Psychology Research and Behavior Management

Dovepress
Taylor & Francis Group

Open Access Full Text Article

REVIEW

The Etiology, Assessment and Treatment of Compulsive Checking: A Review

Sisi Guo, Mina Yadegar, Helen Khaw, Susanna Chang

UCLA Semel Institute for Neuroscience and Human Behavior, Los Angeles, CA, USA

Correspondence: Sisi Guo, Email sisiguo@mednet.ucla.edu

Abstract: Checking is the most reported compulsion of Obsessive-Compulsive Disorder (OCD), impacting 80% of individuals with the psychiatric condition. In this narrative review, we describe the theoretical conceptualization and empirical research of compulsive checking to highlight advancements and limitations in our current understanding of OCD. In terms of etiology, research shows that anxiety, uncertainty and inflated responsibility elicit checking, which in turn negatively impact memory confidence and higher-level cognitive functions. In addition, compulsive checking is linked to altered neural activities in the brain's subcortical regions. Although these studies have their methodological limitations, they collectively highlight the behavioral, cognitive and neurobiological underpinnings of OCD. In terms of assessment of compulsions such as checking, there is a suite of empirically validated tools that range from standardized diagnostic interviews to self-report measures. Recent innovations also include experimental and technology-assisted assessment tools. Finally, in terms of treatment, Exposure and Response Prevention (ERP) is the most empirically supported intervention for OCD that is supported by habituation and inhibitory learning models. There is preliminary support for cognitive therapy to target specific symptoms such as compulsive checking. However, more rigorous testing is warranted to determine its efficacy and mechanism of change.

Keywords: checking, OCD, exposure and response prevention, neurobiological, cognitive behavioral

Introduction

Obsessive-compulsive disorder (OCD) is one of the most common and debilitating psychiatric conditions, impacting 1–3% of the population in the US and globally.[1,2] The defining features of OCD are recurrent and unwanted thoughts, images or urges known as obsessions and repetitive physical or mental acts performed in response to the obsessions known as compulsions. Among the broad repertoire of OCD symptoms, checking is the most reported compulsion. Approximately 80% of individuals with OCD experience compulsive checking at some point in their life.[3] Given its prevalence and highly heterogeneous presentation, checking has garnered extensive attention from researchers and clinicians. In this narrative review, we examine the extant literature on compulsive checking to highlight both advancements and limitations in our current understanding of the etiology, assessment and treatment of OCD.

Compulsive checking can manifest in various ways. Behaviors can range from repeatedly examining physical items in one's environment (eg, checking doors and stoves) to searching for confirmatory information (eg, looking up news articles). Checking can even involve other individuals through excessive questioning and reassurance seeking (eg, "Are you sure it's safe?", "You check for me"). Unlike checking that is functional (eg, locking a door once), compulsive checking (eg, locking a door repeatedly) is problematic because it is distressing, time-consuming, and interfering. Individuals may recognize the behavior as excessive and irrational, though insight can vary based on factors such as age, cognitive ability and psychiatric profile.[4,5] Compulsive checking is often associated with doubt and indecisiveness, resulting in slowed and protracted behaviors. Similar to other compulsions, checking is volitional and may be even delayed or reduced in some circumstances. However, the urge to complete the ritual can build as a source of "internal pressure" (eg, heightened anxiety, discomfort, and/or a sense of incompleteness) that checking is ultimately carried out against the person's rational choice.[6]

Received: 31 January 2025
Accepted: 18 May 2025
Published: 28 May 2025

The heterogeneous presentation of checking underscores its link to a wide range of obsessions. The most commonly reported reasons for checking are a) prevention of harm, b) reduction of uncertainty, and c) achievement of a "just right" feeling.[6,7] However, checking can also occur to alleviate contamination fears, morality/scrupulosity concerns and even obsessions related to hoarding/saving. Indeed, recent network analysis points to checking as an important and central feature of OCD. Using a multinational sample of school-aged and clinic referred youth, Cervin et al[8] found that checking along with doubt were the central nodes in the network structure for pediatric OCD; checking was connected to all other symptoms of OCD, including obsessing, washing, hoarding, ordering and neutralizing. Impressively, checking remained a central node regardless of the child's sex, clinical status and country of origin. However, more research is needed to assess the centrality of checking behaviors when culture and developmental stages are taken into consideration.

Checking is also a characteristic clinical symptom in other psychiatric conditions such as anxiety and depression. However, there are several key distinctions between checking behaviors of OCD and other disorders. First, OCD individuals take longer time to check than others.[9,10] Second, the content of checking is more wide-ranging for OCD individuals; while checking for Generalized Anxiety Disorder is limited to interpersonal situations, OCD checking spans social relationships and physical objects in one's environment.[11,12] Compared to GAD patients, OCD individuals look for specific answers when they check (eg, certain words and tones in the reassurance they seek). Third, OCD checking is more closely tied to the cognitive belief of responsibility; compared to anxious individuals, OCD patients exhibit greater trait and state responsibility. Moreover, higher responsibility predicted greater checking for OCD but not anxious individuals.[9,13] Finally, OCD checking is more focused on the prevention of general harm (eg, safety issues) than other negative outcomes. This distinction was particularly apparent when compared to depressed individuals who checked to prevent social harm and self-esteem concerns.[14] As such, checking may serve as a useful marker to differentiate disorders with overlapping clinical features.

Theoretical Models of Compulsive Checking

There are several prominent theoretical models that explain the development and maintenance of OCD behaviors, including compulsive checking. Dollard and Miller[15] first proposed that classical conditioning reinforces and generalizes fears, which are then maintained over time via avoidance and escape behaviors. For example, when individuals have the fear that they could be harmed, they check to ensure their environment is safe. This behavior is reinforced and repeated over time because it alleviates the anxiety elicited by the obsession, albeit only in the short-term. In this behavioral model, the momentary relief produced by compulsions such as checking also prevents individuals from habituating to their distress, which can result in a paradoxical increase of obsessional anxiety over time.

Cognitive models of OCD focus on the role of beliefs and appraisals in the disorder. These models help explain how intrusive thoughts, urges and images that the general population experience evolve to become pathological obsessions. Namely, individuals with OCD misperceive their cognitions to be important and dangerous. These faulty beliefs include overestimation of responsibility, conflation of thoughts as equivalent to or leading to actions, and the meta-cognition about the meanings and consequences of thinking.[16] Rachman[6] developed a cognitive model specific to the behavior of compulsive checking. In his model, an inflated sense of responsibility is the misappraisal that leads individuals to check as a measure to prevent harm. Rachman also contends that the duration and intensity of checking is influenced by three "multipliers": responsibility, probability of harm, and the seriousness of harm. Similar to previous behavioral models, checking for safety is theorized to have a paradoxical effect and results in a self-perpetuating cycle. Specifically, checking is reinforced because a) there is no certainty that the goal of eliminating danger has been achieved, b) repeated checking decreases the memory confidence that the action has been performed, c) there is an overestimate of the likelihood of harm when individuals assume high level of responsibility, and d) perceived responsibility increases after checking. In other words, checking leads to greater perceived responsibility, higher probability of danger and reduced confidence in one's memory, resulting in further checking.

Doubt has also been hypothesized to be a catalyst for checking. Scholars posit that individuals with greater tendencies to experience doubt will engage in checking in ambiguous situations.[17–19] Checking is performed to decrease feelings of uncertainty. However, the behavior offers only temporary relief and ultimately elicits greater uncertainty, requiring the individual to check again to achieve the same sense of relief.

In neurocognitive models, OCD symptoms such as compulsive checking are explained by deficits in executive function. Executive function refers to cognitive abilities that help individuals regulate their thoughts and behaviors, enabling self-directed behaviors toward goals, risk assessment and decision-making, and task-shifting and prioritization.[20] One domain of executive function that has been implicated in OCD is response inhibition. Chamberlain and colleagues[21] postulate that obsessions such as harm develop when individuals lack cognitive control over their thoughts. In the same vein, compulsions such as checking develop when individuals lack behavioral control over their actions. A more recent neurocognitive model also raises the possibility that compulsions result from bias toward habit responses that are more automatic.[22–24] In this theory, behaviors such as compulsive checking develop because individuals fail to respond appropriately to stimulus changes; they rely on habitual behaviors that appear rote and repetitive instead of engaging in more functional and goal-directed actions.

Finally, biological models propose that the pathophysiology of OCD is explained by alterations in brain neural circuitry. It is hypothesized that an OCD loop starts in the orbitofrontal cortex (OFC), goes through the caudate nucleus, ventral striatum and mediodorsal thalamus, and finally returns to the OFC.[25,26] According to this theory, abnormalities in this circuitry cause executive dysfunction that leads to OCD behaviors such as compulsive checking. Over time, these behaviors strengthen the OCD loop in the brain and further impair neuropsychological functioning.

Empirical Research of Checking

Theoretical models of OCD have developed in tandem with empirical research. In this section, we review experimental, neuropsychological and neuroimaging studies of checking and examine each branch's relative contribution to our current understanding of OCD. Table 1 lists the reviewed studies by study design.

