An in vivo study of compulsions

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Leading cognitive-behavioural models of obsessive-compulsive disorder (OCD) emphasize appraisal of obsessions and the distress they evoke in the development and persistence of obsessional problems. The assumption in both theory and treatment is that once distress over the obsession extinguishes the compulsion will become obsolete. Treatment focuses on reducing distress by addressing appraisal and facilitating its extinction by exposure to the obsession whilst the compulsion is prohibited. Compulsions thus tend to be understood solely in terms of their relation to obsessions. This is reflected in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) which defines them as "repetitive behaviors or mental acts that are intended to reduce the anxiety evoked by obsessions and/or prevent harm" (APA, 2015 p. 237). Although cognitive-behavioural therapy (CBT) is the most effective treatment of OCD to date, at least 53% of people do not benefit from treatment when refusal and drop out are accounted for (Öst, Havnen, Hansen, & Kvale, 2015), and successful treatment is associated with only about a 40% reduction in symptoms (McKay, et al., 2015).

The cognitive model has led to decades of research on appraisal of obsessions and the distress it evokes. This work may have come at the expense of research on compulsions and mechanisms beyond appraisal of the obsession that may cause them to persist, even though models of OCD have long begun to identify self-perpetuating mechanisms responsible for persistence once a compulsion starts. For example, Salkovskis (1999) and Rachman (2002) implicated "stop criteria" as an important factor in the persistence of compulsions. They observed that it is difficult to establish whether a compulsion has achieved its goal, particularly when the harm it is meant to avert is in the future. People thus rely on subjective criteria and an internal, felt sense that it is okay to stop. Salkovskis and colleagues (Salkovskis, Millar, and

Gregory, 2017; Wahl, Salkovskis, & Cotter, 2008) examined how people with OCD make the decision to stop washing via interviews, questionnaires, and lab-based observations of washing. They found that people with washing compulsions relied on a greater number of criteria on which to base the decision to stop washing, and that subjective criteria and an internal reference point (e.g., a "feeling of rightness") factored more heavily in their decision, as compared to how people with other types of OCD and healthy controls made the decision to stop. Bucarelli and Purdon (2015) similarly found that the key reason people terminated a hand wash following "contamination" was that they got the "right" feeling or felt "certain" it was okay to stop.

The problem with relying on an internal felt sense is that it cannot be readily conjured intellectually, so it is elusive, evoking a doubt-repeat-doubt cycle. Repetitive checking is known to have insidious effects. First, repetition reduces confidence in memory for the check (for a meta-analysis see van den Hout, van Dis, van Woudenberg, and van de Groep, 2019) as well as confidence in attention, concentration, and sensory experiences (e.g., Hermans, et al., 2008; Nedeljkovic & Kyrios, 2007). It is thus unsurprising that people with OCD also have lower trait confidence in their memory and ability to maintain focus during a task (e.g., Hermans et al., 2008). Salkovskis (1999) also theorized that repetition increases one's sense of responsibility for the outcome of the act, which increases the stakes in getting it right. Consistent with this, greater responsibility is associated with poorer confidence in memory for a compulsive check (e.g., Moritz et al., 2007; Radomsky, Rachman, and Hammond, 2001), and inducing memory distrust results in greater checking (Alcolado & Radomsky, 2011). van den Hout and Kindt (2003) explained that the more an action is repeated the more familiar it becomes. However, when something is familiar it is processed conceptually, and perceptual processing is actively

inhibited. However, people with OCD demand of themselves a detailed perceptual memory of the compulsive act to feel certain it has been done "properly" (Purdon, 2018).

This body of work helps explain compulsion persistence and could have implications for treatment (e.g., reducing repetitions as a precursor to full response prevention). However, the ironic effect is robust in lab studies of checking behaviour has not consistently been observed. Bucarelli and Purdon (2016) examined visual attention in people with OCD and anxious controls during a stove checking task in which, wearing a portable eye tracker, they boiled a kettle of water, turned off the stove, placed a pot of dry rice on the burner that had been used, and joined the researcher two doors down. In the OCD group, *greater* time spent checking was associated with greater confidence, but this group attended *less* to threat stimuli (paper towels, matches) around the stove than did anxious controls. Bucarelli and Purdon speculated that people with OCD strategically avoided looking at threat to avoid getting locked into a checking-doubt-checking cycle. This was supported by Merritt and Purdon (2021), who found that people high in checking concerns reported greater motivation to avoid looking at threat. Once again, *greater* time spent looking at threat items was associated with *greater* post-task certainty. Participants may have been able to ignore threat because they were ultimately not responsible for harm to the lab, but in their home environment they may behave differently.

Few studies have examined the impact of repetition on washing behaviour. Fowle and Boschen (2011) did not find that repeated washing led to poorer memory confidence. Taylor and Purdon (2016) found that that the longer people high in contamination fears washed their hands, the less confidence they had in the wash afterwards, but, consistent with Cougle et al. (2007), only under conditions of high responsibility. In a follow up study Dean and Purdon (2021) found that people high in contamination fears washed excessively only when their hands had been

"contaminated" and under high responsibility conditions. However, there was no ironic effect of washing on subsequent memory confidence in any group. People high in contamination fears had slightly more repetitions in their wash, introducing the question as to the extent to which repetition is a feature of washing.

