

Why Do Compulsions Persist?

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Leading models for understanding compulsive behaviour assert that concerns about the safety or well-being of oneself or others, combined with overestimates of responsibility for protecting oneself and others from harm, evoke anxiety (Rachman, 2002). This anxiety is not resolved until the person is able to feel certain that potential danger has been neutralized via some kind of action (Salkovskis, 1985; Rachman, 2002). However, we do not have a good understanding of why that sense of certainty is often so elusive. The purpose of the present dissertation was to further elucidate the phenomenology of compulsive behaviours and the factors that influence the decision to repeat or prolong them.

Study 1 examined the relationship between repeated or prolonged washing behaviours and psychological factors, including memory and sensory confidence, perceived responsibility, and desired certainty across individuals low and high in fears of contamination, who either contaminated their hands or did not, prior to either preparing a gift bag for preschoolers or sorting paper. In all conditions, participants were invited to wash their hands however they would like, for as long as they would like, prior to and during completion of the gift-bag or paper tasks. Video recording was used to capture phenomenology of washing behaviours. Participants were administered several self-report questionnaires throughout the study. Findings from Study 1 made salient both the role of contamination fears and contextual factors in the phenomenology of hand washing behaviours. Those participants high in fears of contamination assumed greater responsibility for

potential harm and predicted greater likelihood and severity of potential harm. They washed for significantly longer and included more actions within their wash. However, across all groups, the decision to wash was driven by exposure to a contamination induction and post-wash task. Similarly, across all participants, pre-wash estimates of harm were a significant predictor of wash duration, whereas ratings of responsibility for preventing harm were not. For all groups, exposure to a contamination induction was associated with formation of avoidance-based goals for hand washing (get rid of germs vs. get my hands clean), which were associated with significantly longer wash durations. Those assigned to prepare gift bags desired greater certainty that their hands were washed properly than those in the paper-sorting task. These findings emphasize the importance of examining contextual factors, goals, and termination criteria in addition to presence of contamination fears/OCD symptoms.

Study 2 examined washing and checking compulsions within a sample of community members who met criteria for a diagnosis of OCD. Phenomenological and self-report data was gathered via digital diary entries. This study allowed us to gather novel exploratory descriptive data on the phenomenology of compulsive behaviours as they occurred *in vivo*, including compulsion duration and number of repetitions. Furthermore, this study allowed for testing of a tablet application designed to gather this data and we report on how future studies might utilize and improve upon this method of data collection. Participants reported an obsessive thought, image, or impulse preceding 73% of the compulsions recorded. Therefore,

according to participant report, approximately one quarter of compulsive behaviours did not follow the typical OC cycle described within DSM criteria. Self-reported distress associated with obsessive thoughts was associated with severity of OCD symptoms but was not significantly associated with duration of compulsive episodes or the reported number of repetitions within episodes. The goals rated as most important were to achieve a sense of personal satisfaction, to complete the compulsive behaviours properly, and to ensure that *others* would not hold one responsible for harm. When participants reported a focus on distress reduction as their termination criteria, their compulsive episodes lasted significantly longer than if they reported terminating based on a sense of satisfaction or certainty. Ratings of successful completion were not correlated with episode duration, suggesting that a longer episode did not guarantee a satisfying outcome. Therefore, prolonging or repeating a compulsion may do relatively little to reduce distress or promote satisfaction, further perpetuating the compulsive cycle.

As a whole, this program of research suggests that appraisals of responsibility and harm, goals, and termination criteria play an important role in washing and checking behaviours. Although the leading cognitive model of OCD places primary emphasis on obsessions as preceding and instigating compulsive behaviours, a large amount of the variance within compulsive behaviours could be influenced by factors that come into play as a compulsive behaviour is initiated and completed. Thus, focusing on influential psychological and behavioural factors

during the completion of compulsions yields information crucial to understanding and treating OCD.

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Introduction

Obsessive-Compulsive Disorder (OCD) is a severe and persistent mental health problem estimated to be one of the top 20 causes of illness-related disability for individuals aged 15 to 44 years old (World Health Organization [WHO], 2001). As OCD significantly impairs quality of life in several domains, including the ability to work, perform household duties, maintain social relationships, and take pleasure in leisure activities (Eisen et al., 2006; Norberg, Calamari, Cohen, & Riemann, 2008), the American National Comorbidity Replication Survey Replication identified OCD as the anxiety disorder with the highest proportion of serious cases (50.6%; Kessler et al., 2005). Research suggests that this disorder will afflict 2.3% of the population at some point in their lifetime (Ruscio, Stein, Chiu, & Kessler, 2010).

As defined in the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013), OCD is characterized by the presence of obsessions, defined as unwanted and recurrent, intrusive ideas, images, or impulses, and compulsions, defined as repetitive behaviors or mental acts that are intended to reduce the anxiety evoked by obsessions and/or prevent a dreaded event or outcome. Common obsessions include persistent thoughts of germs or contamination, fears of accidentally harming another individual (e.g., hitting a pedestrian while driving), or doubting whether one has completed an action such as locking a door or turning off the stove (Clark & Purdon, 1999). Typical compulsions include excessive washing and cleaning, repeated checking (e.g., checking doors and

appliances), counting, or arranging and rearranging items. The most common compulsions are washing and checking compulsions (Rachman, 2002).

In understanding OCD, it is important to recognize that the majority of healthy individuals report experiencing fairly frequent unwanted and unpleasant thoughts (Clark, 1992; Rachman & deSilva, 1978; Purdon & Clark, 1993). Similarly, Muris, Merckelbach and Clavan (1997) found that that 54% of the healthy adults they surveyed reported engaging in repetitive behaviours such as checking, washing, and superstitious acts, even though they recognized them as unnecessary and/or excessive. Therefore, it is not simply the experience of intrusive thoughts or repetitive behaviours that separates those with OCD from the majority of the adult population. This raises the question: what accounts for the fact that obsessional thoughts and repetitive behaviours are common but clinically severe OCD is rare?

Current Models of OCD

Leading models of OCD assert that a critical determining factor is the way in which intrusive thoughts are interpreted (Salkovskis, 1989). Salkovskis (1989) proposed that when an intrusion occurs its implications and the necessity of further action will be evaluated. If the intrusion is appraised as having few or no implications, as is the case for most individuals, then further processing of the intrusion is unlikely. However, in those vulnerable to developing OCD, intrusive thoughts activate concerns about the safety or well-being of oneself or loved ones combined with an overvalued sense of responsibility to protect oneself and others from harm, and thus evoke anxiety (Rachman, 2002; Salkovskis, 1989). There is now

a large body of research that supports the idea that those with OCD report significantly higher levels of personal responsibility for harm than both anxious and non-anxious controls (e.g., Coughle, Lee, & Salkovskis, 2007; Foa, Sacks, Tolin, Prezworski, & Amir, 2002; Freeston, Ladouceur, Gagnon, & Thibodeau, 1992; Salkovskis et al., 2000).

In addition to experiencing distress due to a heightened sense of responsibility for harm, individuals with OCD often interpret obsessive thoughts as potentially revealing of negative aspects of the self (e.g., “These thoughts mean that I am damaged, wicked, likely to harm others”; Clark & Purdon, 1993; Rachman, 1993; Salkovskis, 1985; 1999). Additional beliefs and negative appraisals that might contribute to distress resulting from obsessions include inflated estimates of the probability and severity of harm, perfectionism and intolerance of uncertainty, and overestimation of the importance of thoughts (Obsessive Compulsive Cognitions Working Group, 2005).

Such beliefs and negative appraisals of intrusive thoughts evoke significant distress and anxiety and indicate to the individual that there is a need for action, both to reduce distress and to mitigate any perceived danger to the self or others (Salkovskis, 1989). As such, the individual engages in a corrective behaviour. For example, an individual who has intrusive thoughts of contaminating others might wash her hands to prevent the spread of contamination and vindicate herself of any responsibility for harm resulting from contamination. Within this context, the reasoning behind safety-focused behaviours is easily comprehended.

However, although it seems logical that the distress evoked by obsessions results in corrective or neutralizing behaviours enacted to prevent harm or discomfort, it is not clearly understood why individuals with OCD often repeat these behaviours well beyond what would be considered effective by most. For example, individuals with OCD may check to make sure a task has been done correctly as many as 150 times consecutively or take a three-hour shower each morning (MacDonald & Davey, 2005; Rapoport, 1991). For more than two decades, much of the research conducted on OCD has examined the content and beliefs involved in obsessions and intrusive thoughts while there has been relatively little work examining compulsions.

Obsessions versus Compulsions

One reason for this lacuna in the literature is that obsessions may have historically been regarded as a more important component in the OCD model. In the DSM 5 conceptualization of OCD, which varies little from that found in previous editions of the DSM, compulsions are defined solely in the context of their relation to obsessions: repetitive behaviors or mental acts that are intended to *reduce the anxiety evoked by obsessions and/or prevent harm* (APA, 2015). If we view obsession-related distress and fear as the driving force of compulsions, a focus on obsessions is rational: if one can eliminate the distress or threat evoked by obsessions then this renders the compulsions irrelevant.

Indeed, the frontline treatment for OCD, exposure and response prevention (ERP), is based on the principle that if individuals are exposed to their obsessions

repeatedly, without being allowed to engage in compulsive behaviours, they will habituate to the obsessions and the fear response will extinguish, thus also eliminating the need to engage in compulsions (Rowa, Antony, & Swinson, 2007). However, although this treatment is the most effective treatment to date for OCD, outcome research examining ERP has indicated less than impressive treatment results with little to no improvement over the last 20+ years.

A recent meta-analytic study of 37 RCTs published between 1993 and 2014 found that the treatment dropout rate for ERP was 19.1% when delivered alone and 15.5% when combined with a cognitive therapy component (Öst, Havnen, Hansen, & Kvale, 2015). With respect to those who completed treatment, on average, 35% of individuals failed to respond to ERP alone and 37.6% failed to respond to ERP combined with cognitive therapy (Öst et al., 2015). Given these results, at least 53% of individuals are likely not benefitting from our gold standard treatment. Previous reviews have reported similar results (Abramowitz, 2006; Fisher & Wells, 2005). Therefore, there is still considerable opportunity for improvement in treatment efficacy, and this is likely to be accomplished through expanding our understanding of OCD. Current models of this disorder may be overlooking relevant factors that contribute to the persistence of OCD and hinder the effectiveness of treatment. We propose that in-depth examination of compulsive behaviours is one underutilized method of identifying such factors.

Why focus on compulsions?

Findings from a growing body of research examining the phenomenology of compulsive behaviours provide compelling reasons to continue expanding the scope of OCD research to include a focus on the unique aspects of compulsive behaviours. For example, Hinds and colleagues (Hinds, Woody, Schmidt, Ameringen, & Szechtman, 2015) found that individuals diagnosed with OCD and non-patient controls did not differ in their reported motivation to act to ensure security after being exposed to cues for potential danger; however, they did differ significantly in the degree to which this desire decreased after engaging in security-promoting behaviours. It was found that 90 seconds of checking for the presence of a potentially serious mistake in a medication sorting task by those diagnosed with OCD was experienced as being as no more effective than 90 seconds of *not* checking by healthy controls (Hinds et al., 2015). The researchers presented this as evidence that OCD is not defined by disordered hypersensitivity to obsessive thoughts and danger cues, but rather represents a dysfunction in the ability to terminate safety-focused behaviours once these behaviours are initiated.

In parallel to these results, in-vivo investigations of compulsions conducted by Purdon and colleagues have also yielded intriguing findings. A diary-based study of 22 individuals diagnosed with OCD found that whereas distress resulting from obsessions predicted the desire to complete compulsions, it surprisingly did not predict the duration or number of repetitions of compulsive behaviours and did not

predict individuals' feelings of certainty upon the completion of compulsive episodes (Bucarelli & Purdon, 2015).

Therefore, although obsessions may trigger the desire to engage in safety-focused behaviours, it appears that additional factors influence the nature of these behaviours. Indeed, research has begun to make salient the possibility that the mental and physical actions involved in conducting compulsions could influence the prolonged or repetitive nature of these behaviours.

Factors Moderating Compulsive Behaviours

Inflated Sense of Responsibility

As previously stated, research has demonstrated that those with OCD report an inflated sense of responsibility for harm associated with potential negative consequences of their obsessions (Cogle, Lee, & Salkovskis, 2007; Foa et al., 2002). This fear of being held responsible for harm is thought to yield compulsive behaviours (Salkovskis, 1989; Rachman, 2002; 2004). However, it has also been suggested that engaging in compulsive behaviour might serve to further increase estimates of personal responsibility (Rachman, 2002). Research has shown some preliminary evidence for this: after engaging in a check for safety, participants diagnosed with OCD reported an increase in perceived personal responsibility (Rachman, 2002). Additionally, Bucarelli and Purdon (2015) found that increased attention to threat during checking behaviours was associated with increased estimates of responsibility following the check. Therefore, an inflated sense of

responsibility may not only contribute to the onset of compulsive behaviours but also might be maintained or heightened through these behaviours.

Confidence in Memory

At the same time, there is also a growing body of research examining the role of memory in perpetuating compulsive actions. Initial research in this area explored whether compulsions persist because people with OCD have functional impairments in memory. The findings from this work have been very mixed (e.g. Harkin & Kessler, 2011; Hermans et al., 2008). When OCD relevant stimuli are used to test memory, several studies have found no differences between those with OCD and controls (e.g., Ceschi et al., 2003; Tolin et al., 2001; Karadag, Oguzhanoglu, Ozdel, Atesci, & Amuk, 2005). Some studies have also found that those with OCD show a memory bias towards threat related stimuli (e.g., which objects were contaminated, how many times they touched the stove), such that they showed significantly more accurate recall for these stimuli than neutral stimuli (Ceschi, Van der Linden, Dunker, Perroud, & Brédart, 2003; Radomsky, Rachman, & Hammond, 2001). Therefore, current support for the theory that those with OCD are simply forgetting previously enacted safety behaviours is weak. Rather, it is now generally accepted that the problem in OCD is not impairment in memory accuracy but rather strong memory distrust and poor confidence in memory for objects, words and sentences, and actions (Karadag, 2005; Macdonald, Antony, Macleod, & Richter, 1997; McNally & Kohlbeck, 1993; Tolin et al., 2001). This lack of confidence has been observed

particularly in those who engage in checking behaviours, and would quite logically contribute to the desire to repeat actions (Abramowitz et al., 2014).

However, as Tolin, Abramowitz, Brigidi, & Foa (2003) observed, other disorders such as depression, generalized anxiety disorder, or traumatic brain injury might also be associated with decreased confidence in memory; however, compulsive checking or washing is not often observed in those with a diagnosis other than OCD. Tolin et al. (2003) proposed that an important additional factor in the model is intolerance of feelings of uncertainty. They found that those diagnosed with OCD who engaged in checking or repeating rituals also reported significantly higher intolerance of feelings of doubt or uncertainty than those without an OCD diagnosis. Therefore, low tolerance of distress resulting from doubt regarding whether an action has been completed properly could contribute to compulsive patterns of behaviour. Tolin et al. (2003) suggest that this could be an important aspect of treatment for OCD.

Degradation of Memory Quality

Additionally, the factors contributing to memory distrust in those with OCD could differ in meaningful ways from those influencing individuals with other diagnoses. For example, the paradoxical impact of repetition may have a significant influence on compulsive cycles. Research in this area has suggested that one possible explanation for memory distrust may be that the quality of the memory of having completed an action degrades across repetitions, as does confidence that the action has been completed as desired. There is a growing body of research that has

consistently found that repeating an action actually compromises rather than enhances memory. When people repeat an action (for example checking to see whether the burners on a stove are turned off) they report reduced vividness and detail of their memory for the action and reduced memory confidence (Boschen & Vuksanovic, 2007; Coles, Radomsky, & Horng, 2006; Cogle, Salkovskis, & Wahl, 2007; Hermans et al., 2008; Linkovski et al., 2015; Van den Hout & Kindt, 2003). Indeed, it was demonstrated that after 2-5 checks of a fully functioning electric stove, individuals already show memory deterioration of the checked stimuli (Coles, Radomsky, & Horng, 2006). Therefore, engaging in repeated actions appears to be markedly counterproductive, degrading the quality of the memory it is intended to improve.

One explanation for this phenomenon is that as the number of repetitions increases, aspects of the action(s) involved start to be processed automatically rather than deliberately and thus fewer cognitive resources are devoted to encoding specific details of the action, resulting in decreased vividness and clarity of memories (Van den Hout & Kindt, 2003). This erosion of memory clarity may in turn lead to distrust of the memories, which would lead to repeated behaviour. In support of this hypothesis, Linkovski et al. (2015) found that repeated exposure to stimuli was not only associated with reduced memory confidence, but also resulted in reduced response inhibition and decreased reaction time in response to these stimuli, illustrating how familiarity can reduce deliberate processing of stimuli and contribute to automatic response styles. In a series of studies, Dek and colleagues

also found support for the theory that repeated checking reduces quality of memory and increases automatization of checking behaviours (Dek, van den Hout, Giele, & Engelhard, 2014; Dek, van den Hout, Engelhard, Giele, & Cath, 2015). Finally, Giele and colleagues (2016) reported that OCD-like repetition of a word resulted in dissociative-like uncertainty regarding whether the word was related to another target word. This result was also more pronounced in an OCD sample in comparison to a non-clinical control group. Therefore, increased repetition may strengthen familiarity and automaticity, but reduce meaningful processing, which paradoxically would inhibit encoding of the fine-grained details that might be relied upon to ensure confidence in a memory.

Furthermore, confidence in memory also appears to be susceptible to contextual factors such as the degree of personal responsibility for preventing harm. For example, the greater the feeling of personal responsibility for completing a checking task “properly”, the lower the confidence in memory reported (Moritz et al., 2007; Radomsky et al., 2001). As such, a number of factors may interact to foster doubts and uncertainty during the completion of a compulsive episode, leading to the repetition of behaviours, which paradoxically undermines the quality of and confidence in memories used to assuage these areas of concern.

Of note, research suggests that the paradoxical effects of repetition extend beyond quality and confidence in memory (Nedeljkovic & Kyrios, 2007). Similar findings have also been reported in terms of confidence in attention and perception. Those with OCD have been found to report lower levels of confidence in their

attention, or, their ability to maintain focus during a task (Hermans, Martens, De Cort, Pieters, & Eelen, 2003; Hermans et al., 2008). As well, confidence in attention has been found to decrease with repeated behaviour (Hermans et al., 2003; 2008). Those with OCD also demonstrate distrust in their senses, questioning, for example, if they can trust what they have seen or what they have felt (Hermans et al., 2008). In a series of studies, van den Hout and colleagues (2008) also found that in a nonclinical sample, perseverative staring was associated with poorer confidence in sensory perception and appeared to induce dissociation. They found this effect occurred after as little as 30s (van den Hout et al., 2009). Likewise, Taylor and Purdon (2016) found that prolonged washing time following contact with a contaminant was associated with decreased confidence in one's senses (e.g., what one had seen or felt) following the wash. This doubt in attention and perception may further increase individuals' doubt regarding whether compulsions have been completed adequately, leading them to detrimentally prolong or repeat a compulsive behaviour in order to gain confirmation.

Behavioural Parsing

Another factor that may be contributing to this reduced confidence in memory is the parsing of compulsive behaviours into many individual units (Boyer & Lienard, 2006). Individuals can describe behaviours at different levels of specificity. For example, one could reduce getting dressed into putting on pants, putting on a shirt, and then putting on socks and shoes; that is, three actions. Or this unit of behaviours could be described at a much more specific level, involving a

higher level of detail: picking up our shoe, inserting our foot into the shoe, tying the laces, etc.: multiple actions. When describing behaviour, most individuals would describe the behaviour in terms of larger units of behaviour rather than including specific details (Boyer & Lienard, 2006). However, research suggests that those with OCD split compulsive behaviour at a lower level (Boyer & Lienard, 2006). Rather than just “washing my hands”, the behaviour becomes reduced into many steps such as “placing my hand on the tap, turning on the tap, ensuring that the water is a specific temperature, placing my hand in the water, further adjusting the temperature, squeezing soap onto my hand, etc.” It is posited that this low-level parsing might “swamp” working-memory, thus providing temporary relief from intrusive thoughts and associated anxiety. As well, in addition to consciously considering the steps involved in a ritual at a more detailed level, those with OCD often include many non-functional or unnecessary actions in the completion of tasks such as washing one’s hands or checking that a door is locked (e.g., Eilam, Zor, Fineberg, & Hermesh, 2012; Zor, Hermesh, Szechtman, & Eilam, 2009; Zor et al., 2009). Thus when completing a compulsive ritual there are many more steps to attend to, each of which must be executed properly and remembered, which could also heavily tax working memory. As the individual may have difficulty holding all steps in memory, this could contribute to doubting whether the compulsive behaviour has been executed correctly, ultimately leading the individual to repeat the behaviour in an attempt to gain confirmation (Boyer & Lienard, 2006).

Style of Decision Making

Behavioural parsing is not the only factor that may increase working memory load for those with OCD. When we make decisions of low personal importance, our decision-making is quite automatic (e.g., choosing which pair of black socks to wear). However, when we make a decision that has high personal importance (e.g., buying a house), the decision-making processes becomes much more deliberate and conscious. This level of processing requires many more cognitive resources. As those with OCD are more likely to report an increased sense of personal responsibility for preventing harm and are likely to have higher estimates of the severity and probability of harm, it follows that determining when to stop a behaviour enacted to ensure safety will be of higher significance to those with OCD. In support of this, research has shown that when deciding whether to terminate a safety behaviour, people with OCD exhibit a more deliberate and conscious reasoning style, whereas for those without OCD the decision to stop a behaviour such as hand-washing is much more automatic (Wahl, Salkovskis, & Cotter, 2008).

When the personal importance of a decision is perceived as high, a decision is made more purposefully and consciously and we also generally take into account more information before coming to a decision. Therefore, if individuals with OCD are treating the decision to terminate a behaviour as deliberate and conscious, they may take into consideration more information when determining when to stop that behaviour. Consistent with this, in a laboratory-based study, individuals with OCD

required more evidence that a behaviour had been completed “properly” than did those without OCD (Wahl et al., 2008). Thus, they brought a greater number of criteria (e.g., auditory, tactile, visual, cognitive) to bear on the decision to stop a behaviour than did healthy controls. Therefore, it is possible that individuals with OCD rely on maintaining a greater number of factors in working memory, further increasing cognitive load, and potentially contributing to lower confidence in memories.