Table 1 List of Studies Examining Compulsive Checking

Study	Study Design	Participant (n)	Participant Age (M_{age})
Radomsky et al, 2022[10]	Experimental	N = 60 (Clinical group n = 30, Non-clinical group n = 30)	Clinical group M_{age}= 42.10, Non-clinical group M_{age}= 39.13
Toffolo et al, 2013[18]	Experimental	N = 68 (OC+ group n = 36, OC- group n = 32)	OC+ group M_{age}= 22.19, OC- group M_{age}= 21.12
Van Den Hout & Kindt, 2003[19]	Experimental	N = 40	M_{age}= 20.3
Roper, Rachman, and Hodgson, 1973[27]	Experimental	N = 12	
Rachman, De Silva, and Roper, 1976[28]	Experimental	N = 11	
Lopatka & Rachman, 1995[29]	Experimental	N = 30	M_{age}= 36.76
Ladouceur et al, 1995[30]	Experimental	Study 1: N = 60 Study 2: N = 40	
Parrish & Radomsky, 2006[31]	Experimental	N = 124	M_{age}= 22.57
Toffolo et al, 2016[32]	Experimental	N = 88 (Patients with OCD n = 31, Anxiety controls n = 26, Healthy controls n = 31)	Patients with OCD M_{age}= 36.97, Anxiety controls M_{age}= 32.27, Healthy controlsM_{age}= 34.10
Lind & Boschen, 2009[33]	Experimental	N = 163 (Participants with OCD n = 21, Healthy control n = 143)	Participants with OCD M_{age}= 35.40, Healthy control M_{age}= 20.31
Parrish & Radomsky, 2011[34]	Experimental	N = 176	M_{age}= 22.95
Cougle et al, 2013[35]	Experimental	Study 1: N = 166 Study 2: N = 38 Study 3: N = 137	Study 1: M_{age}= 19.52 Study 2 : M_{age}= 19.45 Study 3: M_{age}= 19.03
Gagné & Radomsky, 2017[36]	Experimental	N = 133	M_{age}= 23.26
Davey et al, 2003[37]	Experimental	Experiment 1: N = 60 Experiment 2: N = 40	Experiment 1: M_{age}= 25.1 Experiment 2: M_{age}= 26.1

(*Continued*)

Table 1 (Continued).

Study	Study Design	Participant (n)	Participant Age (M_{age})
Strauss et al, 2020[38]	Meta-analysis	N = 1247 (Participants with OCD n = 633, Healthy controls n = 614)	Participants with OCD M_{age}= 35.94, Healthy controls M_{age}= 34.04
Van Den Hout et al, 2001[39]	Experimental	N = 60	M_{age}= 18.9
Van Den Hout & Kindt, 2003[40]	Experimental	Experiment 1: N = 39 Experiment 2: N = 40 Experiment 3: N = 40	Experiment 1: M_{age}= 21 Experiment 2: $M_{ag\ e}$= 21 Experiment 3: M_{age}= 20.2
Van Den Hout & Kindt, 2004[41]	Experimental	Experiment 1: N = 39 Experiment 2: N = 40 Experiment 3: N = 40 Experiment 4: N = 40 Experiment 5: N = 40	Experiment 1: M_{age}= 24 Experiment 2: M_{age}= 21 Experiment 3: M_{age}= 20 Experiment 4: M_{age}= 20 Experiment 5: M_{age}= 30
Boschen & Vuksanovic, 2007[42]	Experimental	N = 55 (OCD group n = 15, Healthy controls n = 40	OCD group M_{age}= 38.8, Healthy controls M_{age}= 21.05
Coles, Radomsky, and Horng, 2006[43]	Experimental	Study 1: N = 50 Study 2: 78	Study 1: M_{age}= 18.66 Study 2: M_{age}= 19.55
Den Hout et al, 2009[44]	Experimental	N = 80	M_{age}= 22.3
Radomsky, Gilchrist, and Dussault, 2006[45]	Experimental	N = 50	M_{age}= 25.32
Radomsky et al, 2014[46]	Experimental	N = 60 (Non-clinical group n = 30, Clinical group n = 30)	Non-clinical group M_{age}= 33.5, clinical group M_{age}= 33.1
Radomsky & Alcolado, 2010[47]	Experimental	N = 62	M_{age}= 24.65
Tolin et al, 2001[48]	Experimental	N = 42 (Participants with OCD n = 14, Anxious control n = 14, Non-anxious control n = 14)	Participants with OCD M_{age}= 35.21, Anxious control M_{age}= 33.14, Non-anxious control M_{age}= 26.14
Van Den Hout et al, 2008[49]	Experimental	N = 40	M_{age}= 22
Van Den Hout et al, 2019[50]	Experimental & Meta-analysis	Memory accuracy N = 1112 (Patients with OCD n = 63) Memory confidence N = 1622 (Patients with OCD n = 93) Memory vividness N = 1568 (Patients with OCD n = 93) Virtual checking task N = 88	Virtual checking task M_{age}= 22
Linkovski et al, 2016[51]	Experimental	Experiment 1: N = 66 (Randomized to repeated-checking group n = 32, Randomized to control group n = 34) Experiment 2: N = 66 (Randomized to repeated-checking group n = 28, Randomized to control group n = 38)	Experiment 1: M_{age} = n/a; range: 22 to 29 Experiment 2: M_{age} = n/a; range: 21 to 26
Hinds et al, 2015[52]	Experimental	Experiment 1: N = 88 Experiment 2: N = 23 (Checkers n = 8, Washers n = 7, Healthy controls n = 8)	Experiment 1: M_{age}= 29.2 Experiment 2: M_{age}= 32.7
Jaafari et al, 2013[53]	Neuropsych	N = 64 (Patients with OCD n = 32, Healthy controls n = 32)	Patients with OCD M_{age}= 37.6, Healthy controls M_{age}= 37.7
Karadag et al, 2005[54]	Neuropsych	N = 63 (Patients with OCD n = 32, Healthy controls n = 31)	Patients with OCD M_{age}= 34.28, Healthy controls M_{age}= 32.25
Omori et al, 2007[55]	Neuropsych	N = 53 (Checkers n = 27, Washers n = 26)	Checkers M_{age}= 36.2, Washers M_{age}= 33.8
Murayama et al, 2013[56]	Neuroimaging	N = 41 (Checkers n = 10, Controls for checking task n = 10, Washers n = 12, Controls for washing task n = 9)	Checkers M_{age}= 34.9, Controls for checking task M_{age}= 32.6, Washers M_{age}= 37.6, Controls for washing task M_{age}= 30.4
Ravindran et al, 2020[57]	Neuroimaging	N = 48 (Patients with OCD n = 31, Healthy controls n = 17)	Patients with OCD M_{age}= 34, Healthy controls M_{age}= 32.65
Biria et al, 2023[58]	Neuroimaging	N = 61 (Participants with OCD n = 31, Healthy controls n = 30)	Participants with OCD M_{age}= 30.79, Healthy controls M_{age}= 32.16

Experimental Studies

Compulsive Checking as an Outcome

The earliest experiments of compulsive checking provided important empirical support for behavioral models of OCD. For example, Roper and colleagues[27] found that OCD participants' anxiety increased when they performed actions that they deemed to be harmful or dangerous, and this anxiety subsequently decreased when they were allowed to check. The researchers replicated the study and found that anxiety ratings decreased the most in naturalistic settings (ie, in the absence of an experimenter). Rachman and colleagues[28] also experimentally manipulated the urge to check by exposing OCD individuals to feared situations, which led to an increase in anxiety. Consistent with previous research, subsequent checking led to a swift reduction in distress and a desire to check. Interestingly, participants experienced the same decline in anxiety and checking urges when they were re-exposed to the same trigger but prevented from engaging in their compulsions. These early experimental studies elucidated the functional link between obsessions and compulsions. Moreover, they showcase how behaviors such as checking negatively reinforce OCD symptoms over time and may be the prime target in the treatment of the condition.

Experimental research of checking has also produced empirical evidence for cognitive theories of OCD. In particular, responsibility has been shown to be an important predictor of checking behaviors. Lopatka and Rachman[29] found that reduction in perceived responsibility decreased checking, anxiety and threat estimation before and after an at-home exposure task for OCD participants. With healthy controls, researchers also found high responsibility caused greater checking, anxiety, and attention to errors during a classification task.[30] Moreover, high-responsibility participants believed the negative outcomes were more harsh and probable relative to those in the low-responsibility condition. Parrish and Radomsky[31] extended the study of checking to include reassurance seeking with healthy controls. The researchers found that participants in low responsibility condition not only expressed a reduced desire to check and ask for reassurance but they also reported increased confidence in their task performance. In contrast, participants in the high-responsibility condition maintained their checking urges and performance doubt throughout the experiment task.

Uncertainty also appears to be an important antecedent to checking, even under neutral conditions where there is no threat of harm. Experimenters found that ambiguous presentation of stimuli in a visual search task led participants with high OC tendencies to search longer and fixate more than participants with low OC tendencies.[18] When researchers repeated the study with a mixed sample of OCD, anxious and healthy control participants, they found that OCD participants checked more than the two other groups regardless of the certainty of the stimulus presentation.[32] The difference in checking was greatest when uncertainty was induced. Of note, the researchers found that the increased checking did not improve the accuracy of the task. Lind and Boschen[33] took the study of responsibility and uncertainty a step further by examining the relationship of each variable to checking. With a mixed sample of OCD and healthy control participants, the researchers found that the link between responsibility for harm and checking was fully explained by intolerance for uncertainty. In other words, individuals who believe they are responsible for preventing harm experience greater aversion to the feeling of uncertainty, and it is this discomfort of doubt that leads them to check.

