Journal of Behavioral and Cognitive Therapy 31 (2021) 291—308

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com/en

RESEARCH PAPER

Dissociating compulsive washing and hoarding tendencies through differences in comorbidities and the content of concerns

Tingting Liu, Joshua M. Ackerman, Stephanie D. Preston*

Department of Psychology, University of Michigan, 530 Church Street, Ann Arbor, Michigan 48105, USA

Received 20 December 2020; received in revised form 31 May 2021; accepted 31 May 2021
Available online 14 July 2021

KEYWORDS
Anxiety;
Fear;
Compulsive washing;
Compulsive hoarding;
COVID-19

Abstract Clinical compulsive washing and hoarding are intercorrelated and share comorbidities even though they are distinct and appear to manifest through opposing extremes of cleanliness and disorder (respectively). We attempted to resolve this paradox by testing five hypotheses in online, non-clinical samples ($N_{study\ 1}$ = 123, $N_{study\ 2}$ = 177, $N_{study\ 3}$ = 217). We replicated the intercorrelation of washing and hoarding tendencies in all studies, despite observing non-clinical individual differences. Both washing and hoarding were associated with anxiety, depression, and fears of social rejection and failure, but they were also distinguishable. Compulsive washing was associated with greater anxiety, disgust, perceptions of infection vulnerability, and the desire to organize a cluttered space, whereas hoarding was associated with reduced concerns about germs and full or cluttered spaces and higher concerns about assault, threats to safety, and insects. A third study tested and confirmed the hypothesis that washing and hoarding may be related because they are adaptive in combination during stressful conditions, like a global pandemic. During COVID-19, washing and hoarding tendencies were even more strongly interrelated, and disease-avoidant behaviors like wearing a mask and avoiding people increased with washing tendencies but decreased with hoarding tendencies. Overlapping psychopathological states can be distinguished even in non-clinical samples through psychopathological profiles and the content of concerns—that shift with one's context. Treatment may benefit from not only working to cease undesirable behaviors but also from ameliorating root fears and anxieties that are dissociable by condition and individual but not always linked to the behavioral expression.

* Corresponding author.
E-mail address: prestos@umich.edu (S.D. Preston).

https://doi.org/10.1016/j.jbct.2021.05.003

Obsessive—compulsive washing and hoarding behavior often co-occur (Hanna, 1995; Rasmussen & Eisen, 1992; Samuels et al., 2002). Both are also comorbid with anxiety, depression, and other variants of obsessive—compulsive disorders (OCD, Coles, Frost, Heimberg, & Steketee, 2003; Huppert, Simpson, Nissenson, Liebowitz, & Foa, 2009; Murphy et al., 2013; Samuels et al., 2002). Paradoxically, despite their psychopathological commonalities, washing and hoarding are characterized by seemingly opposing manifestations, with compulsive washing producing excessive cleanliness and hoarding producing excessive clutter and disorganization. An important question remains as to how this paradox can be explained.

Compulsive washing and hoarding are similar enough that both were formerly classified as variants of OCD in the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition (DSM-IV; American Psychiatric Association, 2000), they are correlated within individuals (Wu & Watson, 2005), and they have been treated with similar medications and therapy (Sorrell, 2012). Hoarding behavior is also considered by some to be an obsessive—compulsive spectrum disorder, because it displays core anxiety and obsessive—compulsive features (e.g., Phillips et al., 2010). For example, washing and hoarding both involve an exaggerated sense of responsibility for a potentially harmful outcome that is addressed through a behavior that can become excessive or compulsive (Foa et al., 2001; Frost & Hartl, 1996; Phillips et al., 2010). In addition to their conceptual similarities, washing and hoarding symptoms actually co-occur within individuals. For instance, in OCD patients, 20—40% report hoarding symptoms (Frost, Krause, & Steketee, 1996; Frost, Steketee, Williams, & Warren, 2000; Mataix-Cols, Rauch, Manzo, Jenike, & Baer, 1999; Muroff, Bratiotis, & Steketee, 2011; Phillips et al., 2010; Samuels et al., 2002), and in community samples of severe hoarders, 17—25% of cases were also diagnosed as having OCD (Frost et al., 2006; Frost, Steketee, Tolin, & Glossner, 2010). In a sample of 126 OCD patients, 36 had hoarding symptoms (more so in males, and with earlier onset; Samuels et al., 2002). Thus, compulsive washing and hoarding tendencies are similar (and similar to other forms of anxiety) because they co-occur, involve excessive or compulsive thoughts and behaviors designed to avoid a bad outcome, and they are treated with similar medications and cognitive behavioral therapy (CBT).

Despite this range of comparable features, more recent research has confirmed that Hoarding Disorder (HD) is distinct from—and can exist without—OCD, on the basis of behavioral, genetic, and neural evidence (e.g., Samuels et al., 2007; Saxena et al., 2004). As a result, HD has been given its own classification within the DSM-5, separate from OCD (Preston et al., 2014). The question remains as to why such highly correlated disorders, which share comorbidities, produce such diverging behavioral profiles. In theory, there are multiple routes through which these two conditions could be both comorbid and behaviorally distinct that should be further explored.

Overview

To examine the paradoxical similarities and differences between washing and hoarding tendencies, we conducted three online experiments to test five hypotheses (below). We used non-clinical samples, which the evidence suggests will also extend to patient populations. For example, OCD-related phenomena are known to also occur in the general population (Tolin, Woods, & Abramowitz, 2003) and subclinical OCD symptoms are similar in content and structure to more severe OCD symptoms (Burns, Formea, Keortge, & Sternberger, 1995). Moreover, hoarding symptoms have been shown to be normally distributed in the population and they correlate with individual differences in psychopathology in expected ways from research with patients (Preston, Muroff, & Wengrovitz, 2009). In addition, hoarding has been suggested to be a symptom rather than a syndrome, consisting of dimensions that can be measured continuously (Damecour & Charron, 1998). Others have also successfully used undergraduate populations to study the etiology of hoarding, supporting results from patient populations and adding significantly to our understanding of hoarding as a disorder (e.g., Coles et al., 2003; Frost & Gross, 1993; Frost et al., 1996; Preston, Muroff, & Wengrovitz, 2009; Timpano, Buckner, Richey, Murphy, & Schmidt, 2009). Using a non-patient population also allows us to recruit more participants, which could be beneficial for revealing inter-relationships among OC tendencies and other individual difference measures, even if psychopathological scores are right skewed. Caution will be applied when interpreting the findings, however, to consider the non-clinical nature of the sample.

Hypotheses

The first hypothesis, tested in studies 1 and 3, was that similar underlying psychopathologies like depression and general anxiety disorder (GAD) are involved in both washing and hoarding behavior, but their behavioral expression depends upon the level of each psychopathology or their relative strength. For example, theoretically, hoarding compared to washing, could involve more depression (or more than GAD), given that hoarding involves significant inaction and intransigence whereas washing is a fundamentally proactive response. As evidence, one study found increasing depressive symptoms with scores on a hoarding symptom scale (Tolin, Meunier, Frost, & Steketee, 2011). Another study that compared individuals with HD to OCD without HD found more comorbid depression, acquisition impulsiveness, and inattentive ADHD in HD than in OCD alone (Frost, Steketee, & Tolin, 2011). However, this study also found more social phobia in males with HD and another study found more social anxiety in the group with hoarding problems (with or without OCD) than in the non-hoarding OCD group—just not to the level of GAD patients (Pertusa et al., 2008). In contrast, this same latter study found comparable levels of major depression and dysthymia across patient groups (with hoarding problems in the presence or absence of OCD and non-hoarding OCD) and more GAD in the OCD hoarding group than in the hoarding without OCD or non-hoarding OCD groups (Pertusa et al., 2008). Another study found that OCD patients who hoard had more severe OCD that was more resistant to treatment and more social anxiety, skin picking, and personality disorders (Samuels et al., 2002) and another sample found greater functional impairment in OCD with hoarding symptoms (Tolin et al., 2011). Two

studies have found more personality disorders in OCD with hoarding (Samuels et al., 2002; Pertusa et al., 2008). Thus, some evidence suggests a greater involvement of depression with hoarding, but other studies point to greater anxiety or to more severe symptoms. Thus, we predicted differential comorbidity between tendencies, but not the specific direction of these associations.

The second hypothesis, tested in all three studies, was that hoarding and washing symptoms reflect the fact that the qualitative content of people's specific fears or anxieties differ in the two cases, which are then ameliorated through opposing behaviors. For example, compulsive washers overestimate the threat of germs and report high disgust sensitivity (David et al., 2009; Olatunji et al., 2007; Rozin, Haidt, & McCauley, 2008; Rozin et al., 2000; Ruscio, Stein, Chiu, & Kessler, 2010). People who exhibit clinical and non-clinical levels of excessive washing tendencies are more concerned about and overestimate the threat of germs compared to control participants (Olatunji et al., 2007; Ruscio et al., 2010; Tolin et al., 2003; Tolin, Brady, & Hannan, 2008). Disgust sensitivity is associated with all forms of OCD, including hoarding, but is most strongly related to the OCD washing subtype (David et al., 2009). In addition, the brain area associated with felt disgust—the anterior insula—is hyperactivated in contamination-based OCD patients (Bhikram, Abi-Jaoude, & Sandor, 2017).