O’Connor and Robillard (1995) also suggested that individuals with OCD might erroneously confuse imagined possibilities with actual probabilities. They suggested that this is a result of inferences in which the individual dismisses actual evidence (e.g., “the door handle looks and feels relatively clean”) and instead searches for any possible support for their obsessive beliefs (e.g., “but there may be contaminants that I can’t see or detect on it”). This results in the development of a narrative that encourages engaging in compulsive behaviours in order to avert imagined negative outcomes and/or reduce distress. However, as the individual is responding to an imagined scenario, there is an absence of objective evidence by which to judge whether or not harm has been averted, resulting in reliance on extraneous cues such as anxiety reduction in order to determine when to terminate the compulsive ritual. Additionally, O’Conner and Robillard (1995) note that the OCD client fears not what they can see but what they *can’t* see. As such, these individuals are not only working with the evidence in front of them, but also with a wide range of imagined and unobserved scenarios and sources of information.

Again, this increases the burden on working memory, adding to the complexity of information that must be held in mind and carefully processed and assessed.

Reliance on Subjective Criteria

A lack of trust in perception, memory, and attention, as well as erroneous inferences, may also contribute to a reliance on subjective criteria to determine when to stop a behaviour. The cognitive behavioural model of OCD suggests that in response to the fear of harm or fear of being held responsible for harm, individuals use counter productive stopping criteria where they seek to achieve a particular subjective state in order to determine that they have correctly completed a behaviour (Salkovskis, 1999). It has been suggested that this subjective state is a feeling of completeness and of feeling “just right” (Salkovskis, 1999; Wahl et al., 2008). However it is much harder for an individual to evaluate these subjective states in comparison to relying on objective sensory input, and therefore it takes longer to determine when to terminate a behaviour (Salkovskis, 1999; Wahl et al., 2008). Research supports this, and has found that those who engage in compulsive behaviour rely on internal, subjective criterion such as a general sense of feeling clean, as opposed to objective, external criterion such as one’s hands looking clean and not being sticky any more, to determine when to terminate compulsive behaviours (Wahl et al., 2008).

Reliance on a “Feeling of Knowing”

Related to the use of subjective criteria is Szechtman and Woody’s (2004) concept of the “feeling of knowing”. Their Security Motivation Theory emphasizes

that the fears present in OCD are focused on potential rather than imminent threat (for example, that someone will contract a disease because you did not wash your hands). However, it is difficult to determine when a potential danger has passed, as it is not tied to any real stimulus in the environment. Therefore, it is difficult or impossible to obtain external confirmation that there is no potential danger.

Szechtman and Woody (2004) proposed that, in the absence of objective and explicit information we terminate our response to potential threats through an internal, implicitly generated feeling of knowing that is evoked through engaging in preventative/corrective behaviour. This feeling of knowing allows us to terminate thoughts, ideas, or actions that are motivated by concerns of potential harm to the self or others.

Szechtman and Woody (2004) suggested that those with OCD might not experience this feeling of knowing. Although they may know intellectually that there probably is no threat, the knowledge may not be accompanied by a subjective feeling of knowing that the threat has passed or is negligible. As such, they suggested that a subjective feeling that something is wrong haunts those with OCD. Research conducted by Woody and colleagues (2005) supported this hypothesis. They hypnotized participants and told half that they would experience the regular feeling of satisfaction after washing their hands and half that when they washed they would feel little or no sense of satisfaction. It was found that those high in hypnotizability who were told that they would feel little or no satisfaction washed the longest, indicating that this sense of satisfaction is important to the termination

of safety behaviours. This is also consistent with previously cited research by Wahl and colleagues (2008), which found that people who engaged in repetitive washing tended to rely on internal, subjective criteria (e.g., I feel clean, I have done it 10 times) as opposed to external, objective criteria (e.g., my hands look clean and no longer feel sticky; I have washed according to public health guidelines) to determine when to stop. In addition, this theory is consistent with the idea that safety behaviours are repeated when the person's sense of responsibility for preventing harm is excessively high, which changes the goal of very simple tasks, such as washing one's hands, from being rather minor (e.g., get rid of the dirt) to very major (e.g., prevent my family from getting a serious disease). When the stakes are high, we require a high degree of certainty that the behaviour has, indeed, averted harm before the behaviour can be stopped. Therefore, those with OCD may strive to achieve an even greater internal feeling of certainty than the average person in order to terminate safety behaviours.

The Larger OC Model

In summary, as illustrated in a review paper by Purdon (2018), putting all of these components together creates a self-perpetuating cycle wherein an inflated sense of responsibility for preventing harm, exaggerated estimates of the probability and severity of harm, and negative interpretations of intrusive thoughts may lead those with OCD to feel the need to engage in safety behaviours in response to obsessions. When these individuals engage in such behaviours they are likely to parse the behaviour into many individual steps, use a decision-making style that is

suiting to making decisions of high personal importance, attempt to satisfy many criteria to determine that the behaviour has been performed correctly and effectively, and rely on subjective evidence to determine if these criteria have been satisfied. Due to the load this places on working memory, they may doubt their memory of having completed the behaviour properly. They may also doubt their ability to maintain focus during the behaviour and might also question their perception and sensory input. As such, the behaviour is likely to be repeated as the individual attempts to gain certainty that it has been completed well enough to prevent harm or attempts to achieve satisfaction or a “just right” feeling. However, paradoxically, once the behaviour is repeated, the individual is likely to perceive an increased level of personal responsibility for preventing harm, increase their estimates of the probability and severity of potential harm, experience decreased confidence in their memory, attention, and perception, and further tax their working memory. Thus leading to additional repetition of the behaviour, perpetuating an insidious cycle.

Of importance, in this model a large amount of the variance within compulsive behaviour could be accounted for, not by distress evoked by the obsession, but by factors that come into play only after the compulsive behaviour has been initiated. Thus, focusing on influential psychological and behavioural factors during not only epochs of obsessional thought, but also during the completion of compulsions could yield information crucial to understanding and treating OCD.

Furthering Existent Research

While research to date has demonstrated preliminary support for the role these factors might play in the persistence and repetition of compulsive behaviours, many questions remain. For example, while research suggests that those with checking and washing compulsions have more difficulty achieving a sense of security and safety than those without OCD (Hinds, Woody, Van Ameringen, Schmidt, & Szechtman, 2012), it has been found that those with OCD were able to achieve “the right feeling” or the feeling that a compulsive behavior had been completed “properly”, 53% of the time (Bucarelli & Purdon, 2015). What accounts for this ability to achieve satisfaction in the performance of their safety behaviours and/or their outcomes only half of the time? Likewise, those with OCD often display concerns or compulsive behaviours only in specific domains. An individual might meticulously avoid contamination from elevator buttons and handrails in public places, but if needed can pick up her child’s toys from the ground and brush off dirt (O’Connor, Aardema, & Pelissier, 2005). Therefore, the ability to achieve feelings of security and safety does not appear to be globally dysfunctional in those with OCD. If this is the case, what accounts for deficits in this ability in specific OCD-related domains?

One potential variable is predictions of personal responsibility for harm. Taylor and Purdon (2016) examined hand-washing behaviour in undergraduate students low and high in fears of contamination under conditions of low or high potential responsibility for harm. It was found that wash duration predicted post-

wash certainty that the wash had prevented harm, but only in those who were high in fears of contamination, and that effect varied according to responsibility levels: longer wash duration predicted greater certainty under conditions of low responsibility but predicted less certainty under conditions of high responsibility. These findings support the existence of factors that could account for the fact that the self-perpetuating mechanisms of repetition and doubt are not activated across all circumstances — even those within a specific area of obsessive concern. Therefore, further research examining such factors is of value.

The importance of further research is also made salient when we consider that much of the research to-date has been completed using checking tasks has involved lab studies that may lack ecological validity. For example, many studies have used a computerized stove to complete a checking task (e.g., Boschen & Vuksanovic, 2007; van den Hout & Kindt, 2003). Additionally, research on cognitive factors related to washing behaviours has relied heavily on questionnaires rather than behavioural measures (e.g., Taylor, Abramowitz, & McKay, 2005; Tolin, Brady, & Hannan, 2008; Wheaton et al., 2010). As Radomsky and Rachman (2004) described, when studying factors that might influence compulsive behaviour (e.g., memory), it is crucial to use stimuli that are of relevance and importance to the individuals involved in the study. Tasks such as computerized or simulated in-lab experiences might not evoke the levels of anxiety, responsibility, or distress that individuals experience on a daily basis when interacting with objects and situations that hold high personal significance. As well, the constraints present in real world

contexts (e.g., others interrupting compulsions, time limitations due to personal scheduling) might cause the factors of interest to vary; therefore, data collected using the most naturalistic paradigms possible is of high importance.

A second lacunae in our understanding of compulsions that has resulted from conducting the majority of the current research in a laboratory setting is that we know very little about the general, natural phenomenology of compulsive behaviours. For example, how long do compulsions typically last? Are people able to accurately estimate the duration of their compulsive episodes? How many times is a compulsion typically repeated? Do people tend to repeat the whole compulsive act, only certain parts of the behaviour, or simply prolong compulsive behaviours? Gathering descriptive data on compulsions *in vivo* would allow for a more nuanced understanding of the phenomenology of these behaviours.

Additionally, although research on compulsions has increased in the past decade, this research has focused almost exclusively on repeated checking. Findings from the research on repetitive checking may not generalize completely to repetitive washing (Jones & Menzies, 1997; Lopatka & Rachman, 1995; Rachman, 1993). Some studies examining washing have found results similar to those observed with checking behaviours. For example, Fowle and Bosch (2011) found that repeated washing was associated with poorer confidence in memory for the details of the items washed. However, other studies examining washing behaviour have found results that were specific to those with contamination-related

obsessions and not those with checking-related OCD (Hinds et al., 2012; Wahl et al., 2008). Likewise, studies examining checking behaviour have found results specific to those who check compulsively but not those who wash compulsively (Hinds et al., 2015). As such, it is of value to examine washing episodes as a unique compulsive behaviour and explore whether the findings previously discussed extend to this category of compulsions.

There are several areas of interest when differentiating washing compulsions from other compulsive behaviours. For example, whereas we know that people who check repeatedly rely on their memory for the check to determine whether or not it was completed correctly, we do not know if people who engage in repeated washing do the same. It is possible that memory confidence is less important to repeated washing than confidence in one's senses ("I don't see any dirt but can I trust my eyes?" or, "my hands feel really raw, so maybe I washed enough but what if my skin is overly sensitive?"). Wahl et al. (2008) examined stop rules in people with OCD who had washing compulsions as compared to a group of people with OCD without washing compulsions and a group of healthy controls, using interview, self-report, and in vivo observation. As hypothesized, they found that people with washing compulsions uniquely reported a greater reliance on internal criteria than the other groups across the three assessment modalities. Similarly, Taylor and Purdon (2016) found that when individuals contaminated and then washed their hands, wash duration did not predict memory confidence. However, when individuals who reported high fears of contamination were placed in a high responsibility situation

after contaminating and washing their hands, increased wash duration predicted decreased sensory confidence following the wash.

Research does indicate that people who engage in repetitive washing, but not repetitive checking, exhibit a memory bias for sources of contamination (Ceschi et al., 2003; Radomsky & Rachman, 1999). Therefore, it may be the case that whereas people who engage in repetitive checking rely on their memory for contextual *safety* cues (e.g., the burner light being off), repetitive washers may rely on their memory for the *sources of contamination* (e.g., “I touched that dirty plate and that soiled cloth; have I washed enough to rid myself of the germs they would possess? Am I sure those are the only ‘dirty’ items I touched?”).

Additionally, Lopatka and Rachman (1995) suggested that in comparison to compulsive checking, “distortions of responsibility play a lesser role in compulsive cleaning” (p. 673). Results from Taylor and Purdon (2016) partially supported this claim and demonstrated that in a sample of university students, after participants contaminated their hands, estimates of harm were a significant predictor of the duration of individuals’ subsequent hand-washing behaviour while estimates of potential responsibility for this harm were not. This result was consistent across those low and high in reported fears of contamination. However, a general overvalued sense of responsibility, as measured by the Obsessive Beliefs Questionnaire (OBQ-44), predicted wash duration across all participants regardless of their degree of concern regarding contamination. Furthermore, as previously stated, in this study responsibility was found to interact with concerns regarding

contamination to predict feelings of certainty following washing. Therefore, it appears that responsibility does play an important role in washing behaviour; however, this role might depend on specific contamination concerns and/or trait rather than state valuation of personal responsibility.

An additional important phenomenological factor includes the criteria individuals use to determine when to stop a compulsive behaviour (i.e. termination criteria). Researchers have observed that there is value in understanding not just why compulsive behaviours are initiated, but also how and why they are terminated (Salkovskis, 1999; Whal et al., 2008). What are the requirements for determining when to stop a compulsive episode? If a sense of certainty is the goal state, questions include: in what areas and to what extent do individuals attempt to achieve certainty? For example, individuals might seek certainty that harm has been prevented, certainty that they would not be responsible should harm occur, or certainty that the compulsion was completed perfectly according to other rules. Moreover, does the level of certainty required before being able to terminate an action vary (e.g., 90% versus 100% certainty)? If so, what factors influence it? For example, do we require greater certainty when the consequences are more extreme, or when we, rather than others, would be responsible for the consequences?

Similarly, both phenomenology and termination criteria may be influenced by how individuals define the goal of their compulsive behaviour. For example, individuals may define the goal of washing in very specific terms (e.g., to get my hands clean) or very global terms (e.g., to protect preschoolers from a harmful

illness). Additionally, research in the areas of learning, task mastery, and motivation has demonstrated that the valence of goals held in mind when learning and completing tasks influences psychological and behavioural approaches to the task (see Elliot, 1999 for a theoretical review). For example, whether one frames a goal in terms of approaching a desirable outcome versus avoiding a negative one could impact how they think about and approach a task. To our knowledge, studies have yet to examine goal definition and its influence on the duration and repetition of compulsive behaviours or on types and degree of certainty required for termination.

Given these remaining questions when reviewing the literature in this area, we believe that research that examines compulsive behaviours within a naturalistic environment and that considers the phenomenology of compulsive behaviours other than checking is of great value. Gathering basic phenomenological data and information about factors that influence compulsive behaviour both inside and out of the lab will help us to identify where people get “stuck” in compulsions and pinpoint the associated contextual factors. This data has significant implications for both future research and clinical treatment.

Overview of the Present Research

The purpose of the present dissertation was to further elucidate the factors that influence the decision to repeat or prolong safety-focused behaviours. To do so, we conducted two studies that examined the cognitive and behavioural components of safety-focused behaviours and rituals. Study 1 examined hand washing behaviour within an analogue sample of undergraduate students, preselected for self-reported

high and low fears of contamination. Study 2 examined washing and checking compulsions within a sample of community members who met criteria for a diagnosis of OCD. Through the use of video recording, self-report questionnaires, and digital diary entries, we gathered rich phenomenological and psychological data on washing and checking compulsions.

Study 1

The goal of this study was to explore what factors predict engagement in repetitive safety behaviours beyond the point of necessity. The relationship between repeated behaviours and psychological factors, including memory and sensory confidence, perceived responsibility, and certainty was examined across individuals low and high in fears of contamination who either contaminated their hands or did not, prior to either preparing a gift bag for preschoolers or sorting paper. Including a variety of experimental groups and conditions allowed us to explore hand washing under a variety of contexts. In all conditions, participants were invited to wash their hands however they would like, for as long as they would like, should they wish to wash prior to completing the gift-bag or paper task. Participants were also invited to wash their hands at any time while completing the paper or gift-bag task. Video recording was used to capture washing-behaviour and was coded for wash duration and repetition of behaviours. Participants were administered several self-report questionnaires throughout the study.

This naturalistic and relatively open design allowed us to examine the following research questions:

1. Who chose to wash their hands?
2. How long did individuals wash?
3. How many actions did individuals include in a wash?

With respect to phenomenology, we expected that those high in fears of contamination, those in the gift-bag condition, and those exposed to the contamination induction would be more likely to wash their hands and would wash for a longer duration. Further, it was anticipated that those high in fears of contamination, who were exposed to the sponge, and who completed the gift-bag would wash the longest. We expected that those in the high contamination fears group would be more likely to include additional actions in their wash, as found in previous research (e.g., Taylor & Purdon, 2016).

4. What predicts washing beyond 30 seconds?

The Ontario Ministry of Health and Long-term Care (2007) and Public Health Ontario (2009) suggest that approximately 15 seconds is an appropriate hand wash duration. In order to ensure that all participants were aware of the suggested duration of a hand wash, prior to washing their hands, participants were shown a video produced by Public Health Ontario that explicitly stated this recommendation. We identified that continuing to wash beyond twice the recommended duration (i.e., 30s) was a clear indicator of washing for longer than recommended from a health

and safety perspective. We predicted that those high in fears of contamination would be more likely to continue to wash beyond the recommended duration.

5. Did pre-wash estimates of harm and responsibility influence washing behaviour?

It was expected that pre-wash estimates of harm and responsibility would contribute to greater wash duration and that this effect would be more pronounced in the high contamination fears group.

6. Did wash duration effect post-wash appraisals of contamination, confidence, or certainty? Did wash duration have an ironic effect on post-wash appraisals?

Based on the existing literature, in which ironic effects of checking have been consistently observed, we predicted that greater wash duration would be associated with paradoxical increases in post-wash feelings of responsibility and estimates of harm. Additionally, we predicted that longer wash duration would be associated with decreased confidence in memory, attention, and/or perception.

7. How do individuals define the goals of safety-focused behaviours? Did this influence wash duration?

8. What criteria did individuals rely on to determine when to terminate their washing behaviour? Did termination criteria influence wash duration?

In summary, the purpose of the present study was

- a. to gather basic descriptive data on the phenomenology of washing behaviour under a variety of contexts within an OCD analogue sample and a control group;

- b. to examine pre- and post-wash appraisals of harm and responsibility across those low and high in fears of contamination and better understand the relationship between these appraisals and washing behaviour; and
- c. to examine goals and termination criteria held in mind while washing and explore the relationship between these goals and criteria and washing phenomenology.

Method

Participants

A total of 235 participants (21% male) were recruited from a pool of university students at the University of Waterloo. Participants ranged in age from 16 to 41 ($M = 21.14$, $SD = 2.48$). Eligibility for participation in the current study was based on responses on the Concerns about Germs and Contamination subscale of the Dimensional Obsessive Compulsive Scale (described in the Measures section; Abramowitz et al., 2010). This subscale was completed as part of a set of pre-screening questionnaires administered to all students in the psychology studies pool. Individuals who scored within the established low or high ranges (described below) were eligible to complete this study. Those participants who scored more than 0.5 standard deviations below the reported non-clinical (student sample) mean (Abramowitz, 2010) composed the Low Contamination Fears group (LCF; $n = 126$; $M = 0.73$, $SD = 0.83$). Participants who scored greater than 0.5 standard deviations above the reported mean for those diagnosed with OCD (Abramowitz, 2010) were

identified as the High Contamination Fears group (HCF; $n = 109$; $M = 8.71$, $SD = 1.98$). These cutoffs were used to maximize the likelihood of gathering a representative analogue clinical sample and a non-clinical control sample and are consistent with those used by Taylor and Purdon (2016), allowing for comparison of results. Participants were also randomly assigned to the Contaminant Exposure Condition (CE) or Non-Exposure Condition (NE), and to Paper (P) or Gift-Bag (GB) Post-Wash Task conditions. A legend including all abbreviations used to describe the groups and conditions in this study is included in Appendix A. See Table 1 for a complete cross-tabulation of group sizes.

Measures

Please see Appendix A for a diagrammatic representation of the study procedure and timing of questionnaire administration.

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. For the current study, the Concerns about Germs and Contamination subscale score was used to pre-select participants who were either low or high in fears of contamination. The Concerns about Germs and Contamination subscale has shown

good internal consistency and convergent and divergent validity in both clinical and non-clinical samples (Abramowitz et al., 2010)¹.

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS is a 20-item questionnaire designed to measure positive and negative state affect. Participants are asked to use a 5-point Likert scale (*1 = very slightly or not at all to 5 = extremely*) to rate the extent to which they are currently experiencing ten positively valenced emotions and ten negatively valenced emotions. Each set of ten items is totaled to produce a positive affect scale rating and a negative affect scale rating. The PANAS has been widely used and has consistently demonstrated excellent psychometric properties (Crawford & Henry, 2010; Watson, Clark, & Tellegen, 1988). The PANAS positive and negative affect scales showed good internal consistency within our sample (Cronbach's alpha = .90 and .80 respectively).

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

¹ Due to the manner in which DOCS scores were collected in a questionnaire

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). This scale demonstrated excellent internal validity within the current sample (Cronbach's alpha = .95).

Fear of Guilt Scale (FOGS; Chiang, 2013). The FOGS was developed to measure individuals' fear of being regarded as guilty or experiencing feelings of guilt and their engagement in behaviours to minimize, prevent, or atone for guilt. Agreement with items is rated on a 7-point Likert scale. The 49 items can be summed to derive a total score and two subscale scores: Reactive Response and Proactive Response to the feared feeling of guilt. The scale has shown excellent internal reliability and good validity in an undergraduate sample (Chiang, 2013). This scale demonstrated high internal consistency within the current sample (Cronbach's alpha = .89).

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 was found to have excellent internal consistency within the current sample (Cronbach's alpha = .95).

Intolerance of Uncertainty Questionnaire (IUS-12)

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 demonstrated excellent internal consistency within the current sample (Cronbach's alpha = .92).

VAS Scales and Questionnaires

Electronic visual analogue scales ranging from 0 (*not at all/none*) to 100 (*very much/a lot*) were used to collect ratings of perceived hand contamination, disgust, the likelihood of harm, the predicted severity of any potential harm, how responsible and guilty the participant would feel if any harm were to occur, the participant's certainty in his or her memory of washing, the level of detail in the participant's memory of washing, the vividness of the participant's memory of washing, the amount of attention allocated to washing, the participant's certainty that his or her attention was allocated to washing, the reliability of the participant's sight, the participant's tactile reliability, and the participant's general sensory reliability.

Washing Variables

All videos were reviewed and coded for temporal aspects of hand washing by two raters who were blind to group/condition. *Wash Duration* was defined as the time

between the moment a participant began the first action in their wash (e.g., turning on the tap, pressing on the soap pump) and the moment they completed the last action in their wash (e.g., throwing out the last paper towel). There was almost perfect agreement on Wash Duration across the two raters (Cronbach's $\alpha = 1.0$), with the largest difference between the two coders being 2 seconds. Wash duration was averaged across the two coders to calculate the final Wash Duration score.