In sum, we know little about the basic phenomenology of compulsions as conducted in vivo, in the person's own environment, such as how long they last, how often they are repeated, how appraisal and trait memory confidence influence the persistence of a specific compulsive episode, how people decide to stop a compulsion, and whether repetition influences subsequent confidence in memory for the compulsion in vivo. Bucarelli and Purdon (2015) sought to address these lacunae in a diary study of compulsions. They administered participants with OCD trait measures of memory and cognitive confidence and beliefs about obsessions and asked them to use the Repeated Actions Diary (RAD) in paper format to report on aspects of the compulsion before, during, and after three times a day for three consecutive days. They found that beliefs about obsessions and memory/sensory confidence had only a small correlation with distress resulting from the obsession. Trait memory and cognitive confidence was associated with the need for certainty that the compulsion had been done properly heading into the compulsion. Consistent with previous work (Salkovskis et al., 2017; Wahl et al., 2008) analysis of participants' verbatim report of how they decided to stop, the dominant criterion was achieving an acceptable degree of certainty, or the "right" feeling.

Episodes that ended due to having gotten the right feeling ("certain" episodes) were compared to those ending for other reasons (e.g., running out of time; "uncertain" episodes). Over half (53%) of the episodes were "certain". "Uncertain" episodes had longer duration and more repetitions, and were associated with less confidence in sensory experiences, attention, and

concentration during the compulsion, greater doubt it had been done properly, and less relief. However, distress over the obsession was no different across episode type, nor was need for certainty heading into the compulsion. Thus, initial distress was not associated with the circumstances under which the episode was terminated, suggesting that once a compulsion starts factors other than those evoking it direct its course. Bucarelli and Purdon (2015) also found that although the "certain" episodes were not repeated as often as "uncertain" ones, they were often repeated, suggesting that the insidious effects of repetition are not inevitable. The sample in this study was small and participants' entries were often made hours after the compulsion. However, their findings were replicated in a larger sample of people with OCD by Bouvard, Fournet, Denis, Achachi, & Purdon (2020), although in their study 75% of episodes were "certain", despite many being repeated.

Taken together, these data suggest that appraisal and distress prior to a compulsion do not direct its persistence in vivo, nor does repetition alone. Of note is that in studies examining termination criteria the dominant criterion is the feeling of certainty, or satisfaction, or the "right" feeling (Bucarelli & Purdon, 2015; Salkovskis et al., 2017; Wahl et al., 2008). In their study of hand washing in people high and low in contamination fears, Dean and Purdon (2021) interrupted participants while they were washing and asked them to state the goal of their hand wash, taking verbatim recordings. Participants almost invariably framed the goal in very concrete, proximal terms ("get hands clean"). Under conditions of high responsibility, goals were more likely to be framed such that their achievement was both unverifiable and impossible ("get rid of *all* the germs"), and this was the experimental condition associated with greatest wash duration. Dean and Purdon speculated that focus on concrete, proximal goals may be the route by which the central goal of distress and harm reduction is achieved.

In treatment, we would not want people to feel they have to give up goals of distress reduction or harm avoidance to get better. However, we can address the route by which they attempt to achieve those goals. If the proximal goal is both unverifiable and impossible, the feeling of satisfaction and certainty that signals that distal goals have been achieved will be elusive, and the compulsion persists. Identifying and reframing proximal compulsion goals, then, may be a potentially important target in treatment. Based on CBT models of OCD (e.g., Rachman, 2002; Salkovskis, 1999) we can also reasonably speculate that in addition to the proximal goal of the compulsion (feeling satisfied, doing it "properly"), people may have in mind broader goals such as avoidance of harm, responsibility, and guilt. Furthermore, Mancini and colleagues have consistently found that people with OCD are also more sensitive to, and highly motivated to avoid deontological guilt (that is, guilt that arises from having violated one's own values/norms) and the concomitant expectation of being held responsible for the violation and being punished (for a review see Gangemi & Mancini, 2017). To our knowledge there has been no research on the goal of compulsions as conducted in people's own environment, nor on which goals are prioritized, and which are most strongly related to termination criteria.

The purpose of the current study was to replicate Bucarelli and Purdon's (2016) and Bouvard et al.'s (2020) research on the basic phenomenology of compulsions, examining duration, number of repetitions, influence of trait memory confidence and beliefs about obsessions on those parameters, influence of repetition on subsequent memory and stop criteria, and compulsion goals. We also sought to extend their work. First, given that termination criteria involve a sense of certainty we included a trait measure of intolerance of uncertainty to study its impact on compulsion parameters. Second, we used a tablet app to present Bucarelli and Purdon's (2015) Repeated Actions Diary, supplemented by questions about compulsion goals.

The app allowed us to time compulsions precisely and ensured that participants completed diary entries immediately following the episode. We asked participants to state the goal of the compulsion verbatim and to rate the importance of the goals of achieving certainty/ satisfaction the compulsion was done properly (stop criteria), along with the goals of avoiding harm, guilt, and holding oneself responsible for harm (altruistic guilt) and, finally, avoiding being held responsible by others for harm (violating principles and fearing punishment). We predicted that: 1) beliefs about obsessions, memory confidence, and intolerance of uncertainty would predict distress over the obsession, but that distress would not predict compulsion duration or repetitions; 2) the verbatim goal of the compulsion would be framed in terms of the immediate action being performed, but that people would also endorse holding in mind more general goals, such as avoidance of harm, guilt, and responsibility, as well as being held responsible by others.