In contrast, among other things, hoarding tendencies are linked to a perceived lack of control (Timpano & Schmidt, 2013), experiences of loss (O'Connor, 2014), insecure attachment (Danet & Secouet, 2018), and indecision and risk aversion accompanied by a strong sense of responsibility for and fear of causing mistakes or harm (see Frost & Hartl, 1996). Thus, one might think that these foci differentiate hoarding from washing tendencies, but they were not elicited in the context of contradistinguishing them from OCD washing or other anxiety disorders and they do occur in many forms of anxiety. What appears to distinguish these concerns is that, within hoarding tendencies, one's concerns center around their possessions, which are needed for emotional attachments and that people worry about losing, losing control over, needing for mnemonic reasons, or mistakenly discarding (e.g., see Frost & Gross, 1993; Frost & Hartl, 1996; Ruscio et al., 2010; Sampson, Yeats, & Harris, 2012; Steketee, Frost, & Kyrios, 2003; Tolin, Brady, et al., 2008). These possession-related fears seem crucial to distinguishing hoarding from other forms of OCD, including from compulsive washing (model in Frost & Hartl, 1996). Taken together, even if comorbid psychopathologies do not differ between washing and hoarding tendencies, the content and focus of one's fears and anxieties could distinguish them—with washing more linked to concerns about germs, contamination, and disgust and hoarding to concerns about loss, control, and mistakes, particularly associated with possessions.

A third hypothesis, tested in all three studies, is that hoarding more than washing tendencies result from material deprivation, which is adaptively resolved through keeping and reusing items (see Preston, 2014). For example, food hoarding in non-human animals is potentiated by food deprivation (Preston, 2001), and severe human hoarding has been associated with lower socioeconomic status (SES), education, and income (Samuels et al., 2008; Chiu, Chong, & Lau, 2003). However, one study did not find a relationship between financial problems and compulsive hoarding (Tolin, Meunier, Frost, & Steketee, 2010) and another found that most students who reported hoarding tendencies did not report childhood material deprivation (Frost & Gross, 1993). Thus, we tested the hypothesis that hoarding is uniquely linked to material deprivation (operationalized by lower childhood or current SES), even if the existing data did not strongly support such a link.

The fourth hypothesis, tested in study 2, was that individuals with washing versus hoarding tendencies prefer more clean and uncontaminated items that are more organized, which appears different even in the face of excess. For example, HD is at least partly defined by excessive clutter and the retention of items that could be considered useless or trash (e.g., Frost & Hartl, 1996)—intolerable for someone needing cleanliness, symmetry, or order. Moreover, hoarding patients with OCD than without report more possession-related obsessions and compulsions like needing symmetry, order, and checking items along with more magical and superstitious beliefs about them (Pertusa et al., 2008). Thus, individuals with washing tendencies, even if they also hoard, may prefer less contaminated items that they keep more organized than with hoarding tendencies wherein old, contaminated, or cluttered items may be tolerated.

The fifth hypothesis, tested in study 3, was that these seemingly opposing behaviors co-occur because they are adaptive in combination during periods of threat or risk, like a natural disaster or global pandemic. In a time of disease-related risk, individuals must clean frequently and stockpile resources to ensure their health, safety, and continued access to resources. In a context like the COVID-19 pandemic, washing and hoarding may be less in conflict and more adaptive when performed jointly. We tested this possibility in a national adult sample acquired during the COVID-19 pandemic, hypothesizing that washing and hoarding tendencies will be even more intercorrelated than in the pre-pandemic samples.

The current studies

We first attempted to replicate in all three studies the finding that hoarding and washing tendencies are intercorrelated, even in non-clinical samples. Because the three studies shared many features, we first describe their commonalities in a General methods section before describing their unique attributes. Study 1 tested the first hypothesis that the quantitative or relative involvement of depression and GAD differ between washing and hoarding tendencies along with the second and third hypotheses, that washing is associated with higher trait disgust and concerns about germs and infection whereas hoarding is associated with lower SES (respectively). Study 2 employed open-ended qualitative responses from study 1 to examine in greater detail the second hypothesis that the contents of people's fears and anxieties differ between washing and hoarding tendencies and the fourth hypothesis that people with washing tendencies prefer less contaminated items that should be more organized compared to with hoarding tendencies. Study 3 tested the fifth hypothesis that washing and hoard-

Table 1 Demographic description of participants in studies 1, 2, and 3.

Study	Online sample	Sample *n*				Age	
		Recruited	Excluded	Final	Female	*M* (*SD*)	Range
1	Undergraduate	159	36	123	56	19.08 (1.607)	18—32
2	Undergraduate	213	36	177	109	19.84 (0.96)	18—24
3	US TurkPrime	512	67	217[a]	60	28.29 (3.147)	18—32

Female *n* and age values refer to the final, analyzed sample.
[a] The sample size in final *n* for study 3 ($n = 217$) reflects the number after age-matching participants to the range from studies 1 and 2.

ing tendencies would be more interrelated during a global pandemic than in the prior samples and could promote beneficial behaviors for survival like washing more, stockpiling goods, wearing a mask, and avoiding others. Study 3 also replicated our prior results regarding the first three hypotheses.

This is the first set of studies to investigate in detail the underlying mechanisms that produce intercorrelated but distinct profiles of compulsive washing and hoarding tendencies, which can help us better understand their etiology so that we may tailor treatments to the specific issues associated with each tendency.

General methods

Participants

Recruitment

All studies used online recruitment and testing through Qualtrics. Studies 1 and 2 recruited participants with no clinical diagnosis to enroll in an online study through an undergraduate research pool at a large midwestern university in exchange for course credit. To avoid floor effects in a relatively healthy population, which may not include sufficient washing or hoarding tendencies for analysis, studies 1 and 2 oversampled tendencies by prescreening to invite only participants who scored > $M = 2$ on the washing or hoarding subscale of the Obsessive—Compulsive Inventory-Revised (OCI-R, Foa et al., 2002). For study 3, a larger sample was used to permit sufficient variance in OCD tendencies and impacts of COVID-19 without prescreening, in a sample that was also more representative than our student populations in studies 1 and 2. Participants were recruited on Amazon's Mechanical Turk though TurkPrime—an online crowdsourcing platform that recruits and filters participants for online studies in the social and behavioral sciences (Litman, Robinson, & Abberbock, 2017). All studies excluded participants if they either did not finish the experiment or pass all attention check questions.

Sample sizes

Full sample information is provided in Table 1. Study 1 recruited 159 students, excluded 36, leaving 123 for analysis. Study 2 recruited 213 students who had not already participated in study 1, excluded 36, leaving 177 for analysis. Study 3 recruited 512 US adults without prescreening, excluded 67, leaving 445 for analysis. To eliminate confounds from the older age of the online adult sample, we further restricted study 3 analyses to an age-matched subsample of 217 participants aged 18—32.

Measures

Table 2 summarizes the measures employed per study. All three studies administered the Obsessive—Compulsive Inventory-Revised, washing and hoarding subscales (OCI-R; Foa et al., 2002) to demonstrate their intercorrelation, with 6 self-report items from the 18-item scale on a 5-point Likert scale measuring distress associated with compulsive washing and hoarding tendencies in OCD. Hoarding tendencies with and without OCD differ (Samuels et al., 2008), but using the OCI-R for washing and hoarding provided a conservative test of their differences.

All studies also administered the Hoarding Rating Scale-Self-Rating (HRS-SR, (Tolin, Frost & Steketee, 2010a)Tolin, Frost, Steketee, Gray, & Fitch, 2008), a 5-item self-report questionnaire created to measure hoarding symptoms, with one item representing each of the major dimensions (clutter, difficulty discarding, excessive acquisition, distress, and impairment) from 0 (strongly disagree) to 8 (strongly agree). The HRS-SR has been validated as reflecting the result of clinical interviews with HD-diagnosed patients (Tolin, Frost, & Steketee, 2010a) and was only used to verify that effects obtained with the OCI-R hoarding subscale would be captured in another measure designed to measure HD symptoms. All participants also completed basic demographic information at the end of each study, including (in order): gender, age, relationship status (unused here), and socioeconomic status through the visual subjective socioeconomic status (SES) ladder (separate for childhood and currently; John & MacArthur, 2000).