Additionally, in order to measure repetitions of washing behaviours we recorded the number of visits to the various objects and locations involved in hand washing. The spatial coding scheme was based on the work of Eilam and colleagues (2012), who suggested that the completion of rituals or tasks can be described in terms of the number of visits to and actions at the locations and objects involved in the ritual (e.g., the soap, taps, and towel involved in washing one's hands). In the present study, visits were defined as movement to and interaction with an object or location defined as part of the wash. Six objects and locations were defined as part of the washing rituals: the taps of the sink, the soap dispenser, the stream of water from the tap, the air in front of the participant (i.e. the space in front of the participant where participants held their hands while scrubbing or drying them), the paper towel dispenser, and the garbage. A visit was defined as touching the object (e.g., turning the tap) or moving within the location (e.g., scrubbing with hands in the air in front of the participant). Two raters who were blind to participant group and condition coded the number of visits in each wash. The

variable *Total Visits* was calculated by averaging the number of visits coded by the two raters. Inter-rater reliability for this variable was .95.

Procedure

Please see Appendix A for a flow-chart depiction of the study procedure and a legend of all acronyms used to describe study groups and conditions. Participants first provided informed consent for participation and audio and video recording and completed the OBQ, MACCS, and FOGS, followed by the baseline administration of the PANAS, and baseline administration of contamination, disgust, harm, and responsibility ratings (Appendix B). Upon completion of these measures, participants were advised of the post-wash task that they would be asked to complete. Those assigned to the Gift Bag (GB) condition were told that they would be given a variety of items and asked to create three gift bags that would be given to the young children in the onsite preschool. Those assigned to the Paper (P) condition were informed that they would be given a pile of papers and asked to sort them into piles for recycling and shredding. Participants were informed that they would have the opportunity to wash their hands prior to completing the task, should they wish. This marked the end of the pre-video instructions for the non-exposure (NE) condition. Participants in the contamination exposure condition (CE) were further informed that prior to the task, they would be asked to copy the experimenter's movements and rub their hands with a damp sponge that "may have come into contact with trace amounts of dirt, chemicals, or bacteria". All participants were asked to repeat the order of events back to the experimenter to

ensure correct understanding of the procedure (i.e., sponge task if applicable, opportunity to wash hands, gift bag or paper task).

Next, to ensure that all participants were aware of an appropriate hand wash duration according to standard health guidelines, participants were shown a video that described how to wash their hands according to Ontario Public Health guidelines. This video recommended that participants clean all surfaces of their hands and wash for approximately 15 seconds. Following the video, participants again completed VAS ratings of contamination, disgust, harm and responsibility (Appendix C).

Following the video, participants in the NE group proceeded directly to the wash phase of the study, described below, whereas participants in the CE group “contaminated” their hands. The experimenter picked up one of two damp sponges from a clean container and asked participants in the CE group to do the same. The experimenter then reminded the participant that the sponges “may have come into contact with germs, dirt, or bacteria” and asked the participant to copy her movements, proceeding to rub the front and back of her hands with the sponge in a set pattern. Participants then provided post-contamination VAS ratings of contamination, disgust, harm likelihood, and responsibility for harm (Appendix D).

All participants were then provided with the opportunity to wash their hands. If they chose to wash their hands, they were administered the pre-wash questionnaire (Appendix E). They were then invited to wash their hands however they liked, for as long as they liked. If the participants chose to continue washing for

longer than 30 seconds, they were asked about the goal of their hand wash and their motivation to continue washing their hands (Appendix F). Responses were recorded verbatim by the experimenter. Following the hand wash, participants were asked to complete the Post-Wash Questionnaire (see Appendix G).

Participants were then asked to complete either the gift bag or paper task. During this time, they had access to the sink and were allowed to wash their hands as often as they liked, however they liked. Each time a participant chose to wash their hands (i.e., any additional washes after the first wash), they were re-administered Pre-Wash and Post-Wash questionnaires.

Following the completion of the post-wash task, participants again provided VAS ratings of cleanliness, possibility of harm, responsibility, and memory and sensory confidence. They were asked several follow-up questions in order to gather input on study design and participant experience (see Appendix H) and were debriefed. Participants received one research participation credit for their psychology courses in appreciation of their time.

Results

Demographics

Participants had a mean age of 20.14 ($SD = 2.48$) and were 20.9% male. A 2 (Contamination Fears group; CF; Low vs. High) x 2 (Post-wash Task; Task; Gift Bag vs. Paper) x 2 (Contamination Induction; CI; Exposure versus Non-Exposure) ANOVA revealed no significant differences in age between CI groups, $F(1, 227) = 0.45, p = .51$ or Task groups, $F(1, 227) = 0.22, p = .64$. On average, those in the Low

Contamination Fears (LCF) group were slightly older than those in the High Contamination Fears (HCF) group, $F(1, 227) = 4.52, p = .04$ ($M = 20.46, SD = 2.33$ and $M = 19.77, SD = 2.61$, respectively). There were no significant two or three-way interactions. Chi-square tests also indicated that gender was distributed proportionally across groups (see Table 2 for descriptive statistics).

Baseline Differences

When completing the baseline measures, 13 individuals declined to answer a significant portion of the questions (defined as more than 30% of the questions necessary to calculate the subscale or total score), such that total and subscale scores could not be calculated. For the purposes of these analyses, those with more than 30% missing data were excluded from the analyses involving that total or subscale score. A total of 6 participants had missed one item on the OBQ or FOG. For these participants, scores were calculated using the remaining items. A logistic regression was used to analyze whether there were significant differences across the CF, CI, or Task groups in regard to missing data. There were no significant main effects or interactions, suggesting that there are not group differences in regard to which individuals declined to answer questions.

A series of 2 (CF group) x 2 (CI group) x 2 (Task group) ANOVAs was conducted on baseline affect, fear of guilt, intolerance of uncertainty, and OCD related beliefs. Means and standard deviations of baseline measures are presented in Table 2. With respect to baseline affect, PANAS scores did not significantly differ across groups. There was a slight overall difference in negative affect between CF

and Task groups; however, this difference was not present among those who chose to wash their hands and who were the primary focus of our analyses (see Appendix I for further discussion).

As our HCF group was selected on the basis of having attained DOCS scores greater than the average score for a clinical OCD sample, we expected that in comparison to the LCF group, the HCF group would demonstrate significant baseline differences on measures of cognitive appraisals such as fear of guilt and intolerance of uncertainty. The results supported this hypothesis and those in the HCF group had greater fear of guilt, negative beliefs about obsessional thoughts, and intolerance of uncertainty, and less confidence in their memory and cognitive processes than the LCF group (See Appendix I for discussion of analyses). Further, these observed differences between the HCF and LCF groups suggests that our HCF sample was an appropriate analogue sample for a clinical population.

Manipulation Check One: Contamination Appraisals

In order to determine whether the contamination induction in the CE group was successful in inducing an increased perception of contamination, we conducted a 2 (Contamination Fears group; high v low) x 2 (task; gift bag v paper sorting) x 2 (time; pre- v post-contamination, within Ss factor) mixed ANOVA on contamination ratings within the CE group. See Table 3 for analysis results.

There was a main effect of Time and a main effect of CF. There was no main effect of Task. These results were further qualified by a two-way interaction between Time and CF. There were no additional two- or three-way interactions. In

sum, the contamination induction was successful, and regardless of post-wash task, self-reported contamination ratings increased significantly from pre- to post-exposure. There was a marginally significant tendency for those in the HCF group to report greater feelings of contamination across time and to report a greater increase in self-reported contamination following the induction (see Appendix J for further discussion).

Manipulation Check Two: Task

We expected that participants in the Gift Bag (GB) condition would have higher ratings of responsibility for potential future harm and higher likelihood and severity of harm than those in the Paper (P) group. Similarly, it was predicted that those in the High Contamination Fears (HCF) and Contamination Exposure (CE) groups would assume greater responsibility for harm and predict greater likelihood and severity of harm than those in the Low Contamination Fears (LCF) and Non-Exposure (NE) groups. A possible three-way interaction was predicted such that those in the HCF, CE, and GB conditions would have the highest perceived responsibility for and ratings of harm.

Participants' pre-wash VAS ratings of Responsibility for Harm were analyzed using a 2 (CF group) x 2 (CI group) x 2 (Task group) ANOVA. One individual was missing a response to this item and their response was adjusted to the mean response for individuals in the same CF, CI, and Task group. Contrary to our prediction, there was no main effect of Task, $F(1, 227) = 0.24, p = .63, \eta_p^2 = .001$. Those assigned to the GB condition did not report greater feelings of responsibility

($M = 42.19, SD = 33.44$) than those in the P condition ($M = 44.10, SD = 35.75$). There was a main effect of CF such that those in the HCF group ($M = 56.39, SD = 32.31$) reported significantly greater feelings of responsibility for harm than those in the LCF group ($M = 31.75, SD = 32.48$), $F(1, 227) = 33.63, p < .001, \eta_p^2 = .13$. There was also a main effect of Contamination Induction such that those in the CE condition ($M = 50.38, SD = 34.96$) reported significantly greater feelings of responsibility for harm than those in the NE group (NE; $M = 36.39, SD = 32.97$), $F(1, 227) = 10.20, p = .002, \eta_p^2 = .04$.

Prior to being provided the opportunity to wash their hands, participants were also asked to rate the likelihood of harm occurring and the severity of the potential harm. For the purpose of this analysis, pre-wash ratings of likelihood and severity were combined and averaged to form the Harm Composite Score ($r(235) = .79, p < .001$). A 2x2x2 ANOVA was used to examine the effect of CF, Task and CI on these ratings (see Table 3).

As predicted, there was a main effect of Contamination Fear such that those in the HCF group had significantly higher pre-wash estimates of harm than those in the LCF group ($M = 73.29, SD = 55.09$ and $M = 33.86, SD = 43.83$ respectively; $F(1, 227) = 43.28, p < .001, \eta_p^2 = 0.16$). Similarly, those in the CE condition had significantly greater pre-wash estimates of harm than those in the NE condition ($M = 74.71, SD = 56.20$ and $M = 33.89, SD = 39.89$ respectively, $F(1, 227) = 55.69, p < .001, \eta_p^2 = 0.20$). There was no main effect of Task.

There was a significant interaction between Task and Contamination Induction, $F(1, 227) = 4.48, p < .04, \eta_p^2 = 0.02$. A t -test within each level of Task revealed that within both the GB and P conditions, those in the CE condition rated potential harm as significantly greater than those in the non-exposure condition. However, in the GB condition, the difference in ratings between CE and NE conditions was greater ($M_{\text{difference}} = 54.77$) in comparison to the P condition ($M_{\text{difference}} = 33.46$). There were no additional significant two-way or three-way interactions.

Therefore, consistent with our hypotheses, those in the CE/GB condition reported greater likelihood and severity of harm. However, Task did not seem to have unique effects on estimates of responsibility for harm or likelihood and severity of harm. Rather, high contamination fears and contamination induction were significantly associated with greater estimates of responsibility for harm and greater predicted harm regardless of post-wash task. Due to the fact that Task did not seem to influence pre-wash appraisals to a meaningful extent, we made the decision to collapse across Task conditions in analyses involving pre-wash appraisals.

Phenomenology

Who chose to wash?

The first goal of this study was to examine overt hand-washing behavior and covert processes that influence it, particularly the goal of the behavior and factors that influence the decision to repeat, persist, and terminate. All participants were given the opportunity to wash their hands before completing their assigned task. We expected that those in the HCF group, those in the GB condition, and those in the CE condition would be more likely to wash their hands. Of the 235 individuals who participated in this study, 75% ($n = 177$) chose to wash their hands when offered the chance to do so prior to completing the paper sorting or gift bag task. See Table 4 for a breakdown of hand-wash engagement across groups and conditions.

A logistic regression was used to examine how group differences predicted decision to wash pre-task. Contamination Fears, Contamination Induction, and Task were entered simultaneously as predictor variables. As expected, Task was a significant predictor of the decision to wash, such that those in the GB group were significantly more likely to choose to wash their hands prior to the task, $\text{exp}\beta = 4.88$, 95% CI = [2.40, 9.95], $p < .001$. Similarly, consistent with our hypothesis, Contamination Induction was a significant predictor of choosing to wash, such that those exposed to the contamination induction were more likely to choose to wash their hands, $\text{exp}\beta = 3.50$, 95% CI = [1.77, 6.93], $p < .001$. However, contrary to our predictions, Contamination Fears was not a significant predictor wash the decision to wash, $\text{exp}\beta = 1.63$, 95% CI = [0.85, 3.15], $p = 0.14$, such that those in the HCF group were not more likely to wash their hands. There were no significant two-way

or three-way interactions. Therefore, the decision to wash was influenced by contextual factors.

Participants were also provided the opportunity to wash their hands at any time while completing the paper sorting or gift bag tasks. Of the 235 participants, 23% ($n = 51$) chose to wash their hands during or after the gift bag or paper task. Of these 51 individuals, only 2 chose to wash their hands during task completion. One individual was in the Low Contamination Fears group and the other was in the High Contamination Fears Group. Both individuals were in the Contamination Exposure and Gift Bag conditions.

The remainder of these participants washed voluntarily *after completing* the gift bag or paper sorting task. A logistic regression was used to examine how group differences predicted decision to wash post-task. Contamination Fears, Contamination Induction, and Task were entered simultaneously as predictor variables. It was found that Task was a significant predictor of the decision to wash post-task, $\text{exp}\beta = 0.41$, 95% CI = [0.21, 0.79], $p = 0.008$. Those in the Paper condition were more likely to wash post-task than those in the Gift Bag condition. This is consistent with observations made during the study, with participants noting that ink from the papers often remained on their hands. Those in the High Contamination Fears group were slightly more likely to engage in a post-task wash than those in the Low Contamination Fears group, $\text{exp}\beta = 1.71$, 95% CI = [0.91, 3.25], $p = 0.096$. Those in the Contamination Exposure condition were not more

likely to wash post-task than those in the Non-Exposure Condition, $\exp\beta = 1.26$, 95% CI = [0.67, 2.38], $p = 0.476$.

How Long Do Individuals Wash?

We hypothesized that hand washing length would be predicted by experimental group. To test this hypothesis, a 2 (CF; High vs Low) x 2 (Contamination Induction (CI); Exposure vs. No Exposure) x 2 (Task; Gift bag vs Paper) ANOVA was conducted on wash duration. Only participants who chose to wash their hands were included in this analysis ($n = 177$). Of these, 10 participants were excluded due to missing data as a result of technical difficulties with the recoding software, and so wash duration was not recorded. The wash scores of 2 participants were identified as outliers, defined as a value more than 3 standard deviations above their group/condition mean and discontinuous with the distribution for their group and conditions. These scores were winsorized to be 1 second greater than the next highest wash time within their group/condition in order to maintain their rank without unduly influencing the mean. See Table 5 for mean wash duration across groups.

Consistent with our hypotheses, there was a significant difference in Wash Duration between individuals in the LCF and HCF groups, $F(1, 159) = 12.07$, $p = .001$, $\eta_p^2 = .07$. On average, those who were high in fears of contamination washed for 71.14 seconds ($SD = 28.94$), whereas those who were low in fears of contamination washed for an average of 57.77 seconds ($SD = 25.25$). There was a

main effect of Task on Wash Duration, $F(1, 159) = 7.49, p = .007, \eta_p^2 = .05$ but no main effect of CI on Wash Duration, $F(1, 159) = .80, p = .37$.

However, there was a significant interaction between Task and CI, $F(1, 159) = 4.52, p = .035, \eta_p^2 = .03$. A *t*-test within each level of Contamination Induction found that, consistent with our hypothesis, for participants who received the contamination induction, those in the GB condition washed significantly longer ($M = 75.15, SD = 32.33$) than those in the P condition ($M = 56.59, SD = 26.24$), $t(89) = -3.00, p = .004$. In contrast, in the NE group, there was not a significant difference in Wash Duration between GB ($M = 63.24, SD = 25.45$) and P ($M = 60.06, SD = 21.38$), $t(74) = -0.57, p = .57$. There were no additional significant two- or three-way interactions.

We also examined the relationship between wash duration and baseline scores on the OBQ, MACCS, FOG, IUS, and DOCS Contamination subscale. It was found that higher scores on the DOCS Contamination subscale were associated with increased wash duration, $r(165) = .25, p = .001$. There were no additional significant associations between baseline scores and wash duration (see Table 6).

Repetition of Actions Involved in Washing

We predicted that higher fears of contamination and a greater sense of responsibility would be associated with increased repetitions of the behaviours involved in washing. The total number of visits to the sites and objects identified as part of the wash was independently coded for each participant by two raters who were blind to group and condition and the average of these two ratings was

calculated, resulting in the variable Total Visits. The reliability of this variable was found to be .95.

A 2x2x2 ANOVA was conducted to examine the relationship between CF, CI, Task, and Total Visits. It was found that there was a main effect of CF on Total Visits, $F(1, 159) = 3.96, p = .048, \eta_p^2 = .02$. Those in the HCF group ($M = 12.81, SD = 3.94$) visited the sites involved in the wash a significantly greater number of times than those in the LCF group ($M = 11.82, SD = 3.03$). There were no main effects of Task or CI and no significant two-way or three-way interactions.

Additionally, we examined the relationship between Total Actions and baseline scores on the OBQ, MACCS, FOG, IUS, and DOCS Contamination subscale. Total Actions was not found to be significantly associated with scores on any of these measures (see Table 6).

What predicts repeating or prolonging washing beyond the 30s mark?

It was predicted that those in the HCF group would be more likely to wash beyond 30s than those in the LCF group. We also predicted that contamination induction and post-wash task might further influence the decision to continue washing beyond the 30s time-point.

Of those who washed their hands, 99 participants (56%) were still washing 30 seconds after commencing. A logistic regression revealed that, consistent with our predictions, those in the HCF group were more likely to be actively washing at 30s (69% of the HCF group, $n = 60$) than those in the LCF group (43% of the LCF

group, $n = 39$), $\text{exp}\beta = 2.92$, 95% CI = [1.57, 5.43], $p = .001$. However, there was no main effect of Task or CI, and no significant two-way or three-way interactions.

To examine factors that predicted hand washing those still washing at the 30s time-point were asked to comment in an open-ended manner on why they were continuing to wash. These responses were coded for their primary theme. Participants tended to provide very brief responses, including single word responses (e.g., “germs”). As such, it was difficult to code for nuanced factors such as concern for self vs. others. A review of the responses by this author and her supervisor suggested clear delineation between categories of responses; therefore, reasons for continuing to wash were coded by a single rater, who was blind to participant group and condition. The majority (49.5%, $n = 49$) reported continuing to wash due to concerns regarding illness, germs, or contamination. The second most cited reason for continuing to wash was general cleanliness of hands (e.g., to get my hands clean; 26.3%, $n = 26$). The remainder reported continuing to wash in order to remove any remaining soap (15.2%, $n = 15$), to achieve a personal, internal sense of cleanliness (e.g., until I feel clean; 8.1%, $n = 8$), or because they were completing a personal washing routine (0.6%, $n = 1$).

In summary, those high in fears of contamination were more likely to have a prolonged wash. Of those who continued to wash, concerns regarding germs/illness/contamination were the primary motivating factor, with a desire for general hand cleanliness being the second most cited reason for prolonged washing.

Pre-Wash Appraisals

Did pre-wash estimates of harm and responsibility influence washing behaviour?

We predicted that estimates of harm and responsibility would be associated with the duration of the wash for both HCF and LCF groups, but that the relationship would be stronger for those high in fears of contamination. With respect to Task, we had originally expected that the GB condition would be associated with longer wash duration via increased responsibility and harm estimates; however, our manipulation checks did not support the idea that Task had a significant unique effect on ratings of responsibility or harm. As task did not clearly influence pre-wash appraisals we chose to collapse across Task conditions on the analyses involving pre-wash appraisals. For the purpose of these analyses, Prewash estimates of the severity and likelihood of harm ($r(177) = .79, p < .001$) were combined to form the Post-Contamination Harm Composite Score. To test this hypothesis, a hierarchical regression was conducted with Wash Duration regressed on CF and CI (Step 1), Prewash Responsibility and Prewash Harm Composite (Step 2), Prewash Responsibility x CF, Prewash Responsibility x CI, Prewash Harm Composite x CF, and Prewash Harm Composite x CI interaction terms (Step 3), and Prewash Responsibility x CF x CI and Prewash Harm Composite x CF x CI interactions (Step 4). CF was dummy coded with LCF as the reference group and CI was dummy coded with NE as the reference group. Results are summarized in Table 7.

Entry of CF and CI in the first step yielded a significant percentage of variance explained (6%). Likewise, entering Prewash Responsibility and Prewash Harm

Composite scores in step two significantly increased the percentage of variance explained (16%), as demonstrated by the significant change in R^2 . However, only Prewash Harm Composite was found to be a significant predictor of Wash Duration, while Prewash Responsibility was not. Entering the two-way and three-way interaction terms in step three did not yield a significant change in R^2 . As such, these results were only partially consistent with our hypotheses: while pre-wash estimates of harm were found to be a significant predictor of wash duration, this relationship was not found to be stronger for those high in fears of contamination. Further, pre-wash estimates of responsibility were not found to be a significant predictor of wash duration.

Post-Wash Appraisals

Was washing an effective method of reducing feelings of contamination?

We explored whether hand washing was in fact an effective method of reducing perceived contamination across conditions. Within those who chose to wash, a mixed ANOVA was used to examine the effects of CF (LCF vs. HCF groups; between-subjects factor), CI (CE vs. NE groups; between-subjects factor) and Task (P vs. GB; between-subjects factor) on participants' VAS ratings of contamination (Contamination) at Pre- and Post-Wash (Time; within-subjects factor).

There was a significant main effect of Time, $F(1, 169) = 582.71, p < .001, \eta_p^2 = .78$, such that individuals reported reduced contamination ratings from pre- to post-

wash. There was also a significant main effect of CF, $F(1, 169) = 13.22, p < .001, \eta_p^2 = .10$, and a significant main effect of CI, $F(1, 169) = 19.64, p < .001, \eta_p^2 = .10$. There was not a main effect of Task, $F(1, 169) = 0.67, p = .40, \eta_p^2 = .00$.