Method

Participants

Participants were 36 people with OCD (72% female) ranging in age from 18 to 53 ($M = 25.32$, $SD = 7.02$). All participants were recruited through the Anxiety Studies Division (ASD) of the University of Waterloo Centre for Mental Health Research and Treatment (see Moscovitch et al., 2015). The ASD comprises participants from the community who have been administered the MINI International Neuropsychiatric Interview and have agreed to be contacted for research. For the current study, participants were selected on the basis that they had a diagnosis of OCD and that they engaged in one or more washing or checking compulsions every day. Of the 36 participants who participated, 27 (75%) met DSM-5 criteria for the diagnosis of a comorbid anxiety disorder, 9 (25%) met criteria for diagnosis of a comorbid mood disorder, 1 met criteria for a comorbid diagnosis of PTSD, and 1 met criteria for a comorbid diagnosis of Alcohol Use

Disorder. OCD symptom severity was assessed at the time of diagnosis using the Dimensional Obsessive Compulsive Scale (DOCS; Abramowitz et al., 2010). The mean total DOCS score for the current sample was 33.55 (SD = 14.32), which is 3.5 units above the mean for people with OCD in Abramowitz et al., 2010).

Procedure

Participants were contacted by email and invited to participate in a diary study of repetitive actions. They were then invited to come to the lab for a 60-minute one-on-one session during which they provided informed consent and were administered the Dimensional Obsessive Compulsive Scale, the Obsessive Beliefs Questionnaire, the Memory and Cognitive Confidence Scale, and the Intolerance of Uncertainty Scale. They identified one repetitive checking or washing behaviour/routine that they engage in on a daily basis (e.g., checking the stove before leaving for work, washing hands prior to preparing dinner) that they could report on every day for six consecutive days.

The researcher then introduced participants to the tablet and the diary app. The researcher (JD) went through the diary question by question and participants were asked to talk through how they would address each question in response to their identified compulsions. Participants had the opportunity to ask questions and seek clarification for each entry in the diary. Participants were also provided with several styluses and a Bluetooth keyboard should they not wish to touch the tablet screen directly. Participants were paid $20 for the initial visit and returned home with the tablet for a total of six days. Following six days of tracking, participants returned the tablet to the lab and were paid $10 for each day tracked, up to a maximum of $60.

Measures

Dimensional Obsessive Compulsive Scale (DOCS; Abramowitz et al., 2010). The DOCS is a 20-item measure designed to assess OCD symptom severity, including assessment of obsessions, compulsions, and avoidance behaviour. Scores on this measure can be used to calculate a total score and four subscale scores: concerns regarding germs and contamination; concerns about being responsible for harm, injury, or bad luck; concerns regarding unacceptable thoughts; and concerns regarding symmetry, completeness, or things being "just right". Scores on the DOCS have displayed good performance on indices of reliability and validity (Abramowitz et al., 2010). This scale demonstrated excellent internal consistency within this sample (Cronbach's alpha = .92). It was included to determine OCD severity in the sample.

Obsessive Beliefs Questionnaire (OBQ-44; OCCWG, 2005). The OBQ-44 was designed to measure beliefs considered important to the development and maintenance of OCD. Participants are asked to indicate the extent to which different statements are descriptive of their typical attitudes and beliefs. The ratings are totaled to calculate three subscale scores: Responsibility/Threat Estimation (e.g., "If I don't act when I foresee danger, then I am to blame for any consequences"), Perfectionism/Certainty (e.g., "I must be certain of my decisions), and Importance/Control of Thoughts (e.g., "For me, having bad urges is as bad as carrying them out). Each of these subscales has been found to have good internal consistency (OCCWG, 2005; Tolin, Worhunsky, & Maltby, 2006) and the scale has shown good criterion-related and convergent validity in clinical and non-clinical samples (OCCWG, 2005). The scale had strong internal consistency in this sample (Cronbach's alpha = .97).

Memory and Cognitive Confidence Scale (MACCS; Nedeljkovic & Kyrios, 2007).

This measure is designed to capture a range of beliefs about memory and related processes, such as confidence in decision-making abilities, concentration, and attention. Participants provide

responses based on a 5-point Likert scale (1= *Strongly Disagree* to 5 = *Strongly Agree*). The

MACCS has demonstrated good internal consistency and adequate validity (Nedeljkovic &

Kyrios, 2007). This scale had excellent internal consistency within this sample (Cronbach's

alpha = .94).

Intolerance of Uncertainty Questionnaire (IUS-12; Carleton, Norton, & Asmundson, 2007*)*

This scale is a 12-item measure that assesses negative reactions to uncertainty and ambiguous

situations. Items are scored on a Likert scale ranging from 1 (*not at all characteristic of me*) to 5

(*entirely characteristic of me*). The IUS-12 has demonstrated excellent internal consistency and

strong validity (Carleton, Norton, & Asmundson, 2007). This scale had excellent internal

consistency within this sample (Cronbach's alpha = .92).