Studies 1 and 3 also included the following five measures, in common, to replicate key results from the initial study in the larger, national, pandemic sample. The Patient Health Questionnaire (9-Item, PHQ-9; Kroenke, Spitzer, & Williams, 2001) is a 9-item module of the full PHQ assessing the severity of depression symptoms from 0 (''not at all'') to 3 (''nearly every day''). The PHQ-9 has been proven to be a reliable and valid measure of depression severity in large clinical samples (Kroenke et al., 2001; Kroenke & Spitzer, 2002). The Generalized Anxiety Disorder scale (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006) is a 7-item self-report anxiety scale widely used in clinical samples and the general population. The scale has good reliability and procedural validity for measuring general anxiety symptoms

Table 2 Measures used in studies 1, 2, and 3.

Measures	Study 1	Study 2	Study 3
OCI-R Scale (washing and hoarding tendencies)	x	x	x
HRS-SR Brief Hoarding Scale	x	x	x
PHQ-9 Depression Scale	x		x
GAD-7 Scale	x		x
PVD Perceived infectability & Germ aversion	x		x
Disgust Scale-Revised (core & contamination-based disgust)	x		x
Three Domain Disgust Scale (pathogen subscale)	x		x
Saving Inventory-Revised (clutter, discarding, acquisition subscales)		x	
Garage Photo Emotions and Preferences		x	
The Relationship to Objects Scale		x	
Rating Sources of Fears and Anxieties		x	x
COVID-19 impact and behavior			x
Subjective SES in childhood & currently	x	x	x
Demographic Items (gender, age, relationship status)	x	x	x
Additional Demographic and SES measures[a]		x	

OCI-R: Obsessive–Compulsive Inventory-Revised; HRS-SR: Hoarding Rating Scale-Self-Rating version; PHQ-9: The Patient Health Questionnaire; GAD-7: Generalized Anxiety Disorder; PVD: Perceived Vulnerability to Disease.
[a] In order: type of residence (e.g., rent, own), education (self and parents), estimated combined family income (past year and childhood), general health, and history of thirteen major medical problems (e.g., heart attack).

(Löwe et al., 2008); Spitzer et al., 2006). Both were administered to compare comorbidity in washing versus hoarding tendencies.

Three surveys were administered in studies 1 and 3 to test the second hypothesis, that washing tendencies are more associated with concerns about germs, disease, infection and disgust than hoarding tendencies. The Perceived Vulnerability to Disease (PVD; Duncan, Schaller, & Park, 2009) is designed to measure emotional discomfort from and concerns about the transmission of infectious diseases, with subscales for perceived infectability and germ aversion in situations with high potential pathogen exposure (15 items). The Disgust Scale-Revised (DS-R from Olatunji et al., 2007 based on the DS from Haidt, McCauley, & Rozin, 1994), is the most widely used instrument for assessing disgust; we administered the core and contamination-based disgust subscales (17 items) (Olatunji et al., 2007). The Three Domain Disgust Scale (Tybur, Lieberman, & Griskevicius, 2009) is designed to measure pathogen, sexual, and moral disgust sensitivity (21 items); we administered the pathogen subscale (7 items) on disgust from possible sources of contamination (e.g., other individuals, food, dead bodies). This scale shows solid internal consistency (Olatunji et al., 2012), and may have better measurement properties than the DS-R (Tybur et al., 2009).

Analysis plan

Analyses were conducted in IBM SPSS Statistics for Windows, Version 23.0 (IBM Corp. Released 2015). Q-Q plots and skewness and kurtosis were used to evaluate normality after a proposed standard $< |2|$ (George & Mallery, 2010; West, Finch, & Curran, 1995; Gravetter, Wallnau, Forzano, & Witnauer, 2020); ours were normally distributed ($< |1|$). Bivariate correlations were used to verify that washing and hoarding were interrelated and to compare them to alternative measures of hoarding, like the HRS-SR. Studies 1 and 3 used bivariate correlations to compare washing and hoarding tendencies to scores of depression and anxiety on the PHQ-9 and GAD-7 (respectively); these correlation coefficients were then statistically compared with a Fisher r-to-z transformation with a *t*-test in order to test the first hypothesis that the relationship could be stronger for one than the other (e.g., more depression in hoarding or more anxiety in washing, even if both are comorbid in each tendency). Partial correlations were used to test for unique associations between washing and hoarding tendencies and our measures of individual differences, to test the second and third hypotheses (i.e., PVD, disgust scales, and SES measures). Bivariate and partial correlations used Pearson correlations. Additional models are described to examine the measures that are unique to each study below.

Study 1

Methods

Participants who qualified were invited to complete the questionnaires in this order: HRS-SR, PVD, PHQ-9, OCI-R, GAD-7, Three Domain Disgust Scale, and DS-R before two open-ended self-report questions about the content of their fears and anxieties (a pilot measure to create quantitative items for study 2; below). After surveys, participants completed demographic items and the SES ladder before debriefing.

Sources of fear and anxiety

After the scales, participants were asked, in an open-ended format, to write in what they were most fearful and anxious about in their lives (separately, in that order). We defined fear as "similar to but different from anxiety... in fear more than anxiety you believe consciously or

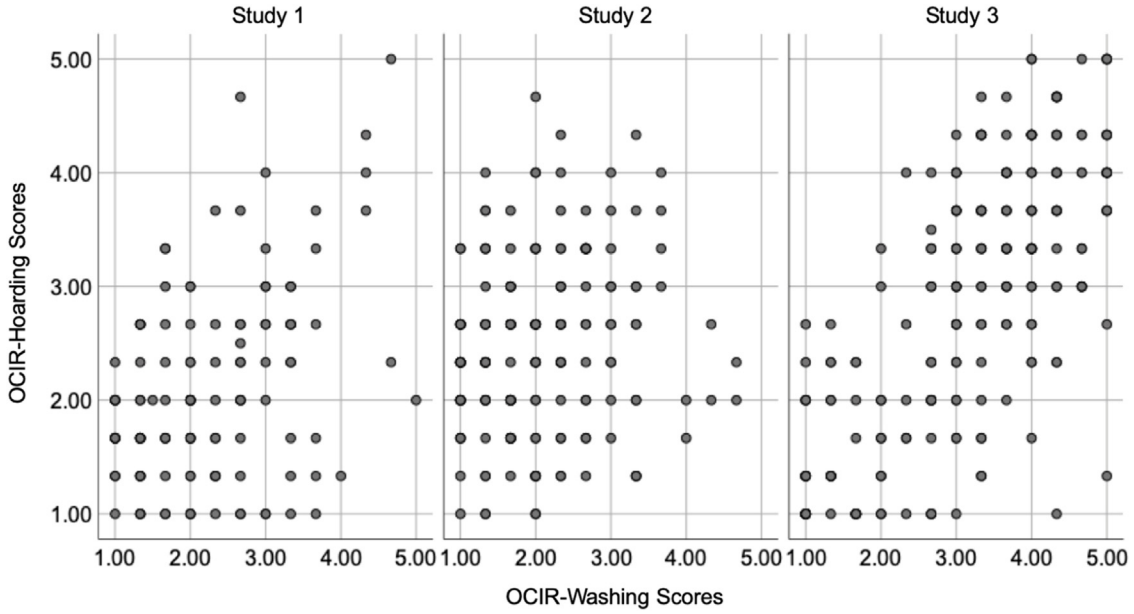

Figure 1 Intercorrelation of Obsessive—Compulsive Inventory-Revised (OCI-R) washing and hoarding scores in three studies.

unconsciously that there is a real and physical danger involved, such as an injury, disease, or death.'' We defined anxiety as ''similar but different from fear because you may worry about the thing or spend time thinking about what may happen or avoiding it, but you don't have to think there is a real or physical danger, even if there is something bad that can happen that you care about deeply.'' These answers were converted into categories by two researchers who discussed them until consensus (listed by frequency in Table S1). To convey their relative frequencies, the top five most common sources of fear (of 34 identified categories) were failure, death, heights, loss, and love; the top five most common sources of anxiety (of 22 identified categories) were uncertainty about an outcome, failure in school, failure to live up to one's potential, germs/contamination, and loss of control. These items were carried forward to create a participant-informed, quantitative measure of fears and anxieties for study 2.

Results

Intercorrelations

We confirmed that OCI-R washing and hoarding were interrelated in our non-clinical sample, $r = .39$, $p < .001$. OCI-R washing also correlated with the alternative hoarding score (from the HRS-SR), suggesting that these effects were not specific to the OCD form of hoarding, $r = .26$, $p = .004$ (Fig. 1). Given the intercorrelation of washing and hoarding tendencies, it was more valid to allow them to vary continuously, within and across individuals, than to group participants into one or the other.