These effects were qualified by a significant three-way interaction between Time, CI, and Task, $F(1, 169) = 7.26, p = .008, \eta_p^2 = .04$. There were no additional significant two- or three-way interactions. The significant interaction between Time, CI, and Task was explored with a series of 2 (Contamination; Exposure vs No Exposure) x 2 (Time; Pre- vs. Post-wash) mixed ANOVAs on contamination ratings. We examined Contamination Induction as a predictor of contamination ratings across time within each condition of Task. In the Paper condition, the interaction of time with Contamination Induction was marginally significant ($\eta_p^2 = .04, p < .07$). Those who were in the Contamination Exposure condition reported significantly greater feelings of contamination than those who were in the Non-Exposure condition at pre-wash, but did not differ from those in the Non-Exposure condition at post-wash. In the Gift Bag condition, the same two-way interaction had a larger effect size ($\eta_p^2 = .32, p < .001$), which accounted for the interaction. See Appendix K for additional information on these post-hoc analyses. Overall, the results demonstrated that washing was associated with a significant decrease in perceived contamination across groups, with those in the Contamination Exposure condition reporting greater perceived contamination than those in the Non-Exposure condition at pre-wash, but not differing significantly from those in the Non-Exposure condition at post-wash.

Did wash duration have a paradoxical effect on post-wash appraisals?

It was hypothesized that greater wash duration would predict paradoxical increases in post-wash feelings of responsibility and estimates of harm.

Additionally, we predicted that longer wash duration would be associated with decreased confidence in memory, attention, and/or perception. To test these hypotheses we conducted a series of regression analyses, as detailed below and in Tables 8-14.

1. Relationship Between Wash Duration and Responsibility Estimation

To examine whether the duration of washing predicted post-wash estimates of responsibility for harm, a hierarchical regression was conducted with the Post-Wash Responsibility Rating regressed on CF, CI, and Pre-Wash Responsibility Rating (step one), Wash Duration (step two), the two-way interactions between CF, CI, and Wash Duration (step three) and the three-way interactions between CF, CI, and Wash Duration (step 4). CF was dummy coded with LCF as the reference group and CI was dummy coded with NE as the reference group. Results are summarized in Table 8.

Entering CF, CI and Pre-Wash Responsibility Rating in step one explained a significant proportion of variance (41%). Pre-Wash Responsibility Rating and CI were found to be significant predictors of post-wash estimates of responsibility, while CF group was not. Entering Wash Duration in step two did not result in a significant change in R^2 . Similarly, entering in the interaction terms for CF, CI, and Wash Duration did not result in a significant increases in the amount of variance

explained. As such, our hypothesis was not supported and wash duration did not predict post-wash ratings of responsibility.

2. Relationship Between Wash Duration and Harm Estimation

For the purpose of this analysis, Post-wash estimates of the severity and likelihood of harm ($r(177) = .72, p < .001$) were combined to form the Post-Contamination Harm Composite Score. To examine whether the duration of washing predicted post-wash estimates of likelihood and severity of harm, a hierarchical regression was conducted with the Post-Wash Harm Composite Score regressed on CF, CI, and Pre-Wash Harm Composite (step one), Wash Duration (step two), the two-way interactions between CF, CI, and Wash Duration (step three) and the three-way interactions between CF, CI, and Wash Duration (step 4). CF was dummy coded with LCF as the reference group and CI was dummy coded with NE as the reference group. Results are summarized in Table 9.

The results did not support a paradoxical relationship between wash duration and harm estimates. Entering CF, CI and Pre-Wash Harm Composite in step one explained a significant proportion of variance (23%). Pre-Wash Harm Composite was found to be a significant predictor of post-wash estimates of harm, while CF and CI were not. Entering Wash Duration in step two did not result in a significant change in R^2 . Similarly, entering in the interaction terms for CF, CI, and Wash Duration did not result in a significant increases in the amount of variance explained.

3. Relationship Between Wash Duration and Feelings of Contamination

To examine whether the duration of washing predicted post-wash feelings of contamination, a hierarchical regression was conducted with the Post-Wash Contamination Rating regressed on CF, CI, and Pre-Wash Contamination Rating (step one), Wash Duration (step two), the two-way interactions between CF, CI, and Wash Duration (step three) and the three-way interactions between CF, CI, and Wash Duration (step four). CF was dummy coded with LCF as the reference group and CI was dummy coded with NE as the reference group. Results are summarized in Table 10.

Entering CF, CI and Pre-Wash Contamination Rating in step one explained a significant proportion of variance (10%). Entering Wash Duration in step two also resulted in a significant change in R^2 , accounting for an additional 4% of the variance. Wash duration was a significant predictor of post-wash ratings of contamination such that greater wash duration predicted lower ratings of contamination. Entering the interaction terms for CF, CI, and Wash Duration did not result in further significant increases in the amount of variance explained.

4. Relationship Between Wash Duration and Trust in Sensory Perception

The relationship between wash duration and trust in sensory perception was also examined. A hierarchical regression was conducted with the Post-Wash Trust of Senses regressed on CF, CI, and Pre-Wash Trust of Senses (step one), Wash Duration (step two), the two-way interactions between CF, CI, and Wash Duration (step three) and the three-way interactions between CF, CI, and Wash Duration (step 4).

CF was dummy coded with LCF as the reference group and CI was dummy coded with NE as the reference group. Results are summarized in Table 11.

Entering CF, CI and Pre-Wash Trust of Senses in step one explained a significant proportion of variance (32%). In step one, Pre-Wash Trust of Senses was found to be a significant predictor of post-wash trust in sensory perception, while CF and CI were not. Entering Wash Duration in step two also resulted in a significant change in R^2 , increasing the explained variance to 35%. Wash Duration was found to be a significant predictor of post-wash trust in sensory perception such that longer wash times were associated with greater feelings of trust following the wash. Entering in the interaction terms for CF, CI, and Wash Duration did not result in a significant increases in the amount of variance explained.

5. Relationship Between Wash Duration and Confidence in Memory

The relationship between Wash Duration and confidence in memory of the wash was examined using a hierarchical regression with confidence in memory regressed on CF and CI (step one), Wash Duration (step two), the two-way interactions between CF, CI and Wash Duration (step three), and the three-way interactions between CF, CI, and Wash Duration (step four). This analysis did not yield any significant results (see Table 12).

6. Relationship Between Wash Duration and Ratings of Quality of Memory

Similarly, we examined the relationship between Wash Duration and participant ratings of the level of vividness and detail in their memory of washing (see Table 13). A hierarchical regression was conducted with Memory Quality

regressed on CF and CI (step one), Wash Duration (step two), the two-way interactions between CF, CI, and Wash Duration (step three) and the three-way interactions between CF, CI, and Wash Duration (step 4). While steps one and two did not yield significant results, the model tested in step 3 accounted for a significant proportion of variance (7%). The interaction between CI and Wash Duration was found to be significant. Further hierarchical regression analyses were used to explore this interaction. It was found that when looking at participants in the CE condition, Wash Duration was a significant predictor of Memory Quality such that longer wash duration predicted higher ratings of memory quality ($R^2 = .07$, $F = 3.38$, $p = 0.04$, $B = 0.19$, $p = .02$). This relationship was not present when examining those who had not been exposed to the contamination induction.

7. Relationship Between Wash Duration and Certainty of Proper Completion

The relationship between Wash Duration and participants' ratings of how certain they were that their hands had been washed properly was analyzed using the same hierarchical regression approach. The results of this analysis are summarized in Table 14. This analysis did not yield any significant effects.

Summary

It was found that wash duration was not a significant predictor of post-wash feelings of responsibility, estimates of harm, certainty of proper completion, or confidence in memory.

In contrast, wash duration was found to be a significant predictor of trust in sensory perception, such that longer wash duration was associated with increased

trust. As well, increased wash duration was significantly associated with lower post-wash ratings of contamination. Finally, within those who were exposed to the potential contaminant, increased wash time was associated with greater reported vividness and detail in memories of washing.

Goals of Washing Behaviour

How do individuals define the goals of safety-focused behaviours?

Logistic regressions were used to examine group differences in regard to goal statements provided by participants prior to washing. One participant was excluded from these analyses due to missing data. As goals are generally task-specific, we chose to include Task in the following analyses. Goals were coded by a single rater blind to group and condition for the presence or absence of three criteria. Goal categories were not mutually exclusive and goals were coded for the presence or absence of each criterion.

1. Feelings-based goals (e.g., “to *feel* cleaner”): 24% of participants ($n = 43$) reported feelings-based criteria in their goals. It was found that Task was a significant predictor of the presences of feeling-based statements, $\text{exp}\beta = 0.296$, 95% CI = [.143, .612], $p = .001$, such that those in the P condition (28%) were more likely to report feelings-based goals than those in the GB condition (15%). CF and CI were not found to be significant predictors of feelings based goals. There were no significant two-way or three-way interactions.

2. Certainty-based goals (e.g., “to remove *all* germs, to be *sure* hands are clean”): 23% of participants ($n = 40$) reported certainty-based criteria as a component of their goals. It was found that Task was a significant predictor of certainty-based goals, $\text{exp}\beta = 3.96$, 95% CI = [1.70, 9.25], $p = .001$, such that those in the GB condition (32%) were more likely to report certainty-based goals than those in the P condition (8%). CF and CE were not found to differ significantly in regards to certainty based goals. There were no significant two-way or three-way interactions.

3. Presence of Avoidance Goals (e.g., avoid illness, discomfort, or spreading contamination): 63% of goals ($n = 110$) contained an avoidance-based goal. It was found that CI was a significant predictor of the presences of avoidance goals, $\text{exp}\beta = 2.37$, 95% CI = [1.25, 4.47], $p = .0098$, such that those in the CE condition (69%) were more likely to report avoidance goals than those in the NE condition (53%). The CF and Task groups were not found to differ significantly in regard to avoidance goals. There were no significant two-way or three-way interactions.

Does goal definition influence hand-wash duration?

Participants were categorized into one of four categories based on their goal definitions: No Avoidance Goals/No Certainty Desired ($n = 59$), No Avoidance Goals/Certainty Desired ($n = 5$), Avoidance Goal/No Certainty Desired ($n = 77$), Avoidance Goal/Certainty Desired ($n = 34$). An ANOVA was used to compare wash duration across groups. Those in the No Avoidance Goals/Certainty Group were

excluded from this analysis as there were only 5 participants in this group. Of the remaining participants, 160 participants had complete wash duration data and were included in the analysis. As the likelihood of reporting certainty goals varied according to Task and the likelihood of avoidance goals varied according to Contamination condition, we collapsed across groups for the purpose of this analysis.

It was found that there was a significant difference in wash duration across goal groups, $F(2, 158) = 7.31, p = .001, \eta_p^2 = .09$. Tukey's HSD analyses revealed that there was a significant difference in wash duration between those in the Avoidance/Certainty group ($M = 73.21, SE = 4.65$) and those in the No Avoidance/No Certainty group ($M = 53.30, SE = 3.57$), 95% CI = [6.05, 33.77], $p = .002$. There was also a significant difference in wash duration between those in the Avoidance/No Certainty group ($M = 68.11, SE = 3.15$) and the No Avoidance/No Certainty condition, ($M = 53.30, SE = 3.57$), 95% CI = [3.55, 26.06], $p = .006$. There was not a significant difference in wash duration between those in the Avoidance/Certainty and Avoidance/No Certainty groups, $p = .64$. Therefore, avoidance goals were associated with a significantly longer wash duration, regardless of the presence of a certainty-based goal.

Termination Criteria and Washing Behaviour

What criteria do individuals consider when terminating a safety-focused behaviour?

Upon completion of the hand wash, participants were asked "How did you determine when to stop washing your hands?" Of the 177 participants who chose to

wash their hands, 153 provided an answer to the question and were included in this analysis. There were no significant between group differences regarding who chose to provide answers to this question.

Individual responses fell into three general categories: Internal/Subjective Criteria (e.g., *I felt clean, I knew I had been thorough*), External/Observable Criteria (e.g., *I could no longer see or feel soap, I followed the steps outlined in the video, I counted to 30 seconds*), and Personal Routine (e.g., *I washed in the same way I always wash, I used my hand washing routine*). A review of the responses by this author and her supervisor suggested clear delineation between categories of responses; therefore, reasons for terminating were coded by a single rater, who was blind to participant group and condition. Of the 153 participants who responded, 56.2% reported that their primary reasons for termination were External Criteria, 32.7% reported that their primary reasons for termination were Internal Criteria, 11.1% indicated Personal Routine. An additional 35 participants (23%) reported a second termination criterion. Of these 35 participants, 40% reported also relying on Internal Criteria, 54.3% reported also using External Criteria, and 5.7% reported also relying on Personal Routine.

These termination criteria were further coded for the presence of reliance on an internal sense or feeling of cleanliness and the presence of a desire to achieve absolute certainty of cleanliness or proper completion. Given the clarity of the presence of absence of these criteria, termination criteria were coded by a single rater, who was blind to participant group and condition. The presence of feelings-

based and certainty-based standards was compared across groups using Logistic Regressions.

1. Feelings-based termination criteria (e.g., “I *felt* I was clean”): 48% of participants ($n = 73$) reported using feelings-based termination criteria. It was found that CF was a significant predictor of the presence of feeling-based statements, $\text{exp}\beta = 2.11$, 95% CI = [1.08, 4.12], $p = .028$, such that those in the HCF condition (66%) were more likely to report feelings-based criteria than those in the LCF group (46%). CI and Task were not found to differ significantly in regards to feelings based termination criteria. There were no significant two-way or three-way interactions.

2. Certainty-based termination criteria (e.g., “I was *sure* that my hands were clean”): 28% ($n = 43$) of participants reported certainty-based criteria. CF, CI, and Task were not found to be significant predictors of certainty-based criteria. There were no significant two-way or three-way interactions.

Do these termination criteria influence hand-wash duration?

An ANOVA was used to compare those who reported feelings-based termination criteria and those who reported certainty-based termination criteria. Of the 153 participants who provided termination criteria, 143 participants had complete data and were included in this analysis. Due to missing wash duration data, 10 participants were excluded from this analysis. It was found that there was a significant main effect of certainty-based termination criteria, $F(1, 139) = 6.45$, $p = .012$, $\eta_p^2 = .04$. Those who reported certainty-based criteria washed for significantly

longer than those who did not report certainty-based criteria ($M = 72.59, SE = 4.14$ and $M = 59.78, SE = 2.88$, respectively). There was not a significant main effect of feeling-based criteria, $F(1, 139) = 0.06, p = .81$ or a significant two-way interaction, $F(1, 139) = 0.07, p = .79$.

Discussion

The purpose of the present study was to employ an ecologically valid paradigm in order to examine the factors that predict engagement in safety behaviours beyond the point of necessity. In doing so, we aimed to improve our understanding of the phenomenology of such behaviours and to examine how cognitive factors such as goals, termination criteria, and perceptions of contamination, responsibility for harm, estimates of harm, and confidence in cognitive and sensory abilities are related to washing behaviours. Further, these factors were compared across individuals who were low and high in fears of contamination.

Undergraduate students who reported high and low levels of concerns about germs and contamination were pre-selected using the DOCS. Analyses of baseline differences demonstrated that in comparison with those who reported low fears of contamination, participants who scored high in fears of contamination also scored significantly higher on measures of psychological processes and mechanisms hypothesized to be important to the development and maintenance of OCD. This finding is consistent with those of other studies, which have demonstrated that OCD-related beliefs are present and associated with symptom severity not only in

clinical samples, but also in analogue or student samples (Taylor & Purdon, 2016; Abramowitz et al., 2014). These findings indicate that our high-contamination fears group was an appropriate analogue sample, anticipated to respond similar to those who would meet criteria for a diagnosis of OCD.

Experimental Manipulations

Influence of Contamination Induction

In order to examine hand-washing behaviour following exposure to a potential contaminant, half of the participants were asked to wipe their hands with a damp sponge that they were informed “may have come into contact with trace amounts of dirt, chemicals, or bacteria”. This manipulation was successful in inducing feelings of contamination, and participants in all conditions reported a significant increase in perceived contamination after touching the sponge. Additionally, despite touching the same sponge, those who were high in fears of contamination reported a greater increase in feelings of contamination from pre- to post-induction and reported experiencing a significantly greater sense of contamination both before and after touching the sponge in comparison to participants who were low in contamination fears. These findings are consistent with those of Taylor and Purdon (2016), who also found that ratings of contamination increased across both groups, but to a greater extent in the high CF group, following exposure to the same contamination induction.

Influence of Post-wash Task

We also attempted to manipulate appraisals of responsibility and the likelihood and severity of harm by varying the post-wash task. We predicted that those informed that they would be creating gift bags for young children would report significantly higher perceived responsibility for harm and higher likelihood and severity of potential harm in comparison to those informed that they would be sorting papers for disposal. It was also predicted that those high in fears of contamination would report greater responsibility and likelihood and severity of harm than those low in fears of contamination and that those exposed to the sponge would report greater responsibility, harm likelihood, and severity than those in the control condition. Finally, we predicted that those high in fears of contamination who were exposed to the contamination induction and also asked to create a gift bag would report the greatest likelihood, severity, and responsibility for potential harm.

Consistent with these hypotheses, we found that those high in fears of contamination reported feeling more responsible for potential harm than those low in fears of contamination and predicted significantly greater likelihood and severity of potential harm. Similarly, those exposed to the contamination induction also reported a greater sense of responsibility for harm and greater harm estimates than those in the non-exposure control condition.

Inconsistent with these hypotheses, those in the gift bag condition did not report a greater sense of responsibility than those in the paper condition. Additionally, those in the gift bag condition did not differ significantly in their harm

estimates. As such, it does not appear that the post-wash task had the predicted influence on personal appraisals of responsibility or the severity of potential harm. Rather, fears of contamination and exposure to a contaminant were significantly associated with greater estimates of responsibility for harm and greater predicted harm regardless of post-wash task.

Summary

As expected, our contamination induction was successful in evoking feelings of contamination. This response was more pronounced within the high contamination fears group. The replicated success of this induction highlights that, as stated by Rachman (2004), a sense of contamination can be easily transferred from an object to a person and even trace amounts of contamination can have a substantial impact.

Our post-wash task did not influence ratings of responsibility or estimates of harm as predicted. Rather, fears of contamination and exposure to the contamination induction were unique predictors of these ratings. In considering these results, it is important to note that our task manipulation and associated questions were not sensitive to factors such as personal feelings of responsibility versus the responsibility assigned by others.

In future, it may be beneficial to examine alternative questions including “how responsible would *others* hold you if harm were to occur”. Likewise, further specifying whether the predicted harm includes harm to self or harm to others may also influence responses.

Washing Phenomenology

Who Chose to Wash?

Participants chose whether or not to wash their hands prior to completing the gift bag or paper task. We expected that those high in contamination fears, those in the gift bag condition, and those exposed to the contamination induction would be more likely to wash their hands.

Consistent with our hypotheses, participants in the gift bag condition and those exposed to the contamination induction were more likely to choose to wash. Interestingly, those who reported high fears of contamination were not more likely to wash than those low in fears of contamination. This suggests that the decision to wash was not simply driven by a general fear of contamination; rather, context played an important role in the decision of whether or not to engage in a safety-focused behaviour.

Phenomenology of Washing Behaviour

We hypothesized that hand washing duration would be predicted by experimental group. As expected, among participants who chose to wash, it was found that participants high in fears of contamination washed for significantly longer than those who were low in fears of contamination. Those who were high in fears of contamination washed for an average of 13.37s longer than those who were low in fears of contamination. Furthermore, those who were completing the gift bag task washed for significantly longer than those who completed the paper task. Additionally, the effect of exposure to a contamination induction varied depending

on the task. Those who were exposed to the sponge and who were asked to create gift bags demonstrated the longest wash duration at an average of 75.15s. In contrast, among participants who were not exposed to the sponge, there was not a significant difference in wash duration across those who completed the paper task and those who created gift bags. This further supports the theory that context played an important role in the decision of when and how to engage in safety-focused behaviours. Additionally, with the exception of scores on the DOCS Contamination subscale, trait level measures of psychological factors commonly associated with OCD symptomatology such as intolerance of uncertainty and fear of guilt were not associated with wash duration. This further supports examining factors specific to an episode of behaviour such as goals or termination criteria in understanding the decision to prolong this behaviour.

As described by Eilam and colleagues (2012), compulsive rituals such as hand washing can also be described spatially, through examining visits to the set of sites or objects at which the ritual is performed. Similar to the findings of Eilam and colleagues (Eilam, Zor, Szechtman, & Hermesh, 2006; Eilam et al., 2012), the completion of hand-washing behaviours by those who were high in fears of contamination involved repetitious visits to the same set of locations and objects. These actions tended to be a repetition of elements within the wash sequence (e.g., returning for additional soap) rather than repetition of the entire wash sequence. As predicted, in contrast to those who were low in fears of contamination, the hand-washing repertoire of those who were high in fears of contamination involved an

average of two more visits to the locations and items involved in the wash. The number of visits did not vary according to contamination induction or task, suggesting that regardless of context, those high in fears of contamination tended to include additional actions within their wash repertoire, although the number of additional actions observed in this study was quite modest.

What Predicted Washing Beyond 30 Seconds?

The Ontario Ministry of Health and Long-term Care (2007) and Public Health Ontario (2009) suggest that approximately 15 seconds is an appropriate hand wash duration. Prior to washing their hands, participants were shown a video produced by Public Health Ontario that explicitly stated this recommendation. Of those who washed their hands, 99 participants (56%) continued to lather their hands 30 seconds after beginning their hand wash. These participants were significantly more likely to be high in fears of contamination. When asked what was driving them to continue to lather, the majority reported concerns regarding germs, illness, contamination, and general cleanliness. This indicates that although those in the high contamination fears group were no more likely to choose to wash, they were more likely to prolong safety-focused behaviours beyond the point of necessity due to contamination concerns.

Pre-Wash Appraisals

Pre-Wash Estimates of Responsibility and Harm

The present study also aimed to examine how beliefs, such as estimates of responsibility and harm, might contribute to prolonged or repetitive washing

behaviours. Numerous studies of those with OCD, as well as healthy controls, have found that inflated feelings of responsibility and overestimates of threat predict increased contamination fear and washing behaviour (Abramowitz et al., 2014). As such, we predicted that estimates of harm and responsibility would be associated with the duration of the wash for both HCF and LCF groups, but that the relationship would be stronger for those high in fears of contamination. We found that those who were high in fears of contamination reported significantly heightened estimates of responsibility and the probability and potential severity of harm in comparison to those who were low in fears of contamination. Exposure to the contamination induction was also associated with heightened estimates of the likelihood and severity of harm across groups. Across groups, estimates of harm were a significant predictor of wash duration. This did not vary between those high and low in fears of contamination. Pre-wash estimates of responsibility were not found to be a significant predictor of wash duration.

These findings are consistent with previous studies (Taylor & Purdon, 2016; Jones & Menzies, 1997; Thorpe, Barnett, Friend, & Nottingham, 2011) that found that estimates of harm were a better predictor of wash duration than estimates of responsibility. These findings further support the theory that while those who fear contamination experience a greater sense of responsibility than those low in fears of contamination, inflated estimates of danger and harm might be the more salient motivator of compulsive washing behaviours (Lopatka & Rachman, 1995), regardless of fears of contamination.