Other variables that have been experimentally manipulated to elicit checking include the seriousness and probability of harm,[10,34] the sensation of incompleteness,[35] belief about loss of control over thoughts[36] and negative mood.[37] A recent meta-analysis of experimental studies that measured checking as a dependent variable also suggests that disruption to the automatic processes and distrust of senses may distinguish checking behaviors of OCD individuals from healthy controls.[38]

Compulsive Checking as a Predictor

In laboratory settings, repeated checking has been shown to have several negative consequences, most notably memory distrust. Van den Hout and colleagues carried out a group of experiments in which healthy controls were instructed to engage in checking rituals of objects in virtual animation tasks. The repeated checking – particularly of relevant objects versus irrelevant objects – reduced the detail, vividness and confidence of memory about the checked event.[19,39,40] The researchers also found that after repeated checking, participants' belief about the effort and responsibility they put forth in the task decreased.[41] Several other studies replicated the findings that repeated checking increased doubt about one's memory. These studies were conducted with both OCD and healthy control participants, employing a variety of checking

methods including physical and mental checking of threatening and non-threatening objects.[42–49] Taken together, the research highlights the self-perpetuating nature of checking; its intent to reduce uncertainty increases doubt and leads to repetition over time.

A recent meta-analysis showed that although compulsive checking had a large effect on memory confidence, vividness and detail, its impact on memory accuracy was small.[50] Closer assessment showed that with repeated checking, participants' subjective accuracy remained high (ie, correspondence between participants' *self-reported* checks and the given experiment instructions) but their objective accuracy was worse (ie, correspondence between *actual* checks versus the given instructions). The authors contend that repetition makes behavior such as checking more automated, which reduces the explicit memory of the behavior even if the implicit memory is still intact.

Repeated checking has also been linked to deficits in inhibition control. Linkovski and colleagues[51] found that repeated checking impaired healthy controls' ability to inhibit their response to familiar stimuli. In another study, researchers found that OCD checkers, compared to OCD washers and healthy controls, had greater difficulty terminating an activated motivational system that handles potential threat, making it more difficult to stop checking.[52]

Experimental investigations have the unique ability to test hypotheses and examine cause-and-effect relationships. Generally, they support behavioral and cognitive models of OCD, identifying anxiety, inflated responsibility, and uncertainty as predictors of checking, and memory distrust as a downstream effect of the compulsion. However, differences in experimental designs (eg, independent versus repeated measures), samples (eg, healthy controls versus clinical patients), and analytic approaches have led to some inconsistent findings. Moreover, experiments are limited in their external validity and clinical implications.

Neuropsychological Studies

Neuropsychological assessments of OCD patients reveal that checking is related to several cognitive deficits, including working memory and executive function. For example, Jaafari and colleagues[53] administered a visual comparison task to OCD and healthy control participants. OCD participants made more gaze movements (ie, checking) and had lower working memory span. Moreover, their reduced task performance was directly linked to their working memory deficits. In a study[54] using a sentence recognition task to assess memory, OCD participants – both checkers and non-checkers – had significantly lower memory confidence relative to healthy controls. They also showed a poorer but non-significant difference in memory recognition. Omori and colleagues[55] used a comprehensive neuropsychological battery to assess differences between OCD checkers and washers. OCD participants with primary checking compulsions had significantly greater deficits in inhibition and cognitive flexibility. Moreover, only OCD checkers – not OCD washers – showed a negative association between their general memory and inhibition scores.

The sample sizes of these neuropsychological studies have been small, and it is difficult to ascertain whether the identified cognitive impairments are precursors or results of OCD behaviors such as checking. However, they offer empirical support for the neurocognitive model of OCD. Specifically, higher level cognitions such as working memory and executive function (eg, inhibition control, cognitive flexibility) are negatively impacted by excessive checking.

Neuroimaging Studies

Neuroimaging techniques such as PET, SPECT, and fMRI have identified the frontal cortex and subcortical structures as important neuroanatomical substrates of OCD. Recent studies suggest there may be further neurobiological differences between OCD subtypes. During a symptom provocation task, researchers found that relative to healthy controls, OCD checkers demonstrated reduced activity in the subcortical regions of left anterior cingulate cortex (ACC) and caudate, which are, respectively, linked to error monitoring and emotional-related information processing.[56] In contrast, OCD washers showed increased activation in large cortical brain regions (eg, cerebellum). Moreover, high checking severity was correlated with increased activity in the left ACC,[56] highlighting the subcortical region as a unique neurobiological substrate of OCD checking.

Checking also appears to impact brain regions associated with memory and inhibitory control. Ravindran and colleagues[57] found that individuals with predominantly checking symptoms showed greater activation in the dorsal and medial posterior cingulate cortex, which plays a role in memory. Checking also shows a stronger emotion-related

connection between the posterior cingulate gyrus and motor cortices, which suggests that checking behaviors may correspond to reduced inhibitory control in the motor cortices and emotion provocation.

Finally, excessive checking was associated with higher glutamate: GABA ratios in the ACC.[58] OCD patients showed greater levels of glutamate and lower levels of GABA compared to healthy controls, which suggests that imbalanced excitatory and inhibitory neural activity in the ACC is related to checking behavior.

Neuroimaging studies largely support the biological models of OCD; its pathophysiology may be explained by abnormalities in the neural circuitry of different brain regions. Moreover, checking along with other OCD subtypes appears to have distinct anatomical and chemical substrates that involve information processing, memory and inhibition. Despite these advancements, neuroimaging studies have been unable to elucidate how neural circuitry abnormalities cause OCD symptoms and how these abnormalities change through treatment. Further, it is unclear the role cognitive factors (eg, inflated responsibility) play in neural processes. Other criticisms of neuroimaging studies include problems in sample size, task setting, and cross-sectional design.

Clinical Assessment of OCD Checking

Given the heterogeneous nature of OCD-related checking behaviors, a comprehensive multidimensional assessment strategy is critical to arriving at an accurate clinical picture, which can in turn inform a clear treatment plan. Depending on the goals of the assessment, an evidence-based plan may include instruments to assess diagnostic profile, the breadth and severity of checking symptoms, as well as treatment relevant variables such as individual distress, functional impairment, level of insight into and family accommodation of OCD checking behaviors.

Standardized structured or semi-structured diagnostic interviews, in addition to being psychometrically valid, offer diagnostic clarity, particularly in cases where clinical presentation is complex and multiple comorbidities need to be teased out, which is often the norm in OCD. It bears mentioning that a careful assessment of anxiety disorders is particularly relevant as checking is a common feature in both conditions[11] and anxiety is directly related to the severity of checking behaviors.[59] Well validated measures include the Anxiety Disorders Interview Schedule for DSM-5 (ADIS-5),[60] ADIS-5 Child and Parent version (ADIS-C/P)[61] for youth, and the Structured Clinical Interview for DSM-5 Axis I Disorders (SCID-V-Clinician Version).[62] The Mini International Neuropsychiatric Interview (MINI) for DSM-5 is a brief and validated with both adults and youth.[63] All three instruments have relative strengths as well as limitations (ADIS - lack of focus on non-anxiety disorders, SCID - lack of OCD specificity), but each offers an empirically validated method towards diagnostic clarification when needed. For example, these instruments can elucidate whether behaviors such as checking are driven by specific obsessions or other anxiety-based worries. When multiple diagnoses are present, they can also help clinicians identify the primary concerns and determine treatment focus.

By far, the gold standard assessment tool of overall OCD symptom severity is the clinician administered Yale-Brown Obsessive Compulsive Scale, which offers a checklist of the most common obsessions and compulsions including checking that are rated with respect to symptom duration, interference, distress, resistance, and control (YBOCS).[64] The YBOCS and its child version CYBOCS (CYBOCS),[65] with a focus on the checking dimension integrated with a detailed clinical interview assessing the specific nature of checking behaviors including triggering situations and associated distress/anxiety levels optimize the likelihood of capturing the full breadth of checking phenomenology.

Self-report measures have an important role in OCD assessment as they are low-cost and require minimal training to use. In addition, given the often secretive and silent nature of OCD symptoms, information gathered from multiple informants across different measures filtered through a clinician's judgement can build the most accurate clinical picture available. Measures such as the Obsessive Compulsive Inventory (OCI-Revised;[66] 18 items) and the Dimensional Obsessive Compulsive Scale (DOCS;[67] 20 items) are brief and also offer a cut-off score for OCD diagnosis as well as subscales/dimensions that include checking (OCI-R) and harm obsessions/checking compulsions (DOCS). Other psychometrically sound instruments include the longer YBOCS - Self-report[68] as well as the Florida Obsessive Compulsive Inventory (FOCI;[69] 20 items). Some of the above instruments have been developmentally adapted for children with OCD (Child-FOCI;[70] Children's OCI-R),[71] with the CYBOCS having both a Child and Parent reports.[72]

Alongside standardized instruments, idiographic and experimental tools have been used to gather more individualized and behaviorally focused data on checking symptoms. Measures such as the Youth Top Problems List (TPL)[73] can help to identify and monitor specific problems that are individually salient from the perspectives of the youth and the caregiver. Behavioral trackers based on patient/caregiver daily observations can assess target symptoms of checking derived from measures such as the YBOCS/CYBOCS or the TPL to provide a symptom severity baseline as well as evaluate ongoing treatment progress.