Differential comorbid psychopathology

Supporting their shared comorbidity, bivariate correlations indicated that both OCI-R washing and hoarding increased with depression and general anxiety, $ps < .01$ (Table 3). In addition, general anxiety was significantly more related to washing than to hoarding tendencies, indicating a possible difference in their relative involvement, Fisher r-to-z transformation with a t-test, $p = .03$, $r_{washing} = .57$, $r_{hoarding} = .39$. In contrast to our first hypothesis, the higher correlation coefficient between depression and hoarding compared to washing tendencies was not significant, $p > .3$, $r_{washing} = .42$, $r_{hoarding} = .50$.

Dissociating the content of concerns—germs, infection, and disgust

The second hypothesis was largely supported, as washing and hoarding tendencies were associated with distinct concerns. As predicted, after controlling for OCI-R hoarding using partial correlations, washing tendencies still increased significantly with germ aversion, perceived infectability, and measures of disgust (core, contamination-based, and pathogen). After controlling for OCI-R washing, hoarding tendencies significantly decreased with the fear of germs and was unrelated to disgust.

SES

In contrast to our third hypothesis, using partial correlations, washing tendencies predicted lower childhood SES after controlling for hoarding tendencies, but washing was unrelated to current SES; hoarding tendencies were not significantly associated with SES in either period, childhood: $r = -.03$, $p = .78$, current: $r = -.17$, $p = .07$ (Table 4).

Study 2

Methods

Methods in study 2 were as in study 1, again administering an online survey to undergraduate students who were prescreened to have either moderate washing or hoarding tendencies. Participants completed, in this order: OCI-R

Table 3 OCI-R washing and hoarding correlations with depression and anxiety in studies 1 and 3.

	Study 1					Study 3				
	OCI-R Hoard	OCI-R Wash	HRS	PHQ-9	GAD-7	OCI-R Hoard	OCI-R Wash	HRS	PHQ-9	GAD-7
OCI-R hoarding	1	.39***	.70***	.50***	.39***	1	.71***	.81***	.74***	.70***
OCI-R washing		1	.26**	.42***	.57***		1	.67***	.61***	.65***
HRS-SR			1	.41***	.39***			1	.80***	.80***
PHQ-9				1	.70***				1	.86***
GAD-7					1					1

All correlations were bivariate correlations. All tests two-tailed: *$p < .05$; **$p < .01$; ***$p < .001$. OCI-R: Obsessive—Compulsive Inventory-Revised [Hoard(ing) or Wash(ing) subscales]; HRS: Hoarding Rating Scale-Self-Report (HRS-SR); PHQ-9: The Patient Health Questionnaire; GAD-7: Generalized Anxiety Disorder.

Table 4 Partial correlations between OCI-R washing and hoarding in studies 1 and 3.

	Study 1				Study 3			
	OCI-R Washing		OCI-R Hoarding		OCI-R Washing		OCI-R Hoarding	
	r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
Core disgust	.29	.002	−.02	.793	.14	.056	−.14	.041
Contamination-based disgust	.45	< .001	−.06	.521	.28	< .001	.09	.215
Pathogen disgust	.43	< .001	−.01	.928	.37	< .001	.11	.118
Perceived infectability	.36	< .001	.02	.825	.20	.003	.28	< .001
Germ aversion	.66	< .001	−.28	.002	.41	< .001	−.30	< .001
Childhood SES	−.19	.039	−.03	.777	.06	.376	.48	< .001
Current SES	−.12	.185	−.17	.067	.04	.557	.47	< .001

OCI-R: Obsessive—Compulsive Inventory-Revised; SES: socioeconomic status.
All correlations above were after controlling out the complementary tendency. All 2-tailed tests. *r* = Pearson partial correlation coefficients. Statistically significant correlation coefficients were bolded.

washing and hoarding, the Saving Inventory-Revised (SI-R), the Relationship to Objects Scale (ROS), ratings of emotions and preferences to four garage photos in random order, ratings of their sources of fear and anxiety, and the Hoarding Rating Scale-Self-Report (HRS-SR). Lastly, participants completed SES and demographic information including (in order): the SES ladder, whether they were born in the US (or years in the US if not), gender, age, race, marital status, primary language at home and a series of measures designed to probe null and unexpected SES effects from study 1 (type of residence (e.g., rent, own); education level for self, mother and father; estimated combined family income in the past year and in childhood; general health, and history of thirteen major medical problems).

Measures

The Saving Inventory-Revised

The Saving Inventory-Revised (SI-R, Frost, Steketee, & Grisham, 2004) is a 23-item self-report questionnaire (on a Likert scale from 0—4) with subscales for clutter, difficulty discarding, and excessive acquisition. It is a reliable measure of HD in clinical and non-clinical samples and can distinguish hoarding individuals from those with non-hoarding OCD (Frost et al., 2004). The SI-R was only used to further validate—with a longer and more established measure than the HRS-SR—that elevated OCI-R hoarding is similarly correlated with a more general HD symptom scale, and not specific to OCD.

Dissociating item preferences—Relationship to Objects Scale

To test the fourth hypothesis, that participants with washing tendencies may retain many items but prefer different types (newer or less contaminated) than for those with hoarding tendencies, we administered the Relationship to Objects Scale (ROS). The ROS lists 27 common domestic items—from nice and new items and technology to semi-useless items like pinecones—that participants rate on their level of interest and/or tendency to acquire or collect (from prior unpublished studies by Preston, Vickers, Abelson, Deldin, & Liu, 2014; see Supplement). Individual ROS items were submitted to PCA to reduce preferences into seven major types that we labeled from top-loading items (Table S2):

- memorabilia (e.g. previous awards);
- monetary documents and tools (e.g., financial records, tools);
- durable goods (e.g., t-shirts);
- packing materials (e.g. gift-wrapping supplies);
- candles and containers (e.g., candles, mugs);
- old school assignments and supplies (e.g., old school assignments, pencils);
- pets (e.g., fish, birds, mice).

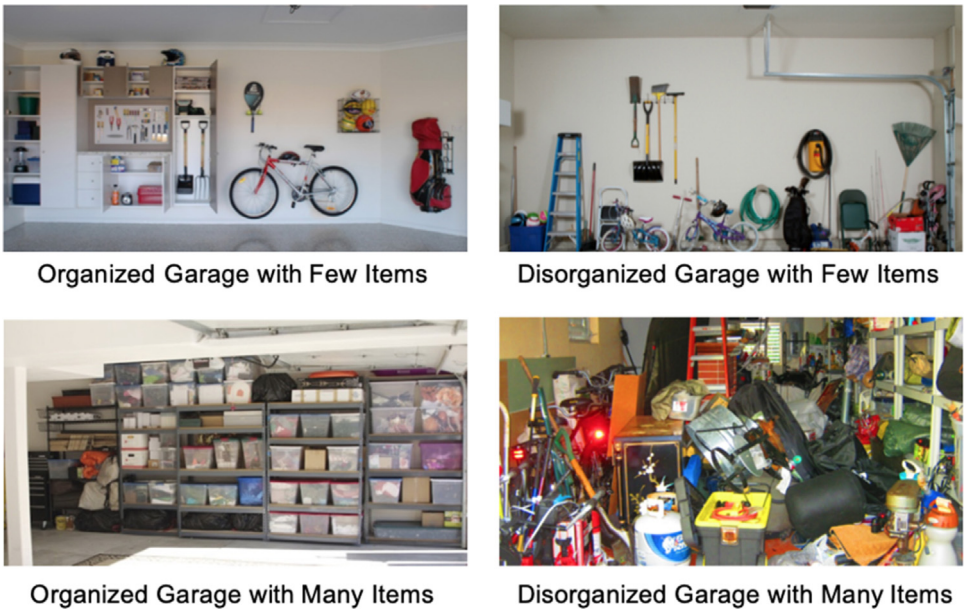

Figure 2 Garage photos from study 2. Garage photos used in study 2 with 2 × 2 within-subject comparisons (without labels during the study).

Dissociating item preferences—Responses to the amount and quantity in a garage

As an additional test of the fourth hypothesis, that people with washing tendencies prefer more organized spaces even when they accumulate items, participants rated four garage photographs from the internet, in random order. The garage is a location that people often use to accommodate extra items that is unobserved by visitors and may be more subject to excess than the home in a non-clinical population. The photos contained few or many items, organized or disorganized (2 × 2; Fig. 2).

Each garage was rated on twelve emotions (overwhelmed, anxious, comfortable, distressed, happy, scared, disgusted, depressed, calm, satisfied, dirty, clean; order randomized; 7-point Likert scale). These emotion ratings were reduced using PCA (separately for each garage using Varimax rotation and Kaiser Normalization) to restrict the number of comparisons and to decrease Type I error. All four garages yielded positive and negative emotion factors but only the garage with few, organized items generated an anxious and overwhelmed factor (which merged into the negative emotion factor in the other three garages). For consistency, we calculated three emotion factor average composite scores for all four images from ratings for items loading > .05 per factor [*positive*: satisfied, calm, happy, comfortable, clean; *negative*: disgust, dirty, scared, depressed, distressed; *anxious and overwhelmed*: anxious, overwhelmed; PCA results in Table S3, *M* (*SD*) in Table S4].

