 0-6.

Separate spaghetti plots for Pre-Treatment EMA and Post-Treatment EMA were computed for each participant and variable in order to get an overview of the distribution of missings, of ceiling and floor effects, etc.

Cleansing of data comprised the deletion of trials with a distance of less than 30 minutes from the preceding trial (due to fixed prompts, this could not be excluded a priori) and the deletion of all ignored, incomplete and dismissed trials. It also included the deletion of all trials from one participant from the CR group who had exhibited an extreme tendency towards the center of the scale on all variables both at Pre and Post sampling and the deletion of trials with implausible response patterns (e. g., same value, if not 4, for the variables *Stress* and *Relaxation,* or whenever *Obsessions* was rated as 1 with *Burden* rated higher than 1).

To evaluate whether the items on emotions and behaviors can be summarized to overall variables (such as "dysfunctional behaviors", "CR behaviors" and "DM behaviors") and with the intention of excluding any artifacts involving that items presented on the same screen are given a similar rating, we applied multilevel factor analysis (Muthén, 1994; Reise, Ventura, Nuechterlein, & Kim, 2005). Prior to hypothesis testing, we computed null models for all items serving as dependent variables, i. e., all items except *Stress*, *Burden* and *Relaxation*, which involved computing the corresponding intraclass correlations (ICC).

Hypothesis testing

Hypothesis testing involved computing multilevel models with trials on the first and participants on the second level. Parameters were estimated using restricted maximum likelihood. For all analyses, we applied a significance level of 0.01. All models were checked for multicollinearity by inspecting the correlations of fixed effects for each model. Homoscedasticity was checked through visual inspection of scatter plots of predicted values and residuals. All regression models including the *Pre-Post* factor were computed with and without incorporating random slopes for participants, followed by model comparisons via likelihood ratio tests (LRTs) and the inspection of AIC and BIC as fit indices.

All regression models computed to test Hypotheses 1 - 4 on the decrease and increase of behaviors, emotions, obsessions and burden due to obsessions included both random intercepts and random slopes concerning the *Pre-Post* variable as we assumed that participants would differ concerning their response to treatment. To avoid confusion, the random intercepts and slopes are not included in the model equations below. As fixed effects, all models included the factor *Pre-Post*, the factor *Group* (DM vs. CR), and, with the exception of Hypothesis 4 (due to problems of convergence), the interaction of the two factors. Even though the comparison of DM vs. CR is not the focus of this publication, the factor *Group* was included as an important covariate, i. e., as a control variable. Since Hypotheses 1, 2 and 4 all dealt with predicting behaviors, emotions and perceived burden following obsessions, *Obsessions* was included as a covariate in each model in order to isolate any reduction effects that are solely due to a decrease of obsession frequency. Apart from that, in order to account for the crucial influence of antecedent stress, we added as another important covariate in all regression models the amount of stress reported at the preceding prompt, which we labeled $Stress_{t-1}$.

In sum, the equation underlying the models for Hypotheses 1 and 2 was:

$Y_t = Intercept + Pre\text{-}Post + Group + Pre\text{-}Post \times Group + Stress_{t-1} + Obsessions + error$,

where Y_t denotes each of the emotion and behavior items. Testing Hypotheses 3 and 4 involved the following equations:

Hypothesis 3:

$Obsessions = Intercept + Pre\text{-}Post + Group + Pre\text{-}Post \times Group + Stress_{t-1} + error.$

Hypothesis 4:

$Burden = Intercept + Pre\text{-}Post + Obsessions + Group + Stress_{t-1} + Pre\text{-}Post \times Group + Pre\text{-}Post \times Obsessions + error.$

Results

Preliminary data analysis

The inspection of the spaghetti plots indicated no effects concerning the distribution of missing values neither concerning Pre-Treatment EMA vs. Post-Treatment EMA nor with regard to weekdays vs. weekend or first vs. second half of sampling period. The plots shed light on some participants' implausible response patterns that motivated data cleansing. The plots did not yield any evidence for autocorrelations. There were hardly any ceiling or floor effects evident across participants, however, the emotions disgust, shame and sadness were hardly ever rated above 3. The spaghetti plots did not yield any evidence for reactivity to EMA since there was no trend showing that across time participants applied more CR and DM strategies.

The total number of trials was 3027, with 1399 Pre-Treatment EMA trials and 1212 Post-Treatment EMA trials. Across Pre-Treatment EMA and Post-Treatment EMA and across all participants (n = 40), 356 prompts were ignored, 60 were dismissed and 25 were interrupted ("incomplete"). The Pre-Post comparison concerning ignored trials bordered on significance, $t(39) = -2.021$, $p = .050$, $d = -0.647$, indicating that compliance was somewhat lower during the Post-Treatment EMA period as compared with the Pre-Treatment EMA period.

Data cleansing reduced the data set by 851 trials, which corresponds to 28.11 %. Thus, all subsequent analyses were conducted on a sample of n = 39 participants (n = 20 from the DM group and n = 19 from the CR group). Thus, all subsequent analyses were based on a total of 2176 trials (Pre: 1155, Post: 1021). Since whenever *Obsessions* was rated as 1, meaning "no obsessions at all", all items concerning emotions and behaviors were skipped, the number of trials for all analyses on the emotion and behavior items was n = 940 at Pre-Treatment EMA and n = 730 at Post-Treatment EMA. With regard to the items concerning the use of the newly learned coping strategies, analyses were based on a sample size varying between n = 316 and n = 367 trials.

We did not find any evidence indicating poor acceptability, practicability or representativeness, and neither did we find evidence for reactivity effects, with all items of the questionnaire exhibiting means below 3 following both sampling periods. Neither did we find any considerable pre to post differences on any of the items.

Concerning the multilevel factor analyses, at Pre-Treatment EMA, all nine emotion items could be represented by one factor. The loadings were between 0.37 for *Shame* and 0.77 for *Tension/Discomfort*. The one-factor solution demonstrated acceptable fit (RMSR = 0.06). At Post-Treatment EMA, the results were comparable (RMSR = 0.05). Artefacts due to the items' randomly allocated position on the screen could be ruled out.

At Pre-Treatment EMA, the behavior items were well represented by three factors (RMSR = 0.03): (1) *CR behaviors* (loadings 0.45-0.75), (2) *DM behaviors* and *Suppression* (loadings 0.25-0.70), and (3) *Avoidance*, *Monitoring* and *Compulsion* (loadings 0.37-0.83). At Post-Treatment EMA, the same proportion of variance was explained by only two factors representing (1) *DM behaviors* (loadings 0.48-0.83) and (2) the other six variables (loadings 0.29-0.69), respectively. The two-factor solution fitted well (RMSR = 0.04). Although the factor structure changed, it did not display screen artefacts at either time.

Due to the results of the factor analyses, we decided to aggregate with regard to the emotion items (one-factor solution) but not in terms of the behavior items since at Post-Treatment EMA the factor structure was too arbitrary.

The computation of null models yielded ICCs between 0.273 (*Compulsion*) and 0.473 (*Monitoring*). Thus, it seemed reasonable to model the multilevel structure of the data in all analyses.

Descriptive data analysis

Table 3 displays descriptive data on all Pre-Treatment EMA items. Regarding emotions, *Tension/Discomfort* was by the far the highest rated item (M = 3.41, SD = 1.62), followed by *Uncertainty* (M = 2.69, SD = 1.82), *Anxiety* (2.55, SD = 1.94), and *Frustration* (M = 2.45, SD = 2.03). Among the behavior items, *Compulsion* turned out as the most frequently used strategy (M = 3.12, SD = 1.84), whereas *Avoidance* exhibited the lowest mean rating (M = 1.80, SD = 1.75). Of note, our results suggest that participants already applied CR and DM strategies at Pre-Treatment EMA, with mean item ratings ranging from 1.18 (*Responsibility*) to 2.15 (*Come and Go*).

Hypothesis testing

With the maximum correlations of fixed effects varying between 0.70 and 0.71 in each of the regression models computed, multicollinearity did not constitute a problem. Similarly, inspection of scatter plots did not yield any evidence for heteroscedasticity. For all regression models involving the Pre-Post factor as a predictor, we found a better fit (based on AIC, BIC, and LRT) for the model including random slopes than for the corresponding one excluding them, so that only the models including random slopes are reported.

Detailed results concerning Hypotheses 1 – 4 can be retrieved from Tables 4 – 7. The main results concerning the hypotheses can be summarized as follows: Regarding the reduc-

tion of dysfunctional behaviors (Hypothesis 1), we found a significant Pre-Post reduction effect in terms of *Avoidance* and a non-significant trend towards a reduction ($p = 0.017$) concerning *Compulsion*. There was no such effect or trend regarding *Monitoring* and *Suppression*, and neither was there any significant *Pre-Post×Group* interaction effect in any of the four regression models. Neither did we find any Pre-Post reduction effect concerning OCD related emotions (1-factor solution resulting from the factor analyses), as postulated by Hypothesis 2. By contrast, we did find a strong and significant reduction effect concerning the frequency of obsessions as implied by Hypothesis 3. With the *Pre-Post×Group* interaction being non-significant, this reduction effect was shown to be independent of the treatment condition. In terms of Hypothesis 4, which dealt with the relationship between the frequency of obsessions and the subjective burden experienced due to obsessions, the only significant predictor next to *Obsessions* was the *Pre-Post×Obsessions* interaction. This interaction indicates that during Post-EMA, the amount of experienced burden due to obsessions increases less markedly as the frequency obsessions rises than during Pre-EMA, which means that Hypothesis 4 was confirmed.

Discussion

Description of Pre-Treatment EMA items

The descriptive analysis of all Pre-Treatment EMA items served as a baseline measure concerning OCD symptoms and associated factors. Overall, our descriptive results are in line with what was to be expected given the literature on dysfunctional behaviors and emotions reviewed above. In support of the diagnostic criteria listed by DSM-5 (APA, 2013) and the theoretical models discussed above (e.g., Rachman, 1998; Salkovskis, 1985, 1999), our EMA data confirm the salient role of compulsions and the emotional state of tension/discomfort as

defining elements of OCD, with most other dysfunctional behaviors (such as thought suppression) and emotions (such as uncertainty and anxiety) obviously playing a relevant, but secondary role. Taking into account Salkovskis's model and the well-established finding that avoidance plays an enormous role in OCD (e. g., Abramowitz & Jacoby, 2014), the low mean score for the item *Avoidance* came as a surprise. This, however, should be interpreted with caution since in the EMA questionnaire we asked participants to what extent they *responded* to obsessions by avoiding triggering stimuli. Yet, avoidance can equally well be thought of as a strategy of actually *preventing* that obsessions arise, which, of course, could not be captured using our approach, probably resulting in the low mean score for the *Avoidance* item.

Also, our findings highlight the important role of dysfunctional thought suppression attempts and excessive action monitoring, as well as the prevalence of anxiety and uncertainty as emotions that result from obsessions and precede compulsions. The relatively high values concerning frustration and helplessness might actually reflect secondary emotions resulting from the emotional burden created by both obsessions and compulsions - rather than primary emotions that trigger compulsions. By contrast, we found rather low values regarding guilt and disgust. Whereas the role of inflated responsibility beliefs in OCD is an established finding (e. g., OCCWG, 1997; Salkovskis et al., 2000; Shafran et al., 1996), Rachman, Thordarson, Shafran, and Woody (1995) already noted that the association between guilt and OCD is complex and varies across situations and individuals. With regard to disgust, Berle and Phillips (2006) concluded that disgust is rather specific to contamination-related forms of OCD – that only a small subset of patients in our sample were affected by. The descriptive results concerning the CR and DM behavior items will be discussed in an upcoming paper.

Conclusions concerning treatment sensitivity

Regarding Hypothesis 1, i. e. the decrease of dysfunctional strategies, we found a strong though non-significant trend towards an effect of treatment concerning the reduction of

compulsions and a significant effect regarding avoidance behavior in patients' everyday lives. This result is noteworthy given the fact that participants were taught about the detrimental effects of compulsions and avoidance, but not explicitly instructed to refrain from it. In spite of psychoeducation including information on the inefficacy of thought suppression, however, we did not find a pre to post reduction of suppression attempts. This, however, may be due to the fact that thought suppression is an ingrained behavior difficult to refrain from within such limited time. The fact that there was no pre to post reduction concerning excessive action monitoring, however, did not come as a surprise because this behavior was not explicitly addressed during treatment. Interestingly, we did not find any differences between the two treatment conditions regarding these pre to post effects, which is in line with our results for the main outcome measure employed in the clinical trial, i. e., the Y-BOCS (Rupp et al., 2019).