More experimental tasks are also being developed to elicit checking behaviors in a controlled laboratory setting, where examination focuses on how factors like visual search and decision-making under specific situations (eg, inflated responsibility, uncertainty and threat) influence checking behaviors (discussed elsewhere in this paper).[38,74] In this realm, new technologies like virtual reality (VR) paradigms will likely change how we assess and treat psychiatric disorders like OCD. Indeed, studies using VR have shown that virtual scenarios can be individualized to trigger OCD symptoms in patients, enabling clinicians to monitor and measure OCD behaviors like checking in real-time.[75] Furthermore, remote monitoring via ecological momentary assessment (EMA) procedures, where a patient is prompted to self-assess in the moment via mobile technologies may ultimately prove useful in the suite of assessment tools for checking behaviors. Studies have shown that while the EMA method resulted in fewer obsessions and compulsions, it logged new symptoms that had not been previously reported.[76] The future portends a wave of dedicated smartphone apps that will likely have significant implications for the way we clinically assess and treat OCD and other psychiatric disorders.

Other relevant considerations include the evaluation of levels of insight and functional impairment related to OCD as well as the degree to which family accommodation is present. The Sheehan Disability Scale (SDS), used commonly in adult OCD studies, measures general (not OCD specific) impairment and has youth and adult versions.[77,78] The Child Obsessive-Compulsive Impact Scale-Revised (COIS-R)[79] is a more specific and psychometrically valid instrument for youth, measuring functioning across multiple domains via parent or child report. Particularly with child patients, studies have shown the importance of assessing and addressing family accommodation in OCD.[80] The most informative measure is likely the clinician administered interview the Family Accommodation Scale for OCD (FAS), which is loosely modeled on the YBOCS format.[81] Self-report versions of the FAS also exist for parent,[82] adult,[83] and adult family member.[84] Finally, the level of insight into OCD is an important factor to evaluate as studies have shown patients with poorer insight demonstrate greater severity and poorer treatment outcomes.[85–87] For adult OCD patients, insight can be assessed using the clinician administered interview Brown Assessment of Beliefs Scale (BABS).[88] In both the YBOCS and CYBOCS, insight can also be assessed using one item from each instrument, which asks the clinician to use their judgement to rate patient insight on a 5-point scale.

Empirical Treatment for OCD Checking

The first-line behavioral treatment for OCD is Exposure and Response Prevention (ERP), which has shown ample empirical support.[89,90] ERP is rooted in the behavioral model described earlier in this paper: compulsions temporarily decrease the anxiety that is triggered by obsessions, thereby reinforcing compulsions and maintaining OCD behaviors. Confronting the obsessions through exposures, without compulsions (response prevention), breaks this cycle and fosters habituation of anxiety[91] and/or inhibitory learning[92] over time. Therefore, exposures elicit obsessions, and the patient is prevented from engaging in compulsions, such as checking. Patients are assigned to practice the exposures outside of treatment on a regular basis between sessions, in order to promote generalizability outside of a therapeutic setting (eg, school, work, home, etc).

The habituation theory of exposure therapy, initially described by Rachman's[93] Emotional Processing Theory and later expanded by Foa and Kozak,[91] centers on exposures as a mechanism of decreasing anxiety. This theory describes that exposures activate a "fear structure" in one's memory, while providing information that is incompatible with the fear, thereby promoting corrective learning. For example, an obsession of igniting a house fire if an individual does not check the stove multiple times, is erased by repeated exposures of using their stove without engaging in these checking compulsions. This "un-learning" occurs as exposures promote lasting fear reduction, and thus exposures are continued until anxiety declines. Traditionally, in the habituation model of exposure therapy, exposures are designed and presented

gradually according to each patient's fear hierarchy, starting with easier exposures and then tackling increasingly challenging exposures.

However, accumulating research has indicated that instead of erasing conditioned fear responses during exposures, this association is left intact, while new learning takes place (eg, "I don't need to check my stove to keep my house safe").[92,94] This theory is known as inhibitory learning,[92] which proposes that while habituation of anxiety does occur during exposures, it is more important to continue exposures until the patient tolerates fear, learns new information (eg, that the fear is not dangerous), and changes their behavior (eg, resists compulsions and approaches feared situations). Inhibitory learning can be optimized through expectancy violation, by maximizing the difference between the feared consequence and the actual consequence of the exposure.[95] Instead of progressive and gradual exposure, the inhibitory learning model encourages variable exposures where exposures from the hierarchy are executed in random order, to enhance the learning that varying levels of distress, differing situations, and at different times can be tolerated.[95] Although treatment may begin with an easier exposure to prevent refusal, inhibitory learning is thereafter enhanced by variability of fear intensity, stimuli, duration, and contexts.

While these differing theories change the way exposures are designed and delivered, the premise remains that exposure therapy is crucial to OCD treatment. Table 2 includes in vivo (real life) exposures across different domains of OCD where checking may take place.

These exposures can be further enhanced by having the patient state the obsession, or even further by stating that the fear already happened (eg, "I left the car door open"). These statements may be especially helpful to combat mental checking, along with incorporating mindfulness (eg, being in the present moment and noticing all relevant sensory experiences) to be fully engrossed in the exposure. If in vivo exposure is not possible (eg, leaving the car door open in a public parking lot), imaginal exposures with present-tense scripts using all senses may be helpful.

Unlike the emphasis of avoidance as the maintaining mechanism of anxiety in behavioral theories, cognitive theories focus on maladaptive thoughts or distorted beliefs as the root of anxiety.[16,96,97] A purely cognitive approach to OCD, originally developed for washing compulsions and then adapted for checking symptoms (Danger Ideation Reduction Therapy [DIRT])[98] aims to decrease threat expectancies without exposures. In an RCT comparing 14 weekly sessions of ERP (n = 22) and DIRT (n = 28), intent-to-treat analysis demonstrated significant improvements for both interventions at

Table 2 Examples of ERP Exercises According to Specific Obsessions and Compulsions

Obsession	Compulsion	ERP Exercise
"I may not have locked the car"	Checking to make sure each door is locked	Walking away from the car after locking the car once
"My pen fell on the floor and it is now full of germs"	Washing pen repeatedly and checking for dirt	Using a pen that fell on the floor without washing or checking
"I may have hit a pedestrian while I was driving"	Retracing my drive to check and make sure I did not hit anyone	Drive without retracing or checking
"I'm not sure if I understood what I just read"	Rereading the same sentence and checking one's understanding	Only reading once without checking (reading aloud or using a bookmark to cover each line and prevent rereading); higher level exposures may include quizzing the patient on what they just read
"I may have inappropriately touched my baby while changing their diapers"	Asking my partner for reassurance	Changing baby's diaper without reassurance-seeking
"I may have made a mistake in my math homework"	Checking each step of the math problem multiple times, asking others to check my work	Independently completing each math problem only once
"I may hurt myself with a knife while I'm cooking"	Avoid using knives, checking for cuts	Chopping with a knife to make a meal, without checking for cuts

post-treatment and 6-month follow-up.[99] DIRT significantly outperformed ERP in percent of patients who achieved "recovery" (defined as a YBOCS score of 7 or less)[100] at post-treatment and follow-up. However, further research is needed to assess the efficacy of DIRT in larger samples.

Radomsky and colleagues[101] developed another cognitive treatment for compulsive checking to target the cognitive factors that Rachman[5] proposed to perpetuate the compulsion over time, including memory distrust, sense of personal responsibility, probability of harm, and seriousness of harm. Specifically, the treatment consisted of behavioral experiments with varying amounts of checking. Before and after each experiment, predictions of responsibility, probability and seriousness of the feared outcome, and memory confidence are collected and compared. An initial pilot study of 12 sessions of cognitive therapy tested with a single-case multiple baseline design[102] (n = 9) indicated a significant decrease in perceived responsibility and a significant increase in memory confidence, both of which predicted decreases in time spent checking. A second pilot study utilizing a within-subjects repeated measure ANOVA with planned contrasts[103] (n = 12) found significant decreases in YBOCS, Vancouver Obsessional Compulsive Inventory (VOCI), and VOCI subscale score at post-treatment and 6-month follow-up. These studies provide preliminary support for cognitive therapy, however more studies with larger sample sizes and RCT designs are needed to compare its benefit over ERP.

Despite the above preliminary evidence supporting cognitive treatments for OCD checking, it is also important to note the risk of cognitive strategies (eg, coping statements, cognitive restructuring) in becoming compulsions. Furthermore, often OCD patients are already able to perceive the obsessions as irrational but still engage in compulsions. Therefore, we caution clinicians to be judicious in the use of cognitive strategies and to do so integrated with ERP. Furthermore, Craske and colleagues[95] propose to enhance inhibitory learning by having a greater difference between expectancy and actual experience. In this way, the expectancy violation is maximized so that exposures (rather than cognitive restructuring) disconfirm fears (or obsessions). Instead of utilizing cognitive strategies before or during exposures, learning is consolidated by discussing discrepancies between the expectancy and experience after each exposure. As the feared consequence for OCD may be in the future or unknowable (eg, "I will die of lung cancer in 5 years if I don't check the air quality every 10 minutes"), Jacoby and Abramowitz[104] suggest expectancy tracking of more immediate expectations, such as being able to tolerate anxiety, obsessions, and uncertainty. For example, an appropriate exposure for the patient with obsessions about developing future lung cancer would be going outside on a foggy day or especially hot day without checking the air quality and practicing tolerating uncertain thoughts that they may or may not develop cancer.