Participants also rated three preferences related to the garage photos on the same 7-point Likert scale (the desire to live in the space, to change the space, and similarity to one's own space) and stated which of the four they would prefer as their own. Two additional manipulation check items (how full and organized), and cleanliness ratings (perceived level of dirtiness and germs) indicated a successful manipulation with the 2 × 2 design, with more full garages being perceived as fuller, dirtier, and more contaminated by germs and disorganized garages perceived as more disorganized, dirtier, and more contaminated by germs, Repeated-Measures (RM) ANOVA *F*s(1, 176) > 223.13, *p*s < .001 (Table S4).

Dissociating the content of concerns—sources of fear and anxiety

From the open-ended responses in study 1, we devised a quantitative measure of the content of participants' fears and anxieties. Each participant rated the 34 fears and 22 anxieties (Table S1) in random order on a 5-point Likert scale from 0 (not fearful/anxious about at all) to 5 (extremely fearful/anxious about). The number of concerns were reduced using PCA with Promax rotation and Kaiser Normalization to separately categorize sources of fear and of anxiety after examining the scree plots. Five categories of fear emerged: (1) threats to safety and security, (2) assault, (3) social rejection and failure, (4) insects, and (5) weight (Table S5). Four categories of anxiety were generated: (1) lack of control/loss, (2) social rejection, (3) strangers, and (4) contamination (Table S6). Each PCA factor was computed by averaging the ratings loaded above 0.05 and correlating these average composite scores with OCI-R tendencies, and compared with a separate linear mixed model in SPSS with participant as a random intercept effect.

Each PCA factor was computed by averaging the ratings loaded above 0.05 and correlating these average composite scores with OCI-R tendencies, and compared with a separate linear mixed model in SPSS with participant as a random intercept effect.

Analysis plan

Bivariate correlations were conducted among OCI-R washing and hoarding scores, HRS-SR, and SI-R total and subscale

scores. Partial correlations were conducted to predict people's item preferences from average composite factor scores on the ROS and on their sources of fear and anxiety, and all SES variables from OCI-R washing and hoarding tendencies separately, controlling for the other.

Linear mixed models were used to analyze participants' emotions and preferences for the four garage images. For the emotions, average composite factor scores from the PCA categories (negative, positive, anxious and overwhelmed; from items loading > .5 on each) were predicted from OCI-R washing and hoarding—in separate models in SPSS—entering participant as a random effect and including two, two-level fixed factors for level of fullness and organization (low or high).

Results

Intercorrelations

Washing and hoarding tendencies were again intercorrelated, $r = .15$, $p = .04$. OCI-R hoarding also positively correlated with the alternative hoarding symptom measures: HRS-SR, $r = .46$, SI-R total, $r = .70$, SI-R difficulty discarding, $r = .73$, SI-R excessive acquisition, $r = .45$, and SI-R clutter, $r = .54$, all $ps < .001$, supporting the interpretation that hoarding tendencies measured by the OCI-R also reflect general hoarding tendencies and not just within OCD. OCI-R washing also increased with SI-R total, $r = .18$, $p = .014$, SI-R excessive acquisition, $r = .15$, $p = .047$, and SI-R clutter, $r = .18$, $p = .015$ with directionally similar effects for HRS-SR and SI-R difficulty discarding that were not significant, HRS-SR $r = .12$, $p = .10$; SI-R difficulty discarding, $r = .12$, $p = .11$.

Dissociating item preferences—the relationship to Objects Scale

Washing tendencies were not significantly correlated with preferences for objects across types, after controlling for hoarding tendencies ($|r|s < .12$, $ps > .1$). Hoarding tendencies significantly increased with the preference for memorabilia ($r = .17$, $p = .021$) and old school assignments and supplies ($r = .25$, $p < .001$), after controlling for washing tendencies (all other $|r|s < .12$, $ps > .1$). This partially supports the second hypothesis, in that only hoarding tendencies increased with preferences for older items that referred to the past.

Dissociating item preferences—emotions to amount and quantity in a garage

People generally felt worse when viewing spaces that were full or disorganized (less positive, more negative, more anxious/overwhelmed; full statistics in the Supplement). These features interacted because people felt more negative and anxious/overwhelmed toward disorganized over organized spaces in spaces with many or few items, $Fs(1,176) > 56.20$, $ps < .001$, but the effect size was more than twice as large in the space with many than few items (e.g., Cohen's d for less full to more full spaces for negative emotions .56 to 1.96 and anxious/overwhelmed .56 to 1.5). Washing tendencies did not significantly alter emotional responses to garages, regardless of fullness, organization, or their interaction, $Fs(1, 522) < 2.94$, $ps > .1$, in contrast to the fourth hypothesis. Hoarding tendencies significantly interacted with the number of items for negative emotions, interaction: $F(1, 522) = 4.17$, $p = .042$; but post-hoc effects of hoarding within many or few items were not significant, $ts < 1.23$, $ps > .2$.

Dissociating item preferences—preferences for amount and quantity in a garage

Full statistics for garage preferences (wanting to live there, viewing it as similar to your own, desire to change) from the linear mixed models are in the Supplement and briefly summarized here. Participants preferred a garage with fewer and more organized items, uninfluenced by washing or hoarding tendencies, $Fs < 2.15$, $ps > .14$.

Participants considered the space more similar to their own with few, disorganized items and least similar with many, disorganized items, main effects and interaction: $Fs(1, 522) > 8.05$, $ps < .005$. Washing did not influence the perception that the space was similar to one's own in general or by amount, organization, or their interaction, $Fs < 2.57$, $ps > .10$. Hoarding tendencies interacted with amount and organization, $Fs > 4.24$, $ps < .05$, in support of their hoarding tendencies (i.e., increased similarity with many over few items (fixed effect marginal within many items but *ns* within few items) and when disorganized over organized (fixed effects both significant, but stronger for disorganized spaces, t (704) = −3.841, $d = 0.29$, $p < .001$]).

People generally wanted to change the space more when it had many items or was less organized, which interacted because the desire to change the disorganized space was almost twice as strong when the space had more items, Cohen's $d = 1.28$ versus 0.71. Supporting the fourth hypothesis, washing tendencies increased the desire to change or fix all spaces, $F(1, 174) = 5.31$, $p = .022$, and the effect of disorganization increased more with washing when there were few items, t (175) = 2.51, $d = 0.19$, $p = .013$ (Fig. 3), whereas hoarding tendencies did not alter the desire to change the space in general or by amount, organization, or their interaction, $Fs < 1.96$, $ps > .16$.

Dissociating the content of concerns—sources of fear and anxiety

From the partial correlations, sources of fear increased with washing tendencies, after controlling for hoarding tendencies, for social rejection and failure, $r = .19$, $p = .01$, all other $|r|s < .1$, $ps > .1$. Fears similarly increased with hoarding tendencies, after controlling for washing tendencies, for social rejection and failure, $r = .26$, $p = .001$; however, indicating some distinctness, hoarding tendencies also uniquely increased with threats to safety and security, $r = .30$, $p < .001$, assault, $r = .26$, $p = .001$, and insects, $r = .17$, $p = .025$ (weight *ns*, $r = .08$, $p = .31$). For anxieties, both washing and hoarding tendencies increased with all four categories (lack of control/loss, social rejection, strangers, contamination), controlling for one another, $ps < .05$, supporting their commonality. To further test the second hypothesis, that washing should be more associated with contamination concerns, we compared their significant correlation coefficients for anxiety about contamination with a Fisher r to z test; washing tendencies were not more related to contamination than hoarding tendencies were, $z = 1.68$, $p = .09$.