This also holds for the reduction of obsessions, i. e. the other cardinal symptom of OCD, which was equally well achieved by both treatment conditions (Hypothesis 3). Also note that the regression model computed for Hypothesis 3 clearly proves the strong association between the frequency of obsessions and antecedent stress levels, with $Stress_{t-1}$ being the only significant predictor next to *Pre-Post*. Hence, this result confirms a well established finding (e. g., Findley et al., 2003; Horowitz, 1975; Lin et al., 2007) by using a new approach, i. e., the EMA method.

Contrary to our expectations, in neither treatment condition did we find evidence in favor of Hypothesis 2, i. e., the reduction effect concerning unpleasant emotions. This, however, might indicate that, as e. g. proposed by all contemporary models of cognitive therapy, altering emotional states is a lengthy process requiring time and practice, e. g. in terms of replacing dysfunctional thoughts with functional ones – which was not provided in our comparably short interventions.

Yet, we found confirming evidence for Hypothesis 4 since our results suggest that in both treatment conditions the association between the frequency of obsessions and the subjective burden experienced because of them was less intense after as compared to before treatment. This may be interpreted as reflecting one major effect of treatment, i. e. experiencing less burden even in the light of persisting obsessions, which may be traced back to the availability of new coping strategies concerning obsessions.

Strengths

In sum, this is the first study that examined OCD symptoms using an EMA approach. Further, it is the first study in OCD research that used EMA as an outcome measure to study the treatment sensitivity of the EMA method. Notably, we were able to demonstrate treatment sensitivity regarding a reduction of subjective burden experienced as a consequence of obsessions – as well as a reduction of obsession frequency as such. Additionally, even though neither of the two treatment conditions directly targeted the reduction of dysfunctional behaviors, we also found a pre to post decrease of avoidance behavior and a trend towards a lower frequency of compulsions. Thus, we were able to add to previous research using diary methods as an outcome measure for OCD (e. g., Boersma et al., 1976; Foa et al., 1980), thereby addressing the call for more outcome data focusing on frequency of target behaviors (Mavissakalian & Barlow, 1981; Taylor, 1995).

Moreover, our results are in line with current OCD models (Rachman, 1998; Salkovskis, 1985, 1999; Wells, 2011) in terms of dysfunctional behaviors and OCD-related emotions. What adds to this is the fact that in all regression models except the one for *Suppression,* the covariate *Obsessions* turned out to be a significant predictor both of emotions and dysfunctional behaviors – which is exactly what those models imply with regard to the pathway that is triggered by obsessions and finally results in compulsions.

Limitations

Due to reasons of practicability, the EMA questionnaire was limited in length, so that each construct could only be measured using very few items or even one single item. Especially with regard to stress, future research should address the different forms and facets of stress. Moreover, the generalizability of our Pre-Treatment EMA results is limited by the fact that we did not have control groups of mentally healthy participants or anxiety disorder patients to compare with our OCD sample concerning variables such as compulsions and avoidance. Future research should address this limitation in order to elucidate the differences that set an OCD sample apart from other clinical or mentally healthy samples.

Furthermore, although the post-monitoring questionnaire and the spaghetti plots did not raise any concerns regarding reactivity, our results concerning behaviors should be interpreted with care since certain reactivity effects cannot be fully ruled out. Future research might address this issue by adding a second baseline EMA period prior to treatment, so that a reactivity effect due to EMA itself can be separated from the actual treatment effect.

Also, our results are limited by the a-priori assumption that compulsions and OCD-related behaviors are always preceded by obsessions, which is reflected in the skipping rules of the EMA programming. Whereas this decision was made on the basis of the theoretical models cited above and the fact that both treatment conditions focused on dealing with *obsessions*, this of course made it impossible to study emotions and behaviors occurring in the absence of clearly identifiable obsessions.

From a statistical point of view, another limitation concerns the fact that our regression models only examined means while neglecting measures of variability in the data. Therefore, even though the spaghetti plots did not yield any signs of autocorrelations, our analyses do not allow any final conclusions concerning the question to what extent the variability of emotions and behaviors changes as a result of treatment.

Conclusions

This study adds to the existing research on OCD symptoms as it provides ecologically valid data confirming traditional models of OCD. Also, it is the first to implement EMA as an outcome measure for a clinical trial on OCD and, as such, was able to show that EMA is sensitive to treatment effects in OCD. Further research is needed to replicate and generalize our results.

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Table 1

Sample description (baseline data from treatment completers)

Variable	**CR** (*n* = 20)	**DM** (*n* = 20)
Age, mean (*SD*)	31.35 (11.49)	31.05 (9.66)
Sex, *n* (*%*)		
Male	11 (55)	6 (30)
Female	9 (45)	14 (70)
Clinical characteristics		
Y-BOCS score (items 1-10), mean (*SD*)	25.05 (2.69)	24.30 (4.00)
BDI-II, mean (*SD*)	17.65 (9.29)	16.55 (10.66)
Persistence of OCD, years, mean (*SD*)	10.18 (9.01)	12.35 (9.64)
Number of comorbid disorders, mean (*SD*)	0.70 (1.42)	0.95 (1.19)
Participants under psychopharmacological medication, number (*%*)	10 (50)	7 (35)
Participants experienced in the intervention delivered, number (*%*)	3 (15)	1 (5)

Note. The sample description is based on baseline data recorded before treatment from *n* = 40 participants who completed the treatment and all assessments. Please note that as described in the text, one male participant from the CR group was excluded from data analysis. The number of participants experienced in the intervention delivered was determined by the therapists who asked participants during treatment whether they are familiar with the strategy, e. g., due to previous CBT-like treatments. *Abbreviations:* CR = cognitive restructuring, DM = detached mindfulness, Y-BOCS = Yale-Brown Obsessive-Compulsive Scale, BDI-II = Beck Depression Inventory II.

Table 2

English translation of EMA items

Variable (short label)	English translation of item
Screen 1 Stress Relaxation	1) Since the last prompt, to what extent have you been under stress? 2) Since the last prompt, to what extent have you felt relaxed?
Screen 2 Obsessions Burden	1) Since the last prompt, how frequently have you experienced obsessions? 2) To what extent have you felt burdened by the obsessions you have experienced since the last prompt?
Screen 3 Anxiety Shame Sadness	1) To what extent were obsessions that you have experienced since the last prompt associated with the following feelings? *anxiety* *shame* *sadness*
Screen 4 Guilt Helplessness Disgust	1) To what extent were obsessions that you have experienced since the last prompt associated with the following feelings? *guilt* *helplessness* *disgust*
Screen 5 Tension/Discomfort Frustration Uncertainty	1) To what extent were obsessions that you have experienced since the last prompt associated with the following feelings? *tension/discomfort* *frustration* *uncertainty*
Screen 6 Suppression (Dys) Come and Go (DM)	1) Please rate to what extent you responded to obsessions that you have experienced since the last prompt in the following ways – regardless of how effective you experienced your response: *I suppressed the obsession.* *I allowed the obsession to come and go.*
Screen 7 Realistic (CR) Compulsion (Dys)	1) Please rate to what extent you responded to obsessions that you have experienced since the last prompt in the following ways – regardless of how effective you experienced your response: *I reviewed to what extent my apprehensions are realistic.* *I performed a compulsion (overt or covert).*
Screen 8 Monitoring (Dys) Distance (DM)	1) Please rate to what extent you responded to obsessions that you have experienced since the last prompt in the following ways – regardless of how effective you experienced your response: *I monitored my actions with special attention.* *I positioned myself at a distance from the obsession.*
Screen 9 Responsibility (CR) Just a Thought (DM)	1) Please rate to what extent you responded to obsessions that you have experienced since the last prompt in the following ways – regardless of how effective you experienced your response: *I wondered how far I overestimated my own responsibility.* *I told myself that it is just a thought.*

Screen 10 Risk (CR) Avoidance (Dys)	1) Please rate to what extent you responded to obsessions that you have experienced since the last prompt in the following ways – regardless of how effective you experienced your response: *I questioned how far I overestimated the risk of something.* *I avoided objects or situations due to my obsessions.*
Screen 11 How often Difficulty Relief	1) How often have you applied the technique you learned in therapy to obsessions - regardless of how effective you experienced it? 2) How difficult did you find it to apply the newly learned technique? 3) To what extent did applying the newly learned technique create relief?

Note. Screen 11 was presented only in the Post-Treatment EMA. Since the German term "Anspannung", which generally fits very well with the emotional experience of OCD patients, does not translate easily into English, we listed both "tension" and "discomfort" as possible translations. The annotations "Dys", "DM" and "CR" are used to indicate which category the corresponding behavior item belongs to. *Abbreviations:* DM = detached mindfulness, CR = cognitive restructuring, Dys = Dysfunctional.

Table 3

Descriptive data concerning all Pre-Treatment EMA items

Variable	*Mean*	*SD*	*Median*
Stress	2.50	1.75	2.0
Relaxation	2.96	1.68	3.0
Obsessions	2.37	1.72	2.0
Burden	2.28	1.82	2.0
Emotions			
Anxiety	2.55	1.94	2.0
Shame	1.16	1.68	0.0
Sadness	1.69	1.97	1.0
Guilt	1.47	1.87	1.0
Helplessness	2.30	1.99	2.0
Disgust	1.25	1.68	0.0
Tension/Discomfort	3.41	1.62	4.0
Frustration	2.45	2.03	2.0
Uncertainty	2.69	1.82	3.0
Behaviors			
Dysfunctional			
Compulsion	3.21	1.84	3.0
Suppression	2.65	1.75	3.0
Avoidance	1.80	1.75	1.0
Monitoring	2.45	1.96	2.0
Detached Mindfulness			
Come and Go	2.15	1.72	2.0
Distance	1.78	1.67	1.0
Just a Thought	1.58	1.62	1.0
Cognitive Restructuring			
Realistic	1.80	1.73	1.0
Responsibility	1.18	1.46	1.0
Risk	1.53	1.61	1.0

Note. All calculations refer to Pre-Treatment EMA data only. Calculations are based on re-coded items (0-6 instead of 1-7). All items had minimal values of 0 and maximal values of 6.

Table 4

Regression models concerning Hypothesis 1 (decrease of dysfunctional behaviors)

Compulsion					**Suppression**				
	b	*SE*	*t*	*p*		*b*	*SE*	*t*	*p*
Intercept	1.32	0.28	4.77	**<0.001**	Intercept	2.80	0.30	9.20	**<0.001**
Pre-Post.*Post*	-0.60	0.24	-2.49	0.017	Pre-Post.*Post*	-0.22	0.36	-0.61	0.545
Group.*DM*	0.22	0.37	0.62	0.541	Group.*DM*	-0.32	0.41	-0.80	0.425
$Stress_{t-1}$	0.02	0.02	0.68	0.498	$Stress_{t-1}$	0.01	0.02	0.24	0.807
Obsessions	0.61	0.03	22.61	**<0.001**	Obsessions	-0.02	0.02	-0.91	0.366
Pre-Post.*Post* × Group.*DM*	0.16	0.33	0.48	0.636	Pre-Post.*Post* × Group.*DM*	-0.61	0.50	0.34	0.237
Observations: *n* = 1598, Participants: *n* = 39					Observations: *n* = 1598, Participants: *n* = 39				
Avoidance					**Monitoring**				
	b	*SE*	*t*	*p*		*b*	*SE*	*t*	*p*
Intercept	1.01	0.29	3.52	**0.001**	Intercept	1.77	0.35	5.01	**<0.001**
Pre-Post.*Post*	-0.61	0.18	-3.25	**0.003**	Pre-Post.*Post*	0.02	0.33	0.08	0.935
Group.*DM*	-0.24	0.38	-0.61	0.540	Group.*DM*	-0.47	0.48	-0.98	0.334
$Stress_{t-1}$	-0.03	0.02	-1.33	0.185	$Stress_{t-1}$	0.05	0.02	2.33	0.020
Obsessions	0.33	0.02	13.52	**<0.001**	Obsessions	0.26	0.03	10.02	**<0.001**
Pre-Post.*Post* × Group.*DM*	0.27	0.26	1.05	0.304	Pre-Post.*Post* × Group.*DM*	0.05	0.46	0.12	0.237
Observations: *n* = 1597, Participants: *n* = 39					Observations: *n* = 1598, Participants: *n* = 39				

Note. The first line of each table lists the dependent variable of the corresponding model. *p* values <.01 are printed in bold. Concerning the predictors "Pre-Post" and "Group", the corresponding reference category is given in italicized letters (*Post*/*DM*). *Abbreviations:* DM = detached mindfulness.