Case Description

The below case description of "Nick" illustrates the use of ERP integrated with behavioral experiments to treat OCD checking. The intervention integrates both habituation and inhibitory learning models. Nick is an 8-year-old Caucasian male referred for OCD contamination concerns. Nick lives with his father, "John", and mother, "Grace". Nick was born after a full-term pregnancy and an uneventful vaginal delivery. He met all developmental milestones on time, and parents reported that he was an affectionate, cautious, and curious infant. Family psychiatric history is positive for OCD, anxiety, and depression.

Assessment

At intake, Nick and his parents indicated that his OCD contamination symptoms started about two years ago after the family changed neighborhoods and Nick started a new school. The family then received weekly psychotherapy from a local psychologist for about a year. Per John's report, the family learned cognitive restructuring techniques, such as using Socratic questioning to respond to Nick's worries. The family reported that the treatment was helpful, but that Nick's obsessions and compulsions returned a few months afterwards and increased significantly about five months after treatment terminated. The family reported an incident when Nick dropped his towel on the bathroom floor and was unable to get out of the bathtub without assistance from his parents. It was at this time that Nick's parents called the current outpatient clinic to seek treatment.

Nick reported a primary obsession of contracting common illnesses through contact with bodily secretions (eg, urine, ear wax, feces, blood). These contamination obsessions are followed by anxiety-reducing compulsions,

including checking, cleaning, telling (his parents or teachers), and reassurance seeking. For example, when Nick worried that he had accidentally touched his pants and belt with his "dirty hand" he used to wipe after a bowel movement, he engaged in checking and cleaning compulsions of washing his hands, pants, belt, and belt loop. After Nick touched something he perceived as "dirty", he would tell his parents and then ask them a number of reassurance-seeking questions (eg, "Will I be okay?"). In response, his parents would use Socratic questioning they had learned in a prior therapy (eg, "What's the worst thing that can happen?"), which automatically and temporarily functioned to decrease the obsessions. For example, during the initial intake, when Nick dropped a piece of food down his shirt, he asked his father if it was "okay". John responded, "What do you think?" At times, Grace would advise Nick to wash his hands (eg, after blowing his nose) due to her concern that he may get sick and to immediately alleviate his worries. At intake, Nick scored a total of 20 on the CYBOCS (Obsessions subscale = 10; Compulsions subscale = 10), indicating OCD symptoms in the Moderate range.

Case Formulation

Nick may have inherited a genetic predisposition to OCD due to a family history of OCD and anxiety. Out of concern for Nick's wellbeing, Grace inadvertently modeled handwashing rituals after coming into contact with contaminated objects. Nick's obsessions about contracting an illness from bodily secretions would trigger anxiety, leading Nick to engage in anxiety-reducing rituals (eg, excessive handwashing, checking, telling his parents, and reassurance seeking). These compulsions were further reinforced by his parents' response of providing reassurance through Socratic questioning or at times advising him to wash his hands (eg, after blowing his nose). In addition, performing the compulsions prevented Nick from disconfirming the obsessions and learning that the anxiety would decrease over time or that the distress was tolerable.

Treatment Goals, Targets, and Interventions

Goal 1: Decrease OCD contamination symptoms, which have caused distress and interference in Nick's ability to complete everyday tasks, such as bathing.

Targets: Decrease avoidance of contaminated objects. Decrease the frequency of cleaning and checking compulsions.

Interventions: Externalize OCD. In-vivo exposures of coming in contact with feared contaminants without engaging in cleaning and checking rituals.

Goal 2: Decrease telling and reassurance-seeking compulsions. When Nick's obsessions of contamination are triggered, Nick tells his parents or teachers and then seeks reassurance from them ("Will I be okay?").

Targets: Break negative reinforcement cycle of OCD by resisting reassurance-seeking compulsions. Have parents not reinforce compulsions.

Interventions: Externalize OCD. Collaborate with family on adaptive responses to reassurance-seeking behaviors following a mini-hierarchy of appropriate parental responses.

Course of Treatment

Treatment consisted of 21 weekly outpatient ERP sessions augmented with parent and family sessions focused on decreasing reassurance-seeking responses.

The first session focused on rapport building, psychoeducation, externalizing the OCD, and providing an overview of ERP. The neurobehavioral framework of OCD was reviewed; OCD was explained as a "brain hiccup" that sends false alarms when no danger is present. The clinician then asked Nick to give OCD a nasty nickname; Nick chose the name "Mr. Bossy". To further externalize OCD, the clinician created a visual of Nick and Mr. Bossy's territory to demonstrate how much OCD interferes with his life. The goal of treatment was explained as the family working together to become stronger than Mr. Bossy. Obsessions were described as "the thoughts that Mr. Bossy makes you think and gets stuck" and compulsions such as checking as "the behaviors that Mr. Bossy makes you do". The negative reinforcement cycle of obsessions and compulsions was introduced, followed by the rationale of ERP exercises to fight Mr. Bossy. The clinician explained exposures as challenges that increase anxiety, but if we continued engaging in the exposure, anxiety would decrease over time, and he would learn new information and thereby claim his territory back. The importance of practicing the exposures daily between sessions was emphasized. ERP psychoeducation was also coupled with

psychoeducation of parent accommodations, particularly how their own responses to reassurance-seeking questions further reinforce OCD.

The first part of the treatment also included self-monitoring of triggers, obsessions, compulsions, and anxiety ratings. The self-monitoring form further increased the family's awareness of these OCD components, and along with the CYBOCS was utilized to create a fear hierarchy of exposures. To help motivate Nick in completing exposures, a reward chart and menu were also introduced and created.

The hierarchy was used as a road map of contamination exposures to target fears of dirt (eg, touching the bottom of his shoes with increasing number of fingers and then the entire hand), blood (eg, touching his bug bites and scabs), ear wax (eg, touching ear wax behind his ears), germs and urine (eg, standing closer and closer to a flushing toilet until his hands are placed inside the toilet bowl, and then sitting on home and public toilets without toilet seats covers and then pulling and zipping up his hands with his contaminated hands). These exposures were completed without cleaning or checking compulsions. Exposures were often designed as an experiment followed by a debrief discussion highlighting the difference between Nick's expected outcome and the actual experience. Later, exposures were further enhanced by stating the obsessions aloud (eg, "I may get sick from sitting on a public toilet seat without a toilet seat cover or checking"). In addition to tracking anxiety levels for habituation, tolerance of challenging and uncertain situations was also monitored (expectancy tracking). All exposures completed in-session were assigned as homework to promote generalization.

Reassurance-seeking or checking compulsions via proxy was planned to be targeted with a mini-hierarchy of responses starting with "I am not going to answer that question, because it will feed Mr. Bossy if I do" followed by more difficult and minimal responses (eg, smiling, nodding, and then keeping a straight face and not responding at all). Nick and his father did well role playing and then practiced the initial response with an exposure of Nick touching a trash can, and thus this response was assigned as homework to any reassurance-seeking questions. The family was also asked to track the number of urges and reassurance-seeking questions each day, and Nick received a sticker in his reward chart for completing a realistic goal of asking no more than 10 reassurance-seeking questions a day. In the following session, which for the first time was also attended by Grace, Nick's parents reported that Nick had a temper tantrum (screaming and rolling around on the floor) when he blew his nose into a tissue, asked his parents for reassurance ("Will I be okay?"), and his parents answered with the planned response. This incident was especially distressing for Grace, who told Nick to wash his hands, immediately alleviating the tantrum behavior. His anxiety then decreased further upon washing his hands. As Grace is a pediatric specialist, she also worried about Nick contracting a serious illness from germs, just as her own patients had contracted serious medical illnesses. The clinician empathized with Nick's parents' difficulty seeing Nick in distress and normalized Grace's reaction to provide reassurance and encourage him to wash his hands. With the clinician's prompting, Nick then helped to explain the OCD negative reinforcement cycle to Grace, and Grace agreed to stop asking Nick to wash his hands in all situations other than the bathroom. Although we planned to continue following the hierarchy of parent responses, after this session, the family reported that Nick did not ask any further reassurance-seeking questions.

The last two sessions focused on review and relapse prevention. Nick's accomplishments and skills in OCD treatment were reviewed, and lapses and relapses were discussed as opportunities to claim back Nick's territory from Mr. Bossy by creating and implementing exposures. If the family is still struggling after a week or two of exposure practice, they were encouraged to contact the clinic for a booster session or to return to treatment.

By the end of the treatment, Nick made significant improvement, as reflected in a subclinical CYBOCS total score of 4 (Compulsions: 1, Obsessions: 3). He was able to independently complete daily grooming tasks (eg, showering, dressing, blowing his nose), use public restrooms, and touch public surfaces with none to minimal compulsions. Of note, the family reported that Nick's bravery and determination to face his fears in exposures inspired Grace to seek treatment for herself.