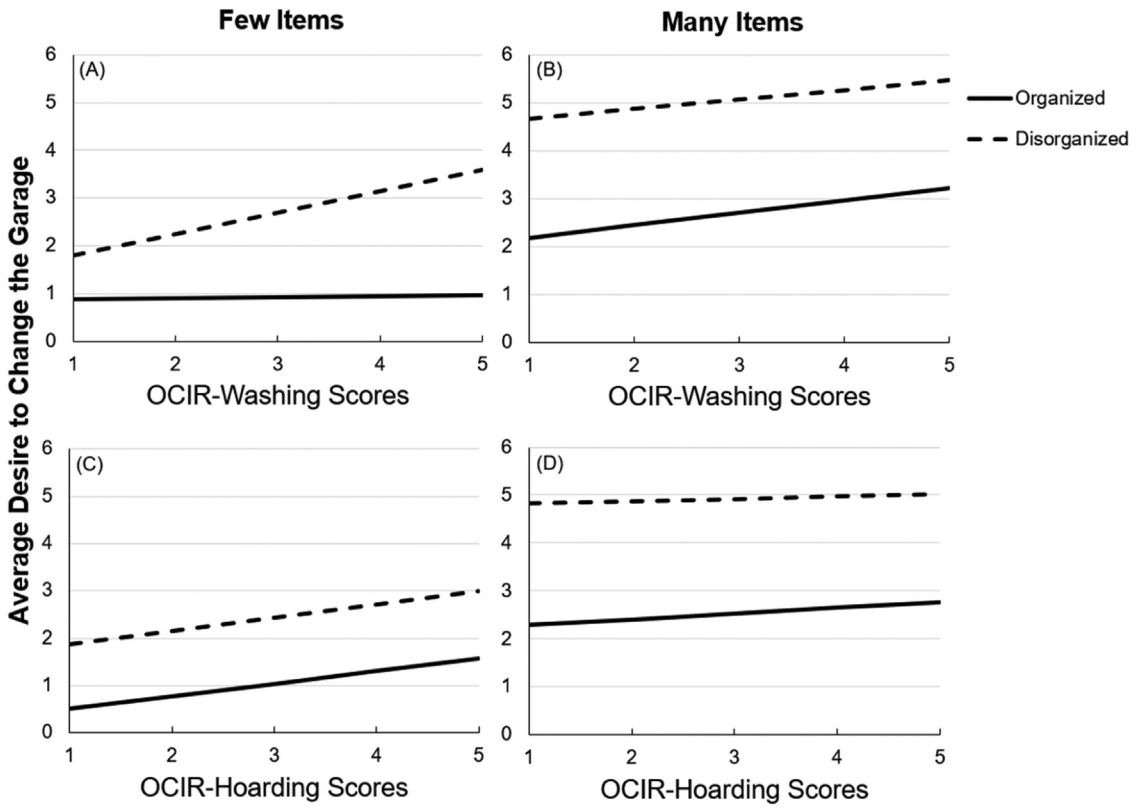

Figure 3 Average desire to change increased by washing tendencies for disorganized spaces. People wanted to change the room more when it had more items or was more disorganized, but the effect of disorganization was more pronounced when there were more items (see changes in the mean score for panels B and D over A and C and increases for dashed over solid lines). Washing tendencies increased the desire to change all spaces, but the effect of disorganization increased more with washing when there were few items (dashed versus solid lines in panel A).

SES

Contradictory to study 1—where washing tendencies were negatively associated with childhood SES—the partial correlation between washing and childhood SES was significantly positive after controlling for hoarding, $r = .15$, $p = .047$. The correlation between washing tendencies and childhood income was also positive, after controlling for hoarding, $r = .15$, $p = .042$. Hoarding tendencies increased with one's own education level, after controlling for washing, $r = .18$, $p = .019$. As in study 1, and in contrast to the third hypothesis, hoarding was not associated with childhood or current SES in study 2, $ps > .1$. All other partial correlations failed to reach significance, $|r|s < .15$, $ps > .05$.

Study 3

Methods

Study 3 was similar to the prior studies, but was administered to a larger, national sample to replicate the effects in a more generalizable population and test the fifth hypothesis: that washing and hoarding tendencies will be more interrelated and beneficial in the context of a pandemic. Testing was completed in late April 2020, during a first-wave peak of the COVID-19 in the US. Participants completed (in order): OCI-R washing and hoarding subscales, HRS-SR, PHQ-9, GAD-7, DS-R (core and contamination-based disgust), the Three Domain Disgust Scale (pathogen subscale), PVD (perceived infectability and germ aversion subscales), sources of fear and anxiety, and SES and demographic items from study 2.

The final block assessed the degree that COVID-19 impacted three aspects of life (on 5-point Likert scales):

- impact on life (*to what degree has the outbreak of COVID-19 been a threat* to physical health, family members' health, financial situation, mental health, well-being, and relationship; each rated separately, adapted from Pew Research Center, 2020);
- impact on emotions (*in the past 14 days, related to the outbreak of COVID-19, how often has it caused you to feel* nervous, feel depressed, feel lonely, have trouble sleeping, feel hopeful about the future, and have a physical reaction; each rated separately, from Pew Research Center, 2020);
- protective behaviors (how often have you read news about COVID-19, stayed 6 feet away from someone, avoided a group gathering, disinfected items that entered your home, washed your hands for more than 20 seconds, went out of your way to cover a cough/sneeze, wore a face mask, wore gloves, stocked up on supplies at your home, ordered no-contact food pickup or delivery; rated separately, adapted from Wang et al., 2020).

A ''not applicable'' (NA) option was added to these protective behaviors because some are irrelevant for isolated participants (e.g., staying 6 ft away or wearing a mask).

Results

Intercorrelations

We replicated the intercorrelation between washing and hoarding tendencies, $r = .71$, $p < .001$. We also confirmed the fifth hypothesis that washing was more strongly intercorrelated with hoarding during COVID-19 than in the samples collected before the pandemic in study 1, $z = 4.14$, $p < .001$ and study 2, $z = 7.17$, $p < .001$ (Fisher r-to-z transformations with a t-test). Comparing the magnitude of participants' washing or hoarding tendencies by study, participants also reported significantly higher OCI-R washing and hoarding scores during COVID-19 than in the prior studies, washing tendencies: COVID-19 M (SD) = 2.92, RM ANOVA $F(2, 516) = 66.49$, $p < .001$ (study 1 versus study 3: t (338) = −7.43, $p < .001$; study 2 versus study 3: t (392) = −10.59, $p < .001$); hoarding tendencies: COVID-19 M (SD) = 3.19, RM ANOVA $F(2, 516) = 29.61$, $p < .001$ (study 1 versus study 3: t (338) = −6.91, $p < .001$; study 2 versus study 3: t (392) = −4.33, $p < .001$).

Differential comorbid psychopathology

Bivariate correlations in study 3 replicated the link between washing and hoarding tendencies and depression, $r_{washing} = .61$, $p_{washing} < .001$; $r_{hoarding} = .74$, $p_{hoarding} < .001$ and general anxiety, $r_{washing} = .70$, $p_{washing} < .001$; $r_{hoarding} = .65$, $p_{hoarding} < .001$. Moreover, we confirmed a directional effect that was not significant in study 1, with a significantly greater impact of hoarding tendencies on depression than washing tendencies, $z = 2.5$, $p = .012$; Table 3. The greater association between anxiety and washing over hoarding tendencies from study 1 did not replicate, $p > .05$.

Dissociating the content of concerns—germs, infection, and disgust

There was again evidence for our second hypothesis in that partial correlations replicated the increase with washing tendencies of contamination-based and pathogen disgust, perceived infectability, and germ aversion, $r > .20$, $p < .004$ (core disgust now below significance; $r = .14$, $p = .056$; Table 4). We also replicated decreasing germ aversion with hoarding tendencies, $r = -.30$, $p < .001$; and in this sample, the decrease in core disgust with hoarding tendencies was significant, $r = -.14$, $p = .041$ (while controlling out washing tendencies). In contrast to our hypothesis, however, hoarding tendencies increased with perceived infectability in this sample after controlling for washing, $r = .28$, $p < .001$ (previously unrelated), all other $ps > .1$ (Table 4).

SES

Further indicating instability in the relationships between OCI-R tendencies and SES, partial correlations in Study 3 did not reveal relationships between washing tendencies and childhood or current SES and now hoarding tendencies increased with both, in contrast to our third hypothesis (Table 4).

Dissociating the content of concerns—sources of fear and anxiety

As in study 2, we computed the five factors for fear and anxiety sources from the original PCA (Table S1). Partial correlations were used to test the impact of washing and hoarding tendencies on these average composite factor scores (full statistics in the Supplement). Extending the results from study 2, washing tendencies during COVID-19, after controlling for hoarding, were significantly positively correlated with all five categories of fears (threats to safety and security, assault, social rejection and failure, insects, and weight), $rs > .18$, $ps < .008$. Correlations between hoarding tendencies and fears, after controlling for washing, replicated study 2, $rs > .13$, $ps < .05$, except that during COVID-19 assault was no longer significant, $r = .13$, $p = .053$ and the fear of weight was, $r = .37$, $p < .001$. For anxieties, we replicated study 2, with both washing and hoarding tendencies increasing all four anxiety categories (lack of control/loss, social rejection, strangers, contamination), $rs > .19$, $ps < .001$.

Impact of COVID-19 on emotions and behaviors

Higher washing tendencies uniquely increased with feelings of threat from one's financial situation, $r = .32$, $p < .001$ and family members' health, $r = .21$, $p = .002$, after controlling for hoarding. Both washing and hoarding tendencies increased with threats to physical health, mental health, well-being, and relationships, $rs > .13$, $ps < .05$, and increased with negative emotions related to COVID-19 (feeling more nervous, depressed, lonely, and having trouble sleeping, $rs > .17$, $ps < .01$), after controlling for one another (full statistics in the Supplement).