Diary App

Participants had the tablet with them when they completed the compulsion on which they

were reporting. The app was designed such that at the start of a compulsion participants pressed

an on-screen "start" button which activated a timer hidden to the participant, and when the

compulsion was finished, they pressed a "stop" button. The app then presented the sequence of

questions from Bucarelli and Purdon's (2015) Repeated Actions Diary (RAD), one at a time,

supplemented by questions about the goals of the compulsion. The RAD featured entries with

qualitative and quantitative responses. The former included verbatim descriptions of the

obsessional concern (if any) that preceded the compulsion and the compulsion itself, a statement

of the main goal of the compulsion, the reason(s) the compulsion was repeated (if repeated), and

a statement as to how they decided to stop the compulsion, which participants typed into the

tablet. Quantitative responses included participants' estimate of how long the compulsive

episode lasted and how often it was repeated. Repetitions were defined as "performing the identified compulsive behaviour once and then immediately performing it again" Other quantitative responses were reported using 1-7 Likert scales, and included rating how distressing the obsessional concern preceding the compulsion was and how satisfied they were with the outcome of the episode ("not at all"/ "very"); how harmful participants thought the consequences of not doing the compulsion properly would be ("not harmful"/ "very harmful"); and how much general relief, relief from responsibility, and relief from guilt they felt after completing the compulsion ("none"/ "total"). The app presented the question with the scale and people tapped the number on the scale and pressed "enter" to register their answer.

If the compulsion was repeated participants were presented with 5 statements that began with "The more I repeated the compulsion the more I…" and finished with 1) doubted my senses; 2) doubted my memory; 3) doubted my attention; 4) doubted I had done it properly; 5) doubted it was okay to stop. Participants responded using 1-7 scales ("strongly disagree"/ "agree"). Finally, in recognition that participants might have several general or distal goals in mind while performing the compulsion, including simply doing the compulsion properly, participants rated how important the following goals were: 1) achieving certainty that the compulsion had been done properly; 2) feeling personally satisfied with the compulsion; 3) harm had been avoided; 4) they would not feel guilty if harm were still to occur; 5) they would not hold themselves responsible if harm were to occur; and, 6) others would not hold them responsible if harm were to still occur.

Data Analysis

As per Bucarelli and Purdon (2015) data for each variable were summed across entries and average scores were calculated for each participant by dividing the summed total by the

number of entries completed by the participant; thus, the values on which analyses were conducted were each participant's own average for each variable across their reported episodes. Qualitative data such as termination criteria were coded for content themes and it was not possible to create an average score. In such cases each compulsive episode was treated as an independent occurrence, but frequency counts were used to get total frequency of each category of qualitative response.

Data for each variable of interest were examined for extreme values. In advance of each analysis, we examined data for univariate outliers, defined as a z score +/- 3 and discontinuous from the distribution. Variables identified as meeting these two criteria were adjusted to be 3 standard deviations from the mean to account for individual variability while not inflating overall averages. For exploratory purposes we compared people who reported on washing ($n = 26$) and checking ($n = 10$) compulsions on compulsion parameters and the impact of repetition on memory confidence.

Results

Demographics and Trait Measures

Participants had a mean age of 25.32 ($SD = 7.02$) and were 72% female. Of these, 26 reported on a cleaning-related compulsion and 10 reported on a checking compulsion. Scores on symptom severity and trait measures are reported in Table 1. There were no significant differences in age, gender, or baseline scores between individuals who reported a checking compulsion and those who reported on a cleaning compulsion.

Table 1: *Means and Standard Deviations of OCD Symptom Severity and Trait Measures*

Dimensional Obsessive Compulsive Scale (DOCS)	*M*	*sd*
Contamination	9.50	4.59
Responsibility for Harm	9.36	4.73
Unacceptable Thoughts	7.22	5.30
Symmetry and Completeness	7.47	4.61
DOCS Total Score	33.56	14.32
Obsessive Beliefs Questionnaire-44 (OBQ-44)		
Responsibility/Threat	81.53	19.54
Perfectionism/Certainty	81.61	17.83
Importance/Control of Thoughts	43.86	16.14
Memory and Cognitive Confidence Scale (MACCS)		
Distrust of Memory	46.50	12.77
Distrust of Concentration	17.11	4.64
Distrust of Decisions	13.36	3.67
Perfectionism	12.78	4.04
MACCS Total Score	89.75	23.45
Intolerance of Uncertainty Scale- 12 (IUS-12)		
Total Score	42.89	11.50

The majority of participants completed 6 or more days of tracking ($n = 29$), and, of those, 10 participants continued reporting on their compulsion for an extra day or two. Seven participants only completed 3-5 days. In total 217 episodes were reported. Of these, 59 (27%) were checking episodes (e.g., checking locks or appliances before leaving the house, checking

the stove) and 158 (73%) were washing or cleaning episodes (e.g., washing hands after returning home from work, cleaning the kitchen after preparing dinner).

Relationship of beliefs, memory and cognitive confidence, and intolerance of uncertainty to distress over obsession and compulsion parameters

Participants reported experiencing an obsessional thought prior to the compulsion in 162 (75%) of the episodes. In the 55 (25%) episodes in which no obsessional thought was reported participants either left the question blank or wrote "nothing, just habit". It is possible that participants did have an obsession but failed to report it in the diary, so we cannot be confident that this reflects an actual percentage of compulsions not preceded by an obsession. To determine whether beliefs, memory and cognitive confidence, and intolerance of uncertainty were associated with distress over the obsession and the parameters of compulsions we examined zero order correlations. These data are presented in Table 2.