Post-Wash Appraisals

Washing and Sense of Contamination

We examined the impact of hand washing on perceived contamination. The influence of context on the effectiveness of hand washing was also observed. It was found that across all conditions, washing was effective in reducing feelings of contamination. Participants in all conditions reported a significant decrease in perceived contamination following the wash. Additionally, prior to washing, those exposed to the sponge reported feeling more contaminated than those in the control condition; however, they did not differ significantly from the control condition after washing. This again draws attention to the effects of exposure to a contamination induction, demonstrating that despite the vague nature of the contamination induction, washing was effective in reducing the perceived presence of contamination. Furthermore, while this effect was observed in both the paper and gift bag conditions, the difference between the sponge and control conditions at pre-wash was greater in the gift bag condition. This suggests that prior to washing, potential contamination was likely more salient to those in the gift bag condition, but was equally reduced through hand washing. This further indicates that context plays a significant role in the perception of and response to contamination inductions, above and beyond general fears of contamination.

Ironic Effect of Prolonged Washing on Post-Wash Appraisals

It has been suggested that the mental or physical components of washing might further perpetuate or prolong washing behaviours (e.g., Rachman, 2002). For

example, previous research has demonstrated that those with OCD exhibit significant distrust in their memory (Tolin et al., 2001; Karadag, 2005; Macdonald et al., 1997; McNally & Kohlbeck, 1993) and that repetition of actions (e.g., checking to see whether a stove has been turned off) compromises rather than enhances memory (Boschen & Vuksanovic, 2007). As such, it was hypothesized that greater wash duration and frequency would predict paradoxical increases in post-wash feelings of responsibility and estimates of harm. Additionally, we predicted that longer wash duration and frequency would be associated with decreased confidence in memory, attention, and/or perception. Inconsistent with these hypotheses, it was found that wash duration was not a significant predictor of post-wash feelings of responsibility, estimates of harm, certainty of proper completion, or confidence in memory. However, it is noteworthy that while there was not a paradoxical relationship between wash duration on these variables, increased wash duration was not associated with *increased* certainty or confidence in memory- thus not conferring an advantage to those who washed longer.

In contrast, increased wash duration was found to predict greater post-wash trust in sensory perception. This finding is inconsistent with the results of Taylor and Purdon (2016) which found that increased wash duration was associated with decreased sensory confidence in a sample of 80 undergraduate students. However, the predictive power of wash duration in determining sensory confidence was relatively small within these previous results and it is possible that with an increased sample size and a more nuanced study design, we were able to detect a

more robust effect of wash duration on sensory confidence. Additionally, in the present study, within those who were exposed to the contamination induction, increased wash time was associated with greater reported vividness and detail in memories of washing. Increased wash duration was also associated with lower post-wash ratings of contamination.

These findings suggest that in respect to washing behaviours, perhaps cognitive factors such as memory of the wash are not as important as tactile and sensory cues that the wash has been completed adequately. While one must walk away from the stove or the locked door, it is quite possible to consistently reflect on sensations of contamination. The sensory and tactile cues that indicate the cleanliness of one's hands are constantly available, and as such, individuals may be less likely to experience doubt or the ironic effects of repetition that have been found when examining checking behaviour. Given the opportunity to wash for as long as they'd like, across both high and low contamination fears groups, wash duration was associated with a decrease in feelings of contamination and greater trust in one's sensory perception. In future, it would be interesting to examine the effect of being stopped at the 30s mark. This would allow us to examine whether those high in fears of contamination are able to achieve a similar sense of cleanliness when their washing is constrained or whether the longer wash duration observed in this study is a result of greater difficulty achieving their desired state of cleanliness.

Goals of Washing Behaviour

Research in the areas of learning, task mastery, and motivation has demonstrated that the valence of goals held in mind when learning and completing tasks influences psychological and behavioural approaches to the task (see Elliot, 1999 for a theoretical review). Particularly, whether individuals are motivated to approach a desired outcome versus avoid an undesirable end-state influences how they learn and approach tasks. Similarly, one could define the goals of a hand wash in terms of approach goals (e.g., make my hands clean) versus avoidance goals (e.g., avoid spreading illness to children). More generally, the goals of compulsive behaviours could include reducing distress regarding obsessive thoughts and urges or achieving a felt sense of certainty. In the present study, we examined the goals participants reported prior to washing and the association of these goals with wash duration.

It was found that approximately one quarter of the participants mentioned the desire to achieve certainty (e.g., be *sure* that my hands are clean) and one quarter noted that they were focusing on achieving an internal feeling (e.g., to *feel* cleaner, in general). It was found that those in the gift bag condition were more likely to desire certainty when stating their goals while those in the paper condition were more likely to frame their goals in terms of feelings. This suggests that a clearly defined and/or meaningful task might be associated with increasingly absolute goal states. In contrast, fears of contamination and exposure to the sponge were not found to be significant predictors of feelings- or certainty-based goals.

More than half of the participants framed their goals in terms of avoidance goals. It was found that exposure to the contamination induction was a significant predictor of phrasing a goal in terms of avoidance. Task and fears of contamination did not predict the presence of an avoidance goal. It was found that those who reported a goal that was phrased in terms avoidance washed significantly longer than those who framed their goals in terms of approaching a desired state, regardless of whether the goal also contained a reference to desiring certainty. Therefore, the goals participants held predicted the duration of washing behaviour and were associated with contextual elements such as the exposure to a contamination induction and the task completed after washing.

Termination Criteria and Washing Behaviour

Following the hand wash, participants were also asked to reflect on the criteria they used to determine when to stop washing. The majority of participants reported relying on either internal, personal feelings of cleanliness or thoroughness or external criteria such as the absence of soap on their hands, to determine when to stop washing. A small number of participants (11%) reported relying primarily on habit or the completion of their hand wash in a routine manner to determine when to terminate the behaviour. It was found that those high in fears of contamination were significantly more likely to rely on an internal sense of cleanliness or completeness in determining when to terminate the hand wash. This finding is consistent with previous work by Salkovskis (1989) and Woody et al. (2005), suggesting that those with OCD may rely on an internal felt sense of completeness to

determine when to terminate a safety-focused behaviour. However, there was not a significant association between feeling-based termination criteria and hand wash duration. In contrast, it was found that participants who held certainty-based criteria washed for an average of 12.8s longer than those who did not report certainty-based criteria. Contamination fears, exposure to the sponge, and task were not found to predict the presence of certainty-based termination criteria. In future, asking participants to further elaborate on their termination criteria might help us to understand how participants are defining a sense of certainty and what contributes to achieving this desired state.

Implications and Future Directions

The current study was conducted in order to examine hand-washing behaviour within a variety of contexts. Including a control group of individuals who were low in contamination fears, a non-contamination condition, and a relatively menial paper sorting task allowed us to examine washing under normative conditions. We could examine under which conditions individuals chose to wash and how individuals washed when simply allowed to wash their hands however they'd like for as long as they'd like.

Overall, consistent with previous research, we found that those high in fears of contamination assumed greater responsibility for potential harm, reported greater likelihood and severity of potential harm, and reported significantly greater feelings of contamination prior to washing. They washed for significantly longer and

included more actions within their wash. They were also significantly more likely to continue washing beyond the 30s mark.

However, our findings also highlight the important role of contextual factors in hand-washing behaviours. Those high in fears of contamination often behaved similarly to those who did not endorse contamination fears. Those high in fears of contamination were no more likely to choose to wash than those in the control group. Rather, the decision to wash was driven by exposure to a contamination induction and task. Similarly, across all individuals, pre-wash estimates of harm were a significant predictor of wash duration, while estimates of responsibility were not. Across both groups, wash duration was associated with decreased ratings of contamination and increased trust in one's sensory perception. Furthermore, post-wash task, rather than contamination fears, was a significant predictor of holding certainty-based goals and feelings-based goals. Likewise, exposure to the contamination induction predicted the presence of avoidance goals, which were associated with significantly longer wash durations. These findings emphasize the importance of examining contextual factors in addition to presence of contamination fears/OCD symptoms. As posited by Rachman (2002) and Salkovskis (1989), it is likely that those with OCD experience minor daily occurrences as "contamination inductions" and attribute increased personal significance to tasks completed following a hand-wash. Examining contextual factors and associated perceptions, goals, and termination criteria within a treatment context may allow us

to further tailor treatment targets and goals resulting in more meaningful exposure tasks and ultimately improved treatment outcomes.

In future studies, it would be beneficial to examine more nuanced questions regarding these contextual factors. For example, our study was limited by the fact that we did not clearly delineate self versus other in regards to responsibility and potential harm. Would participants' responses change if we asked them how responsible the preschoolers' parents might hold them for potential harm? It is also difficult to know whether some portion of responsibility for preventing harm was transferred to the researcher. Did this influence decision-making and washing behaviour?

Additionally all participants were allowed to wash until they achieved their desired goal state. Would there have been more salient differences between groups had participants been asked to stop washing at the 30s mark? And finally, can we further unpack how participants define their termination criteria and what they pay attention to in order to determine when they have researched their desired end state? Answering these questions will allow for a more nuanced interpretation of the present findings and increased understanding of safety-focused behaviour.

Study 2

The goal of this study was to examine the phenomenology of compulsive behaviours *in vivo* within a sample of community members who met diagnostic criteria for OCD. We chose to limit the compulsions included in this study to cleaning and checking related compulsions as these are the two most commonly reported compulsive behaviours (Rachman, 2002), are behaviour-based compulsions (rather than mental rituals), and focus on achieving a desired end state and/or avoiding future negative outcomes. We gathered data on the length of compulsions (as recorded via a stopwatch app on a tablet), the goals of compulsions, factors involved in determining when to terminate a compulsive behaviour, and additional factors related to repetitive behaviours such as memory and sensory confidence. Participants completed self-report measures at home on a tablet immediately following the completion of the same compulsive behaviour or ritual once per day for six days.

The study objectives were:

- a. to gather exploratory, phenomenological data including the duration of compulsive rituals and the behaviours these rituals are comprised of;
- b. to examine the goals held in mind while completing a compulsive ritual and the criteria used to determine when to terminate such behaviours; and
- c. to examine the psychological factors associated with the completion of compulsive behaviours and to explore the relationship between these factors and compulsion phenomenology such as duration and repetitions.

This study also allowed us to explore the feasibility of using a tablet application to collect *in vivo* data on compulsions. Considerations regarding this method of data collection are explored within the Discussion section.

Method

Participants

Participants were 36 people (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. All participants were identified as meeting the criteria for a diagnosis of OCD using the MINI International Neuropsychiatric Interview administered by senior graduate students in the UW PhD program in Clinical Psychology.

Participants also endorsed engaging in one or more daily washing or checking compulsions. Exclusion criteria were: current or past diagnosis of a psychotic disorder or bipolar disorder.

Of the 36 participants, 27 met DSM-5 criteria for the diagnosis of a comorbid anxiety disorder, 9 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 severity was assessed using the Dimensional Obsessive Compulsive Scale (DOCS). The mean total DOCS score for the current sample was 33.55 ($SD = 14.32$), indicating that the level of OCD symptoms within the present sample was 0.23 standard deviations above the mean level of symptoms

reported by the clinical sample on which the measure was originally validated (see Abramowitz et al., 2010).

Procedure

Participants were invited in to the lab for a 60-minute session, during which they provided informed consent and the study procedure was explained. They were administered the Dimensional Obsessive Compulsive Scale, the Obsessive Beliefs Questionnaire, the Memory and Cognitive Confidence Scale, the Fear of Guilt Scale, and the Intolerance of Uncertainty Scale. They were also asked to identify 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 for the purpose of this study. In order to choose the washing or checking compulsion that would be reported on, participants discussed with the experimenter which rituals they engaged in on a *daily* basis and were asked to choose *one* that they would be able to consistently report on for the purpose of this study.

Participants were then provided with an Android tablet and introduced to the timer and survey application designed for this study. They were asked to use this application to report on the *same* compulsive episode (e.g., checking the stove after making dinner) once per day for a total of six successive days. It was expected that collecting information on the same compulsive episode across six days would allow for a valid and general representation of the compulsion of interest from each participant. Participants were instructed to first use a timer function that recorded

the duration of the selected behaviour. The participant was asked to press an on-screen “start” button immediately prior to beginning the compulsive behaviour and then press a “stop” button immediately after terminating the behaviour, in order to record the duration of compulsion. The time was not displayed on the tablet screen. Participants were then asked to complete the diary portion of the study (based on Buccarelli, 2014; see Appendix L) on the tablet. Participants were provided with several styluses and a Bluetooth keyboard in the event that they did not wish to touch the tablet screen directly. Once provided with this information during the initial in-lab visit, in order to confirm understanding of the study procedure, participants were asked to imagine tracking the identified compulsion and to verbally talk the experimenter through how they anticipated tracking the behaviour using the tablet. Questions and any areas in need of clarification were addressed. Participants were paid \$20 for completing this 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).

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). This scale was found to have excellent internal consistency in this sample (Cronbach’s alpha = .97).

Fear of Guilt Scale (FOGS; Chiang, 2013). The FOGS was developed to measure individuals’ fear of being regarded as guilty or experiencing feelings of guilt and their engagement in behaviours to minimize, prevent, or atone for guilt. Agreement with items is rated on a 7-point Likert scale. The 49 items can be summed to derive a total score and two subscale scores: Reactive Response and Proactive Response to

the feared feeling of guilt. The scale has shown excellent internal reliability and good validity in an undergraduate sample (Chiang, 2013). This scale had excellent internal reliability within this sample ($\alpha = .90$)

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)

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

The diary used in this study was a modified version of the Repeated Actions Diary (RAD) used by Bucarelli (2014) to gather information on compulsive acts immediately following completion of a compulsive episode. Diary items for the RAD were developed based on a review of Purdon and colleagues' (2005) diary

evaluating the suppression of obsessions and a review of the current literature on compulsive checking and washing. The RAD asks about both psychological and behavioural aspects of the compulsion. Psychological aspects include content of obsessive thoughts and urges, associated discomfort, the perceived consequences of not completing the compulsion properly, the level of certainty desired and the criteria used to determine completeness of the compulsion. The diary also assesses the individual's confidence in memory, perception, and attention. Behavioural aspects include a description of the acts involved in the compulsive episode, subjective estimate of duration, and number of repetitions within the episode. Please see Appendix L for the diary.

Results

Demographics

Participants had a mean age of 25.32 ($SD = 7.02$) and were 72% female. Of these participants, 26 tracked a cleaning-related compulsion that occurred on a daily basis and 10 tracked a checking compulsion. Scores from baseline questionnaire measures are reported in Table 15. There were no significant differences in age, gender, or baseline scores between individuals who reported a checking compulsion in comparison to those who reported on a cleaning compulsion².

² Due to significant heterogeneity of behaviours captured within the washing/cleaning and checking categories, we were cautious regarding the inclusion of further comparisons of washing versus checking compulsions in these results. This decision is explored further within the Discussion section.

The majority of participants completed 6 or more days of tracking ($n = 19$). Of those who did not complete exactly 6 entries, 7 participants completed between 3-5 days of tracking and several participants ($n = 10$) chose to complete 1-2 extra days of tracking for a total of 7-8 entries each. The total number of compulsive episodes reported on across participants was 217. Of these, 59 were checking episodes (e.g., checking locks or appliances before leaving the house, checking the stove) and 158 were washing or cleaning episodes (e.g., washing hands after returning home from work, cleaning the kitchen after preparing dinner).

Data Analysis

Data for each variable of interest were cleaned and examined for extreme values. Potential univariate outliers were identified through a screening of residuals (i.e., z scores) for each variable of interest. A case was considered extreme if the z score was greater than or equal to 3 and if the value was discontinuous with 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.

Data for each variable of interest 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 data reported in this study controlled for the number of diary entries completed. This approach is consistent with Bucarelli and Purdon's (2015) diary study examining *in vivo* compulsive episodes. For a single set of analyses involving coded termination

criteria, an average for each category could not be computed for each participant, as we did not have data within each category for each participant. For these two ANOVA analyses involving termination criteria, we examined compulsive episodes as independent occurrences rather than using participant averages.

Compulsion Parameters

The average compulsion duration, as measured by the timer, was 6.36 minutes ($SD = 10.31$). Compulsions ranged in duration from 5.4s to 54.19 minutes. The duration of two episodes was identified as extreme (greater than three standard deviations from the mean and discontinuous with the distribution for the group). These values were adjusted to be within three standard deviations of the mean for the remaining analyses. The average duration of cleaning/washing compulsions was 7.00 minutes ($SD = 11.60$). The average duration of checking compulsions was 4.72 minutes ($SD = 5.98$).

In addition to using the timer, participants were asked to provide a subjective estimate of how long their compulsive episode had taken. On average, participants estimated that their episode took 5.66 minutes ($SD = 8.51$). Participant's average estimates of episode duration were highly similar to the average objective duration, $r(34) = 0.98, p < .001$. The average absolute discrepancy between the objective duration and subjective estimate was 2.10 minutes ($SD = 2.46$).

Participants were also asked to report on the number of behavioural repetitions in a compulsive episode. Repetitions were defined to participants as

performing the identified compulsive behaviour once and then immediately performing it again (e.g., washing one's hands once then immediately washing again; checking the knob on the stove by wiggling it once then immediately wiggling it again). Of the 36 participants, 33 reported one or more compulsive episodes that contained repetition of a compulsive behaviour. In total, participants reported including repetitions 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 of repetitions reported was 10 repetitions. Washing and cleaning episodes had an average of 1.46 repetitions ($SD = 0.90$). Checking episodes had an average of 3.96 repetitions ($SD = 3.39$).

It was found that scores on the OBQ Importance and Control of Thoughts subscale were significantly associated with average number of repetitions, $r(34) = .36, p = .03$. Scores on the OBQ Perfectionism/Certainty subscale were associated with average compulsion duration, $r(35) = .33, p = .05$, and scores on the DOCS Symmetry/Completeness subscale were trending towards significance, $r(34) = .312, p = .06$. There were no additional significant or trending associations between trait measures of OCD symptoms (OBQ, IUS, FOG, MACCS, or DOCS) and average compulsion duration or number of repetitions (see Table 16).

What was the Obsession that Evoked the Compulsion?

It was reported that an obsessive thought, image, or impulse preceded 159 of the compulsive episodes described (73%). Specific images (e.g., the curtains on fire, the house being broken into) were described in 26 of these obsessions, while the

remainder were described as more general thoughts or ideas. In regard to content of the obsessive thoughts, 96 referred to a specific feared scenario such as the house burning down, germs or dirt being present on an individual's hands, or something going wrong if a wash was not completed. An additional 50 obsessions contained reference to more general feelings rather than a specific feared scenario, such as washing to alleviate general feelings of guilt, anxiety, or incompleteness. Finally, 13 compulsive episodes were described as occurring due to an urge or impulse to complete a routine or habitual behaviour, such as a hand wash that is completed every day after work regardless of thoughts of harm or contamination.

Participants were asked to rate the level of distress evoked by the obsessive thought, image or impulse on a scale of 1 (Not at All Distressing) to 7 (Very Distressing). The average distress associated with an obsession was rated as 3.86 ($SD = 1.78$). Average distress associated with an obsession was significantly correlated with scores on the DOCS, IUS, MACCS, and OBQ (see Table 16). Average distress related to the obsession was not significantly correlated with average compulsion duration, $r(34) = 0.06, p = .75$, or with the average number of reported repetitions within a compulsive episode, $r(34) = .29, p = .09$.

Goal of the Compulsive Episode

Participants were asked to rate the importance of several goals on a scale of 0-100 (see Diary Question 7 in Appendix L). It was found that the three highest rated goals 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 ($M = 87.60, SD = 12.73$). Participants also rated the importance of avoiding harm ($M = 75.85, SD = 27.08$), ensuring that one would not hold *themselves* responsible for harm ($M = 55.12, SD = 34.39$), and avoiding possible guilt ($M = 52.95, SD = 32.89$). It was found that avoiding others holding the individual responsible for harm 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 17). It was found that achieving a sense of personal satisfaction, completing the compulsive actions properly, and avoiding others holding oneself responsible for harm were significantly correlated ($p < .01$). Self-reported goals of avoiding holding oneself responsible for harm, avoiding harm, and avoiding feelings of guilt were also significantly correlated ($p < .01$). The goal of avoiding harm was also significantly correlated with completing compulsive actions properly ($p < .01$). A principal-components factor analysis was conducted and suggested the presence of two underlying factors (see appendix M for further discussion).

Outcome Satisfaction and Termination Criteria

Participants were asked to rate their satisfaction with the outcome of their compulsive episode on a scale of 1 (Not at All) to 7 (Very Much). One participant failed to respond to this diary question for 4 of 6 episodes. The average of her two existing ratings was used to estimate satisfaction for the remaining 4 episodes. The

average outcome satisfaction was 5.56 ($SD = 1.14$). Average outcome satisfaction was not significantly correlated with the average recorded duration of compulsive episodes, $r(34) = -0.14, p = .43$.

Participants were also asked to describe, in their own words, how they decided when to stop the compulsive behaviour. Of the 217 compulsive episodes reported, participants provided termination criteria for 212 episodes³. As there was clear delineation between the three coding categories, reasons for termination were coded by an individual rater.

It was found that 163 episodes were terminated due to participants achieving a sense of satisfaction, certainty, or the right feeling (Satisfaction; e.g., “Hand washing compulsion satisfied. No longer concerned about possible contamination.” “All burners and knobs had been properly checked and seen to be off.”). An additional 11 episodes were reportedly terminated when participants felt a reduction in distress or anxiety (Distress Reduction; e.g., “I had completed all of the tasks that were part of my routine and felt relieved of anxiety.”). Finally, 38 episodes were reported as terminated due to reasons other than satisfaction or relief of distress (Other Factors), such as a partner providing reassurance or assistance (e.g., “I am so tired and want to rest, I almost cried so my partner came and helped me.”), running out of time to complete the episode (e.g., “this was not a

³ Due to the high level of within-person variability in the compulsive behaviours reported on and the fact that we did not have data for each participant within each coding category, for these analyses we chose to treat compulsive episodes as independent. This decision is explored further in the Discussion section.

natural stop for me as I had only a small frame in which to complete part of my routine”), or physical pain or consequences (e.g., “I decided to stop once the water got too hot that I was unable to bear the heat.”). Each category had a minimum of four participants who accounted for data within that category (Distress Reduction: $n = 4$; Satisfaction: $n = 34$; Other: $n = 13$).