Summary

In the current paper, we reviewed the theoretical conceptualization and empirical research of compulsive checking, highlighting both advancements and limitations in our understanding of the etiology and treatment of OCD. As a clinical

phenomenon, checking underscores the complexity of OCD as a behavioral, cognitive and neurobiological condition. Studies have consistently identified anxiety, inflated responsibility, and uncertainty as antecedents of checking and memory distrust as a downstream effect that in turn perpetuate the deleterious behavior. Excessive checking is also correlated with working memory and executive function deficits, though it is unclear to what extent these cognitive impairments are precursors or results of the compulsion. In terms of neurobiological factors, compulsive checking is linked to altered neural activities in subcortical regions such as the cingulate cortex and caudate nucleus. Yet, research has not clearly explained how these neural circuitry alterations cause OCD symptoms or can be altered by OCD treatments.

In tandem with the empirical research on OCD etiology, the assessment and treatment of OCD has also advanced significantly in the last decades. Notably, compulsive checking – along with other OCD symptomatology – can be effectively measured via standardized diagnostic interviews, self-report measures, experimental tasks and even technology-assisted tools. Given the heterogeneous and at times secretive nature of OCD, we contend that the most accurate and comprehensive evaluation should be conducted with multiple informants using a variety of assessment tools. Finally, the first-line psychosocial treatment of OCD is ERP, which is supported by habituation and inhibitory learning models. For compulsive checking, there is preliminary support for cognitive therapy as an empirical treatment. However, more studies are needed to determine how and when cognitive interventions should be integrated to effectively optimize OCD treatment.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Stein DJ, Costa DLC, Lochner C, et al. Obsessive–compulsive disorder. *Nat Rev Dis Primers*. 2019;5(1):52. doi:10.1038/s41572-019-0102-3
2. Fawcett EJ, Power H, Fawcett JM. Women are at greater risk of OCD than men: a meta-analytic review of OCD prevalence worldwide. *J Clin Psychiatry*. 2020;81(4). doi:10.4088/JCP.19r13085
3. Ruscio AM, Stein DJ, Chiu WT, Kessler RC. The epidemiology of obsessive-compulsive disorder in the national comorbidity survey replication. *Mol Psychiatry*. 2010;15(1):53–63. doi:10.1038/mp.2008.94
4. Kamaradova D, Prasko J, Latalova K, et al. Correlates of insight among patients with obsessive compulsive disorder. *Act Nerv Super Rediviva*. 2015;57(4):98–104.
5. Lewin AB, Bergman RL, Peris TS, Chang S, McCracken JT, Piacentini J. Correlates of insight among youth with obsessive-compulsive disorder. *Child Psychology Psychiatry*. 2010;51(5):603–611. doi:10.1111/j.1469-7610.2009.02181.x
6. Rachman S. A cognitive theory of compulsive checking. *Behaviour Research and Therapy*. 2002;40(6):625–639. doi:10.1016/S0005-7967(01)00028-6
7. Coles ME, Ravid A. Clinical presentation of not-just right experiences (NJREs) in individuals with OCD: characteristics and response to treatment. *Behaviour Research and Therapy*. 2016;87:182–187. doi:10.1016/j.brat.2016.09.013
8. Cervin M, Lázaro L, Martínez-González AE, et al. Obsessive-compulsive symptoms and their links to depression and anxiety in clinic- and community-based pediatric samples: a network analysis. *Journal of Affective Disorders*. 2020;271:9–18. doi:10.1016/j.jad.2020.03.090
9. Bucarelli B, Purdon C. Stove checking behaviour in people with OCD vs. anxious controls. *Journal of Behavior Therapy and Experimental Psychiatry*. 2016;53:17–24. doi:10.1016/j.jbtep.2016.03.005
10. Radomsky AS, Alcolado GM, Dugas MJ, Lavoie SL. Responsibility, probability, and severity of harm: an experimental investigation of cognitive factors associated with checking-related OCD. *Behaviour Research and Therapy*. 2022;150:104034. doi:10.1016/j.brat.2022.104034
11. Coleman SL, Pieterefesa AS, Holaway RM, Coles ME, Heimberg RG. Content and correlates of checking related to symptoms of obsessive compulsive disorder and generalized anxiety disorder. *Journal of Anxiety Disorders*. 2011;25(2):293–301. doi:10.1016/j.janxdis.2010.09.014
12. Rector NA, Katz DE, Quilty LC, Laposa JM, Collimore K, Kay T. Reassurance seeking in the anxiety disorders and OCD: construct validation, clinical correlates and CBT treatment response. *Journal of Anxiety Disorders*. 2019;67:102109. doi:10.1016/j.janxdis.2019.102109
13. Arntz A, Voncken M, Goosen ACA. Responsibility and obsessive–compulsive disorder: an experimental test. *Behaviour Research and Therapy*. 2007;45(3):425–435. doi:10.1016/j.brat.2006.03.016
14. Parrish CL, Radomsky AS. Why do people seek reassurance and check repeatedly? An investigation of factors involved in compulsive behavior in OCD and depression. *Journal of Anxiety Disorders*. 2010;24(2):211–222. doi:10.1016/j.janxdis.2009.10.010
15. Dollard J, Miller NE. *Personality and Psychotherapy; an Analysis in Terms of Learning, Thinking, and Culture*. McGraw-Hill; 1950.
16. Kalanthroff E, Wheaton MG. An integrative model for understanding obsessive-compulsive disorder: merging cognitive behavioral theory with insights from clinical neuroscience. *JCM*. 2022;11(24):7379. doi:10.3390/jcm11247379
17. Nedeljkovic M, Kyrios M. Confidence in memory and other cognitive processes in obsessive–compulsive disorder. *Behaviour Research and Therapy*. 2007;45(12):2899–2914. doi:10.1016/j.brat.2007.08.001
18. Toffolo MBJ, Van Den Hout MA, Hooge ITC, Engelhard IM, Cath DC. Mild uncertainty promotes checking behavior in subclinical obsessive-compulsive disorder. *Clinical Psychological Science*. 2013;1(2):103–109. doi:10.1177/2167702612472487