Table 2: *Zero-order correlations between beliefs, confidence, and certainty measures, number of repetitions, compulsion duration, and distress over obsession.*

Measure	Average Compulsion Duration		Average Repetitions		Average Distress Over Obsessions	
	r	p	r	p	r	p
OBQ-44						
Responsibility/Threat	.24	.16	.18	.29	.42*	.01
Perfectionism/Certainty	.33*	.05	.19	.26	.40*	.02
Importance/Control of Thoughts	-.08	.65	.36*	.03	.39*	.02
MACCS						

Distrust of Memory	-.07	.71	.22	.20	.25	.16
Distrust of Concentration	.01	.98	.15	.38	.26	.13
Distrust of Decisions	-.01	.97	.13	.45	.28	.10
Perfectionism	-.08	.64	.24	.15	.37*	.03
Total Score	-.05	.78	.21	.22	.29	.09
IUS-12						
Total Score	-.02	.91	.09	.61	.51*	.02

n's range from 35-36. OBQ-44=Obsessive Beliefs Questionnaire 44-item version; MACCS = Memory and Cognitive Confidence Scale; IUS-12=Intolerance of Uncertainty Scale-12 item version *p < .05

The average distress caused by obsessional thoughts was 3.86 (*SD* = 1.78), in the moderate range of the 7-point Likert scale. Distress over the obsession was associated with all three OBQ scales, as well as the MACCS Perfectionism scale and the IUS, which was consistent with our first hypothesis. The OBQ Importance and Control of Thoughts subscale was significantly associated with average number of repetitions and the OBQ Perfectionism/Certainty was associated with average duration of the compulsion. As hypothesized, there was no significant correlation between distress and average number of repetitions (*r* = .30, *p* < .09) or average duration of compulsions (*r* = .07, *p* < .68).

Compulsion length, repetition, and satisfaction with outcome

The average compulsion duration as measured by the diary app, was 6.36 minutes (*SD* = 10.31), after two outlying cases were adjusted to be one unit above the next highest value. Compulsions ranged in duration from 5.4s to 54.19 minutes. The average duration of cleaning/washing compulsions was 7.00 minutes (*SD* = 11.60) and the average duration of

checking compulsions was 4.72 minutes (SD = 5.98). The difference was not significant (t(34) = 0.59). Participants' average subjective estimates of how long the compulsion lasted were almost perfectly consistent with the average objective duration, r(34) = 0.98, p < .001.

Of the 36 participants, 33 reported one or more compulsive episodes that contained repetition of a compulsive behaviour. In total, participants reported repetition in 91 compulsive episodes. When an episode included one or more repetitions, the average number of repetitions was 2.15 (SD = 2.20) and the maximum number was 10. Washing and cleaning episodes had an average of 1.46 repetitions (SD = 0.90) and checking episodes had an average of 3.96 repetitions (SD = 3.39), which was a significant difference (t(26) = -3.52, p < .001). We created a variable called "doubt" by summing across the five items on memory, sensory, and cognitive doubt and dividing by five. Those with checking compulsions reported that the more they repeated, the more they doubted (M = 3.50, SD = 2.01) as compared to those with washing compulsions (M = 1.64, SD = 2.01; t(34) = -2.80, p < .01).

We then examined satisfaction with outcome. One participant had missing data on 4 of their 6 episodes so the average of their two existing ratings was used to estimate satisfaction for the remaining 4 episodes. The mean satisfaction with the outcome of washing compulsions (M = 5.76, SD = 1.10) did not differ from that of checking compulsions (M = 5.05, SD = 1.75), t(34) = 1.75, p < .09. Average outcome satisfaction was not significantly correlated with the average duration of compulsive episodes, r(34) = -0.14, p = .43 or the number of repetitions, r(34) = -0.06, p = .74.

Termination criteria

Participants' verbatim report on how they made the decision to terminate the compulsion were coded based on Bucarelli and Purdon (2015) into three general categories: 1) feeling of satisfaction, certainty, or feeling certain enough; 2) distress and/or the obsessional concern were resolved; 3) other reasons, such as needing to get to an appointment, someone else providing reassurance, or negative consequences of the compulsion (e.g., hands were burning). The second author and the same coder as above independently coded the responses into these three categories. The Kappa was .99 and the one discrepancy was discussed until accordance was reached. There was missing data on four of the 217 episodes. Two episodes were uncodeable because they contained both a feeling of satisfaction and a reduction in distress and one simply read "it just wasn't very strong". The majority of episodes were terminated because respondents felt satisfied ($n = 163$, 78%), with 37 (18%) of the episodes terminating due to other factors, and 10 episodes (5%) terminating due to distress reduction or reduction in obsessional thoughts.