Regarding behaviors that could reduce the impact of the disease, as washing tendencies increased, after controlling for hoarding, participants engaged more in protective behaviors, including more frequently reading the news, staying 6 feet away, avoiding gathering, disinfecting items entering the home, washing hands, covering cough/sneeze, wearing masks and gloves, stockpiling supplies, and ordering no-contact food. As hoarding tendencies increased, after controlling for washing, participants reported engaging less in protective behaviors, including staying 6 feet away, avoiding gatherings, washing hands, or covering cough/sneeze. There were no relationships between hoarding and reading the news, disinfecting items, wearing a mask/gloves, increasing stockpiling or ordering no-contact food, $rs < .1$, $ps > .1$ (full statistics in Table 5).

General discussion

We began with the premise that it is unclear how such similar psychopathological profiles for washing and hoarding tendencies could manifest with seemingly opposing behaviors, like extreme cleanliness with compulsive washing versus extreme clutter with hoarding. To explore this, we surveyed non-clinical individuals to test five hypotheses about how and why these features could be similar yet different—and potentially beneficial during a global pandemic.

All three studies confirmed that washing and hoarding are similar in that they are highly intercorrelated and both increase with self-reported depression and general anxiety,

Table 5 Partial correlations between COVID-19 protective actions and OCI-R subscales in study 3.

COVID-19 protective actions	OCI-R washing		OCI-R hoarding	
	r	*p*	*r*	*p*
Read news about COVID-19	.182	.044	.041	.649
Stayed 6 feet away from someone	.235	.009	−.293	.001
Avoided a group gathering	.238	.008	−.314	< .001
Disinfected items that entered your home	.294	.001	.019	.835
Washed your hands for more than 20 seconds	.240	.008	−.240	.007
Went out of your way to cover a cough/sneeze	.211	.019	−.208	.021
Wore a face mask	.209	.020	.090	.321
Wore gloves	.328	< .001	.145	.110
Stocked up on supplies at your home	.261	.004	.171	.059
Ordered no-contact food pickup or delivery	.197	.029	.083	.361

OCI-R: Obsessive—Compulsive Inventory-Revised.
All correlations represent the remaining level after controlling out the complementary tendency.

as in clinical samples (see Frost, Steketee, & Tolin, 2011; Hanna, 1995; Pertusa et al., 2008; Rasmussen & Eisen, 1992; Samuels et al., 2002; Tolin, Meunier, Frost, & Steketee, 2011). This was true even though we tested non-clinical samples and examined individual differences in OCD tendencies, rather than testing patients with more severe symptoms and comorbidities. The fact that we could relate OC tendencies to each other and their expected comorbidities, in non-clinical samples, is a testament to their continuous rather than discrete nature (e.g., see Burns et al., 1995; Coles et al., 2003; Damecour & Charron, 1998; Frost & Gross, 1993; Frost et al., 1996; Preston, Muroff, & Wengrovitz, 2009; Timpano et al., 2009; Tolin et al., 2003).

Washing and hoarding tendencies were also commonly associated with fears of social rejection and failure, along with anxieties about a lack of control/loss, social rejection, strangers, and contamination. These shared concerns, along with the social isolation, negative emotionality, and emotional security issues that are linked to OCD and its symptoms (Grisham et al., 2011; Russell et al., 2011) suggest that washing and hoarding are similar to one another—and to anxiety disorders in general—because they are designed to cope with security-related concerns (Woody & Szechtman, 2005, 2011).

Differential comorbid psychopathology

Despite these robust similarities, however, we also revealed both qualitative and quantitative differences between washing and hoarding tendencies, as predicted. Largely supporting our first hypothesis, we found greater involvement of depression in hoarding tendencies (below significance in study 1, significant in study 3). This is consistent with prior studies finding an increase in depressive symptoms with hoarding symptoms (Tolin et al., 2011) and that OCD individuals with compared to without hoarding had more comorbid depression (Frost et al., 2011). This result does perhaps contrast with another study that found comparable percentages of major depression and dysthymia OCD individuals with or without hoarding and in hoarding individuals without OCD—-although their samples were small (Pertusa et al., 2008). Prior studies have also found more severe impairment or comorbidity when OCD was accompanied by hoarding, but we did not measure these additional features (e.g., personality disorders, schizophrenia) and our non-clinical samples are less likely to suffer from severe issues. More depressive symptoms with hoarding than washing tendencies may be structurally related to the symptoms themselves, given that issues with excess and clutter can emerge from simple inaction (e.g., failure to clean, winnow) that would be exacerbated by depression, whereas compulsive washing per se requires energy that may or may not be fueled by greater anxiety (our results were mixed on this latter point). Consistent with this, washing tendencies in our study were more associated with the hoarding dimensions of excessive acquisition and clutter than with trouble discarding—the most intransigent aspect of hoarding and its core feature (Frost et al., 2012).

GAD only increased with washing more than with hoarding in one of two studies. This could be consistent with a study that found that more individuals with non-hoarding OCD had GAD compared to hoarding participants without OCD; however, the greatest percentage of GAD in their sample was in OCD patients with hoarding problems, which is perhaps most similar to our higher hoarding participants who were assessed with an OC scale (we used OCI-R and they used the Yale-Brown OC Scale; Pertusa et al., 2008). Thus, the relative presence of GAD with washing versus hoarding is still somewhat unclear.

Dissociating the content of concerns

Largely supporting our second hypothesis, washing and hoarding tendencies were also associated with distinct concerns. For example, washing tendencies were uniquely associated with more germ aversion, perceived infectability, and disgust (core, contamination-, and pathogen-based)—consistent with prior work (de Jong & Merckelbach, 1998; Olatunji et al., 2004, 2007; Rachman, 1994). Given that most of these features were not associated with hoarding tendencies, which also decreased significantly with germ aversion in both studies and with core disgust in one study, there was partial support for the expectation that hoarding conditions could be promoted by a higher tolerance

for possible contamination. However, disgust was not significant in the other cases (i.e., core disgust in one study and contamination or pathogen disgust in both studies) and perceived vulnerability for infection actually increased with hoarding tendencies in one study. Thus, even if hoarding disorder appears to produce environments and the retention of items that other people may consider disgusting (suggesting a higher tolerance in people who hoard), such a relationship may not be observed if it is a small effect, is specific to certain features of hoarding (e.g., not with compulsive shopping but with poor discarding and higher functional impairment), or if detection requires a more impaired population. Further complicating this issue, some prior work reported increased disgust responses with hoarding; however, these studies measured a different phenomenon, such as emotional liability in general and feeling incensed when asked to discard goods (David et al., 2009; Timpano et al., 2014). More research is needed on this topic, with careful attention to the exact nature of the disgust being measured.

The second hypothesis was also partially supported by the content of participants' fears and anxieties. The two tendencies did share many concerns, but hoarding was more strongly associated with fears of assaults, threats to safety and security, and insects. Such perceived threats may promote hoarding to achieve emotional safety and security, which could promote an attachment to and identification with items that feel protective (Frost et al., 2011; Preston & MacMillan-Ladd, 2021). Once people feel attached to and identify with goods, throwing the items away would add to the perception of lost security and safety—even a part of one's self (Woody & Szechtman, 2011). A compensatory attachment to goods, which satisfies a need to feel safe and secure, coheres with the fact that hoarding tendencies increase people's initial attachment to an endowed good (Grisham et al., 2009) and their endowment effect (with trouble discarding and overall impairment; Pushkarskaya et al., 2020).

The third hypothesis was not supported as we found inconsistent connections between washing and hoarding tendencies and SES, similar to past work—which reported lower SES with hoarding in one study (Samuels et al., 2008) but no relationship in another (Tolin, Meunier, et al., 2010). We had hypothesized that hoarding may be associated with a lower SES, given the past study (Samuels et al., 2008), and the link in other species and domains between hoarding and deprivation (e.g., Chiu et al., 2003; Preston, 2001; Preston, 2014; Samuels et al., 2008; Tolin, Meunier, et al., 2010). Contrary to this hypothesis, the correlation between hoarding tendencies and both childhood and current SES was not significant in the first two studies and was actually positive in the third; moreover, hoarding tendencies increased with education in study 2. Adding to this confusion, washing tendencies were generally associated with lower SES on the subjective ladder measure, but only significant for childhood SES in study 1; in study 2 the partial correlation was actually positive for childhood SES and income. Washing tendencies could focus people on cleanliness to compensate for childhood deprivation if the situation included a less clean environment (i.e., more pollution, lower water quality, less ability to clean; see review in (Evans & Kantrowitz, 2002), but much more research is needed on this topic, using different designs and measures, to understand the unstable impact of deprivation on such behaviors.