Table 5

Regression models concerning Hypothesis 2 (decrease of emotions)

All emotions (1-factor-solution)				
	b	*SE*	*t*	*p*
Intercept	0.82	0.21	3.86	**<0.001**
Pre-Post.*Post*	-0.10	0.13	-0.73	0.473
Group.*DM*	0.14	0.29	0.46	0.647
$Stress_{t-1}$	0.05	0.01	4.39	**<0.001**
Obsessions	0.35	0.01	27.09	**<0.001**
Pre-Post.*Post* × Group.*DM*	-0.19	0.19	-1.01	0.319
Observations: *n* = 1597, Participants: *n* = 39				

Note. The first line lists the dependent variable of the corresponding model. *p* values <.01 are printed in bold. Regarding the predictors "Pre-Post" and "Group", the corresponding reference category is given in italicized letters (*Post*/*DM*). *Abbreviations:* DM = detached mindfulness.

Table 6

Regression model concerning Hypothesis 3 (decrease of obsessions)

Obsessions				
	b	*SE*	*t*	*p*
Intercept	2.22	0.23	9.51	**<0.001**
Pre-Post.*Post*	-0.67	0.18	-3.67	**<0.001**
Group.*DM*	-0.26	0.32	-0.82	0.419
$Stress_{t-1}$	0.10	0.02	4.68	**<0.001**
Pre-Post.*Post* × Group.*DM*	0.27	0.26	1.06	0.295
Observations: *n* = 2176, Participants: *n* = 39				

Note. The first line lists the dependent variable of the model. *p* values <.01 are printed in bold. Concerning the predictors "Pre-Post" and "Group", the corresponding reference category is given in italicized letters (*Post*/*DM*). *Abbreviations:* DM = detached mindfulness.

Table 7

Regression model concerning Hypothesis 4 (link between Burden *and* Obsessions*)*

Burden				
	b	*SE*	*t*	*p*
Intercept	0.24	0.12	2.05	0.045
$Stress_{t-1}$	0.02	0.01	1.80	0.071
Group.*DM*	-0.23	0.15	-1.60	0.119
Pre-Post.*Post*	0.09	0.11	0.84	0.406
Obsessions	0.88	0.02	49.74	**<0.001**
Pre-Post.*Post* × Group.*DM*	0.06	0.14	0.43	0.672
Pre-Post.*Post* × Obsessions	-0.10	0.03	-3.92	**<0.001**
Observations: *n* = 2176, Participants: *n* = 39				

Note. The first line lists the dependent variable of the model. *p* values <.01 are printed in bold. Concerning the predictor "Pre-Post", the corresponding reference category is given in italicized letters (*Post*).

7. Study 3: An EMA comparison of two interventions for OCD

Comparing effects of detached mindfulness and cognitive restructuring in obsessive-compulsive disorder using ecological momentary assessment

Christian Rupp[a,c], Charlotte Jürgens[a,c], Daniela Gühne[b], Philipp Doebler[b], Fabian Andor[c], & Ulrike Buhlmann[a]

[a] Institute of Psychology, Westfälische Wilhelms-University Münster, Fliednerstrasse 21, 48149 Münster, Germany

[b] Department of Statistics, TU Dortmund University, 44221 Dortmund, Germany

[c] Christoph-Dornier-Stiftung, Schorlemerstrasse 26, 48143 Münster, Germany

Corresponding author:

Prof. Dr. Ulrike Buhlmann

Westfälische Wilhelms-University Münster

Institute of Psychology

Fliednerstrasse 21

48149 Münster

Germany

Phone: +49-251-8334112 | Fax: +49-251-8331331 | Email: ulrike.buhlmann@wwu.de

Conflict of Interest Statement

The authors declare no conflict of interest.

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Abstract

As part of a larger clinical trial and in connection with a preceding paper on the treatment sensitivity of ecological momentary assessment (EMA) in obsessive-compulsive disorder (OCD), this EMA study deals with a comparison of two treatment conditions, i. e., cognitive restructuring (CR) and detached mindfulness (DM). The sample of n = 40 OCD patients was the same as in previous publications, of which n = 39 were included in the analyses. EMA sampling was smartphone-based and spread over four days, presenting 10 random prompts per day. There was one sampling period before (Pre-Treatment EMA) and after (Post-Treatment EMA) participants underwent a 2-week intervention of either CR or DM. This study focuses on nine EMA items reflecting CR strategies (e. g., questioning an appraisal by re-evaluating risk), DM strategies (e. g., allowing one's thoughts to come and go), and details about the application of those newly learned strategies during Post-Treatment EMA. Although there was a trend towards DM strategies being applied more often during Pre-Treatment EMA than CR strategies, we did not find any differences during Post-Treatment EMA between CR and DM regarding how often participants applied them, how difficult it was for them to apply them and how much relief they experienced from applying them. In line with our hypotheses, we found a clear pre-post increase for all CR and DM behaviors except for one DM item. However, contrary to our expectations, we did not find the increase of CR and DM strategies to depend on what treatment participants had undergone, i. e., we did not find evidence in favor of specific but rather general treatment effects promoted equally well by both interventions. However, as reactivity and social desirability effects cannot be ruled out, this conclusion must be handled cautiously, and further research is needed to replicate and generalize our results.

Key Practitioner Message:

- In this study, we used ecological momentary assessment (EMA) to compare treatment effects of cognitive restructuring (CR) and detached mindfulness (DM) for obsessive-compulsive disorder (OCD).
- The two EMA sampling periods were set prior to and after the completion of a 2-week intervention in either of the two conditions.
- Overall, CR and DM did not differ regarding frequency of use, perceived difficulty and experience of relief after treatment.
- Pre-Post comparisons show a marked increase of both CR and DM behaviors across participants.
- However, CR and DM behaviors increased similarly across both treatment conditions, pointing more towards general or shared than specific treatment effects.

Keywords: Obsessive-compulsive disorder; OCD; ecological momentary assessment; EMA; cognitive restructuring; detached mindfulness

Comparing effects of detached mindfulness and cognitive restructuring in obsessive-compulsive disorder using ecological momentary assessment

Following the definition of DSM-5, obsessive-compulsive disorder (OCD) is characterized by obsessions, i. e., intrusive and unwanted thoughts, images or urges, which lead to compulsions, i. e., overt behaviors or mental acts that serve the purpose of reducing patients' experience of tension, fear or discomfort (American Psychiatric Association, 2013). The functional relationship between obsessions, negative emotional states, and compulsions constitutes the core of influential theoretical models such as those by Rachman (1997, 1998) and Salkovskis (1985, 1999).

In addition to the functional relationships described above, both Rachman (1997, 1998) and Salkovskis (1985, 1999) assume that the negative emotional states experienced by patients are not a direct consequence of the intrusions themselves but rather of the meaning that patients attach to them. Drawing on classic models of cognitive therapy (e. g., Beck, 1979), Salkovskis refers to these evaluative cognitions as "automatic thoughts", whereas Rachman uses the term "misinterpretations". For instance, in an OCD patient, the intrusive thought "I did not lock the front door" could be followed by the automatic thought "Burglars will come and steal all my belongings, so that I will lose everything I own". Following the Obsessive Compulsive Cognitions Working Group (OCCWG, 1997), this automatic thought is an example of the overestimation of threat, which is one typical cognitive distortion inherent to OCD. Another prominent cognitive distortion emphasized by both Salkovskis and the OCCWG is the overestimation of responsibility, which is closely linked to the experience of guilt.

In contrast to the assumption of specific cognitive distortions, Wells (2011) has complemented the above-described perspective on OCD by introducing the concept of metacognition, which reflects attitudes and beliefs *about* cognitions such as intrusive thoughts. As such, the metacognitive model of OCD as proposed by Wells claims that what is driving OCD is a sort of metacognition that classifies mental events such as intrusive thoughts as important *per se* and assigns them a salient meaning or even power. Referring to the above-named example, Wells's model would put the emphasis not on a specific interpretation of the intrusive thought "I did not lock the front door" but rather on the metacognitive belief "Thoughts tell you what's about to happen" – a belief that is usually referred to as "Thought-Event-Fusion".

In this article, we are referring to a clinical trial (registered at ClinicalTrials.gov under the ID NCT03002753) in which we compared an intervention derived from cognitive models (Rachman, 1997, 1998; Salkovskis, 1985, 1999) with another intervention based on the metacognitive perspective (Wells, 2011). To be precise, we compared two different approaches to dealing with obsessions, i. e., detached mindfulness (DM) and cognitive restructuring (CR).

Drawing on the theoretical models by Salkovskis and Rachman, CR educates patients to *actively* question their distorted misinterpretations of intrusive thoughts and to develop alternative appraisals of intrusions, e. g., by re-evaluating risk and re-assessing personal responsibility. Since it requires a lot of involvement, motivation and action from the patient, CR can be regarded as a rather effortful technique. Please see Rupp et al. (2019) for a detailed review of studies on the efficacy of CR interventions in OCD.

In contrast to this active and rational approach, DM is based on Wells's (2011) metacognitive perspective on OCD and teaches them to position themselves at a distance in order to *passively* observe their obsessions – instead of categorizing them as important events that push them towards an immediate response (e. g., a compulsion). DM instructions, therefore, comprise to let thoughts come and go, to position oneself at a distance from the obsession,

and to tell oneself that it is "just a thought". When comparing DM with CR, one major advantage may be that DM is a less effortful technique, requiring less action and involvement from the patient. Please confer Rupp, Jürgens, Doebler, Andor, and Buhlmann (2019) regarding a review of efficacy studies on metacognitive treatments in general and DM in particular.

Both interventions were delivered in the form of four double sessions of 100 minutes each within two weeks. As described in the publication dealing with the efficacy results (Rupp et al., 2019), both approaches turned out to be similarly effective concerning OCD symptoms reduction from pre to post assessment as measured with the German version of the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Hand & Büttner-Westphal, 1991), yielding effect sizes of $d = 1.67$ (CR) and $d = 1.55$ (DM). Please refer to Rupp et al. (2019) regarding a more detailed review of treatment strategies for OCD in general and for further details on the two treatment procedures.

As described in a preceding paper (Rupp, Jürgens, Gühne, Doebler, Andor, & Buhlmann, submitted for publication), we complemented our clinical trial with an ecological momentary assessment (EMA) study in order to measure OCD symptoms, emotions, and the application of functional as well dysfunctional coping behaviors in patients' everyday life – both before and after undergoing treatment. As a modern sort of diary method, EMA offers a wide range of ways to collect data in people's everyday lives, e. g., by using a smartphone that asks patients to rate the intensity of their symptoms various times per day by sending random acoustic prompts. Compared with retrospective symptom scales (both clinician-administered and self-report) that are usually regarded as the gold standard in outcome research, the advantages of EMA comprise the reduction of retrospective bias and enhanced ecological validity (Ebner-Priemer & Trull, 2009; Schwarz, 2007; Shiffman, Stone, & Hufford, 2008). As described in detail by Rupp et al. (submitted for publication), such diary-based outcome research is under-represented in the OCD literature, which gave rise to the idea of using EMA

to study in how far two comparably short treatments (DM and CR) lead to measurable changes in OCD symptoms and the application of functional and dysfunctional behaviors in patients' everyday lives.

In our preceding paper (Rupp et al., submitted for publication), we were already able to demonstrate that the EMA method is sensitive to treatment effects in OCD. To be precise, our results showed a decline of obsession frequency and avoidance behavior as well as a trend towards a reduction of compulsions from Pre-Treatment EMA to Post-Treatment EMA. Importantly, we did not find any effect of the type of treatment (CR vs. DM) for any of these variables, indicating that both interventions were similarly effective. Whereas we did not find any pre-post effect concerning OCD-related emotions (such as discomfort, anxiety, and guilt) and other dysfunctional coping behaviors such as thought suppression, we did find that the degree to which the amount of subjective burden experienced due to obsessions depended on the actual frequency of obsessions was greater during Pre-Treatment EMA than during Post-Treatment EMA. Since this result points to an effect of treatment in the form of using alternative strategies in *dealing* with (persisting) obsessions, it seemed reasonable to use the EMA approach in order to further study in how far new functional coping behaviors (i. e., behaviors taught in the DM and CR interventions, respectively) are promoted through treatment, that is, from Pre-Treatment EMA to Post-Treatment EMA.

Thus, whereas our preceding paper (Rupp et al., submitted for publication) dealt with the treatment sensitivity of the EMA method in OCD, demonstrating a decrease of symptoms (obsessions) and, in part, of dysfunctional coping behaviors, this paper aims at elucidating in what way the EMA data reveal that 1) newly learned coping behaviors are applied more often after than prior to treatment, 2) the degree to which the use of a certain coping behavior increases through treatment depends on the treatment condition (CR vs. DM), i. e., whether

treatment effects are specific or general, and 3), CR and DM differ concerning their applicability.

Due to the crucial role that stress plays in how OCD symptoms vary (e. g., Horowitz, 1975; also see Rupp et al., submitted for publication, for a more detailed review on stress and OCD), we decided to include antedecent stress, i. e., stress measured at the preceding prompt, as an important covariate in all regression models.