A univariate ANOVA was used to compare compulsion duration across episodes that were reportedly terminated due to Satisfaction, Distress Reduction, or Other Factors. It was found that there was a significant main effect of reported termination criteria, $F(2, 209) = 24.43, p < .001, \eta_p^2 = .19$. Tukey’s HSD post-hoc analyses revealed that episodes terminated due to Satisfaction were significantly shorter ($M = 4.11$ min, $SD = 17.45$) than those terminated due to Distress Reduction ($M = 36.76$ min, $SD = 57.74$), $p < .001$, or those terminated due to Other Factors ($M = 11.88$ min, $SD = 17.35$), $p = .02$. Those terminated due to Distress were significantly longer than those terminated due to Other Factors, $p < .001$.

A univariate ANOVA was used to compare satisfaction across episodes that were terminated due to Satisfaction, Distress Reduction, or Other Factors. It was found that there was a significant main effect of termination criteria, $F(2, 209) = 19.77, p < .001, \eta_p^2 = .16$. Tukey’s HSD post-hoc analyses revealed that episodes terminated due to Other Factors were associated with significantly less outcome satisfaction ($M = 4.67, SD = 1.71$) than those terminated due to Distress Reduction ($M = 6.30, SD = 0.48$), $p < .001$, or those terminated due to Satisfaction ($M = 5.99, SD$

= 1.06), $p < .001$. There was not a significant difference between those terminated due to Satisfaction and those terminated due to Distress Reduction, $p = .71$.

Discussion

The aim of Study 2 was to gather novel phenomenological data on compulsions performed *in vivo* by a sample of individuals who met diagnostic criteria for OCD. Through the use of a tablet application, participants tracked the occurrence of the same daily compulsion for six days. They answered self-report questionnaires following the behaviour, allowing us to gather information on psychological factors that were anticipated to contribute to the compulsive episode. We also asked participants to reflect on how they determined when to terminate the compulsive episode and their level of satisfaction with the outcome of the episode. This data allows us to examine factors unique to compulsive behaviours that may help us to understand why people prolong or repeat these behaviours beyond the point of necessity, to the point of interference.

Phenomenology

The majority of compulsive episodes examined in this study were washing/cleaning compulsions. The results indicate that washing/cleaning rituals were, on average, longer than checking rituals and contained fewer repetitions. The findings of this study also suggest that participants are able to estimate the duration of compulsive behaviours with a high degree of accuracy. This is reassuring, as clinical assessment of OCD often relies on client reports of how much time is spent engaging with obsessions and compulsions on a daily basis.

Examining the relationship between commonly used measures of OCD symptomatology and compulsion duration and repetitions suggested that only certain aspects of these trait level measures are predictive of compulsion parameters *in vivo*. Greater self-reported significance of thoughts and importance of controlling thoughts, as measured by the OBQ, was associated with an increased average number of repetitions. Greater self-reported desire for certainty, symmetry, and completeness, as measured by the DOCS and OBQ, was associated with greater average compulsion duration. These results are consistent with later discussed results, which found that achieving satisfaction and certainty were salient factors in the decision to terminate a compulsive episode.

The remaining subscales of the DOCS, OBQ, MACCS, IUS, and FOG were not associated with compulsion parameters. These findings are similar to those of Study 1, which found that, with the exception of the DOCS Contamination subscale, scores on these trait measures were not associated with wash duration and number of actions included in washing within a laboratory setting. This suggests that these trait level measures of OCD symptoms are at best modestly predictive of *in vivo* compulsive parameters and provide support for examining factors specific to individual compulsive episodes such as goals and termination criteria in understanding the persistence of compulsive episodes.

It was found that participants reported an obsessive thought, image, or impulse preceding 73% of the compulsions recorded. This means that while many compulsions were preceded by an obsession, according to participant report,

approximately one quarter of compulsive behaviours did not follow the typical OC cycle described within DSM criteria. Furthermore, the average distress associated with reported obsessions was moderate, an average of 4/7. Distress ratings *were* correlated with baseline measures of trait psychological factors such as perfectionism and fear of guilt, but were not found to be correlated with the duration of compulsive episodes or number of repetitions within episodes. This finding is consistent with those of Bucarelli and Purdon (2015) who also found that distress resulting from obsessions did not predict the reported duration or number of repetitions of compulsive behaviours. This highlights the importance of considering compulsive behaviours as separate from obsessions and even occurring in the absence of a clearly defined or highly distressing obsessive thought.

Goals

What then, did individuals define as the goal of engaging in a compulsive behaviour? Participants' top rated goals were achieving a sense of personal satisfaction, completing the compulsive behaviours properly, and ensuring that *others* would not hold them responsible for harm. The latter goal is of particular interest, as participants rated avoiding *others* holding them responsible for harm as significantly more important than avoiding harm in general and significantly more important than avoiding holding oneself responsible for harm. This parallels Lopatka and Rachman's (1995) observation that patients' concern over a harmful event is drastically reduced if responsibility for the event is not their own but someone else's, even if the event can happen all the same. Concerns regarding being

held responsible for harm not just by oneself but also by others may trigger feelings of distress, anxiety, and guilt. Furthermore, if we consider the significant correlations between the goal of avoiding being held responsible by *others* for harm, satisfaction, and certainty of proper completion, we can imagine that rather than relying on their own instincts, people instead try to perform according to external criteria that can only be guessed at. These three ratings appeared to form one of two factors that captured how participants rated the goals of their compulsion and had an average composite rating of 87 out of 100. Compulsive behaviours may thus persist in part because they must be done until either the individual believes that someone else would be satisfied or that they have a strong enough case that another individual would absolve them of responsibility. This further emphasizes the importance of looking at responsibility as a nuanced construct and including self vs. other when asking for ratings of responsibility, as discussed in Study 1. It also suggests that a sense of social responsibility may be an important construct to explore within a treatment context. Similarly attachment style and interpersonal schemas may inform our understanding of compulsive behaviour. Research shows that people with OCD tend to have higher attachment anxiety (e.g., Doron et al. 2012) and that parental criticism is considered a pathway to inflated responsibility (Salkovskis et al. 1999). Therefore, the relationship between compulsions, attachment styles, and schemas regarding responsibility and trust may be additional avenues of inquiry.

Additionally, avoiding harm, avoiding feelings of guilt, and avoiding holding oneself responsible for harm were also inter-correlated and were found to form the second of two factors that appeared to account for goal ratings. These goals were rated as less important than the previously discussed goals but had an average composite rating of 61 out of 100, suggesting that harm avoidance and personal responsibility and guilt also play a role in motivating compulsive behaviour. The relationship between these two factors and a more nuanced understanding of the goals that comprise them should be further examined in future studies.

Termination Criteria and Outcome Satisfaction

Participants reported that they terminated the majority of episodes due to achieving a sense of satisfaction, certainty, or the right feeling. Interestingly, when participants reported a focus on distress reduction as their termination criterion, their compulsive episodes lasted significantly longer than if they reported terminating based on a sense of satisfaction or certainty. It is possible that longer episodes were simply associated with greater distress and as such, distress reduction became a salient focus. However, as previously discussed, this finding suggests that prolonging or repeating a compulsion may do relatively little to reduce distress, further perpetuating the compulsive cycle. Overall, ratings of successful completion were not correlated with episode duration, suggesting that a longer episode did not guarantee a satisfying outcome. Furthermore, terminating due to factors extraneous to the compulsion such as exhaustion led to the least satisfying outcomes, while terminating due to distress reduction or satisfaction were similar

in associated outcome satisfaction. Describing termination criteria in terms of certainty, satisfaction, or achieving a right feeling was associated with similar overall satisfaction with the outcome of the compulsion in comparison to aiming for distress reduction. Therefore, it may be of benefit to look beyond reduction of distress in understanding why individuals engage in a compulsive action and how they decide to terminate or prolong a compulsive episode. This would allow for a more detailed understanding of what is driving compulsive behaviour and could provide useful information for exploration when attempting cognitive restructuring during therapeutic intervention. Additionally, exploring what happens following compulsions terminated due to extraneous factors such as exhaustion or time demands could yield interesting data. For example, as participants were significantly less satisfied after episodes terminated due to extraneous factors, did they engage in other compulsive behaviours following the completion of the reported episode? Did they experience increased distress following the completion of these episodes and, if so, for how long did this distress persist?

Use of a Tablet Application for In Vivo Data Collection

Testing the feasibility of the tablet app and the questions included in the app across many types of behaviour was a useful endeavour and will allow us to further refine the app for future studies. We found that use of the timer function clearly captured the objective duration of cleaning compulsions. In comparison, tracking the number of checks through use of a count feature (e.g., pressing a button each time a check is completed) might be more fitting when examining checking

compulsions in future. Regardless of the timing or count feature used, it was extremely beneficial to hide the objective measurement from participants' view. In the current study, this allowed us to also ask participants to reflect on the perceived duration of the compulsive episode, allowing for comparison of objective measurement and subjective estimates. As clinicians often rely on self-report data from clients to determine the frequency, intensity, and duration of compulsive behaviours, it is useful to explore how accurate this self-report data might be. The current study provides support for the accuracy of these estimates. In future, it would be of interest to examine repetitions using similar objective recording and subjective estimates.

In the current study we asked participants to respond to a self-report questionnaire contained in the tablet application following completion of the compulsive episode. It is possible that this allowed us to collect the most valid information on compulsion phenomenology, as participants were not primed to consider the self-report questions immediately prior to completing the compulsive behaviour. However, this means that participants reflected on the decision to complete the compulsion and the goals of completing the compulsion following the compulsive episode. This made it difficult to consider the relationship between goals and compulsion duration, as in Study 1. In future, we might choose to split the questionnaire into pre- and post-episode sections, similar to the administration of questionnaires in Study 1. One benefit of using a tablet application versus paper questionnaires is that the use of an application would allow for an extremely user-

friendly process where participants would be electronically guided through which questionnaires to complete at which point in the compulsive episode.

Limitations and Future Directions

We chose to limit the compulsions included in this study to cleaning and checking related compulsions as these are the two most commonly reported compulsive behaviours, are behaviour-based, and focus on achieving a desired end state and/or avoiding a future negative occurrence. Within these two categories of compulsions we found that there was still a high degree of heterogeneity both between and within participants. There was significant variability in terms of what comprised checking compulsions (e.g., checking the stove, checking to make sure water faucets were completely turned off, checking to be sure belongings weren't forgotten prior to leaving the house). The same was found of cleaning compulsions (e.g., washing hands, cleaning spaces such as the kitchen, cleaning objects such as a phone). Given this heterogeneity within the checking and cleaning categories, we were cautious in grouping these compulsive behaviours together to compare washing versus checking episodes. While the aim of this study was not to compare washing versus checking episodes, as discussed in Study 1, it is possible that there are distinct differences between washing and checking compulsions. In future, it would be beneficial to examine specific, common compulsions in vivo, such as hand washing and stove checking, and compare differences across compulsion types.

Similarly, despite being asked to track the same compulsive behaviour each day, participants often varied the behaviours included in the compulsive episode.

For example, cleaning the kitchen counters each night prior to making dinner was extended to include washing the microwave one day, emptying the sink the next, and emptying the dishwasher another. One participant reported using hand sanitizer as a method of cleansing her hands on several occasions and washing her hands on others. This made it difficult to conduct within-person analyses, as discussed further below.

For the purpose of this study, we accounted for the number of diary entries completed by each individual by averaging ratings across the number of recorded episodes. This approach is consistent with that taken by Bucarelli and Purdon (2015) in their diary study of compulsive behaviours. For the analyses on termination criteria where averages could not be utilized, the decision was made to examine compulsive episodes on a global level, treating individual episodes as independent occurrences. The decision to explore compulsive episodes on an occurrence-by-occurrence basis (rather than person-by-person) was influenced by the high level of variability regarding what actions comprised a compulsive episode, even within the same individual, as previously discussed. However, we recognize that these episodes are in fact nested within individuals; therefore, in addition to attempting to maintain consistency in the compulsive behaviour tracked in future studies, future analysis of our diary data are expected to utilize data analytic techniques that account for the nested nature of this data such as multi-level modeling.

A final limitation of our data is that it relies on post-hoc reporting of factors such as goals and termination criteria. Therefore, this data represents participants' post-event understanding of their behaviour. This offers important clues to the determinants of behaviour. At the same time, we must be cautious in our interpretation of post-hoc, self-report data and not assume that participants are able to reflect on the determinants of the behaviour with complete accuracy. In future, we may consider asking participants specific questions throughout their compulsive episode, as in Study 1, rather solely relying on a post-event questionnaire measure. However, this approach would risk disrupting the flow of a typical compulsive episode, introducing its own confounding factors.

General Discussion

Although the leading cognitive model of OCD places primary emphasis on obsessions as preceding and instigating compulsive behaviours, a growing body of literature suggests that a large amount of the variance within compulsive behaviour could be accounted for by factors that come into play only after a compulsive behaviour has been initiated. Thus, focusing on influential psychological and behavioural factors during not only epochs of obsessional thought, but also during the completion of compulsions was expected to yield information crucial to understanding and treating OCD. The present program of research aimed to contribute to our understanding of compulsive behaviours through examining these behaviours both within a controlled laboratory setting and as they occurred naturally in participants' day-to-day lives. The results of our studies provided

significant support for the theory that aspects of a compulsive episode are a relevant area of focus both in research and treatment. These findings parallel those of previous studies and offer unique contributions to this literature.

In Study 1 we found that context played a significant role in the decision to engage in a safety focused behaviour regardless of contamination fears. As we would expect based on previous research, exposure to a potential contaminant increased the likelihood of engaging in a hand wash regardless of group or experimental condition. However, those in the high contamination fears group washed for significantly longer than those low in fears of contamination regardless of contaminant exposure. This finding is similar to that of Hinds et al. (2015) who found that there was no difference between an OCD sample and non-patient controls in regard to their motivation to act to ensure safety after exposure to cues for potential danger but that there was a significant difference in the degree to which this desire decreased after engaging in safety-promoting behaviours, such that 90s of checking by those diagnosed with OCD was experienced as being as no more effective than 90 seconds of *not* checking by healthy controls. The researchers presented this as evidence that OCD is not defined by disordered hypersensitivity to obsessive thoughts and danger cues, but rather represents a dysfunction in the ability to terminate safety-focused behaviours once these behaviours are initiated. Consistent with this theory, in Study 2, we again found evidence that aspects of the compulsive episodes themselves played a significant role in understanding compulsive behaviour, irrespective of obsessive thoughts or beliefs. Indeed, in

almost one quarter of compulsive episodes, participants were unable to identify an obsession that preceded the compulsive behaviour. When an obsession was present, distress associated with the obsession did not predict the duration of the compulsive episode. These findings are consistent with those of a diary-based study conducted by Bucarelli and Purdon (2015) who also found that distress resulting from obsessions did not predict the duration or number of repetitions of compulsive behaviours and did not predict individuals' feelings of certainty upon the completion of compulsive episodes. What then appeared to account for variation in washing behaviour and compulsive episodes?

Appraisals of Harm and Responsibility

Consistent with models proposed by Salkovskis (1989) and Rachman (2002; 2004), appraisals regarding the likelihood and severity of harm and personal responsibility played an important role in compulsion duration. In Study 1, appraisals regarding the likelihood and severity of harm predicted the duration of the washing behaviour. Those high in fears of contamination also perceived greater responsibility for preventing harm and predicted greater severity and likelihood of harm. This is consistent with previous research findings (Coughe, Lee, & Salkovskis, 2007; Foa et al., 2002). Similarly, in Study 2, avoiding *others* holding one responsible for harm was rated as one of the most important goals of compulsive episodes. As such, appraisals regarding harm and responsibility may trigger the decision to engage in a compulsive behaviour and could also prolong engagement in such behaviours.

However, research has also suggested that engaging in compulsive behaviour might serve to further increase estimates of harm and personal responsibility (Rachman, 2002). Additionally, previous research would suggest that that repetition of actions may also reduce confidence in and clarity of memory (e.g., Boschen & Vuksanovic, 2007; Cogle, Salkovskis, & Wahl, 2007; Tolin et al., 2001). Our findings did not suggest a paradoxical effect of prolonged washing behaviour. In Study 1, it was found that wash duration was not a significant predictor of post-wash feelings of responsibility, estimates of harm, certainty of proper completion, or confidence in memory. In contrast, increased wash duration was found to predict greater post-wash trust in sensory perception and decreased ratings of contamination. Further, when there was a greater threat level due to exposure to a potential contaminant, participants in Study 1 showed increased quality of memory with longer wash duration, which may be viewed as consistent with findings of previous research that demonstrated that those with OCD displayed a memory bias towards threat-related stimuli in comparison to neutral stimuli (e.g., Ceschi et al., 2003). Similarly, Chiang & Purdon (2019) found that greater perceived responsibility for preventing harm was associated with greater confidence in decisions made during a decision-making task. As such, the findings of Study 1 suggest that perhaps tactile cues, memory, and threat play a different role in washing behaviours in comparison to checking behaviours and that hand washing may vary even further in comparison to cleaning specific objects or areas. The varied nature of the compulsions in Study 2 resulted in an inability to analyze the relationship between repetition/compulsion length and

these factors. In future research, further isolating and examining specific categories of compulsions would help to further clarify these relationships.

Goals of Safety-Focused Behaviours

In Study 1, we found that when participants held in mind a goal that was focused on avoiding an undesirable outcome, they washed for significantly longer than if they held in mind a goal that involved achieving a desired state. Exposure to a potential contaminant increased the likelihood of holding an avoidance-based goal. In Study 2, participants reported that achieving a sense of personal satisfaction, completing the compulsive actions properly, and avoiding *others* holding them responsible for harm were the most important goal states. Interestingly, a growing body of research suggests that fear of guilt is characteristic of OCD and may influence decision-making by raising the perceived stakes and personal importance of minor decisions (e.g., whether one has washed their hands correctly; Chiang & Purdon, 2019). Chiang and Purdon (2019) found that greater self-reported incapacity to forgive oneself for guilt was associated with requesting greater amounts of information during a decision-making task. As well, they found that fear of guilt was associated with pervasive feelings of doubt in decision-making, with greater fear of guilt being associated with greater self-reported difficulty making decisions, less satisfaction with the decisions made, and less confidence in those decisions, even while accounting for beliefs about responsibility and harm likelihood. Similarly, Ottaviani et al. (2019) found that guilt related to violating one's own moral standards triggered the activation of physiological correlates of the

emotion disgust and was associated with increased repetition of cleaning behaviours and more thorough cleaning of an item. As such, fear of guilt and avoiding an undesirable end state appear to drive compulsive behaviours and could prolong safety-focused behaviours such as washing, cleaning, and checking.

Furthermore, if these fears of responsibility and guilt are introduced within the OC-cycle, it would make sense that individuals would place high importance on achieving the desired end state. This would then lead to a conscious and deliberate style of decision making, for example, as found in a previous study of washing behaviours (Wahl et al., 2008), contributing to higher demands on cognitive processes and potentially taxing working memory.

Termination Criteria

In Study 1 we found that those who were high in fears of contamination were more likely to terminate their wash based on achieving an internal feeling of cleanliness. In Study 2 we also found that in the vast majority of episodes (77%) participants reported focusing on achieving a sense of satisfaction, certainty, or the right feeling in order to determine when to terminate the compulsion. These findings are consistent with those of previously proposed models and research findings that suggest that in response to the fear of being held responsible for harm, individuals seek to achieve a particular subjective state in order to determine that they have correctly completed a behaviour (Salkovskis, 1999; Szechtman & Woody, 2004; Wahl et al., 2008). Additionally, in Study 1 we found that when participants reported termination criteria that included desiring absolute certainty (e.g., I was

sure my hands were washed properly), they also washed for significantly longer than if they did not include certainty-based criteria. As well, in Study 2, when participants reported that they terminated their compulsive episode due to achieving reduced distress, these compulsive episodes took significantly longer than reportedly terminated due to achieving satisfaction or other factors such as running out of time. This could indicate that if a sense of satisfaction is achieved initially, then the compulsion can be terminated relatively quickly. However, if an individual was unable to achieve satisfaction, perhaps this led to distress and shifted the focus of the compulsion to reducing this distress, thus prolonging the compulsive episode. Again, this is consistent with previous research that suggests that for those with OCD, an internal sense of satisfaction is of high importance when determining when to stop a behaviour (Szechtman & Woody, 2004; Whal et al., 2008) and that distress reduction or certainty may be difficult to achieve due to deficits in the ability to achieve this internal state of satisfaction and/or because it is impossible to prove absolutely that future harm has been averted (i.e., prove the absence of something with absolute certainty; Szechtman & Woody, 2004).

Summary

Our research provided unique insights into factors that play a critical role in the compulsive cycle. Specifically, our findings suggest that appraisals of responsibility and harm, goals, and termination criteria play an important role in washing and checking behaviours. Furthermore, we can compare the results of this program of research to the integrative model outlined by Purdon (2019) in which a

self-perpetuating compulsive cycle is created through interactions between appraisals of responsibility for preventing harm, exaggerated estimates of the probability and severity of harm, reliance on false inferences and a complex decision-making style that is suited to making decisions of high personal importance, and attempts to satisfy many, often subjective, criteria to determine that behaviours have been performed correctly and effectively. This model suggests that due to the load this places on working memory, individuals may doubt their memory of having completed the behaviour properly or might doubt their ability to maintain focus during the behaviour and question their perception and sensory input. As such, the behaviour is repeated in an attempt to gain certainty that it has been completed well enough to prevent harm or to achieve satisfaction or a “just right” feeling. However, it is suggested that repetition could paradoxically lead to increased perceived responsibility and estimates of harm and decreased confidence in memory, attention, and perception, thus leading to additional repetition of the behaviour, perpetuating an insidious cycle.

Consistent with this model, in Studies 1 and 2 we found that appraisals regarding harm and responsibility were described as key factors in the decision to engage in a compulsive behaviour and were related to prolonged engagement in washing behaviour. Similarly, goals focused on avoiding undesirable outcomes and avoiding *others* holding one responsible for harm were found to be commonly held goal states and it was found that avoidance-based goals were associated with prolonged washing. Finally, across both studies, the majority of compulsions were

terminated based on achieving an internal sense of cleanliness or a sense of satisfaction, certainty, or achieving the right feeling. An inability to achieve distress reduction or the sense of satisfaction or certainty was associated with prolonged behaviours during a compulsive episode in Study 2 and was associated with prolonged washing in Study 1. When behaviours were repeated or prolonged, we did not find that participants reported paradoxical increases in estimates of harm and responsibility or decreases in memory or sensory confidence. However, we did find that prolonged washing was associated with increased confidence in memory when the threat of contamination was salient and that prolonged washing was associated with increased trust in sensory perception. Therefore, when considering hand-washing behaviours, it is possible that prolonged and/or repeated behaviour is reinforced through increased perceived confidence and trust in sensory perception. However, we know that from a public health and safety perspective, a thorough and adequate hand wash can be completed within 15 seconds (Public Health Ontario, 2014); therefore, from a safety-focused perspective, washing beyond the 30s mark, as done by 69% of those high in fears of contamination, does not confer an advantage and may actually undermine health and safety (e.g., through damaging skin integrity leading to chapped and cracked hands).