Compulsion goals

Participants' verbatim reports of the goals of their compulsion were independently coded into three categories by the second author and a coder blind to the purpose of the study. The categories were based on Dean and Purdon (2021). The first category included goals expressed in terms of total certainty of having avoided an undesired state (e.g., "Get all the germs out from all day"), certainty that one had achieved a desired state (e.g., "to make sure that my hands were completely clean", "to ensure stove was safely off"), or both avoid an undesired state and achieve a desired state, with certainty (e.g., "ensure there are no germs on my fingers and that my fingers are completely clean") The second category included goals expressed as avoiding an undesired state, absent the need for certainty (e.g., "remove dirt"), achieving a desired state, absent a need for certainty (e.g., "get clean"), or to both avoid an undesired state and achieve a

desired state, absent a directive for certainty (e.g., "To remove dirt from hands and have clean hands"). The third category were goals expressed in terms of distress reduction in and of itself (e.g., "to rid the anxious feeling something wrong was going to happen"), distress reduction via avoiding an undesirable state or achieving a desired state (e.g., to make sure the stove was off so I could go to bed without worrying"), or reduction in obsessional thoughts or doubt (e.g., "to remove the idea from my mind that door might not be locked").

The kappa coefficient was .90. Discrepancies were resolved via discussion until accordance was achieved. We found that in 101 episodes (48%) the goal was to avoid an undesired state or achieve a desired state with an imperative for certainty. In 83 episodes (39%) the goal was expressed in terms of avoiding an undesirable state or achieving a desired state without an imperative for certainty. In 22 episodes (10%) the goal was to reduce the obsessional concern and/or distress. One participant uniquely reported that in five of their six episodes the compulsion had no particular goal, it was "just habit". As in Bucarelli and Purdon (2015) harm avoidance was seldom referred to in participants' verbatim reports, which is why we did not have a category for it. However, in 18 episodes participants expressed the goal in terms of achieving a desired state to avoid harm ("Ensure no harm came from the oven being on by ensuring the oven was off"). All but 2 of these episodes were reports of checking compulsions. These findings are consistent with our second hypothesis, that goals would proximal.

Compulsion Priorities

Consistent with our second hypothesis, participants reported having a range of goals in mind, ranging in importance from 52.95 to 88.47 on the 100-point Likert scale). The highest rated priorities were: achieving a sense of personal satisfaction ($M = 88.47$, $SD = 19.12$), completing the compulsive actions properly ($M = 86.27$, $SD = 19.12$), and ensuring that *others*

would not hold one responsible for harm ($M = 87.60$, $SD = 12.73$). The priority of avoiding harm

was next highest ($M = 75.85$, $SD = 27.08$), followed by ensuring that one would not hold *oneself*

responsible for harm ($M = 55.12$, $SD = 34.39$), and avoiding possible guilt ($M = 52.95$, $SD =$

32.89). The priority to avoid being held responsible for harm by others was rated as significantly

more important than avoiding harm in general, $t(35) = 2.55$, $p = .015$, and significantly more

important than avoiding holding oneself responsible for harm, $t(35) = 5.66$, $p < .001$. The

correlations between these goals were also examined (see Table 3). Distress over the obsession

was correlated with the goal of doing the compulsion properly and with harm avoidance, and the

goals of doing the compulsion properly and harm avoidance were significantly correlated. The

goals of avoiding harm, guilt, and responsibility were strongly correlated with each other. The

goal most highly correlated with doing the compulsion properly and with achieving satisfaction

was ensuring others would not hold oneself responsible for harm.

Finally, we were interested to know the extent to which trait factors were associated with

compulsion goals. These data are presented in Table 4.

Table 3. Zero-order correlations between compulsion priorities.

	Complete the Compulsion Properly	Achieve Satisfaction	Avoid Harm	Avoid Feeling Guilty	Avoid Feeling Responsible for Harm	Avoid Being Held Responsible by Others for Harm	Satisfaction With Outcome
Complete the Compulsion Properly	-	.77*	.43*	.20	.22	.57*	.34*
Achieve Satisfaction		-	.31	.25	.14	.59*	.23
Avoid Harm			-	.65*	.54*	.19	.46**
Avoid Feeling Guilty				-	.66*	.18	.19
Avoid Feeling Responsible for Harm					-	.18	.14
Avoid Being Held Responsible by Others for Harm						-	.12

$* p < .01$, $N = 36$

Table 4. Zero-order correlations between compulsion priorities and trait factors.

	Complete the Compulsion Properly	Achieve Satisfaction	Avoid Harm	Avoid Feeling Guilty	Avoid Feeling Responsible for Harm	Avoid Being Held Responsible by Others for Harm
OBQ-Responsibility	.04	-.14	.32	.11	.31	-.09
OBQ-Perfectionism	.20	.02	.40*	.07	.40*	-.02
OBQ-Importance of Thoughts	.00	-.06	.30	.08	.33*	-.20
MACCS-Decision Making	.21	.04	.33*	.17	.37*	.10
MACCS-Concentration	.36*	.09	.34	.06	.23	.12
MACCS-Perfectionism	.30	.09	.46**	.33*	.46**	.21
MACCS-Memory	.29	.15	.32	.10	.27	.09
Intolerance of Uncertainty	.09	-.15	.39*	.20	.42*	-.01

* $p < .05$, **$p < .01$, $N = 36$ OBQ=Obsessive Beliefs Questionnaire; MACCS = Memory and Cognitive Confidence Scale

The measures of beliefs about obsessions and intolerance of uncertainty were significantly correlated with the goals of harm avoidance and avoidance of holding oneself responsible for harm, but not with avoidance of being held responsible by others for harm. The MACCS Perfectionism scale was significantly correlated with avoidance of harm, guilt, and avoiding holding oneself responsible for harm.