Concerning the pre-post effects, we hypothesized that:

(1) during Pre-Treatment EMA, DM strategies are more often employed by patients than CR strategies because engaging in a mode of passive observation (DM) requires less effort and cognitive load than actively questioning appraisals,

(2) all behaviors related to the CR treatment condition, such as questioning to what extent a risk has been overestimated, increase from Pre-Treatment EMA to Post-Treatment EMA, but only in patients who have undergone the CR treatment,

(3) all behaviors related to the DM treatment condition, such as allowing one's obsessions to come and go, increase from Pre-Treatment EMA to Post-Treatment EMA, but only in patients who have undergone the DM treatment,

(4) during Post-Treatment EMA, DM strategies are employed more often, are perceived as less burdensome and yield a greater amount of relief than CR strategies.

Methods

We conducted our study between January 2017 and July 2018. The ethics committee of the Department of Psychology and Sport Science at the University of Münster, Germany, approved of the study protocol. Written informed consent was provided by all participants following a detailed explanation of the study procedure.

Participants

This paper reports results from the exact same sample of $n = 40$ participants as our two preceding papers (Rupp et al., 2019; Rupp et al., submitted for publication). Please see especially Rupp et al. (2019) regarding data on the intention-to-treat sample and concerning details on recruitment, inclusion and exclusion criteria and diagnostic assessment. By contrast, please confer Table 1 in Rupp et al. (submitted for publication) concerning a description of the completer sample ($n = 40$) that underlies the EMA data. All participants enrolled in the study fulfilled the DSM-5 criteria for OCD and exhibited a Y-BOCS score of at least 17.

Design and procedure

Both the Pre-Treatment EMA and the Post-Treatment EMA sampling period comprised Friday through Monday, i. e. four days, and involved the presentation of ten random prompts per day. Further details concerning design and procedure have been described in our preceding paper (Rupp et al., submitted for publication).

Items in the EMA questionnaire

All EMA items were rated on a Likert scale that ranged from 1 (*not at all*) to 7 (*very much*). Whereas the original questionnaire was presented in German, we provide English translations of all items in Table 1. Please note that Screen 11, on which participants are asked three questions about their application of the newly learned coping behaviors (Hypothesis 4), was presented only during Post-Treatment EMA. Also note that the item *Relaxation* only served the purpose of detecting implausible response patterns. Please see Rupp et al. (submitted for publication) for further details on the reasons underlying the choice of items and concerning the description of skipping rules within the questionnaire. The six CR and DM behavior items this article focuses on were deliberately chosen to best reflect the strategies that participants were educated to apply in the corresponding treatment condition.

Feasibility and reactivity to EMA

We assessed feasibility of and reactivity to EMA by means of a post-monitoring questionnaire that participants filled in after each of the two sampling periods. Please see Rupp et al. (submitted for publication) for details on the items in this questionnaire and the corresponding results. Importantly with regard to the results discussed below, we did not find any evidence in favor of reactivity effects.

Data cleansing and analysis

All analyses employed multilevel modeling performed with the statistical software R (R Core Team, 2018), especially the packages *lme4* (Bates, Mächler, Bolker, & Walker, 2015), *nlme* (Pinheiro, Bates, DebRoy, & Sarkar, 2018), *lmerTest* (Kuznetsova, Brockhoff, & Christensen, 2017), and *MuMIn* (Barton, 2018). All items were centered at 0, so that data were transformed from 1-7 to 0-6.

Please refer to Rupp et al. (submitted for publication) with regard to spaghetti plots, cleansing of data, and multilevel factor analysis. As in our preceding paper (Rupp et al., submitted for publication), the final analyses were based on n = 39 participants because one participant from the CR group had to be excluded due to an extreme tendency towards the center of the scale on all items across both sampling periods.

In terms of data cleansing, all values (but not the entire trials) on the three variables concerning the application of the nearly learned strategies (Screen 11) were deleted whenever the frequency of obsessions (Item *Obsessions*) had been rated as 1 (i. e., “not at all”). Also, all values on the variables *Difficulty* and *Relief* were deleted if *How often* had been rated as 1.

Preliminary data analysis also involved the computation of null models for all items that were used as dependent variables. This step included computing the corresponding intraclass correlations (ICC), i. e., the percentage of the total variance in the dependent variable that is due to mean differences *between* (as opposed to *within*) participants.

Hypothesis testing

Except for Hypothesis 1, hypothesis testing was based on the computation of multi-level models with trials on the first and participants on the second level. Parameter estimation employed restricted maximum likelihood. We applied a significance level of 0.01 for all analyses. Further details on checks for multicollinearity and homoscedasticity as well as our procedure regarding the modelling of random slopes and model comparisons have been described in our preceding paper (Rupp et al., submitted for publication) and were the same for the analyses reported in this article.

The regression models underlying Hypotheses 2 and 3 included both random intercepts and random slopes regarding the *Pre-Post* variable, as we expected participants to differ in terms of their response to treatment. For the purpose of avoiding confusion, the random intercepts and slopes are not included in the model equations below. The two regression models underlying Hypotheses 2 and 3 included the factor *Group* (i. e., CR vs. DM), the factor *Pre-Post* (i. e., Pre-Treatment EMA vs. Post-Treatment EMA) and the interaction of these two factors as fixed effects. As both models dealt with predicting the frequency of newly learned coping behaviors, *Obsessions*, i. e., the frequency of obsessions, was added as a covariate in order to control for any reduction effects that can be solely traced back to a decrease of obsession frequency. Aiming at accounting for the considerable influence that stress exhibits on OCD symptoms and the choice of coping behavior, we added as another covariate the *Stress* rating at the preceding prompt, which we labeled $Stress_{t-1}$.

Testing Hypothesis 1 employed a one-sided *t*-test contrasting DM strategies vs. CR strategies during Pre-Treatment EMA. The *t*-test was based on mean DM and CR values for each person.

The equation underlying the regression models for Hypotheses 2 – 3 was:

$$Y_t = Intercept + Pre\text{-}Post + Group + Pre\text{-}Post \times Group + Stress_{t-1} + Obsessions + error,$$

where Y_t denotes each of the DM and CR behavior items.

Regarding Hypothesis 4, i. e., the items on the use of the newly learned strategies, we did model random intercepts, but not random slopes because the model did not include the *Pre-Post* factor. The model equation was as follows:

$Y = Intercept + Group + Stress_{t-1} + error$,

where Y denotes the variables *How often*, *Difficulty* and *Relief*.

Results

Preliminary data analysis

Please see our preceding paper (Rupp et al., submitted for publication) concerning our results regarding the spaghetti plots, data cleansing, feasibility and reactivity, and multilevel factor analysis. Note that with regard to factor analysis, we did not aggregate with regard to the CR and DM items because the factor structure was too arbitrary. Instead, we computed separate regression models for each of the six items.

Importantly, due to a step of data cleansing that only affected the three items on the use of the newly learned coping behaviors (Screen 11), the number of trials that underlies the regression models for Hypothesis 4 was smaller than for the regression models concerning Hypotheses 2 and 3. Since all values on these three variables were deleted whenever the frequency of obsessions (Item *Obsessions*) had been rated as 1 (i. e., "not at all"), and since all values on the variables *Difficulty* and *Relief* were deleted if *How often* had been rated as 1 (i. e., "not at all"), the three regression models underlying to Hypothesis 4 were based on a sample size varying between $n = 316$ and $n = 367$ trials.

Regarding null models, we found ICCs between 0.347 (*Realistic*) and 0.449 (*Come and Go*) for the six CR and DM items, which are the focus of this paper. Regarding the items *How often*, *Difficulty*, and *Relief*, the ICCs were 0.600, 0.554, and 0.631, respectively. Thus, it seemed reasonable to model the multilevel structure of the data in all analyses.

Descriptive data analysis

Table 2 once again presents the same descriptive data on all Pre-Treatment EMA items and on the three items concerning the newly learned coping behaviors (presented only presented during Post-Treatment EMA) that have already been reported in our preceding paper (Rupp et al., submitted for publication). Note that, as Table 2 reveals, participants did already use DM and CR strategies during Pre-Treatment EMA, i. e., prior to actually being taught these strategies during treatment. Please confer Rupp et al. (submitted for publication) for a discussion of the remaining descriptive results.

Hypothesis testing

With the maximum correlations of fixed effects varying between -0.69 and -0.72 in each of the regression models computed, multicollinearity did not constitute a problem. Neither did the inspection of scatter plots raise any concerns in terms of heteroscedasticity. For the two regression models involving the *Pre-Post* factor (Hypotheses 2 and 3), the model comparisons indicated a better fit (based on AIC, BIC, and LRT) for the models including random slopes than for those one excluding them, so that we only report the models including random slopes.

Regarding Hypothesis 1, there was a strong but non-significant trend towards DM strategies being used more frequently than CR strategies during Pre-Treatment EMA, $t(38) = 2.212$, $p = 0.017$, $d = 0.717$, so that Hypothesis 1 was not fully confirmed. The results concerning Hypothesis 2 to 4 can be retrieved from Tables 3 to 5. The results can be summarized as follows:

Both concerning CR and DM behaviors (Hypotheses 2 and 3), we found a significant effect of the *Pre-Post* factor, i. e., an increase of those behaviors from Pre-Treatment EMA to Post-Treatment EMA, for all items except *Come and Go.* The contribution of the covariates *Obsessions* and $Stress_{t-1}$ was significant in some of the models. However, the *Group* factor

was not significant in any of the models. And although in most models there emerged a certain trend towards a *Pre-Post×Group* interaction, this trend did not reach significance in any of the models. Thus, neither of the two Hypotheses was fully confirmed. While there was a clear pre-post increase, there was no evidence confirming that the increase of a certain behavior was specific to the corresponding intervention.

Regarding Hypothesis 4, we did not find a significant effect of the *Group* factor in any of the three models using *How often*, *Difficulty*, and *Relief* as dependent variables. Hence, it appears that in both treatment conditions, participants applied the nearly learned coping behaviors equally often, experienced them as similarly difficult and experienced a comparable degree of relief. In sum, Hypothesis 4 was not confirmed.

Discussion

Participants' application of CR and DM coping behaviors

Both Hypothesis 1 and 4 dealt with the way coping behaviors related to CR and DM are applied by participants in their everyday lives. Interestingly, the Pre-Treatment EMA data (see Table 2) show that patients already tried to apply certain CR and DM strategies before actually being taught these strategies during treatment. And even though Hypothesis 1, which claimed that prior to treatment DM strategies are used more often than CR strategies, was not fully confirmed, there was a strong statistical trend towards this pattern. However, it is important to bear in mind that these results only reveal how often participants applied each strategy, whereas this does not reveal anything about their *success* in doing so. So, although we did not find evidence in favor of reactivity effects as far as the post-monitoring questionnaire goes, we need to bear in mind that reactivity may have played a role since presenting the item itself may have encouraged participants to apply the corresponding coping behavior.

The fact that DM strategies showed a tendency towards being applied more often than CR strategies before treatment may indicate that DM strategies require less effort and cognitive load. However, this result may equally well be taken as a sign that especially approaches such as letting thoughts come and go are more part of common parlance than the questioning of appraisals, so that the latter are used less frequently in everyday life.

An important aspect that contradicts the perspective concerning effort and cognitive load is that with regard to Hypothesis 4, we did not find any evidence suggesting that after treatment participants applied DM more often than CR, found DM less difficult to apply than CR, and experienced DM as more relieving than CR. In sum, the results for Hypotheses 1 and 4 seem to reflect that whereas DM strategies may be easier to grasp due to their presence in colloquial speech, there are no differences concerning applicability after treatment, i. e., frequency of use, difficulty, and experienced relief. Though contradicting our hypotheses, this finding is in line with our main result from the clinical trial (Rupp et al., 2019), where we found both CR and DM to be equally effective at reducing OCD symptoms as measured with the Y-BOCS. Thus, this finding adds to the overall impression that CR and DM seem rather equal not only in terms of efficacy but also with regard to applicability.

General vs. specific effects of CR and DM treatment

As predicted by Hypotheses 2 and 3, there was a clear pre to post increase concerning the application of the newly learned coping behaviors in both treatment conditions, which adds to the result that the frequency of obsessions, the experienced burden due to obsessions, and avoidance behavior decreased from Pre-Treatment EMA to Post-Treatment EMA (Rupp et al., submitted for publication). As such, this result can be taken as further evidence for the treatment sensitivity of the EMA method in OCD. The reason for which the DM item *Come and Go* failed to show this pre-post increase probably was the above-discussed presence of

this strategy in common parlance, leading to a comparably high mean at Pre-Treatment EMA, which meant less room for a pre-post increase.