Clinical Implications

Examining these factors within naturalistic laboratory settings and in real-life contexts will allow us to continue to disentangle the factors that keep people stuck in their OC cycle and perpetuate/prolong compulsive behaviours. As a result

of increasing our understanding of these factors, we can tailor discussions, exposures, and experiments in treatments such as ERP to improve treatment outcomes. If we focus primarily on obsessions and miss the factors unique to compulsions, we will miss significant psychological underpinnings of these behaviours. Encouraging clients to reflect personally on factors such as the goals held in mind while completing a safety-focused behaviour and the termination criteria employed will allow them to better understand their unique patterns of behaviour. If we can help clients to reframe the task at hand, shift goals away from desiring absolute certainty, and collaborate with them in determining appropriate non-subjective termination criteria, the results of this research in combination with those of previous studies suggest that this might help to reduce repetition and compulsion duration.

Similarly, as originally suggested by Bucarelli (2014), the diary tool itself could be a valuable addition to treatment protocols. In conducting Study 2, we received feedback from a number of participants that they found completing the diary allowed them to gain beneficial insight into what was driving often frustrating compulsive rituals. In asking participants to reflect explicitly on components of their compulsive behaviours we may be able to begin to shift goals or highlight and compare values that are being pursued versus compromised through engaging in a compulsive ritual.

As well, this program of research replicates past findings that suggest that those with OCD seek a subjective sense of completeness, satisfaction, or certainty

prior to terminating their compulsive behaviour and that this often leads to prolonging or repeating behaviours. Providing psycho-education on the detrimental aspects of repeating and prolonging behaviours would allow clients to begin to experiment with the impact of restricting vs. prolonging their compulsive rituals. Such experiments would also provide exposure to tolerating uncertainty and discontinuing a compulsive behaviour in the absence of achieving perfect certainty or satisfaction. As noted by Purdon (2018), clients are often able to tolerate a significant amount of uncertainty in domains unrelated to their OCD-concerns. For example, a client may worry that a tiny spec of dirt could spread serious illness and that they would be at fault; however, they are willing to accept the significantly greater risk of driving to their appointment.

In parallel, our research suggests that if clinicians focus primarily on extinguishing distress related to obsessional concerns, we might miss valuable opportunities to address aspects of compulsive behaviours that also drive the OC cycle (e.g., intolerance of uncertainty related to whether the compulsive behaviour was completed properly). When conducting ERP, we often treat compulsive episodes as a single unit, asking clients to refrain from the behaviour in its entirety. However, particularly with respect to safety-focused behaviour, it is often unreasonable to expect that a client will eliminate the compulsive behavior altogether. We all engage in safety-focused behaviours such as hand washing. However, what differentiates compulsive behaviours in the OC-cycle from typically occurring behaviours includes the frequency, intensity, and duration of these

behaviours. Indeed, as clinicians, we frequently discuss with clients when are reasonable and appropriate times to wash one's hands (e.g., following handling raw meat) versus when a hand wash is unnecessary (e.g., each time a doorknob is touched) or what is a reasonable duration for washing behaviours. Taking into consideration our results, it may be useful to work with clients on identifying the specific behaviours that comprise their compulsive episode and aiming to eliminate or shorten unnecessary or extraneous aspects of the compulsive episode (e.g., washing the palms and backs of the hands just once rather than several times). This would also allow for a gradual or stepped approach to exposure, which could increase willingness to engage in and tolerate treatment. As well, exposure to completing compulsions only partially or in a manner that varies from a typical routine would allow participants to build tolerance of uncertainty and experimentally observe outcomes when satisfaction or distress reduction is not achieved.

Limitations and Future Directions

This program of research allowed us to identify the ways in which we might continue to refine our exploration of compulsive behaviours. For example, the results of both studies highlighted the importance of considering perceptions of responsibility from not only a personal perspective but also on an interpersonal level. In future we hope to explore how individuals perceive responsibility for harm personally and how they perceive others' perception of their responsibility for harm. Research addressing this area of inquiry is recently underway in the lab,

examining how individuals wash when they are instructed to wash well enough that parents of pre-school children would not hold them responsible for harm.

We also continue to explore methods that might help us further understand individuals' goals, termination criteria, and motives for engaging in compulsive behaviours. Both studies in this program of research relied on self-report measures and, for some variables of interest, post-hoc reporting. We acknowledge the limitations of relying on self-report and introspection in understanding motives for behaviour. Individuals may not always be conscious of or able to accurately report on their reasons for behaviour. At the same time, there is value in understanding the narrative individuals construct regarding their behaviour and reliance on self-report of cognitions and motives is a significant aspect of ERP, our current gold-standard treatment for OCD. As such, examining how these self-reports related to aspects of compulsive behaviour allows us to understand one aspect of the obsessive-compulsive cycle and can inform treatment. In future, we may consider using a stream of consciousness protocol that asks participants to reflect aloud on their decision-making process *while* completing the compulsive episode, rather than reflecting immediately following the episode as in Study 2. Additionally, we may consider building on this program of research through the use of an interview that would allow for more thorough reflection on goals of compulsive behaviour and termination criteria. An interview study of obsessions conducted by Chiang and Purdon (in preparation) has yielded interesting insights regarding the content of

obsessions. In future, we may consider completing a similar study regarding compulsions, using an interview to explore compulsive episodes.

Conclusion

We conducted this program of research in the hopes of better understanding a set of behaviours that are observed and discussed frequently in clinical settings but are associated with a relative paucity of empirical examination. While compulsions are defined as a core feature of OCD in the DSM, we do not have a clear empirical picture of the phenomenology of compulsions or how individuals themselves define the goals of their compulsive behaviours. As well, in addition to observing what drives an individual to engage in such behaviours, it seems critical to understand how they decide to terminate these actions, given the investment of significant time and effort into the, often repetitious, completion of these behaviours. These studies allowed us to identify several factors of interest such as valuations of harm and responsibility, the presence of avoidance goals, and distress and certainty-based termination criteria that were important in influencing the parameters of compulsive behaviours. Future research into the nuances of compulsive behaviours will continue to allow us to understand the OCD cycle and provide clinicians and clients with treatment-relevant information that could improve outcomes and quality of life for clients with OCD.

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Appendix A: Study 1 Procedure and Acronyms

Contamination Fears Groups (CF):

LCF = Low Contamination Fears

HCF = High Contamination Fears

Note. Participants were identified as LCF or HCF based on the DOCS, administered in the psychology participant pool survey package, completed prior to this study.

Contamination Induction Groups (CI):

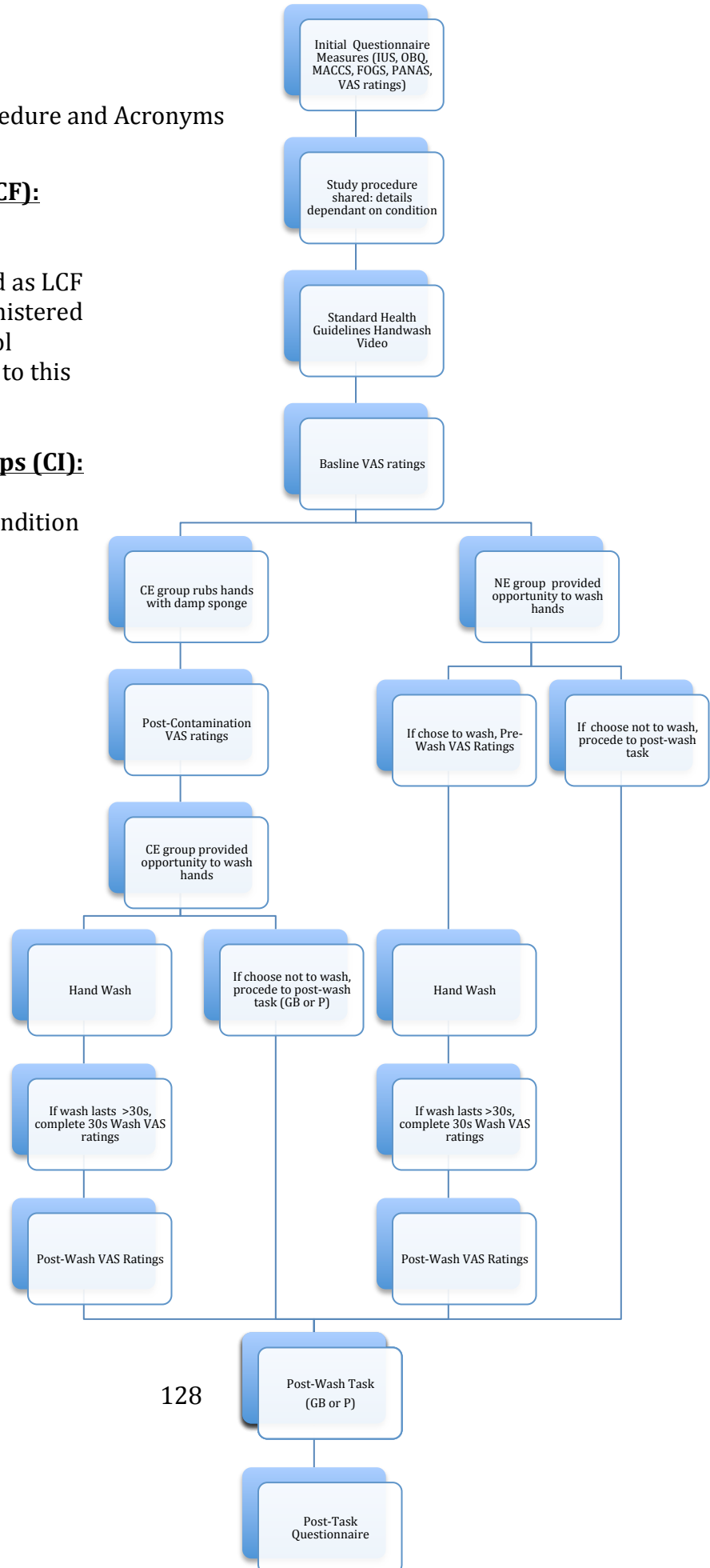
NE = Non-Exposure Condition

CE = Contamination Exposure Condition

Post-Wash Task (Task):

P = Paper Task

GB = Gift Bag Task








Appendix B: Pre-Study VAS
(Administered Electronically)

Please respond to the following questions using the scale below.

(0 = not at all/none to 100 = very much/a lot)

0 10 20 30 40 50 60 70 80 90 100

How contaminated are your hands right now?	
How disgusted do you feel?	
If you didn't wash your hands right now, how much harm could occur?	
If you didn't wash your hands, how likely is harm to occur?	
If harm were to occur, how responsible would you feel?	






Appendix C: Baseline VAS

(Administered Electronically)

Please respond to the following questions using the scale below.

(0 = not at all/none to 100 = very much/a lot)

0 10 20 30 40 50 60 70 80 90 100

How contaminated are your hands right now?	
How disgusted do you feel?	
If you didn't wash your hands right now, how much harm could occur?	
If you didn't wash your hands, how likely is harm to occur?	
If harm were to occur, how responsible would you feel?	

Appendix D: Post-Contamination Questionnaire

Please answer the following questions using the same 0 to 100 scale you used before, where 0 = not at all/none and 100 = very much/a lot. I [the RA] will record your responses.

Q1 How contaminated are your hands right now?

Q2 How much do you trust what your senses are currently telling you about how dirty your hands are? *If rewording/clarification needed: Senses meaning sight or touch.*

Q3 How disgusted do you feel?

Q4 If you didn't wash your hands right now, how much harm could occur?

Q5 If you didn't wash your hands, how likely is harm to occur?

Q6 If harm were to occur, how responsible would you feel?

Appendix E: Pre-Wash Questionnaire

Note: VAS scales (Q1-Q6) only administered if participant was in the NE condition and had not completed the post-contamination VAS ratings.

Please answer the following questions using the same 0 to 100 scale you used before, where 0 = not at all/none and 100 = very much/a lot. I [the RA] will record your response

Q1 How contaminated are your hands right now?

Q2 How much do you trust what your senses are currently telling you about how dirty your hands are? *If rewording/clarification needed: Senses meaning sight or touch.*

Q3 How disgusted do you feel?

Q4 If you didn't wash your hands right now, how much harm could occur?

Q5 If you didn't wash your hands, how likely is harm to occur?

Q6 If harm were to occur, how responsible would you feel?

Q7 Before you wash, I'd like to ask you a couple of open-ended questions. Can you please describe to me why you are choosing to wash your hands?

Q8 What is your goal in washing your hands? That is, what are you hoping to accomplish by washing?

Q9 Is there anything you are trying to prevent by washing your hands?

Appendix F: 30 Second Wash Questionnaire

Please answer the following questions using the same 0 to 100 scale you used before, where 0 = not at all/none and 100 = very much/a lot. I [the RA] will record your responses.

Q1 How contaminated are your hands right now?

Q2 How much do you trust what your senses are currently telling you about how dirty your hands are? *If rewording/clarification needed: Senses meaning sight or touch.*

Q3 How disgusted do you feel?

Q4 If you didn't wash your hands right now, how much harm could occur?

Q5 If you didn't wash your hands, how likely is harm to occur?

Q6 If harm were to occur, how responsible would you feel?

Q7 Before you continue wash, I'd like to ask you a few more open-ended questions. Is there anything you are paying attention to, to help you decide when to stop washing your hands?

Q8 What is your goal in continuing to wash your hands? That is, what are you hoping to accomplish?

Q9 Is there anything you are trying to prevent by continuing to wash your hands?

Appendix G: Post-Wash Questionnaire

Please answer the following questions using the same 0 to 100 scale you used before, where 0 = not at all/none and 100 = very much/a lot. I [the RA] will record your responses.

Q1 How contaminated are your hands right now?

Q2 How much do you trust what your senses are currently telling you about how dirty your hands are? *If rewording/clarification needed: Senses meaning sight or touch.*

Q3 How disgusted do you feel?

Q4 If you didn't wash your hands right now, how much harm could occur?

Q5 If you didn't wash your hands, how likely is harm to occur?

Q6 If harm were to occur, how responsible would you feel?

Q7 How certain are you that your hands have been washed adequately (0 to 100%)?

Q8 Thinking about the most recent hand wash... (On the same scale of 0 to 100)
How vivid and detailed (*if clarification needed: clear*) is your memory of washing?

Q9 How confident are you in your memory of washing? (*If clarification needed: how much do you trust your memory of washing?*)

Q10 How much do you trust what you saw while washing?

Q11 How much do you trust what you felt with your hands while washing?

Appendix H: Follow-Up Questionnaire

Q1 Did your hand washing method change at all over the course of the study? If so, how? (If you didn't wash, please answer N/A)

Q2 In general, did the task you were completing (sorting or making a bag) influence how you washed your hands? (If you didn't wash, please answer N/A)

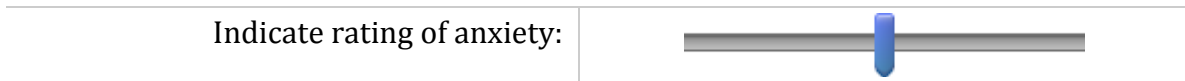
Q3 Did having the RA present in the room influence how you washed your hands? (If you didn't wash, please answer N/A)

Q4 In general, how did you decide when to stop washing? (If you didn't wash, please answer N/A)

Q5 If you chose not to wash your hands, please explain why you chose not to wash:

Q6 On a scale of 0 (not at all) - 100 (very much), how anxiety provoking was this study?

0 10 20 30 40 50 60 70 80 90 100



Q7 Did you have any questions or doubts about the nature of the study design as you were completing the study?

Appendix I: Baseline Scores

It was found that there was not a significant difference between CF, CE, or PWT groups with regard to Positive Affect as measured by the Baseline PANAS, $F(1, 224) = 2.01, p = .16$, $F(1, 224) = 0.13, p = .72$, and $F(1, 224) = 1.75, p = .19$ respectively. There were no two-way or three-way interactions between CF, CE, and PWT. There was also no difference between the CE groups on Negative Affect as measured by the Baseline PANAS $F(1, 224) = 0.04, p = .85$. There was an overall difference between the CF groups and PWT groups on Negative Affect as measured by the Baseline PANAS, $F(1, 224) = 5.37, p = .02, \eta_p^2 = .02$ and $F(1, 224) = 6.25, p = .0, \eta_p^2 = .03$ respectively. However, within participants who chose to wash their hands ($n = 177$), there was no difference between CF and PWT groups on Negative Affect as measured by the Baseline PANAS, $F(1, 167) = 3.38, p = .07$ and $F(1, 167) = 1.36, p = .25$.

As expected, there was a significant difference in Total Fear of Guilt as measured by the FOGS between the High and Low CF groups, $F(1, 215) = 23.23, p < .001, \eta_p^2 = .10$, such that the HCF group had higher scores on the FOGS. There was no significant difference between the CE conditions, $F(1, 215) = 0.02, p = .90$, and no significant difference between the PWT conditions, $F(1, 215) = 0.47, p = .50$. There were no significant two-way or three-way interactions between CL, CE, and PWT.

Additionally, there was a significant difference between the HCF and LCF groups on all OBQ-44 subscales: Responsibility/Threat Estimation, $F(1, 214) = 21.72, p < .001, \eta_p^2 = .09$, Perfectionism/Certainty, $F(1, 214) = 12.43, p = .001, \eta_p^2 =$

.06, and Importance/Control of Thoughts, $F(1, 214) = 10.71, p = .001, \eta_p^2 = .05$, such that those in the HCF group scored significantly higher on these subscales. There was not a significant difference between CE or PWT groups on the OBQ-44 subscales and no significant two-way or three-way interactions.

Compared to those in the LCF group, those in the HCF group also showed significantly lower confidence in their general memory abilities, $F(1, 214) = 7.26, p = .008, \eta_p^2 = .03$, lower confidence in their decision making abilities, $F(1, 214) = 11.11, p = .001, \eta_p^2 = .05$, lower confidence in their ability to concentrate, $F(1, 214) = 6.13, p = .01, \eta_p^2 = .03$, and a greater need to perform tasks properly or perfectly, $F(1, 214) = 9.84, p = .002, \eta_p^2 = .04$. There were no significant differences across these four factors between the PWT and CE groups and no significant two-way or three-way interactions.

Similarly, compared to those in the LCF group, those in the HCF group demonstrated significantly lower tolerance of uncertainty as measured by the IUS, $F(1, 212) = 8.39, p = .004, \eta_p^2 = .04$. There were no significant differences between the PWT and CE groups and no significant two-way or three-way interactions.

Appendix J: Contamination Appraisals

It was found that there was a main effect of Time, $F(1, 110) = 152.42, p < .001, \eta_p^2 = .58$, and a main effect of CF, $F(1, 110) = 15.89, p < .001, \eta_p^2 = .13$. These effects were further qualified by a marginally significant interaction between Time and CF, $F(1, 110) = 3.62, p = .06, \eta_p^2 = .03$.

To follow up the observed interaction, we conducted univariate tests contrasting HCF and LCF at each time point as well as change across these time points. It was found that those in the HCF group reported significantly greater feelings of contamination at both pre- and post-contamination ($M_{pre} = 42.22, SD = 24.49; M_{post} = 69.89, SD = 20.66$) in comparison to those in the LCF group ($M_{pre} = 31.00, SD = 21.11; M_{post} = 51.37, SD = 25.00$), $t_{pre-contamination}(112) = -4.29, p < .001$ and $t_{post-contamination}(112) = -2.62, p = .01$, respectively. Additionally, those in the HCF group reported a marginally greater increase from pre- to post- contamination ($M_{difference} = 27.67, SD = 19.01$) than those in the LCF group low contamination fears group ($M_{difference} = 20.37, SD = 22.11$), $t(112) = -1.88, p = .06$.

There was no main effect of PWT, $F(1, 110) = 3.64, p = .06, \eta_p^2 = .03$, no significant interaction between CF and PWT, $F(1, 110) = 0.25, p = .62, \eta_p^2 = .002$, and no significant three-way interaction between CF, PWT, and Time, $F(1, 110) = .20, p = .68, \eta_p^2 = .002$.

Appendix K: Post-Wash Appraisals

There was a significant main effect of Time, $F(1, 169) = 582.71, p < .001, \eta_p^2 = .78$, such that individuals reported reduced contamination ratings from pre- to post-wash. There was also a significant main effect of CF, $F(1, 169) = 13.22, p < .001, \eta_p^2 = .10$, such that those in the HCF group generally reported greater perceived overall contamination than those in the LCF group. There was also a significant main effect of CE, $F(1, 169) = 19.64, p < .001, \eta_p^2 = .10$, such that those exposed to the potential contaminant reported significantly greater perceived contamination than those who were not. There was not a main effect of PWT.

$F(1, 169) = 7.26, p = .008, \eta_p^2 = .04$. Mixed ANOVAS within the Paper and Gift Bag conditions were conducted to further examine this interaction. It was found that within the P condition, there was a significant main effect of time, $F(1, 75) = 195.89, p < .001, \eta_p^2 = .72$, such that perceived contamination decreased from pre- to post-wash. Further, within the P condition, the interaction between Time and CE was approaching significance, $F(1, 75) = 3.45, p = .07, \eta_p^2 = .04$, such that prior to washing there was a significant difference in contamination ratings between the CE and NE groups prior to washing, $t(75) = -2.08, p = .04$, and those exposed to the potential contaminant reported feeling significantly more contaminated ($M = 59.07, SD = 25.34$) than those in the non-exposure control group ($M = 47.03, SD = 24.27$). Ratings at post-wash did not differ significantly between the CE and NE groups, $t(75) = -0.25, p = .80$. Similarly, within the GB condition there was also a main effect

of time, $F(1, 98) = 429.10, p < .001, \eta_p^2 = .81$, such that perceived contamination decreased from pre- to post-wash. Additionally, there was also a significant interaction between time and CE, $F(1, 98) = 46.21, p < .001, \eta_p^2 = .32$.