19. Van Den Hout M, Kindt M. Phenomenological validity of an OCD-memory model and the remember/know distinction. *Behaviour Research and Therapy*. 2003;41(3):369–378. doi:10.1016/S0005-7967(02)00097-9
20. Snyder HR, Miyake A, Hankin BL. Advancing understanding of executive function impairments and psychopathology: bridging the gap between clinical and cognitive approaches. *Front Psychol*. 2015;6:6. doi:10.3389/fpsyg.2015.00328
21. Chamberlain SR, Blackwell AD, Fineberg NA, Robbins TW, Sahakian BJ. The neuropsychology of obsessive compulsive disorder: the importance of failures in cognitive and behavioural inhibition as candidate endophenotypic markers. *Neuroscience & Biobehavioral Reviews*. 2005;29(3):399–419. doi:10.1016/j.neubiorev.2004.11.006
22. Gillan CM, Morein-Zamir S, Urcelay GP, et al. Enhanced avoidance habits in obsessive-compulsive disorder. *Biological Psychiatry*. 2014;75(8):631–638. doi:10.1016/j.biopsych.2013.02.002
23. Voon V, Derbyshire K, Rück C, et al. Disorders of compulsivity: a common bias towards learning habits. *Mol Psychiatry*. 2015;20(3):345–352. doi:10.1038/mp.2014.44
24. Watkins LH, Sahakian BJ, Robertson MM, et al. Executive function in Tourette's syndrome and obsessive–compulsive disorder. *Psychol Med*. 2005;35(4):571–582. doi:10.1017/S0033291704003691
25. Savage CR. Neuropsychology of obsessive-compulsive disorder: research findings and treatment implications. *Obsessive-Compulsive Disorders*. 1998;1998:254–275.
26. Saxena S, Brody AL, Schwartz JM, Baxter LR. Neuroimaging and frontal-subcortical circuitry in obsessive-compulsive disorder. *Br J Psychiatry*. 1998;173(S35):26–37. doi:10.1192/S0007125000297870
27. Roper G, Rachman S, Hodgson R. An experiment on obsessional checking. *Behaviour Research and Therapy*. 1973;11(3):271–277. doi:10.1016/0005-7967(73)90003-X
28. Rachman S, De Silva P, Röper G. The spontaneous decay of compulsive urges. *Behaviour Research and Therapy*. 1976;14(6):445–453. doi:10.1016/0005-7967(76)90091-7
29. Lopatka C, Rachman S. Perceived responsibility and compulsive checking: an experimental analysis. *Behaviour Research and Therapy*. 1995;33(6):673–684. doi:10.1016/0005-7967(94)00089-3
30. Ladouceur R, Rhéaume J, Freeston MH, et al. Experimental manipulations of responsibility: an analogue test for models of obsessive-compulsive disorder. *Behaviour Research and Therapy*. 1995;33(8):937–946. doi:10.1016/0005-7967(95)00024-R
31. Parrish CL, Radomsky AS. An experimental investigation of responsibility and reassurance: relationships with compulsive checking. *International Journal of Behavioral Consultation and Therapy*. 2006;2(2):174–191. doi:10.1037/h0100775
32. Toffolo MBJ, Van Den Hout MA, Engelhard IM, Hooge ITC, Cath DC. Patients with obsessive-compulsive disorder check excessively in response to mild uncertainty. *Behavior Therapy*. 2016;47(4):550–559. doi:10.1016/j.beth.2016.04.002
33. Lind C, Boschen MJ. Intolerance of uncertainty mediates the relationship between responsibility beliefs and compulsive checking. *Journal of Anxiety Disorders*. 2009;23(8):1047–1052. doi:10.1016/j.janxdis.2009.07.005
34. Parrish CL, Radomsky AS. An experimental investigation of factors involved in excessive reassurance seeking: the effects of perceived threat, responsibility and ambiguity on compulsive urges and anxiety. *Journal of Experimental Psychopathology*. 2011;2(1):44–62. doi:10.5127/jep.011110
35. Cougle JR, Fitch KE, Jacobson S, Lee HJ. A multi-method examination of the role of incompleteness in compulsive checking. *Journal of Anxiety Disorders*. 2013;27(2):231–239. doi:10.1016/j.janxdis.2013.02.003
36. Gagné JP, Radomsky AS. Manipulating beliefs about losing control causes checking behaviour. *Journal of Obsessive-Compulsive and Related Disorders*. 2017;15:34–42. doi:10.1016/j.jocrd.2017.08.013
37. Davey GCL, Startup HM, Zara A, MacDonald CB, Field AP. The perseveration of checking thoughts and mood–as–input hypothesis. *Journal of Behavior Therapy and Experimental Psychiatry*. 2003;34(2):141–160. doi:10.1016/S0005-7916(03)00035-1
38. Strauss AY, Fradkin I, McNally RJ, Linkovski O, Anholt GE, Huppert JD. Why check? A meta-analysis of checking in obsessive-compulsive disorder: threat vs. distrust of senses. *Clinical Psychology Review*. 2020;75:101807. doi:10.1016/j.cpr.2019.101807
39. Van Den Hout M, Muris P, Salemink E, Kindt M. Autobiographical memories become less vivid and emotional after eye movements. *British J Clinic Psychol*. 2001;40(2):121–130. doi:10.1348/014466501163571
40. Van Den Hout M, Kindt M. Repeated checking causes memory distrust. *Behaviour Research and Therapy*. 2003;41(3):301–316. doi:10.1016/S0005-7967(02)00012-8
41. Van Den Hout M, Kindt M. Obsessive–compulsive disorder and the paradoxical effects of perseverative behaviour on experienced uncertainty. *Journal of Behavior Therapy and Experimental Psychiatry*. 2004;35(2):165–181. doi:10.1016/j.jbtep.2004.04.007
42. Boschen MJ, Vuksanovic D. Deteriorating memory confidence, responsibility perceptions and repeated checking: comparisons in OCD and control samples. *Behaviour Research and Therapy*. 2007;45(9):2098–2109. doi:10.1016/j.brat.2007.03.009
43. Coles ME, Radomsky AS, Horng B. Exploring the boundaries of memory distrust from repeated checking: increasing external validity and examining thresholds. *Behaviour Research and Therapy*. 2006;44(7):995–1006. doi:10.1016/j.brat.2005.08.001
44. Den Hout MAV, Engelhard IM, Smeets M, Dek ECP, Turksma K, Saric R. Uncertainty about perception and dissociation after compulsive-like staring: time course of effects. *Behaviour Research and Therapy*. 2009;47(6):535–539. doi:10.1016/j.brat.2009.03.001
45. Radomsky AS, Gilchrist PT, Dussault D. Repeated checking really does cause memory distrust. *Behaviour Research and Therapy*. 2006;44(2):305–316. doi:10.1016/j.brat.2005.02.005
46. Radomsky AS, Dugas MJ, Alcolado GM, Lavoie SL. When more is less: doubt, repetition, memory, metamemory, and compulsive checking in OCD. *Behaviour Research and Therapy*. 2014;59:30–39. doi:10.1016/j.brat.2014.05.008
47. Radomsky AS, Alcolado GM. Don't even think about checking: mental checking causes memory distrust. *Journal of Behavior Therapy and Experimental Psychiatry*. 2010;41(4):345–351. doi:10.1016/j.jbtep.2010.03.005
48. Tolin DF, Abramowitz JS, Brigidi BD, Amir N, Street GP, Foa EB. Memory and memory confidence in obsessive–compulsive disorder. *Behaviour Research and Therapy*. 2001;39(8):913–927. doi:10.1016/S0005-7967(00)00064-4
49. Van Den Hout MA, Engelhard IM, De Boer C, Du Bois A, Dek E. Perseverative and compulsive-like staring causes uncertainty about perception. *Behaviour Research and Therapy*. 2008;46(12):1300–1304. doi:10.1016/j.brat.2008.09.002
50. Van Den Hout MA, Van Dis EAM, Van Woudenberg C, Van De Groep IH. OCD-like checking in the lab: a meta-analysis and improvement of an experimental paradigm. *Journal of Obsessive-Compulsive and Related Disorders*. 2019;20:39–49. doi:10.1016/j.jocrd.2017.11.006

51. Linkovski O, Kalanthroff E, Henik A, Anholt GE. Stop checking: repeated checking and its effects on response inhibition and doubt. *Journal of Behavior Therapy and Experimental Psychiatry*. 2016;53:84–91. doi:10.1016/j.jbtep.2014.12.007
52. Hinds AL, Woody EZ, Schmidt LA, Van Ameringen M, Szechtman H. In the wake of a possible mistake: security motivation, checking behavior, and OCD. *Journal of Behavior Therapy and Experimental Psychiatry*. 2015;49:133–140. doi:10.1016/j.jbtep.2015.03.016
53. Jaafari N, Frasca M, Rigalleau F, et al. Forgetting what you have checked: a link between working memory impairment and checking behaviors in obsessive-compulsive disorder. *Eur psychiatr*. 2013;28(2):87–93. doi:10.1016/j.eurpsy.2011.07.001
54. Karadag F, Oguzhanoglu N, Ozdel O, Atesci FC, Amuk T. Memory function in patients with obsessive compulsive disorder and the problem of confidence in their memories: a clinical study. *Croat Med J*. 2005;46(2):282–287.
55. Omori IM, Murata Y, Yamanishi T, et al. The differential impact of executive attention dysfunction on episodic memory in obsessive-compulsive disorder patients with checking symptoms vs. those with washing symptoms. *Journal of Psychiatric Research*. 2007;41(9):776–784. doi:10.1016/j.jpsychires.2006.05.005
56. Murayama K, Nakao T, Sanematsu H, et al. Differential neural network of checking versus washing symptoms in obsessive-compulsive disorder. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*. 2013;40:160–166. doi:10.1016/j.pnpbp.2012.09.002
57. Ravindran A, Richter M, Jain T, Ravindran L, Rector N, Farb N. Functional connectivity in obsessive-compulsive disorder and its subtypes. *Psychol Med*. 2020;50(7):1173–1181. doi:10.1017/S0033291719001090
58. Biria M, Banca P, Healy MP, et al. Cortical glutamate and GABA are related to compulsive behaviour in individuals with obsessive compulsive disorder and healthy controls. *Nat Commun*. 2023;14(1):3324. doi:10.1038/s41467-023-38695-z
59. Wang P, Yan Z, Chen T, et al. Visuospatial working memory capacity moderates the relationship between anxiety and OCD related checking behaviors. *Front Psychiatry*. 2023;13:1039849. doi:10.3389/fpsyt.2022.1039849
60. Brown TA, Barlow DH. *Anxiety and Related Disorders Interview Schedule for DSM-5, Adult and Lifetime Version: Clinician Manual*. Oxford University Press; 2014.
61. Silverman WK, Albano AM. *Anxiety Disorders Interview Schedule for DSM-IV. Child Version*. Oxford University Press; 1996.
62. First MB, Williams JBW, Karg RS, Spitzer RL. User's guide for the structured clinical interview for DSM-5 disorders, research version (SCID-5-RV). 2015.
63. Sheehan DV, Sheehan KH, Shytle RD, et al. Reliability and validity of the mini international neuropsychiatric interview for children and adolescents (MINI-KID). *J Clin Psychiatry*. 2010;71(03):313–326. doi:10.4088/JCP.09m05305whi
64. Goodman WK. The Yale-Brown obsessive compulsive scale: I. development, use, and reliability. *Arch Gen Psychiatry*. 1989;46(11):1006. doi:10.1001/archpsyc.1989.01810110048007
65. Scahill L, Riddle MA, McSWIGGIN-HARDIN M, et al. Children's Yale-Brown obsessive compulsive scale: reliability and validity. *J Ame Acad Child Adolescent Psychiatry*. 1997;36(6):844–852. doi:10.1097/00004583-199706000-00023
66. Huppert JD, Walther MR, Hajcak G, et al. The OCI-R: validation of the subscales in a clinical sample. *J Anxiety Disorders*. 2007;21 (3):394–406. doi:10.1016/j.janxdis.2006.05.006
67. Abramowitz JS, Deacon BJ, Olatunji BO, et al. Assessment of obsessive-compulsive symptom dimensions: development and evaluation of the dimensional obsessive-compulsive scale. *Psychological Assessment*. 2010;22(1):180–198. doi:10.1037/a0018260
68. Steketee G, Frost R, Bogart K. The Yale-Brown obsessive compulsive scale: interview versus self-report. *Behav Res Ther*. 1996;34(8):675–684. doi:10.1016/0005-7967(96)00036-8
69. Storch EA, Bagner D, Merlo LJ, et al. Florida obsessive-compulsive inventory: development, reliability, and validity. *J Clin Psychol*. 2007;63 (9):851–859. doi:10.1002/jclp.20382
70. Storch EA, Khanna M, Merlo LJ, et al. Children's Florida obsessive compulsive inventory: psychometric properties and feasibility of a self-report measure of obsessive–compulsive symptoms in youth. *Child Psychiatry Hum Dev*. 2009;40(3):467–483. doi:10.1007/s10578-009-0138-9
71. Shafran R, Frampton I, Heyman I, Reynolds M, Teachman B, Rachman S. The preliminary development of a new self-report measure for OCD in young people. *J Adolescence*. 2003;26(1):137–142. doi:10.1016/S0140-1971(02)00083-0
72. Storch EA, Murphy TK, Adkins JW, et al. The children's Yale-Brown obsessive–compulsive scale: psychometric properties of child- and parent-report formats. *Journal of Anxiety Disorders*. 2006;20(8):1055–1070. doi:10.1016/j.janxdis.2006.01.006
73. Weisz JR, Chorpita BF, Frye A, et al. Youth top problems: using idiographic, consumer-guided assessment to identify treatment needs and to track change during psychotherapy. *J Consulting Clin Psychol*. 2011;79(3):369–380. doi:10.1037/a0023307
74. Clair AH, N'Diaye K, Baroukh T, et al. Excessive checking for non-anxiogenic stimuli in obsessive-compulsive disorder. *Eur Psychiatr*. 2013;28(8):507–513. doi:10.1016/j.eurpsy.2012.11.003
75. Van Bennekom MJ, Kasanmoentalib MS, De Koning PP, Denys D. A virtual reality game to assess obsessive-compulsive disorder. *Cyberpsychol Behav Soc Network*. 2017;20(11):718–722. doi:10.1089/cyber.2017.0107
76. Tilley PJM, Rees CS, Rizzi A. A clinical case study of the use of ecological momentary assessment in obsessive compulsive disorder. *Front Psychol*. 2014;5:5. doi:10.3389/fpsyg.2014.00339
77. Sheehan KH, Sheehan DV. Assessing treatment effects in clinical trials with the Discan metric of the Sheehan disability scale. *Int Clin Psychopharmacol*. 2008;23(2):70–83. doi:10.1097/YIC.0b013e3282f2b4d6
78. Whiteside SP. Adapting the Sheehan Disability Scale to assess child and parent impairment related to childhood anxiety disorders. *J Clin Child Adolescent Psychol*. 2009;38(5):721–730. doi:10.1080/15374410903103551
79. Piacentini J, Peris TS, Bergman RL, Chang S, Jaffer M. BRIEF REPORT: functional impairment in childhood OCD: development and psychometrics properties of the child obsessive-compulsive impact scale-revised (COIS-R). *J Clin Child Adolescent Psychol*. 2007;36 (4):645–653. doi:10.1080/15374410701662790
80. Thompson-Hollands J, Edson A, Tompson MC, Comer JS. Family involvement in the psychological treatment of obsessive–compulsive disorder: a meta-analysis. *J Fam Psychol*. 2014;28(3):287–298. doi:10.1037/a0036709
81. Calvocoressi L, Mazure CM, Kasl SV, et al. Family accommodation of obsessive-compulsive symptoms: instrument development and assessment of family behavior. *J Nervous Mental Dis*. 1999;187(10):636–642. doi:10.1097/00005053-199910000-00008
82. Flessner CA, Sapyta J, Garcia A, et al. Examining the psychometric properties of the family accommodation scale-parent-report (FAS-PR). *J Psychopathol Behav Assess*. 2011;33(1):38–46. doi:10.1007/s10862-010-9196-3