Even though there was a slight trend towards an interaction effect of *Group* and *Pre-Post* suggesting that CR behaviors increase more markedly in the CR condition and vice versa, the overall conclusion to draw from the regression results is rather that both treatments also promoted the use of strategies that actually belonged to a different treatment rationale. On the one hand, this may be interpreted in the light of general or shared as opposed to specific factors of treatment efficacy (e. g., Grawe, Donati, & Bernauer, 1994), since all nearly learned behaviors reflect forms of problem actualization and all imply the creation of new learning experiences. Drawing on this perspective, it also seems reasonable that at a certain point, CR and DM strategies become indistinct for patients, who may e. g. also use a CR strategy (questioning an appraisal) as a stepping stone for letting go of an obsession (i. e., a DM strategy), or vice versa. As summarized by Kazdin (2007), however, determining the working mechanism behind an effective psychological treatment is a challenging issue far beyond the scope of this article. Apart from these considerations, it is crucial to annotate that, on the other hand, this result may also be partly due to the fact that during Pre-Treatment EMA and Post-Treatment EMA, participants were presented *all* items concerning both CR and DM – which may have encouraged them to engage in either of them. Next to reactivity, this result may also partly be due to social desirability, which affects EMA as much as it affects all questionnaire-based research (Schwarz, 2007), since the structure of the EMA questionnaire made it easy for participants to guess that the researchers were aiming at finding CR and DM strategies to be used more often during Post-Treatment EMA.

Strengths

Next to being the first study on treatment sensitivity of the EMA method for OCD (Rupp et al., submitted for publication), it is also the first study that used EMA as an outcome

measure to reflect the effect of two different OCD-specific treatments. Therefore, the major strength of this study consists in providing ecologically valid data on OCD patients' use of specific coping behaviors prior to and after treatment.

Limitations

As already noted in our previous paper (Rupp et al., submitted for publication), a major limitation of our study is that for the sake of practicability, each construct could be measured by only a few items or even one single item in the EMA questionnaire. This is especially true of the item *Stress*, which is why future research should definitely differentiate more between the various facets of stress. However, this limitation also affects the choice of behavior items employed to reflect CR and DM strategies, which is anything but exhaustive given the wide range of strategies that can be labeled as pertaining to the CR or DM approach, respectively. For example, in the CR condition, questioning of appraisals also involved the issue of dealing with uncertainty, which the OCCWG (1997) listed as one cognitive distortion typical of OCD (see also, e. g., Gentes & Ruscio, 2011) – which, however, was not represented in the EMA items due to our a-priori decisions. So, in order to arrive at a more representative result regarding the question to what extent effects of treatment are reflected in the EMA results and whether these results reveal a *specific* effect of the type of treatment, future research should employ a larger set of behavior items to capture a wider range of facets pertaining to both DM and CR.

Furthermore, we did not have any control groups of mentally healthy participants or participants with an anxiety disorder, which we could have compared with our OCD sample on variables such as the use of CR and DM related behaviors prior to treatment. Since this limits especially the generalizability of our Pre-Treatment EMA results to a certain extent, future research should address this aspect.

Another limitation concerns the issue of reactivity. Even though the spaghetti plots and the post-monitoring questionnaire did not suggest any severe reactivity effects, it would be wrong to ignore that all CR and DM items were presented during Pre-Treatment EMA and Post-Treatment EMA equally across all participants, so that solely answering these items may have inspired participants to engage in those behaviors. Therefore, the conclusion that both treatments equally promote the use of CR and DM behaviors must be drawn with caution. In future research, this issue might be addressed by adding a second baseline EMA before treatment, so that the actual treatment effects can be separated from the reactivity effects. Also note that, whereas EMA allows to rule out retrospective memory biases, other confounding variables such as social desirability and effects of response formatting still play a role and cannot be ruled out (Schwarz, 2007), which may have contributed to our results, as well.

From a statistical point of view, it is important to note that since our regression models only dealt with means, measures of variability in the data have been neglected. So, although the spaghetti plots did not raise any concerns regarding autocorrelations, our analyses do not provide a definite answer to the question to what extent the variability of the newly learned behaviors changes from Pre-Treatment EMA to Post-Treatment EMA.

Conclusions

This study adds to the existing outcome research in OCD by providing ecologically valid data on how the use of functional coping behaviors changes following a specific intervention of either cognitive restructuring or detached mindfulness. In contrast to our expectations, the two types of newly learned functional coping behaviors hardly differed in terms of applicability. Also, our results suggest that the use of functional coping behaviors was promoted equally through both treatment conditions, pointing more towards general than specific factors of treatment efficacy. However, as reactivity effects and other biases cannot be ruled

out, this conclusion must be handled cautiously, and further research is needed to replicate and generalize our results.

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Table 1

English translation of EMA items

Variable (short label)	English translation of item
Screen 1	
Stress	1) Since the last prompt, to what extent have you been under stress?
Relaxation	2) Since the last prompt, to what extent have you felt relaxed?
Screen 2	1) Since the last prompt, how frequently have you experienced obsessions?
Obsessions	2) To what extent have you felt burdened by the obsessions you have experienced since the last prompt?
Burden	
Screen 3	1) To what extent were obsessions that you have experienced since the last prompt associated with the following feelings?
Anxiety	*anxiety*
Shame	*shame*
Sadness	*sadness*
Screen 4	1) To what extent were obsessions that you have experienced since the last prompt associated with the following feelings?
Guilt	*guilt*
Helplessness	*helplessness*
Disgust	*disgust*
Screen 5	1) To what extent were obsessions that you have experienced since the last prompt associated with the following feelings?
Tension/Discomfort	*tension/discomfort*
Frustration	*frustration*
Uncertainty	*uncertainty*
Screen 6	1) Please rate to what extent you responded to obsessions that you have experienced since the last prompt in the following ways – regardless of how effective you experienced your response:
Suppression (Dys)	*I suppressed the obsession.*
Come and Go (DM)	*I allowed the obsession to come and go.*
Screen 7	1) Please rate to what extent you responded to obsessions that you have experienced since the last prompt in the following ways – regardless of how effective you experienced your response:
Realistic (CR)	*I reviewed to what extent my apprehensions are realistic.*
Compulsion (Dys)	*I performed a compulsion (overt or covert).*
Screen 8	1) Please rate to what extent you responded to obsessions that you have experienced since the last prompt in the following ways – regardless of how effective you experienced your response:
Monitoring (Dys)	*I monitored my actions with special attention.*
Distance (DM)	*I positioned myself at a distance from the obsession.*
Screen 9	1) Please rate to what extent you responded to obsessions that you have experienced since the last prompt in the following ways – regardless of how effective you experienced your response:
Responsibility (CR)	*I wondered how far I overestimated my own responsibility.*
Just a Thought (DM)	*I told myself that it is just a thought.*

Screen 10 Risk (CR) Avoidance (Dys)	1) Please rate to what extent you responded to obsessions that you have experienced since the last prompt in the following ways – regardless of how effective you experienced your response: *I questioned how far I overestimated the risk of something.* *I avoided objects or situations due to my obsessions.*
Screen 11 How often Difficulty Relief	1) How often have you applied the technique you learned in therapy to obsessions - regardless of how effective you experienced it? 2) How difficult did you find it to apply the newly learned technique? 3) To what extent did applying the newly learned technique create relief?

Note. Screen 11 was presented only in the Post-Treatment EMA. Since the German term "Anspannung", which generally fits very well with the emotional experience of OCD patients, does not translate easily into English, we listed both "tension" and "discomfort" as possible translations. The annotations "Dys", "DM" and "CR" are used to indicate which category the corresponding behavior item belongs to. *Abbreviations:* DM = detached mindfulness, CR = cognitive restructuring, Dys = Dysfunctional.

Table 2

Descriptive data concerning all EMA items

Variable	*Mean*	*SD*	*Median*
Stress	2.50	1.75	2.0
Relaxation	2.96	1.68	3.0
Obsessions	2.37	1.72	2.0
Burden	2.28	1.82	2.0
Emotions			
Anxiety	2.55	1.94	2.0
Shame	1.16	1.68	0.0
Sadness	1.69	1.97	1.0
Guilt	1.47	1.87	1.0
Helplessness	2.30	1.99	2.0
Disgust	1.25	1.68	0.0
Tension/Discomfort	3.41	1.62	4.0
Frustration	2.45	2.03	2.0
Uncertainty	2.69	1.82	3.0
Behaviors			
Compulsion Suppres-	3.21	1.84	3.0
sion	2.65	1.75	3.0
Avoidance	1.80	1.75	1.0
Monitoring	2.45	1.96	2.0
Come and Go	2.15	1.72	2.0
Distance	1.78	1.67	1.0
Just a Thought	1.58	1.62	1.0
Realistic	1.80	1.73	1.0
Responsibility	1.18	1.46	1.0
Risk	1.53	1.61	1.0
Use of new strategies			
How often			
DM	2.74	1.81	3.0
CR	3.30	1.59	4.0
Difficulty			
DM	2.68	1.64	2.5
CR	2.25	1.21	2.0
Relief			
DM	3.22	1.66	3.0
CR	3.01	1.42	3.0

Note. Except for the items concerning the use of new strategies, which were only presented at Post-Treatment EMA and for which data is given separately for DM and CR, all calculations are based on Pre-Treatment EMA data only. Calculations are based on recoded items (0-6 instead of 1-7). All items had minimal values of 0 and maximal values of 6. Please see Table 1

for a description of the DM and CR items for which this table only lists the corresponding abbreviations. *Abbreviations:* CR = cognitive restructuring, DM = detached mindfulness.

Table 3

Regression models concerning Hypothesis 2 (increase of CR strategies)

Realistic				
	b	*SE*	*t*	*p*
Intercept	1.40	0.26	5.39	**<0.001**
Pre-Post.*Post*	1.30	0.33	3.89	**<0.001**
Group.*DM*	-0.51	0.34	-1.50	0.141
$Stress_{t-1}$	0.04	0.02	1.72	0.086
Obsessions	0.15	0.03	5.34	**<0.001**
Pre-Post.*Post* × Group.*DM*	-0.38	0.46	-0.83	0.415
Observations: *n* = 1598, Participants: *n* = 39				
Responsibility				
	b	*SE*	*t*	*p*
Intercept	0.81	0.26	3.055	**0.004**
Pre-Post.*Post*	1.48	0.33	4.43	**<0.001**
Group.*DM*	0.14	0.35	0.39	0.700
$Stress_{t-1}$	0.05	0.02	2.70	**0.007**
Obsessions	0.05	0.02	2.12	0.034
Pre-Post.*Post* × Group.*DM*	-0.66	0.46	-1.44	0.160
Observations: *n* = 1597, Participants: *n* = 39				
Risk				
	b	*SE*	*t*	*p*
Intercept	1.06	0.28	3.81	**<0.001**
Pre-Post.*Post*	1.38	0.31	4.38	**<0.001**
Group.*DM*	-0.02	0.37	-0.05	0.960
$Stress_{t-1}$	0.02	0.02	0.93	0.354
Obsessions	0.13	0.03	4.99	**<0.001**
Pre-Post.*Post* × Group.*DM*	-0.82	0.43	-1.87	0.070
Observations: *n* = 1597, Participants: *n* = 39				

Note. The first line of each table lists the dependent variable of the corresponding model. *p* values <.01 are printed in bold. Concerning the predictors "Pre-Post" and "Group", the corresponding reference category is given in italicized letters (*Post*/*DM*). *Abbreviations:* CR = cognitive restructuring, DM = detached mindfulness.

Table 4

Regression models concerning Hypothesis 3 (increase of DM strategies)

Come and Go				
	b	*SE*	*t*	*p*
Intercept	2.16	0.31	6.88	**<0.001**
Pre-Post.*Post*	0.33	0.33	1.002	0.323
Group.*DM*	0.47	0.43	1.10	0.279
$Stress_{t-1}$	-0.03	0.02	-1.48	0.141
Obsessions	-0.07	0.02	-2.74	**<0.001**
Pre-Post.*Post* × Group.*DM*	0.69	0.46	1.48	0.148
Observations: *n* = 1598, Participants: *n* = 39				
Distance				
	b	*SE*	*t*	*p*
Intercept	2.28	0.30	7.49	**<0.001**
Pre-Post.*Post*	1.10	0.33	3.38	**0.002**
Group.*DM*	0.04	0.41	0.09	0.928
$Stress_{t-1}$	-0.04	0.02	-1.815	0.070
Obsessions	-0.13	0.03	-4.97	**<0.001**
Pre-Post.*Post* × Group.*DM*	0.22	0.45	0.50	0.617
Observations: *n* = 1598, Participants: *n* = 39				
Just a Thought				
	b	*SE*	*t*	*p*
Intercept	1.88	0.30	6.20	**<0.001**
Pre-Post.*Post*	0.98	0.31	3.19	**0.003**
Group.*DM*	-0.41	0.41	-1.00	0.325
$Stress_{t-1}$	0.02	0.02	0.92	0.360
Obsessions	-0.04	0.03	-1.40	0.162
Pre-Post.*Post* × Group.*DM*	0.79	0.43	1.85	0.073
Observations: *n* = 1597, Participants: *n* = 39				

Note. The first line of each table lists the dependent variable of the corresponding model. *p* values <.01 are printed in bold. Concerning the predictors "Pre-Post" and "Group", the corresponding reference category is given in italicized letters (*Post*/*DM*). *Abbreviations:* DM = detached mindfulness.