Discussion

This study used a diary in tablet form to study compulsion parameters, stable and situational factors related to those parameters, impact of repetition on subsequent confidence, compulsion goals, goal priorities, and the relationship of goals to stable factors.

Factors associated with distress over obsession and compulsion duration and repetition

Consistent with leading cognitive-behavioural models of OCD, negative beliefs about obsessions were associated with greater distress over obsessions that preceded compulsive episodes, as was intolerance of uncertainty. The Perfectionism scale of the MACCS was also significantly associated with distress. It may be the case that greater perfectionism and intolerance of uncertainty evoke anxious anticipation about how readily the subsequent compulsion will yield the right feeling and can be terminated. However, consistent with our hypothesis, which was based on Bucarelli and Purdon (2015), distress was not associated with compulsion duration or number of repetitions. We did find that the OBQ Perfectionism scale was associated with compulsion duration, and OBQ Importance of thoughts was associated with number of repetitions. This suggests that beliefs about the obsession that resurface during compulsions may interfere more with their resolution than initial distress over the obsession. In treatment it may be useful to address beliefs about the obsessional concern in terms of their implications for the compulsion. Meanwhile, distress over the obsession had only a small

correlation with the goal of doing the compulsion properly, and a moderate correlation with the goal of avoiding harm. This also suggests that once compulsions begin, they may take on a life of their own that is not strongly directly by appraisal of the obsession.

Compulsion parameters and termination criteria

We were also interested in replicating and extending previous findings on basic phenomenology of compulsions. Participants' estimates of compulsion duration were highly consistent with the timed duration, which may be attributable to completing the diary immediately after the compulsion. The average duration of the compulsion in this study was considerably shorter (6.36m, $SD = 10.31$) than that reported by Bucarelli and Purdon (34.36m, $SD = 30.96$), as was the average number of repetitions (6.08 vs 2.15). In Bucarelli and Purdon the reported lag between the compulsion and the entry in the diary on it was 130 minutes, which may have compromised judgement of compulsion length. Bucarelli and Purdon had people report on three compulsions a day (morning, afternoon, evening) over three days using a paper diary. Participants may have waited until the end of each time-period and thus reported on more salient, or disruptive episodes that were better recalled. In the current study people reported on the same compulsion every day for six days, immediately following the episode. They may have reported on any episode for which they had time immediately afterwards to make the entry.

In the current study, washing compulsions were about 2 minutes longer than checking compulsions, but this was not significant. However, checking compulsions were repeated significantly more often (3.96 vs. 1.46). People with checking compulsions reported that repetition degraded their memory, sensory, and cognitive processes to a significantly greater degree than did those with washing compulsions, but this may simply reflect that washing compulsions simply were not repeated very often. This finding is consistent with Dean and

Purdon's (2021) observation that washing compulsions may be prolonged rather than repeated. It is possible that people repeated their washing compulsion after completing the diary entry. We also know that compulsions include non-functional or unnecessary actions, particularly at the tail end (e.g., Eilam, Zor, Fineberg, & Hermesh, 2012; Zor, Hermesh, Szechtman, & Eilam, 2009; Zor et al., 2009). In future work it might prove useful to examine the "chain" of steps in compulsions and compare washing and checking compulsions, as well as the psychological factors that predict extra, prolonged, or repeated steps. We may also want to have people report on their compulsion once they have moved on to the next activity in their day. It could be that people try to leave, experience doubt, and then repeat the whole compulsion. At the very least, given that insidious effects of repetition are implicated in compulsion persistence more data on the extent to which compulsions are in fact repeated in vivo is important.

Washing and checking compulsions produced the same relatively high degree of satisfaction with the outcome, and satisfaction was not associated with compulsion duration or number of repetitions. As in with Bucarelli and Purdon and Bouvard et al. (2020) in the current study most episodes were terminated because people felt satisfied they had done the compulsion properly, had the "right" feeling, felt certain it was done properly, or felt certain enough. That is, compulsions "worked" a good deal of the time regardless of a seeming reliance on an internal, felt sensation. It was noteworthy that the number of repetitions of checking in vivo was less than is typically imposed in lab studies. Coles, Radomsky, and Horng (2006) found that memory confidence was undermined in as little as three repetitions, yet in all three diary studies of compulsions now we have seen that they yield a sense of satisfaction more often than not, despite repetition, meaning that other factors contribute to compulsion termination.

As in our previous studies, distress reduction and harm avoidance were not listed as termination criteria, with only 5% of episodes terminating due to distress reduction. It may be that harm avoidance is the route to distress reduction, and completion of specific goals ("get hands clean"), as determined by an internal, felt sense, is the route to distress reduction. In future work it would be interesting to determine the extent to which "successful" completion of a compulsion is associated with a reduction in distress (negative reinforcement) or the evocation of a positive state (positive reinforcement); if the latter, the extinction model may not be fully apt.