Additional *t*-tests within the GB condition revealed that there was a significant difference in contamination ratings between the CE and NE groups prior to washing, $t(98) = -6.16, p < .001$, such that those exposed to the potential contaminant reported feeling significantly more contaminated ($M = 66.84, SD = 23.19$) than those in the non-exposure control group ($M = 38.31, SD = 23.13$). However, contamination ratings at post-wash did not differ significantly between the CE and NE groups, $t(98) = 0.64, p = .52$.

Appendix L: Study 2 Diary

Daily Tracking Form

Please complete at the first available opportunity following a compulsive episode.

Date: _____ Time of diary completion: _____

Approximate Time of episode: _____

Estimated total length of episode (in minutes or seconds):

Did you use the stopwatch as instructed to time the episode: yes/no

Approximately how many times did you repeat the compulsive action(s) within this episode? ____

1. Did an obsessional thought, image, impulse, or doubt precede the compulsive episode? If so, please describe.

How distressing was this obsessional thought, image or impulse? (select the number that best applies)

1	2	3	4	5	6	7
Not at all			Moderately			Very

2. Please describe the compulsive action(s) in this episode.

3. What was the main goal you wanted the compulsive episode to achieve? (Please use your own words.)

4. Was there anything you were trying to avoid or prevent from happening? If so, please describe.

The more I repeated the compulsive action, the:

1) More I found myself doubting my senses (e.g., sight, touch, hearing, smell, taste)	1 2 3 4 5 6 7
2) More I found myself trusting my senses	1 2 3 4 5 6 7
3) More I found myself doubting my memory	1 2 3 4 5 6 7
4) More I found myself feeling confident in my memory	1 2 3 4 5 6 7
5) More I found myself doubting whether I had paid proper attention	1 2 3 4 5 6 7
6) More I was confident I had paid proper attention	1 2 3 4 5 6 7
7) More I was doubted that I had completed it properly	1 2 3 4 5 6 7
8) More I was certain I had completed it properly	1 2 3 4 5 6 7
9) More I doubted whether it was ok to stop	1 2 3 4 5 6 7
10) More I was certain that it was ok to stop	1 2 3 4 5 6 7

12. How did you decide when to stop the compulsive episode? (Please answer in your own words.)

13. How satisfied are you with the outcome of the compulsive episode?

1 2 3 4 5 6 7
 Not at all/ Moderate Very much
 None

Appendix M: Principal-Components Analysis

A principal-components factor analysis was performed and Eigen values suggested that two-factors explained 50% and 26% of the variance in average self-reported goal importance respectively. There were no additional factors with an Eigen value > 1 and the scree plot demonstrated levelling off of Eigen values after two factors. A varimax rotation with Kaiser normalization was used to examine the two identified factors. It was found that personal satisfaction, completing the compulsive actions properly, and avoiding others holding one responsible for harm loaded heavily on Factor 1 while self-reported goals of avoiding holding oneself responsible for harm, avoiding harm, and avoiding feelings of guilt loaded heavily on Factor 2. These factors were moderately related, $r(35) = .31, p = .07$. Chronbach's alpha for Factor 1 was found to be .82 and the alpha for Factor 2 was found to be .83. Composite scores for each factor were calculated. The mean importance rating of Factor 1 was 87.44 ($SD = 12.76$) and the mean importance rating of Factor 2 was 61.30 ($SD = 27.21$). There was a significant difference between importance ratings of Factors 1 and 2, $t(35) = 5.98, p < .001$.

Tables

Table 1
Sample Size Across Contamination Fears, Contamination Induction and Responsibility Level Groups

Contamination Fears Group	Contamination Induction				Total
	Non-Exposure (NC)		Exposure Condition (EC)		
	Paper (P)	Gift Bag (GB)	Paper (P)	Gift Bag (GB)	
Low Contamination Fears (LCF)	36	31	29	30	126
High Contamination Fears (HFC)	28	26	29	26	109
Total	64	57	58	56	235

Table 2
Demographics and Baseline Measure Scores

Measure	Low CF Group				High CF Group			
	P		GB		P		GB	
	NE	CE	NE	CE	NE	CE	NE	CE
	Mean (SD)		Mean (SD)		Mean (SD)		Mean (SD)	
Gender (% male)	13.9%	17.2%	22.6%	16.7%	17.9%	37.9%	26.9%	15.4%
Age	20.33 (2.01)	20.42 (2.39)	20.97 (3.03)	20.17 (1.84)	19.50 (1.53)	19.41 (1.80)	20.69 (4.49)	19.54 (1.36)
DOCS Contamination Score	0.78 (0.80)	0.86 (0.91)	0.71 (0.82)	0.57 (0.82)	8.93 (1.82)	8.62 (1.99)	8.81 (2.43)	8.46 (1.68)
PANAS Positive Affect	21.29 (7.60)	21.90 (7.22)	22.83 (7.92)	23.33 (8.18)	23.68 (8.44)	22.69 (6.97)	23.77 (8.73)	25.16 (8.62)
Negative Affect	12.43 (3.51)	12.24 (3.01)	14.00 (4.64)	13.53 (4.17)	13.68 (3.73)	13.66 (3.18)	14.42 (5.65)	15.52 (5.01)
OBQ-44 Responsibility/Threat	57.54 (13.36)	56.43 (17.19)	56.13 (15.35)	58.07 (13.96)	64.68 (15.11)	67.83 (13.27)	68.17 (11.55)	64.04 (15.52)
Perfectionism/Certainty	60.55 (13.74)	59.75 (18.10)	61.73 (16.59)	63.82 (11.39)	67.64 (17.80)	68.34 (13.25)	71.61 (16.51)	67.36 (14.38)
Importance/Control of Thoughts	32.16 (12.67)	29.79 (14.60)	32.17 (12.67)	34.46 (10.79)	36.89 (12.51)	35.45 (7.89)	39.70 (10.80)	34.56 (12.60)
MACCS Distrust of Memory	36.65 (9.68)	38.04 (12.41)	38.50 (10.50)	39.36 (9.89)	43.25 (10.93)	43.20 (10.88)	41.70 (10.61)	39.92 (10.50)
Distrust of Concentration	9.55 (2.83)	9.64 (3.39)	10.47 (3.34)	10.82 (3.40)	11.36 (3.15)	11.13 (3.38)	11.17 (3.50)	11.24 (3.62)
Distrust of Decisions	12.16 (3.07)	12.00 (4.35)	12.87 (3.49)	12.68 (4.14)	14.23 (4.25)	14.72 (4.05)	14.74 (4.04)	13.12 (4.03)
Perfectionism	9.77 (3.29)	9.56 (3.73)	9.87 (3.29)	10.32 (2.94)	11.64 (3.21)	11.48 (3.11)	11.30 (3.95)	11.00 (4.19)
Total Score	68.13 (18.00)	69.25 (22.69)	71.70 (20.84)	73.18 (18.89)	80.68 (20.49)	80.55 (20.34)	78.91 (20.30)	75.28 (21.43)
FOG Total Score	65.13 (16.01)	67.79 (17.58)	68.23 (11.95)	67.18 (13.48)	77.64 (16.36)	78.83 (10.20)	75.30 (13.55)	73.44 (12.84)
IUS Total Score	31.10 (8.66)	31.93 (10.85)	33.43 (10.79)	35.19 (9.72)	34.82 (9.91)	36.52 (10.28)	39.26 (9.80)	36.88 (10.59)

Note. CF = Contamination fears; P = Paper, GB= Gift Bag; NE = no contamination exposure, CE = contamination exposure.

Table 3
Manipulation Check: Analyses of Variance

Dependent Measure	Effect	df	<i>F</i>	<i>p</i>	η_p^2
<i>Contamination Rating</i>	CF	1, 110	15.888	.000	.126
	PWT	1, 110	3.638	.059	.032
	Time (pre- and post- exposure)	1, 110	152.418	.000	.581
	CF x PWT	1, 110	.251	.618	.002
	Time x CF	1, 110	3.618	.060	.032
	Time x PWT	1, 110	.960	.329	.009
	Time x CF x PWT	1, 110	.199	.657	.002
<i>Pre-Wash Responsibility Rating</i>	CF	1, 227	33.634	.000	.129
	CI	1, 227	10.202	.002	.043
	PWT	1, 227	.237	.627	.001
	CF x CI	1, 227	.257	.612	.001
	CF x PWT	1, 227	.106	.745	.000
	CI x PWT	1, 227	2.160	.143	.009
	CF x CI x PWT	1, 227	2.329	.128	.010
<i>Pre-Wash Harm Composite Score</i>	CF	1, 227	43.284	.000	.160
	CI	1, 227	55.692	.000	.197
	PWT	1, 227	.871	.352	.004
	CF x CI	1, 227	2.837	.093	.012
	CF x PWT	1, 227	.550	.459	.002
	CI x PWT	1, 227	4.476	.035	.019
	CF x CI x PWT	1, 227	.793	.374	.003

Note. CF = Contamination Fears; PWT = Post-wash Task; CI = Contamination Exposure.

Table 4
Decision to Wash Pre-Task: Table of Main Effects

Group	Chose to Wash	
	No n (%)	Yes n (%)
Contamination Fear (CF)		
High CF	22 (20.18)	87 (79.82)
Low CF	36 (28.57)	90 (71.43)
Contamination Induction (CI)		
Exposure	16 (14.04)	98 (85.96)
No Exposure	42 (34.71)	79 (65.29)
Task		
Gift Bag	13 (11.50)	100 (88.50)
Paper	45 (36.89)	77 (63.11)

Table 5
Mean Wash Duration (in seconds) Across Contamination Fears Groups, Contamination Induction Groups, and Task Groups

Contamination Fears (CF)	Mean Wash Duration (SD)			
	Non-Exposure (NE)		Contaminant Exposure (CE)	
	Paper	Gift Bag	Paper	Gift Bag
Low CF	53.18(17.14)	59.09(23.76)	45.75(22.06)	68.85(29.23)
High CF	68.43(23.57)	67.59(26.96)	65.63(26.42)	82.95(34.93)

Table 6
Pearson Correlations Between Wash Duration, Total Actions, and Baseline Measures

Measure	Wash Duration		Total Actions	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
DOCS				
Contamination	.246**	.001	.102	.192
OBQ-44				
Responsibility/Threat	.134	.094	.013	.868
Perfectionism/Certainty	.118	.141	.085	.287
Importance/Control of Thoughts	.063	.429	.002	.978
MACCS				
Distrust of Memory	.006	.940	-.063	.433
Distrust of Concentration	.058	.468	-.062	.443
Distrust of Decisions	.023	.777	-.049	.544
Perfectionism	.055	.495	-.035	.662
Total Score	.027	.738	-.058	.467
FOG				
Total Score	.155	.052	.037	.647
IUS				
Total Score	.018	.828	-.014	.865

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $df = 156$.

Table 7
Hierarchical Multiple Regression Analysis Examining Estimates of Harm and Responsibility as Predictors of Wash Duration

Predictor Variables	Step 1		Step 2		Step 3		Step 4	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Constant	55.65***	3.69	54.55***	4.01	53.021***	5.077	53.045***	5.237
CF	13.29**	0.475	7.69	4.30	18.567*	7.452	18.839*	7.613
CI	3.95	4.21	-3.92	4.43	-9.338	7.009	-9.370	7.134
Responsibility			-.109	.081	-.096	.140	-.071	.162
Harm Composite			.221***	0.06	.235*	.114	.208	.190
Harm x CF					-.160	.102	-.115	.226
Harm x CI					.115	.116	.155	.212
Responsibility x CF					-.022	.163	-.074	.236
Responsibility x CI					-.020	.164	-.064	.218
Harm x CF x CI							-.070	.259
Responsibility x CF x CI							.088	.289
<i>R</i> ²	.063		.159		.193		.194	
<i>F</i>	5.511**		7.646***		4.729***		3.747***	
ΔR^2	.063		.096		.034		.000	
ΔF	5.511**		9.228***		1.683		.048	

Note. **p* < .05. ***p* < .01. ****p* < .001. Contamination Fears (CF) was dummy coded with LCF as the reference group and Contamination Induction (CI) has been dummy coded with NE as the reference group.

Table 8
Hierarchical Multiple Regression Analysis Examining Wash Duration as a Predictor of Post-Wash Responsibility

Predictor Variables	Step 1		Step 2		Step 3		Step 4	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Constant	.298	3.487	3.205	4.919	-1.400	8.742	.438	9.146
Pre-Wash Responsibility	.573***	.057	.579***	.057	.589***	.058	.584***	.058
CF	-1.377	3.743	-.765	3.816	-6.154	9.393	-7.084	9.503
CI	7.327*	3.646	-7.191	3.653	3.242	9.336	1.515	9.675
Wash Duration			-.056	.067	.014	.140	-.038	.159
CF x Wash Duration					.078	.134	.138	.160
CI x Wash Duration					-.169	.138	-.099	.171
CF x CI x Wash Duration							-.077	.111
<i>R</i> ²	.414		.417		.424		.426	
<i>F</i>	37.737***		28.426***		19.253***		16.517***	
ΔR^2	.414		.003		.007		.002	
ΔF	37.737***		.703		.945		.484	

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. Contamination Fears (CF) was dummy coded with Low Contamination Fears as the reference group and Contamination Induction (CI) has been dummy coded with Non-Exposure as the reference group.

Table 9
Hierarchical Multiple Regression Analysis Examining Wash Duration as a Predictor of Post-Wash Harm Estimates

Predictor Variables	Step 1		Step 2		Step 3		Step 4	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Constant	14.610***	4.140	21.775***	6.250	14.124	11.240	16.481	11.710
CF	4.367	4.974	5.219	4.985	-.701	12.358	-2.016	12.506
CI	-9.775	5.141	-10.395	5.136	4.782	12.098	2.440	12.533
Pre-Wash Harm	.299***	.050	.326***	.053	.342***	.054	.340***	.054
Wash Duration			-.139	.091	-.020	.182	-.090	.206
CF x Wash Duration					.079	.175	.161	.208
CI x Wash Duration					-.254	.181	-.159	.223
CF x CI x Wash Duration							-.105	.143
<i>R</i> ²	.231		.242		.253		.255	
<i>F</i>	16.045***		12.715***		8.854***		7.643***	
ΔR^2	.231		.011		.010		.003	
ΔF	16.045***		2.327		1.099		.534	

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. Contamination Fears (CF) was dummy coded with Low Contamination Fears as the reference group and Contamination Induction (CI) has been dummy coded with Non-Exposure as the reference group.

Table 10

Hierarchical Multiple Regression Analysis Examining Wash Duration as a Predictor of Post-Wash Contamination Estimates

Predictor Variables	Step 1		Step 2		Step 3		Step 4	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Constant	2.300	1.800	5.820	2.238	4.671	3.430	4.280	3.489
CF	2.716	1.555	3.529*	1.561	3.712	3.707	4.004	3.741
CI	-1.121	1.665	-1.111	1.637	.336	3.664	.824	3.747
Pre-Wash Contamination	.107**	.033	.120***	.033	.122***	.033	.120***	.034
Wash Duration			-.072*	.028	-.054	.050	-.038	.056
CF x Wash Duration					-.003	.051	-.024	.061
CI x Wash Duration					-.023	.053	-.046	.064
CF x CI x Wash Duration							.030	.046
<i>R</i> ²	.099		.134		.135		.138	
<i>F</i>	5.963*		6.279**		4.176*		3.627*	
ΔR^2	.099		.035		.001		.002	
ΔF	5.963**		6.610*		.108		.422	

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. Contamination Fears (CF) was dummy coded with Low Contamination Fears as the reference group and Contamination Induction (CI) has been dummy coded with Non-Exposure as the reference group.

Table 11

Hierarchical Multiple Regression Analysis Examining Wash Duration as a Predictor of Post-Wash Trust of Sensory Input

Predictor Variables	Step 1		Step 2		Step 3		Step 4	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Constant	40.023***	4.321	30.344***	5.366	23.264**	8.754	26.797**	9.028
CF	-2.178	3.151	-4.475	3.179	-7.888	7.998	-9.878	8.075
CI	.979	3.161	.243	3.100	11.625	8.253	8.292	8.512
Pre-Wash Trust	.517***	.060	.524***	.059	.544***	.060	.540***	.060
Wash Duration			.170**	.058	.268*	.123	.168	.139
CF x Wash Duration					.048	.116	.163	.138
CI x Wash Duration					-.183	.123	-.052	.150
CF x CI x Wash Duration							-.144	.095
<i>R</i> ²	.318		.353		.363		.372	
<i>F</i>	25.044***		21.799***		14.979***		13.268***	
ΔR^2	.318		.035		.010		.009	
ΔF	25.044***		8.544**		1.221		2.276	

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. Contamination Fears (CF) was dummy coded with Low Contamination Fears as the reference group and Contamination Induction (CI) has been dummy coded with Non-Exposure as the reference group.

Table 12

Hierarchical Multiple Regression Analysis Examining Wash Duration as a Predictor of Post-Wash Memory Confidence

Predictor Variables	Step 1		Step 2		Step 3		Step 4	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Constant	75.125***	3.003	71.159***	4.625	79.194***	8.356	81.192***	8.704
CF	2.655	3.401	1.688	3.504	3.910	8.824	2.677	8.957
CI	-1.601	3.413	-1.905	3.421	-15.641	8.993	-17.626	9.314
Wash Duration			.072	.064	-.060	.134	-.120	.153
CF x Wash Duration					-.030	.129	.040	.154
CI x Wash Duration					.219	.133	.298	.163
CF x CI x Wash Duration							-.088	.106
<i>R</i> ²	.005		.013		.030		.034	
<i>F</i>	.412		.698		.985		.934	
ΔR^2	.005		.008		.017		.004	
ΔF	.412		1.270		1.411		.688	

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. Contamination Fears (CF) was dummy coded with Low Contamination Fears as the reference group and Contamination Induction (CI) has been dummy coded with Non-Exposure as the reference group.

Table 13
Hierarchical Multiple Regression Analysis Examining Wash Duration as a Predictor of Post-Wash Memory Quality

Predictor Variables	Step 1		Step 2		Step 3		Step 4	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Constant	74.113***	3.030	69.097***	4.656	78.290***	8.354	79.467***	8.715
CF	5.292	3.431	4.069	3.528	9.399	8.822	8.673	8.968
CI	-6.100	3.444	-6.484	3.444	-24.313	8.991	-25.482	9.325
Wash Duration			.091	.065	-.059**	.134	-.094**	.153
CF x Wash Duration					-.078	.129	-.037	.154
CI x Wash Duration					.284*	.133	.331*	.164
CF x CI x Wash Duration							-.052	.106
<i>R</i> ²	.033		.045		.074		.076	
<i>F</i>	2.734		2.502		2.548*		2.153	
ΔR^2	.033		.012		.030		.001	
ΔF	2.734		2.004		2.545		.238	

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. Contamination Fears (CF) was dummy coded with Low Contamination Fears as the reference group and Contamination Induction (CI) has been dummy coded with Non-Exposure as the reference group.

Table 14

Hierarchical Multiple Regression Analysis Examining Wash Duration as a Predictor of Post-Wash Certainty

Predictor Variables	Step 1		Step 2		Step 3		Step 4	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Constant	70.512***	3.456	63.348***	4.988	68.278***	7.712	68.780***	7.718
CF	-2.825	3.912	-4.508	3.970	-4.618	9.436	-5.348	9.449
CI	.446	3.931	-.045	3.904	-8.175	9.356	-9.424	9.412
Wash Duration			.127	.064	.049	.114	.005	.120
CF x Wash Duration					.000	.132	.081	.150
CI x Wash Duration					.126	.133	.213	.153
CF x CI x Wash Duration							-.128	.112
<i>R</i> ²	.003		.027		.033		.041	
<i>F</i>	.265		1.482		1.073		1.112	
ΔR^2	.003		.024		.006		.008	
ΔF	.265		3.904		.476		1.295	

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. Contamination Fears (CF) was dummy coded with Low Contamination Fears as the reference group and Contamination Induction (CI) has been dummy coded with Non-Exposure as the reference group.

Table 15
Baseline Questionnaire Scores

Measure	Mean	Standard Deviation
DOCS		
Contamination	9.50	4.595
Responsibility for Harm	9.36	4.73
Unacceptable Thoughts	7.22	5.30
Symmetry and Completeness	7.47	4.61
Total Score	33.56	14.32
OBQ-44		
Responsibility/Threat	81.53	19.54
Perfectionism/Certainty	81.61	17.83
Importance/Control of Thoughts	43.86	16.14
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
Total Score	89.75	23.45
FOG		
Total Score	85.61	16.53
IUS		
Total Score	42.89	11.50

Table 16

Pearson correlations between Mean Compulsion Duration, Repetitions, and Distress Associated with Obsessions and Baseline Measures

Measure	Avg. Compulsion Duration		Avg. Repetitions		Avg. Distress Regarding Obsessions	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
DOCS						
Contamination	-.171	.318	-.138	.422	.450*	.007
Responsibility for Harm	.139	.420	.042	.809	.382**	.024
Unacceptable Thoughts	-.056	.746	.120	.485	.434**	.009
Symmetry and Completeness	.312	.064	.083	.630	.227	.189
Total Score	.070	.683	.041	.814	.518**	.001
OBQ-44						
Responsibility/Threat	.238	.162	.183	.286	.419*	.012
Perfectionism/Certainty	.327	.051	.194	.257	.389*	.021
Importance/Control of Thoughts	-.079	.649	.363*	.029	.387*	.022
MACCS						
Distrust of Memory	-.065	.708	.220	.198	.245	.157
Distrust of Concentration	.005	.975	.150	.384	.262	.128
Distrust of Decisions	-.007	.970	.129	.454	.284	.099
Perfectionism	-.080	.642	.242	.154	.369*	.029
Total Score	-.049	.777	.211	.217	.294	.086
FOG						
Total Score	.129	.455	.210	.218	.257	.136
IUS						
Total Score	-.019	.911	.089	.606	.513*	.002

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $df = 34$.

Table 17
Pearson Correlations Between Compulsion Goals Averaged Across Occasions

	Achieve Proper Completion	Achieve Satisfaction	Avoid Harm	Avoid Feelings of Guilt	Avoid Responsibility for Harm- Self	Avoid Responsibility for Harm- Others
Achieve Proper Completion	-	.769**	.428**	.201	.217	.572**
Achieve Satisfaction	.769**	-	.310	.254	.144	.594**
Avoid Harm	.428**	.310	-	.649**	.542**	.185
Avoid Feelings of Guilt	.201	.254	.649**	-	.663**	.183
Avoid Responsibility for Harm- Self	.217	.144	.542**	.663**	-	.180
Avoid Responsibility for Harm- Others	.572**	.594**	.185	.183	.280	-

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $df = 34$.