Table 5

Regression models concerning Hypothesis 4 (use of newly learned strategies)

How often				
	b	*SE*	*t*	*p*
Intercept	3.44	0.34	10.07	**<0.001**
Group.*DM*	-0.57	0.46	-1.23	0.228
$Stress_{t-1}$	-0.03	0.03	-1.03	0.305
Observations: *n* = 730, Participants: *n* = 38				
Difficulty				
	b	*SE*	*t*	*p*
Intercept	1.97	0.28	6.91	**<0.001**
Group.*DM*	0.36	0.38	0.94	0.356
$Stress_{t-1}$	0.06	0.03	2.08	0.038
Observations: *n* = 667, Participants: *n* = 36				
Relief				
	b	*SE*	*t*	*p*
Intercept	3.34	0.31	10.74	**<0.001**
Group.*DM*	0.15	0.42	0.36	0.725
$Stress_{t-1}$	-0.06	0.03	-2.05	0.041
Observations: *n* = 667, Participants: *n* = 36				

Note. The first line of each table lists the dependent variable of the corresponding model. *p* values <.01 are printed in bold. Concerning the predictor "Group", the corresponding reference category is given in italicized letters (*DM*).

8. General discussion

8.1. Summary and interpretation of results

8.1.1. Efficacy of cognitive and metacognitive interventions in OCD

Study 1 aimed at demonstrating that a comparably short but intense intervention of either CR or DM is efficacious in reducing OCD symptoms as measured with the Y-BOCS. In fact, we were able to show that both interventions were supervior to the waitlist condition, yielding high effect sizes of $d = 1.55$ (DM) and $d = 1.67$ (CR) and a remarkable percentage (40 %) of patients exhibiting clinically significant change in either treatment condition.

With regard to research question 1, the aspect to be highlighted here is that unlike most preceding studies on cognitive therapy for OCD (e. g., Wilhelm et al., 2005), CR in our trial was restricted to classic "Beckian" cognitive restructuring without behavioral experiments. By demonstrating the efficacy of CR without behavioral experiments, we thus confirm and extend the findings by Belloch et al. (2008), ruling out the overlap with ERP that makes CT including behavioral experiments difficult to interpret. Hence, one of the first conclusions to draw from our research is that, even when delivered in such a short setting (four double sessions within two weeks), cognitive restructuring restricted to the questioning of dysfunctional appraisals of intrusive thoughts effectively reduced OCD symptoms.

In terms of research question 2, we were able to show that DM, when used as a single intervention in the same short and intense setting as CR, turned out to be about as efficacious as purely "Beckian" CR. We thereby extend previous findings from a case study (Firouzabadi & Shareh, 2009) and an analogue study with a non-clinical sample (Ludvik and Boschen, 2015), which had already suggested that DM may be effective in dealing with intrusive thoughts, by demonstrating the clinical usefulness of DM in an OCD sample.

The main merit of these findings is what they imply with regard to the improvement of effective treatments for OCD, given the undesirable side effects of ERP, i. e., refusal rates of around 25 % and drop-out rates of around 20 % (Schruers et al., 2005). Regarding our clinical trial (Study 1), three patients dropped out (i. e., around 7 %), and none of them did because of experiencing the treatment as too demanding. Thus, our results raise some hope regarding the provision of alternative and effective treatments for OCD patients, extending the already established knowledge on the merits of cognitive and metacognitive therapy in general by demonstrating the efficacy of two single interventions derived from each of the two approaches, i. e., CR and DM.

Of course, due to the short follow-up period of only one month, we cannot make any profound statement on the long-term efficacy of the forms of CR or DM used in our study. Nevertheless, the fact that across participants, the treatment effect was maintained over four weeks and even showed a trend towards further improvement can be taken as proof concerning the importance of intense practice of either CR or DM between Post and FU assessment. When combining this result with the high ratings concerning participants' homework compliance between sessions two and four, a likely conclusion is that intense practice as homework assignment plays a crucial role in making either treatment (CR/DM) effective, since the important moderating role homework assignments exhibit concerning treatment outcome has been demonstrated by meta-analyses (Kazantzis, Whittington, & Dattilio, 2010; Mausbach, Moore, Roesch, Cardenas, & Patterson, 2010). However, moderator and mediator analyses regarding the efficacy of CR and DM in our study are not part of the research presented in this dissertation and will be reported in a separate article.

8.1.2. EMA: OCD symptoms in patients' everyday lives

Research question 3 dealt with the question to what extent ecologically valid data on OCD symptoms, associated behaviors and OCD-specific emotional states (as measured by

EMA) reflect what theoretical models of OCD would predict. In sum, our EMA results at Pre-Treatment EMA are in line with most predictions from the models by Rachman (1997, 1998), Salkovskis (1985, 1999) and Purdon and Clark (1999), with compulsions evolving as a salient feature as compared with all other dysfunctional behaviors, and tension/discomfort being the highest rated emotional state. All three models also predict dysfunctional thought suppression attempts as well as emotional states of uncertainty and anxiety following obsessions, which is what our data reflect. Regarding thought suppression attempts, our descriptive result is in line with one of the very few EMA studies on OCD by Purdon et al. (2007).

As discussed in Study 2, the comparably low mean ratings regarding emotional states of guilt and disgust as well as avoidance behavior need to be interpreted with caution since they probably reflect artifacts of (1) the sample characteristics (few participants with disgust-related OCD), (2) the setup of the EMA questionnaire (asking for avoidance *following* obsessions instead of measuring "preventive" avoidance), and (3) the fact that, regarding experiences of guilt, the association between guilt and OCD seems to vary across situations and participants (Rachman, Thordarson, Shafran, & Woody, 1995), which is not reflected by those means but could be a point for further EMA-based time-series analyses.

Taking this account, our descriptive results actually lack significant surprises and are well in line with the theoretical models discussed in Chapter 1. Hence, our results contribute to the OCD literature by complementing the established knowledge about OCD symptoms and related phenomena with real-time data collected in patients' everyday lives.

8.1.3. Treatment sensitivity: Application of EMA as an outcome measure

With regard to research question 4, the results from Study 2 suggest that the EMA method is sensitive to treatment effects in OCD up to a certain degree, since we were able to show that important features of OCD (obsessions, subjective burden due to obsessions, avoidance behavior, and, though only bordering on significance, compulsions) decrease from Pre-

Treatment EMA to Post-Treatment EMA, whereas we did not find any treatment-related changes concerning OCD-related emotions and other dysfunctional behaviors. Interestingly, however, we were able show that obviously, one effect of treatment is that after as compared with before treatment, our participants reported experiencing less burden following obsessions when controlling for obsession frequency – indicating that their way of *dealing* with obsessions had changed. Note that all these treatment effects emerged equally for CR and DM, thus confirming the Y-BOCS results from Study 1 that also suggest CR and DM to be equally efficacious.

In sum, Study 2 provides promising evidence in favor of EMA being sensitive to treatment effects of CR and DM, however, the generalizability of this result is limited. First, further research is required to show the applicability of EMA as an outcome measure to other forms of OCD-specific treatment beyond CR and DM, such as ERP. Second, applying an EMA-based outcome measure to a much lengthier clinicial trial might, contrary to our study, also result in treatment-related changes concerning emotions, which, as suggested by classic cognitive theories (e. g., Beck, 1979), is a lengthy process probably requiring more than two weeks. Similarly, a lengthier trial might also yield significant reduction effects for compulsions (which only bordered on significance in our study), thought suppression and excessive action monitoring.

As a byproduct not directly related to the research questions formulated in Chapter 4, Study 2 also provided EMA-based proof on the well-documented association between antecedent stress and obsession frequency, thereby confirming a relationship that has been found and described repeatedly and consistently (cf., e. g., Horowitz, 1975; Rachman, 1997).

In spite of all limitations, this result constitutes a relevant contribution to the literature on the efficacy of OCD-specific treatments, for it complies with both Taylor's (1995) call for research on how OCD treatments affect patients in their habitual environment and Mavissa-

kalian and Barlow's (1981) request for operationalizing treatment outcome via changes in directly measured symptom frequency. We thereby extend what Boersma et al. (1976) and Foa et al. (1980) found by means of paper-pencil diary methods in OCD and extend the findings of other studies that employed EMA as an outcome measure to cognitive-behavioral treatments for other disorders (cf. Chapter 3). In sum, the main merit of our results is that they provide proof of treatment effects that are hardly affected by retrospective biases and are based on data that were not collected in a laboratory setting, but in the patient's habitual environment.

8.1.4. Comparison of CR and DM on the basis of EMA

Study 3 dealt with comparing effects of CR and DM on the basis of EMA data. In terms of research question 5, we found clear evidence in favor of a marked increase on all CR and DM strategies from pre to post assessment except for the DM item *Come and Go*, which was probably due to the fact that this strategy is ubiquitous in common parlance. Regarding research question 6, however, both treatment conditions were apparently equally effective at promoting the use of either strategy, suggesting rather general instead of specific treatment effects. Concerning research question 7, even though there was a non-significant trend towards DM being used more frequently prior to treatment, we did not find any aspects of applicability (frequency of use, perceived difficulty, perceived relief) differing between CR and DM after treatment – thus not providing any evidence that a conceptually rather passive approach such as DM requires less effort than a comparably active strategy like CR.

In sum, these results can be interpreted in different ways. Of course, one possible interpretation is that indeed, CR and DM are perceived as less different from one another by OCD patients than they are perceived by professionals. This perspective would be in line with the assumption that all effective psychotherapeutic treatments actually share a limited set of working mechanisms such as problem actualization (Grawe, Donati, & Bernauer, 1994), which sets functional strategies (both CR and DM) apart from dysfunctional strategies, thus offering a

possible explanation for our results pattern. An important aspect strengthening this view is that in Study 1, we also found CR and DM to be similarly effective with regard to Y-BOCS change scores. If this interpretation was correct, a reasonable conclusion would be to promote and recommend either type of treatment or even a combination of CR and DM, since there is no evidence indicating that they differ concerning (1) efficacy and (2) applicability across participants.

On the other hand, this result might be an artifact of (1) reactivity effects, i. e., participants might use either strategy because answering the EMA questionnaire itself encourages them to do so, or (2) social desirability effects arising from participants' wish to comply with the researchers' (assumed) goals. Future research is needed in order to detangle these confounds and to arrive at a more profound conclusion.

8.2. Limitations and future research directions

8.2.1. Generalizability of efficacy results

As pointed out in all three studies, a number of factors limit the generalizability of our efficacy results. With regard to the clinical trial itself (Study 1), it is important to consider that the sample was comparably small and not designed to include all possible symptom dimensions. Also, our sample consisted only of adult patients with a minimum age of 18 years, thus precluding any conclusions concerning pediatric patients. Due to the small sample size, statistical power was by far insufficient to determine if one treatment was superior to the other. For the lack of a placebo condition, we were not able to measure the effects of general working mechanism such as the working alliance between therapist and patient, so that it is not justified to conclude that CR and DM alone account for the whole effect of treatment that we measured. A certain bias towards an overestimation of pre to post change cannot be ruled out since the evaluators could not be blinded with regard to whether the patient was in the waitlist or in the non-

waitlist condition and since in all cases the treatment was delivered by the same two therapists (i. e., Charlotte Jürgens and the author himself) who had also developed the treatment manual and designed the study as such. Finally, the short follow-up period of only four weeks precludes any conclusions of long-term effects resulting from our treatment approach.

In sum, future research should therefore (1) test CR and DM as interventions in a much lengthier trial, in which (2) the treatment is delivered by several therapists not otherwise involved in the study design, and in which (3) outcome is assessed by evaluators who do not know whether a patient has received treatment or not. Ideally, such a study would include (4) a placebo condition to isolate general from specific working mechanisms and, if possible, (5) a third active condition, i. e., ERP, to broaden the picture regarding working mechanisms and differential efficacy. Since our clinical trial employed a randomized controlled design, another point future research should address is the question to what extent DM proves to be effective under routine clinical practice conditions, i. e., effectiveness studies are needed.