Compulsion goals

As in Dean and Purdon (2021) the goals of specific compulsions were expressed in terms of avoiding an undesired state (getting rid of germs) or achieving a desired state (getting my hands clean) with the imperative for certainty (48%) or without the imperative for certainty (39%). In only 10% or less of episodes was the explicit goal to reduce distress or harm. The internal feeling of satisfaction or certainty may be the essential step to distress or harm reduction, achieved once is certain the specific goal of the compulsion task has been accomplished (get hands clean, ensure the stove is off). We also saw that memory and cognitive confidence, and particularly perfectionism, were associated with the goal of doing the compulsion properly, avoiding harm, and avoiding holding oneself responsible for harm. If people frame the goal of their compulsion in perfectionistic terms, such that it is unverifiable and impossible to achieve ("get rid of *all* the germs") they will need to rely on spurious rules to establish when that goal has been achieved. Although people may be able to achieve that sense more often than not, reliance on that feeling, rather than developing trust in one's intellectual judgement, is a factor in OCD persistence. There may be merit in identifying and addressing such goals in treatment. At

the very least, through identifying goals that are impossible and unverifiable people may be able to make better sense of their struggle with compulsion termination.

We also asked participants to rate the importance of goals connected to termination criteria (feeling personally satisfied, doing the compulsion "properly") and more general/distal goals of avoiding harm, guilt, holding oneself responsible for harm, and avoiding being held responsible for harm by others. We found that the three most important goals were: achieving a sense of personal satisfaction, doing the compulsion "properly", and ensuring that others would not hold oneself responsible for harm. The latter was significantly more important than avoiding harm and holding oneself responsible for harm. Distress over the obsession had a small correlation with the goal of doing the compulsion properly and a moderate correlation with harm avoidance, but not with any of the other goals. This again underscores that factors other than distress guide compulsions once they begin. We also found a strong correlation between the importance of completing the compulsion properly and achieving satisfaction, suggesting these goals are nested. It was noteworthy that these goals, which reflected termination criteria, had their strongest association with the goal of avoiding being held responsible for harm *by others*.

It may be the case that the sense of satisfaction or having done the compulsion properly is achieved when the individual is able to assure themselves that someone else would be satisfied or that they have enough of a case to be absolved of responsibility by others. Interestingly whereas beliefs about obsessions, memory and cognitive confidence, and intolerance of uncertainty were associated with the goal of avoiding feeling responsible for harm, they were not at all associated with avoiding being held responsible for harm by others. Salkovskis (1999) observed that people with OCD are not concerned about the probability of harm so much as they are being responsible for that harm. Perhaps fear of being held responsible by others for harm is

an important and distinct aspect of responsibility. Altogether our findings suggest that this may be a novel construct that is worth studying in future research.

The goal of avoiding being held responsible for harm by others emerged as central. This is consistent with research that implicates deontological guilt in the development and persistence of OCD, in that deontological guilt is associated with the expectation of punishment (e.g., Mancini and Gangemi, 2015, 2017). Chiang and Purdon (2021) studied doubt in people with OCD, finding that doubt was often experienced as an internal dialogue between the self and a "voice" which was dominant in nature and hostile to neutral in tone. Doubt itself was directly tied to core beliefs about self-worth. Drawing on Gilbert et al. (2001) they proposed that the "voice" may be an internal representation of an attachment figure, particularly one who used shame and derogation to subordinate the person, as is characteristic of families high in expressed emotion. Consistent with this, we know that people with OCD exhibit anxious attachment (e.g., van Leeuwen, Wingen, and van Marle, 2020). Furthermore, Salkovskis has argued that parental criticism is a pathway to inflated responsibility (Salkovskis, Rachman, Shafran, and Freeston,1999). Assessing and addressing attachment issues in treatment may be an important supplement to standard CBT, at least in some people. Furthermore, if the goal of avoiding being held responsible by others is strong, there may be merit in examining the dynamics of the internal dialogue in research and addressing it in treatment, as suggested by Chiang and Purdon (2021).

A limitation of the study was the relatively small sample size, particularly those reporting on checking compulsions. This meant that we were not able to determine if there were important differences in predictors and correlates of compulsion parameters, termination criteria, and goals between washing and checking compulsions. Second, the sample was over-represented by

women. Although there is no theoretical reason to anticipate gender differences in the variables assessed, the generalizability of the data may be limited. Third, even though the diary questions were answered immediately following the compulsion, data were still based on retrospective self-report which could be influenced by mood state and satisfaction with the outcome of the compulsion. In future work it could prove useful to observe and code compulsions while they are being conducted and while having people speak aloud, to get at the reasoning as it unfolds in real time.

In sum, our findings suggest that understanding the distress evoked by the obsession is only part of the story in compulsion persistence and that we would do well to understand the other factors and processes that prolong the compulsion. We found that compulsions were not repeated very often, particularly washing compulsions, which warrants further investigation given that repetition is viewed as a factor in compulsion persistence. The way in which the compulsion goal is framed (e.g., as impossible and unverifiable) could be an important target in treatment. Furthermore, people may have an "audience" who need to be appeased in mind while completing their compulsions. Avoidance of being held responsible by others for harm may be an important factor to examine further in research and to assess and address in treatment.

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Conflict of Interest

Neither author has a conflict of interest.

Author Statement

Jasmine Dean - Data curation; Formal analysis; Funding acquisition; Investigation; Project administration; Visualization; Roles/Writing - original draft; Writing - review & editing.

Christine Purdon - Conceptualization; Formal analysis; Funding acquisition; Methodology; Resources; Supervision; Validation; Writing – original draft; review & editing.