83. Wu MS, Pinto A, Horng B, et al. Psychometric properties of the family accommodation scale for obsessive–compulsive disorder–patient version. *Psychol Assessment*. 2016;28(3):251–262. doi:10.1037/pas0000165
84. Pinto A, Van Noppen B, Calvocoressi L. Development and preliminary psychometric evaluation of a self-rated version of the family accommodation scale for obsessive-compulsive disorder. *Journal of Obsessive-Compulsive and Related Disorders*. 2013;2(4):457–465. doi:10.1016/j.jocrd.2012.06.001
85. Bellino S, Patria L, Ziero S, Bogetto F. Clinical picture of obsessive-compulsive disorder with poor insight: a regression model. *Psych Res*. 2005;136(2–3):223–231. doi:10.1016/j.psychres.2004.04.015
86. Catapano F, Sperandeo R, Perris F, Lanzaro M, Maj M. Insight and Resistance in Patients with Obsessive-Compulsive Disorder. *Psychopathology*. 2001;34(2):62–68. doi:10.1159/000049282
87. Storch EA, Milsom VA, Merlo LJ, et al. Insight in pediatric obsessive-compulsive disorder: associations with clinical presentation. *Psych Res*. 2008;160(2):212–220. doi:10.1016/j.psychres.2007.07.005
88. Eisen JL, Phillips KA, Baer L, Beer DA, Atala KD, Rasmussen SA. The Brown Assessment of Beliefs Scale: reliability and Validity. *AJP*. 1998;155(1):102–108. doi:10.1176/ajp.155.1.102
89. Abramowitz JS. Variants of exposure and response prevention in the treatment of obsessive-compulsive disorder: a meta-analysis. *Behav Ther*. 1996;27(4):583–600. doi:10.1016/S0005-7894(96)80045-1
90. Öst LG, Havnen A, Hansen B, Kvale G. Cognitive behavioral treatments of obsessive–compulsive disorder. A systematic review and meta-analysis of studies published 1993–2014. *Clin Psychol Rev*. 2015;40:156–169. doi:10.1016/j.cpr.2015.06.003
91. Foa EB, Kozak MJ. Emotional processing of fear: exposure to corrective information. *Psychol Bull*. 1986;99(1):20–35. doi:10.1037/0033-2909.99.1.20
92. Craske MG, Kircanski K, Zelikowsky M, Mystkowski J, Chowdhury N, Baker A. Optimizing inhibitory learning during exposure therapy. *Behav Res Ther*. 2008;46(1):5–27. doi:10.1016/j.brat.2007.10.003
93. Rachman S. Emotional processing. *Behav Res Ther*. 1980;18(1):51–60. doi:10.1016/0005-7967(80)90069-8
94. Bouton ME. Context, time and memory retrieval in the interference paradigms of Pavlovian learning. *Psychol Bull*. 1993;114(1):90–99. doi:10.1037/0033-2909.114.1.80
95. Craske MG, Treanor M, Conway CC, Zbozinek T, Vervliet B. Maximizing exposure therapy: an inhibitory learning approach. *Behav Res Ther*. 2014;58:10–23. doi:10.1016/j.brat.2014.04.006
96. Beck AT, Emery G, Greenberg RL. *Anxiety Disorders and Phobias: A Cognitive Perspective*. 20th anniversary ed. Basic Books; 2005.
97. Clark DM. Anxiety disorders: why they persist and how to treat them. *Behav Res Ther*. 1999;37:S5–S27. doi:10.1016/S0005-7967(99)00048-0
98. Vaccaro LD, Jones MK, Menzies RG, Wootton BM. Danger ideation reduction therapy for obsessive–compulsive checking: preliminary findings. *Cognitive Behav Ther*. 2010;39(4):293–301. doi:10.1080/16506073.2010.512643
99. Vaccaro LD, Jones MK, Menzies RG, Wootton BM. The treatment of obsessive-compulsive checking: a randomised trial comparing danger ideation reduction therapy with exposure and response prevention. *Clin Psychol*. 2014;18(2):74–95. doi:10.1111/cp.12019
100. Pallanti S, Hollander E, Bienstock C, et al. Treatment non-response in OCD: methodological issues and operational definitions. *Int J Neuropsychopharm*. 2002;5(02). doi:10.1017/S1461145702002900
101. Radomsky AS, Shafran R, Coughtrey AE, Rachman S. Cognitive-behavior therapy for compulsive checking in OCD. *Cognitive Behav Pract*. 2010;17(2):119–131. doi:10.1016/j.cbpra.2009.10.002
102. Radomsky AS, Wong SF, Giraldo-O'Meara M, et al. When it's at: an examination of when cognitive change occurs during cognitive therapy for compulsive checking in obsessive-compulsive disorder. *J Behav Ther Exp Psych*. 2020;67:101442. doi:10.1016/j.jbtep.2018.12.003
103. Radomsky AS, Giraldo-O'Meara M, Wong SF, et al. Cognitive therapy for compulsive checking in obsessive-compulsive disorder: a pilot trial. *Psych Res*. 2020;286:112850. doi:10.1016/j.psychres.2020.112850
104. Jacoby RJ, Abramowitz JS. Inhibitory learning approaches to exposure therapy: a critical review and translation to obsessive-compulsive disorder. *Clin Psychol Rev*. 2016;49:28–40. doi:10.1016/j.cpr.2016.07.001