8.2.2. Working mechanisms underlying CR and DM

Most importantly, the research presented in this dissertation does not allow any conclusions concerning the working mechanisms underlying either CR or DM, which would, however, be very interesting to study since CR and DM differ considerably concerning the conceptually more active (CR) vs. passive (DM) way of dealing with obsessions and the appraisals attached to them. Also, as Salkovskis (2002) put it, the "effectiveness of a particular treatment tells us nothing about the mechanisms involved in a particular disorder" (p. 5). In other words, even though our findings of both CR and DM being effective at reducing OCD symptoms can be counted as evidence in favor of the models these interventions are based on (Rachman, 1997, 1998; Salkovskis, 1985, 1999; Wells, 2011), it would be wrong to conclude that therefore, all mechanisms postulated in these models actually exist.

In fact, the design of our clinical trial also comprised several general and specific process measures. As discussed above, one important general process measure and possible mediator, i. e., working mechanism, is homework compliance. With regard to specific working mechanisms, it is of course interesting to see whether treatment effects are mediated by changes in metacognition, as measured with questionnaires such as the TFI (Wells et al., 2001), or by changes in cognitive belief domains as captured with the OBQ (OCCWG, 1997, 2001, 2005).

As summarized in detail by Kazdin (2007), determining the working mechanism behind a psychological intervention is a sophisticated process. Regarding the working mechanism proposed by cognitive models, i. e., a change in cognition that precedes a change in emotion, there is some confirmatory evidence, e. g. for the case of panic disorder (Teachman, Marker, & Clerkin, 2010).

Interesting findings regarding cognitive vs. metacognitive mediation effects in OCD have been provided by Sassaroli et al. (2015), who used a questionnaire-based regression approach to demonstrate that the relationship between OCD symptoms and beliefs about inflated responsibility (i. e., a cognitive belief domain) was fully mediated by beliefs concerning the need to control thoughts and beliefs regarding participants‘ perception of control over events and reactions associated with anxiety – i. e., metacognitions. Similarly, Solem, Håland, Vogel, Hansen, and Wells (2009) were able to show that in a sample of OCD patients undergoing ERP treatment, changes in metacognition (as measured with the MCQ-30; Wells & Cartwright-Hatton, 2004) was the only significant predictor of post-treatment Y-BOCS scores when included in a regression together with measures of responsibility and perfectionism (OBQ-44; OCCWG, 2005), indicating that, as the term *metacognition* implies, metacognitions might indeed be conceptually superior to cognitive belief domains.

Though not being part of this dissertation, a paper dedicated to testing this mediation hypothesis implying the superiority of metacognitions over cognitive belief domains on the

basis of our data is currently in progress and will also examine the mediating role of homework compliance. Thus, it will be possible to further integrate the EMA results in order to hopefully arrive at a bigger picture regarding how CR and DM actually work. Ideally, such a bigger picture would also involve future research aiming at integrating detached mindfulness, more traditional and broader concepts of mindfulness (e. g., Kabat-Zinn, 2005) as well as methods derived from ACT (e. g., Eifert & Forsyth, 2005).

8.2.3. Generalizability of EMA findings

As pointed out in Studies 2 and 3, while ruling out retrospective biases to a large extent, a major problem in EMA is reactivity effects leading participants to answer in a certain way only because they were *asked* by the EMA questionnaire. Similarly, as all questionnaire-based psychological research, the interpretation of EMA results is affected by social desirability, i. e., participants answering in a certain way because they assume to comply with what the researchers wish to find. Also, question comprehension needs to be taken into account because it strictly limits how EMA results can be interpreted (Schwarz, 2007). All three aspects limit the generalizability of our EMA results.

Regarding reactivity and social desirability, it is reasonable to assume that the structure of the EMA questionnaire, which made it for instance easy for participants to guess that the researchers were aiming at revealing an increase of functional coping strategies from pre to post assessment, may have given rise to either of the two sorts of bias. Similarly, regarding question comprehension, even though participants were instructed on what each item was supposed to mean, it remains unclear to what extent participants agreed on conceptual terms such as “guilt”, “anxiety”, or “stress”. Whereas the reactivity issue could be resolved by means of a second baseline EMA sampling period, question comprehension might, next to precise instructions, be partly improved by using a greater variety of items per construct, so that more facets are captured. Such an approach would be especially beneficial with regard to measuring stress, further

dysfunctional behaviors such as reassurance seeking and brief, but non-repetitive covert behaviors, as well as behaviors related to CR and DM. Concerning the latter two, including a wider set of items would be very helpful not only in order to capture more facets of what CR and DM entail, but also because in our study, there deliberatey was a large overlap between CR and DM items and what patients were actually taught in therapy. By using a wider set of items, by contrast, it would be possible to demonstrate carry-over effects concerning the application of the general *concepts* of CR and DM rather than only particular *strategies*. Perhaps, in contrast to our study, this might also result in finding EMA-based differences between the two treatment conditions.

With regard to our descriptive findings, an important limitation of course concerns the lack of a control group to compare our results with. In order to enhance the explanatory power of descriptive EMA results, future studies should at least compare an OCD group with a healthy control group in order to make clear in what way an OCD sample stands out. Additionally, a comparison with a sample of anxiety disorder patients would be interesting in order to shed light on the degree to which OCD and anxiety disorders overlap, e. g., regarding avoidance behavior, and to what extent OCD is really different from anxiety disorders – thereby contributing to the ongoing debate on the new DSM-5 chapter of Obsessive-Compulsive and Related Disorders (cf. Chapter 1 of this dissertation).

Beside the aspects discussed above, EMA research in OCD seems beneficial with regard to shedding light on whether the sequence of processes postulated by contemporary maintenance models (Rachman, 1997, 1998; Salkovskis, 1985, 1999; Wells, 2011), i. e., obsessions being followed by appraisals that lead to negative emotions, which, in turn, give rise to neutralizing behavior, is confirmed when using time series data as provided by EMA. Note that, as a byproduct, Study 2 has already provided preliminary evidence of this presumed sequence, since

the regression models revealed that the frequency of obsessions resulted as a significant predictor of both emotions and dysfunctional behaviors.

Acknowledging that DSM-5 (APA, 2013) differentiates between forms of OCD with good versus poor or lacking insight, another application of EMA in future research could be measuring fluctuations of delusionality and its determinants. Even though patients with body dysmorphic disorder tend to exhibit even poorer global insight on average, delusionality seems to be an important aspect to study in OCD, as well (Eisen, Phillips, Coles, & Rasmussen, 2004).

Last, taking into account the strong association of OCD and depression reviewed in Chapter 2 and cross-sectional research indicating that intrusion frequency rises as depressiveness increases (Ricciardi & McNally, 1995), EMA would be an excellent method to study the interrelationship of intrusions and depressiveness under a time series design.

8.3. Conclusion

Weighing all evidence from the three studies and their limitations, the overall conclusion to draw from the research presented in this dissertation is that it has shown two conceptually very different interventions other than exposure and response prevention, i. e., purely "Beckian" cognitive restructuring without behavioral experiments and detached mindfulness, to yield considerable changes in OCD symptoms, even when applied in a treatment setting as short as two weeks. Treatment effects have been demonstrated both on a gold standard rating scale instrument, i. e., the Y-BOCS, and via ecological momentary assessment, whose sensitivity to treatment effects seems promising, indicating that EMA may constitute a reasonable addition to traditional rating scales in quantifying treatment outcome. Among other aspects such enhancing the quality of a subsequent clinical trial in order to overcome the limitations of our research and further improving the EMA methodology in order to arrive at more con-

clusive results, future research should address the question whether and to what extent cognitive restructuring, detached mindfulness, and possibly exposure and response prevention are similar vs. different in terms of their working mechanisms.

9. Summary

Typically being characterized by intrusive and unwanted thoughts, images or urges, i. e., obsessions, and neutralizing behaviors, the so-called compulsions, obsessive-compulsive disorder (OCD) is a condition that is just as heterogenous as it is debilitating and disabling. Formerly known as difficult-to-treat, the prognosis for OCD patients has improved markedly since the development of exposure and response prevention (ERP), which is based on purely behavioral theories and involves confronting the patient with triggering stimuli while refraining from any neutralizing behavior. However, since it is an emotionally demanding and stressful procedure, around 25 % of patients refuse ERP treatment, with another 20 % dropping out of treatment. Also, contemporary theoretical models of OCD postulate that cognitive processes such as misinterpretations of obsessions and distorted beliefs concerning risk and responsibility play a crucial role in the maintenance of OCD. Even more novel within the OCD literature, metacognitive models, which highlight the meaning of attitudes people hold *about* their thoughts (such as the idea that thoughts equal actions or foreshadow the future) are becoming increasingly popular.

In sum, these circumstances gave rise to the research presented in this dissertation, which focuses on examining the efficacy of cognitive and metacognitive interventions for OCD. Since there is plenty of evidence demonstrating the efficacy of complex cognitive and meta-cognitive treatment programs, we decided to study and compare the efficacy of two rather short single interventions each representing cognitive and metacognitive therapy, respectively. Thus, we conducted a randomized waitlist-controlled trial with one group (n = 20) receiving four double sessions of cognitive restructuring (CR, the core strategy in cognitive therapy that aims at questioning and correcting misinterprations and faulty beliefs) and another group (n = 20) receiving the same number of sessions of detached mindfulness (DM), which is a major strategy

in metacognitive therapy and aims at teaching patients to distance themselves from their intrusive thoughts.

The second major theme of this dissertation is the broadening of perspectives on how to assess OCD symptoms and how to operationalize treatment outcome. Since retrospective rating scales, which constitute the gold standard in evaluating the efficacy of psychotherapeutic treatments, are limited concerning their ecological validity and are accompanied by memory biases, we decided to add a form of real-time data capture, i. e., smartphone-based ecological momentary assessment (EMA), to our clinical trial. We did this in order to investigate (1) how OCD symptoms in patients' everyday lives are reflected by the EMA method, and (2) to what extent EMA is sensitive to effects of treatment (CR and DM).

Study 1 describes the clinical trial as such and reports on the major results concerning the efficacy of the two treatment conditions as measured with the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS). Both CR and DM were shown to lead to a more marked decrease in symptoms than the waitlist condition, yielding similar effect sizes (CR: $d = 1.67$; DM: $d = 1.55$). In each treatment condition, 8 out of 20 patients exhibited a clinical significant change at post assessment.

Studies 2 and 3 report the results from the EMA study, which comprised two sampling periods, one set before the start of treatment and the other one taking place directly after the completion of treatment. Thus, Studies 2 and 3 report results from the exact same sample as Study 1. In the EMA questionnaire, patients were, among other things, asked to rate obsessions, compulsions and other dysfunctional behaviors, emotions, and functional behaviors related to CR and DM.

Study 2 focuses on the descriptive results from the Pre-Treatment EMA and on demonstrating that the EMA method is sensitive to treatment effects in OCD. Our descriptive results highlight the outstanding role of emotional states of tension/discomfort and compulsions as

compared with other dysfunctional behaviors such as avoidance, thus confirming theoretical models of OCD. Regarding treatment sensitivity, we found a pre to post decrease of obsession frequency, subjective burden due to obsessions, and avoidance behavior, with a reduction effect concerning compulsions bordering on significance. There was no significant reduction effect in terms of OCD-related emotions and neither regarding other dysfunctional behaviors such as thought suppression attempts. In neither of the regression models did we find an effect of treatment condition, i. e., both CR and DM were shown to be equally efficacious in terms of EMA.

By contrast, Study 3 examined to what extent CR and DM treatment lead to an increase regarding how frequently participants apply CR and DM strategies in their everyday lives. Moreover, we investigated in what way increased frequencies of DM and CR strategies are specifically related to CR vs. DM treatment, thus aiming at shedding light on general vs. specific treatment effects. Also, we aimed at answering the question whether CR and DM differ regarding their applicability. In sum, we found a clear pre to post increase for most CR and DM items, which was, however, not moderated by treatment condition. Hence, our results suggest that both treatment conditions promoted the application of CR and DM behaviors equally well. Neither did we find any differences between CR and DM regarding applicability, i. e., concerning how frequently participants applied strategies, how difficult it was for them to apply the strategies and as how relieving participants experienced the strategies.

The results of the three studies are discussed regarding their contribution to the knowledge about the efficacy of cognitive and metacognitive single interventions for OCD and with regard to the usefulness of complementing retrospective rating scales with EMA. Important limitations to our research entail limited statistical power precluding any conclusions concerning superiority or non-inferiority of CR vs. DM, the lack of a placebo condition making it impossible to separate general and specific working mechanisms, and the limited generalizability given that all treatments were delivered the same two therapists who are also the first and

second authors of all three publications. Regarding EMA, major limitations of our findings comprise reactivity and social desirability as well as the lack of a control group without OCD to compare our descriptive results with.

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11. Erklärung des Promovenden

Erklärung des Promovenden

zur Dokumentation von **Open Science-Aktivitäten** und der Erklärung zur **Beschäftigung mit ethischen Aspekten** im Rahmen der Promotion und zum **eigenen Anteil** an den vorgelegten wissenschaftlichen Abhandlungen mit zwei oder mehr Autor(inn)en

(kumulative Dissertation)

Promovend/Promovendin: **Christian Rupp**

Titel der Dissertation (Englisch): **Effects of cognitive and metacognitive interventions in obsessive-compulsive disorder**

Titel der Dissertation (Deutsch): **Effekte von kognitiven und metakognitiven Interventionen bei der Zwangsstörung**

1. Dokumentation von **Open Science-Aktivitäten**

Wissenschaftliche Abhandlung 1

	ja	nein	Wenn ja, unter welcher Quelle verfügbar
Präregistrierung	x		https://clinicaltrials.gov; ID: NCT03002753
Veröffentlichung von Daten	x		https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0213895
Veröffentlichung von Auswertungsskripten	x		https://clinicaltrials.gov; ID: NCT03002753
Veröffentlichung von Materialien	x		https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0213895
Open Access Publikation	x		https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0213895
Preprint		x	

ggf. (freiwillig) Erläuterung, warum Open Science Aktivitäten bei dieser Studie keine/kaum Berücksichtigung fanden

Wissenschaftliche Abhandlung 2

	ja	nein	Wenn ja, unter welcher Quelle verfügbar
Präregistrierung	x		https://clinicaltrials.gov; ID: NCT03002753
Veröffentlichung von Daten		x	
Veröffentlichung von Auswertungs-skripten		x	
Veröffentlichung von Materialien		x	
Open Access Publi-kation		x	
Preprint		x	

ggf. (freiwillig) Erläuterung, warum Open Science Aktivitäten bei dieser Studie keine/kaum Berücksichtigung fanden

Wissenschaftliche Abhandlung 3

	ja	nein	Wenn ja, unter welcher Quelle verfügbar
Präregistrierung	x		https://clinicaltrials.gov; ID: NCT03002753
Veröffentlichung von Daten		x	
Veröffentlichung von Auswertungs-skripten		x	

Veröffentlichung von Materialien		x	
Open Access Publikation		x	
Preprint		x	

ggf. (freiwillig) Erläuterung, warum Open Science Aktivitäten bei dieser Studie keine/kaum Berücksichtigung fanden

2. Erklärung zur **Beschäftigung mit ethischen Aspekten**

Studiennummer	**Quellenangabe (Manuskript / Kapitel der Promotion):** z.B. Studie 1 in Paper 2, Studie 1 beschrieben in Kapitel 4	**Begutachtung der Studie durch eine Ethikkommission**	
		Ja	**nein**
1	Study 1, beschrieben in Chapter 5	x	
2	Study 2, beschrieben in Chapter 6	x	
3	Study 3, beschrieben in Chapter 7	x	

ggf. (freiwillige) Erläuterung, in welcher Weise eine Auseinandersetzung mit ethischen Aspekten im Rahmen der Planung und Durchführung der Studien erfolgte:

3. Erklärung zum **eigenen Anteil** an den vorgelegten wissenschaftlichen Abhandlungen mit zwei oder mehr Autor(inn)en

Wissenschaftliche Abhandlung 1

Titel	A randomized waitlist-controlled trial comparing detached mindfulness and cognitive restructuring in obsessive-compulsive disorder		
Autor(en)	Christian Rupp, Charlotte Jürgens, Philipp Doebler, Fabian Andor & Ulrike Buhlmann		
Publikationsstatus:	nicht eingereicht		(bitte ankreuzen)
	eingereicht		
	in Begutachtung		
	in Revision		
	angenommen		
	publiziert	x	
Journal	PloS ONE		
Publikationsjahr	2019		

Die Konzeption, Identifizierung des wissenschaftlichen Problems sowie die Entwicklung des Untersuchungsdesigns erfolgte in Kooperation mit den Koautoren Charlotte Jürgens, Ulrike Buhlmann und Fabian Andor. Die Datenerhebung wurde gleichermaßen durch mich und Charlotte Jürgens durchgeführt. Die Aufbereitung und Auswertung der Daten wurde ebenfalls gleichermaßen durch Charlotte Jürgens und mich sowie teilweise durch Philipp Doebler durchgeführt; Philipp Doebler stand bei der Datenanalyse zudem beratend zur Seite. Die Interpretation und Diskussion der Daten erfolgte durch Charlotte Jürgens und mich in Kooperation mit allen anderen Koautoren. Die Verschriftlichung der Arbeit erfolgte durch mich und Charlotte Jürgens, die Koautoren gaben Anregungen, Hinweise und kritisches Feedback.

Wissenschaftliche Abhandlung 2

Titel	A study on treatment sensitivity of ecological momentary assessment in obsessive-compulsive disorder		
Autor(en)	Christian Rupp, Charlotte Jürgens, Daniela Gühne, Philipp Doebler, Fabian Andor & Ulrike Buhlmann		
Publikationsstatus:	nicht eingereicht		(bitte ankreuzen)
	eingereicht		
	in Begutachtung		
	in Revision	x	
	angenommen		
	publiziert		
Journal	Clinical Psychology and Psychotherapy		
Publikationsjahr	(noch nicht publiziert)		

Die Konzeption, Identifizierung des wissenschaftlichen Problems sowie die Entwicklung des Untersuchungsdesigns erfolgte in Kooperation mit den Koautoren Charlotte Jürgens, Ulrike Buhlmann und Fabian Andor. Die Datenerhebung wurde gleichermaßen durch mich und Charlotte Jürgens durchgeführt. Die Aufbereitung und Auswertung der Daten erfolgte durch mich, Daniela Gühne sowie teilweise durch Philipp Doebler; Philipp Doebler stand bei der Datenanalyse zudem beratend zur Seite. Die Interpretation und Diskussion der Daten erfolgte durch mich in Kooperation mit allen anderen Koautoren. Die Verschriftlichung der Arbeit erfolgte durch mich, die Koautoren gaben Anregungen, Hinweise und kritisches Feedback.

Wissenschaftliche Abhandlung 3

Titel	Comparing effects of detached mindfulness and cognitive restructuring in obsessive-compulsive disorder using ecological momentary assessment		
Autor(en)	Christian Rupp, Charlotte Jürgens, Daniela Gühne, Philipp Doebler, Fabian Andor & Ulrike Buhlmann		
Publikationsstatus:	nicht eingereicht	x	(bitte ankreuzen)
	eingereicht		
	in Begutachtung		
	in Revision		
	angenommen		
	publiziert		
Journal	(noch nicht eingereicht)		
Publikationsjahr	(noch nicht eingereicht)		

Die Konzeption, Identifizierung des wissenschaftlichen Problems sowie die Entwicklung des Untersuchungsdesigns erfolgte in Kooperation mit den Koautoren Charlotte Jürgens, Ulrike Buhlmann und Fabian Andor. Die Datenerhebung wurde gleichermaßen durch mich und Charlotte Jürgens durchgeführt. Die Aufbereitung und Auswertung der Daten erfolgte durch mich, Daniela Gühne sowie teilweise durch Philipp Doebler; Philipp Doebler stand bei der Datenanalyse zudem beratend zur Seite. Die Interpretation und Diskussion der Daten erfolgte durch mich in Kooperation mit allen anderen Koautoren. Die Verschriftlichung der Arbeit erfolgte durch mich, die Koautoren gaben Anregungen, Hinweise und kritisches Feedback.

Bitte fortsetzen, falls die Dissertation aus mehr als 3 wissenschaftlichen Abhandlungen besteht.

_____ _____

Ort, Datum Unterschrift Promovend

12. Curriculum Vitae

PERSONALIEN

Name	Christian Rupp
Geboren	30.05.1990 in Mönchengladbach
Familienstand	verheiratet
Straße und Wohnort	Ronnenbergweg 3 24340 Eckernförde
Praxisadresse	Hauptstraße 22 24848 Kropp
Telefon	0172 68 61 405
Email	info@psychotherapie-rupp.com

BERUFLICHE LAUFBAHN

Seit November 2018	Niedergelassen in eigener Vertragsarztpraxis (volle Kassenzulassung). Hauptstraße 22, 24848 Kropp, Schleswig-Holstein
Mai – Oktober 2018	Niedergelassen in eigener Privatpraxis (Praxisgemeinschaft mit Dr. Beate Paterok und Dr. Tilmann Müller) Rothenburg 19, 48143 Münster, NRW
2016 – 2018	Ambulante psychotherapeutische Tätigkeit in der Christoph-Dornier-Stiftung (Institut Münster)
2015 –2017	Ambulante psychotherapeutische Tätigkeit in der Psychotherapie-Ambulanz der Westfälischen Wilhelms-Universität Münster
2014 – 2015	Stationäre psychotherapeutische Tätigkeit in der LWL-Klinik Lengerich (Depressionsstation)
2012 – 2013	Tutor in drei verschiedenen Projektseminaren/experimentellen Forschungspraktika an der Westfälischen Wilhelms-Universität Münster

2011 – 2014 und 2015 – 2018	Werkstudent/Büro- und Empfangsmitarbeiter in der Praxis für Psychotherapie Dr. Beate Paterok und Dr. Tilmann Müller, Münster

STUDIUM, AUSBILDUNG UND PROMOTION

Seit Januar 2016	Laufende Promotion (Dr. rer. nat.) zum Thema „Effects of cognitive and metacognitive interventions in obsessive-compulsive disorder“ an der Westfälischen Wilhelms-Universität Münster (Doktormutter: Prof. Dr. Ulrike Buhlmann)
2014 – 2018	Ausbildung zum Psychologischen Psychotherapeuten am IPP Münster Abschluss: Staatsexamen (Note 1,0) Erlangung der Approbation mit Fachundenachweis Verhaltenstherapie
2012 – 2014	Masterstudium mit dem Fokus Klinische Psychologie und Experimentelle Psychopathologie an der Westfälischen Wilhelms-Universität Münster Abschluss: Master of Science (Note: 1,1)
2009 – 2012	Bachelorstudium an der Westfälischen Wilhelms-Universität Münster Abschluss: Bachelor of Science (Note: 1,1)
2000 – 2009	Gymnasium Gartenstraße Mönchengladbach-Rheydt Abschluss: Abitur (Note: 1,0)

PRAKTIKA WÄHREND DES STUDIUMS

2013 (8 Wo.)	Christoph-Dornier-Klinik Münster
2013 (4 Wo.)	LWL-Klinik Münster, Institutsambulanz
2012 (4 Wo.)	Island Dolphin Care, Key Largo, Florida, USA
2011 (6 Wo.)	Uniklinikum Münster, Bereich Kinder- und Jugendlichenpsychosomatik („Czerny-Station“)

2010 (5 Mon.)	Psychotherapeutische Praxengemeinschaft Dr. Elvira Ewald-Cloer und Kollegen, Münster

STIPENDIEN

Seit Januar 2016	Promotionsstipendium der Christoph-Dornier-Stiftung
2012 – 2017	Stipendium der Studienstiftung des deutschen Volkes

PUBLIKATIONEN (PEER REVIEW)

Rupp, C., Jürgens, C., Doebler, P., Andor, F., & Buhlmann, U. (2019). A randomized wait-list-controlled trial comparing detached mindfulness and cognitive restructuring in obsessive-compulsive disorder. *PLoS ONE*, *14*, e0213895. doi: 10.1371/journal.pone.0213895

Jürgens, C., Rupp, C., Doebler, P., Andor, F., & Buhlmann, U. (2019). Metacognition in obsessive-compulsive disorder symptom dimensions: Role of fusion beliefs, beliefs about rituals and stop signals. *Journal of Obsessive-Compulsive and Related Disorders*, *21*, 102-111. doi: 10.1016/j.jocrd.2019.03.002

Rupp, C., Doebler, P., Ehring, T., & Vossbeck-Elsebusch, A. N. (2017). Emotional Processing Theory put to test: A meta-analysis on the association between process and outcome measures in exposure therapy. *Clinical Psychology and Psychotherapy*, *24*, 697-711. doi: 10.1002/cpp.2039

REVIEWERTÄTIGKEITEN

Clinical Psychology & Psychotherapy

KENNTNISSE & FÄHIGKEITEN

Fremdsprachen	Englisch: sehr gut in Wort und Schrift (Niveau C1) Spanisch: sehr gut in Wort und Schrift (Niveau B2) Französisch: gut in Wort und Schrift (Niveau B1) Schwedisch und Japanisch: Grundkenntnisse Großes Latinum

PC-Kenntnisse	Microsoft Office (Word, Excel, PowerPoint) SPSS und R Patientenverwaltungssoftware (PsychoDat, Med7, Psyprax)

ENGAGEMENT

Seit 2011	Eigenständiges aktives Mitglied bei Amnesty International Deutschland e.V.
Seit 2011	Autor des Wissenschaftsblogs psychology.com
2006 – 2009	Schulsanitäter am Gymnasium Gartenstraße

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Ort, Datum Unterschrift