The fourth hypothesis was largely supported, which suggested that washing would be associated with a preference for different items and greater organization, even if both tendencies lead to excesses. There were no unique preferences for washing tendencies, but only hoarding tendencies were associated with a greater preference for older items like memorabilia and old school assignments. These items may be particularly relevant to students, but they replicate data from the same instrument linking hoarding tendencies to used and even broken items (Preston et al., 2014) and this focus on the past coheres with the link between hoarding and insecure attachment (Danet & Secouet, 2018; Frost et al., 1995; Mathes, Timpano, Raines, & Schmidt, 2020; Preston & MacMillan-Ladd, 2021).

As predicted, washing tendencies were positively associated with the desire to change or fix all spaces, particularly when few items were disorganized. Perhaps these spaces were aversive because they seemed dirtier or full of germs, which activated their sensitivity to infection, contamination, or disgust—which does not require contact (Coughtrey, Shafran, Lee, & Rachman, 2013; Radomsky, Rachman, Shafran, Coughtrey, & Barber, 2014). It is also possible that typical OC features like a need for control, order, and symmetry increase the need for change without requiring the unique features of OC washing. Supporting their self-reported hoarding tendencies, participants with higher hoarding tendencies perceived full and disorganized spaces as more similar to their own and may have felt less negative about full and disorganized spaces (or more negative when there were few; the significant interaction was followed by non-significant post-hoc tests). This diverging emotional response to spaces of varying fullness and disorder should be replicated in future studies.

Impact of COVID-19 on emotions and behaviors

Supporting our fifth hypothesis, that the link between washing and hoarding might be context-sensitive and advantageous under certain conditions, the two tendencies were significantly more intercorrelated during the first US wave of COVID-19 than in our prior samples. We also replicated in this larger, national sample that both washing and hoarding tendencies increase with depression, general anxiety, and most of the fears and anxieties revealed in the prior studies. Pointing to the context-sensitivity of these measures, hoarding tendencies during COVID-19 were no longer associated with a fear of assault and were newly associated with a fear of weight—concerns that reflect their changed reality in which people are less exposed to strangers and often gain weight (e.g., Zachary et al., 2020). Moreover, multiple results for hoarding tendencies were only significant in this sample—the greater impact of hoarding tendencies on depression, increased perceived infectibility, and decreased core disgust—potentially indicating that the behavior is triggered by external conditions, at least in non-patients.

The pandemic also appeared to have impacted people more when they reported OC tendencies. For example, both washing and hoarding tendencies increased people's sense

of threat to their physical and mental health, well-being, and relationships and it increased their negative emotions (even after controlling for the other tendency); washing tendencies also uniquely increased concerns about finances and family health. Thus, perhaps people are more sensitive to infectibility during a pandemic, which alters how they feel, perceive, and report upon their experience—consistent with the concept of a behavioral immune system that is sensitive to cues of disease, more so in those who view themselves as vulnerable (e.g., Ackerman, Hill, & Murray, 2018; Mortensen, Becker, Ackerman, Neuberg, & Kenrick, 2010). Supporting the idea that such tendencies naturally protect people during risky situations like a pandemic or shortage, washing tendencies increased with all protective behaviors (e.g., hand washing, wearing a mask, staying 6 ft away)—including stockpiling. Of course, OC washing symptoms per se overlap considerably with actions recommended to avoid COVID-19 (i.e., hand washing, disinfecting items but also social problems, which could increase staying 6 ft away or avoiding gatherings), but this is not a problem and, rather, is why we predicted its adaptiveness in this context.

In contrast to our hypothesis, as hoarding tendencies increased, participants reported engaging less in protective behaviors, including less distancing, avoiding gatherings, washing hands, and covering their cough or sneeze (without impacting reading the news, disinfecting, wearing a mask/gloves, stockpiling or using no-contact pickup). The fact that even stockpiling did not increase with hoarding tendencies in the pandemic is surprising. It is possible that this effect was limited by public shaming of ''panic buying'' or stockpiling (Preston, 2020) that reduced their willingness to admit the behavior or because of our non-clinical sample. It is also possible that hoarding in the home as a disposition is undergirded by different mechanisms than the adaptive form that is found across species (Preston, 2014). It is unlikely that people prone to hoarding were less able to acquire or buy items, given that they avoided people less and SES increased with hoarding tendencies here. Further research is needed on the link between normative, situational hoarding behavior (e.g., stockpiling items in a pantry or shelter for an uncertain time) and dispositional symptoms—as has been suggested for washing behaviors (Ackerman et al., 2018).

Implications for treatment

Many existing treatments for OCD and other anxiety disorders are ineffective for people suffering from hoarding problems, including exposure therapy, response prevention, and serotonergic medication; drop-out rates are higher and the treatment response is lower (e.g., Bloch et al., 2014; Muroff et al., 2011; Steketee et al., 2003). In one meta-analysis of over three thousand OCD patients (over 300 had hoarding symptoms), treatment responses were significantly lower for those with hoarding symptoms [odds ratio = 0.5 (CI = 0.42—0.60); Bloch et al., 2014].

To date, the most promising treatment for hoarding disorder has been cognitive behavioral therapy (CBT). Based on a cognitive behavioral model of HD, researchers have advocated for treatments that focus on restructuring patients' thoughts and beliefs surrounding their possessions—in general and during symptom provocation (e.g., emotional comforts, mnemonic value, excessive feelings of responsibility and need to control; Levy et al., 2017; Muroff et al., 2011). One study that employed this technique reported a significant reduction in hoarding symptoms, but even this one-third reduction in symptoms left patients with scores that were still highly elevated. A meta-analysis of CBT interventions with HD reported that just over a third of patients were significantly improved, with two thirds still exhibiting pathological symptoms after treatment (Tolin et al., 2015), even when employing time-consuming home visits or doubling the number of visits (Levy et al., 2017). The effectiveness of a therapy based on controlling one's thoughts and beliefs may be limited by the fact that hoarding disorder is characterized by poor insight, and impaired decision and executive processes (reviewed in Grisham & Baldwin, 2015). A study that employed cognitive remediation did improve attention but not memory, executive processes, or hoarding symptoms (Grisham & Baldwin, 2015). One study even found that the common attributes of hoarding across populations (students, non-clinical ''packrats'', OCD patients, and HD patients) were low insight, low treatment motivation, and failure to resist the compulsion to hoard—along with significant comorbid psychopathology (Damecour & Charron, 1998).

It may be more effective to a focus treatment on the initiating feelings and worries that precede the disordered thoughts and beliefs, and that subsequently foster the need to acquire, become attached to, and be surrounded by items (e.g., David et al., 2009; Mathes et al., 2020; Preston & MacMillan-Ladd, 2021; Timpano et al., 2014; Pushkarskaya, Lenkic, Stewart, Tolin, & Woody, 2020). Indicating the potential for change through emotions, one study found that hoarding patients were cognitively impaired, but performed normally on an emotional decision-making task (Grisham & Baldwin, 2015) — suggesting an intact capacity that could be developed. Moreover, successful OCD treatment in young adults in another study was associated with adopting more adaptive emotion regulation strategies (less rumination and suppression and more reappraisal; Wei et al., 2020). However, the fact that OCD individuals are cognitively impaired (Grisham & Baldwin, 2015) and are cognitively inflexible when facing triggers (Caudek, Sica, Marchetti, Colpizzi, & Stendardi, 2020) might suggest that these cognitive features need to be addressed for treatment to succeed. To fully explore this space, our results should be merged with prior reports on the specific emotional vulnerabilities and concerns associated with washing and hoarding (e.g., Frost & Gross, 1993; Frost & Hartl, 1996; Grisham et al., 2011; Steketee et al., 2003) and with direct comparisons of treatments that focus on improving cognition versus emotions.

Given what we know about what is both in common and distinct between washing and hoarding tendencies, we can tailor treatments to each patient's precise condition. For example, washing and hoarding likely share concerns about social rejection, failure, losing control, loss, strangers, and contamination—concerns that are fairly universal and also occur in other anxiety disorders. However, washing compared to hoarding focuses more on concerns about germs, contamination, and disgust—which may be less relevant to hoarding participants (especially without OCD); in contrast, hoarding compared to washing focuses more on threats to

one's safety and security, assault, insects, and weight. Thus, patients may alternately need to be more reassured about the possibility of a chemical attack that impacts the inside of the body (washing) versus a physical attack that impacts the outside (hoarding)—while reassuring both about the possibility of losing control and social problems. In general, future research may benefit from a heightened focus on the unique emotional and cognitive features of these syndromes (see Caudek et al., 2020; Wei et al., 2020) in order to better tailor interventions to the precise psychologies of individuals with these conditions.

Limitations

There were multiple limitations in this work that should be addressed in the future. We examined student and online participants rather than patients, which means that our samples are both more homogeneous in age, education, and wealth than the general population and less impaired than patients are. Other important studies on hoarding have used similar samples, and it is reassuring that our results replicated in the larger, national sample. However, online participants are also younger, more educated, and more likely to be Caucasian and Asian than the general population (Paolacci & Chandler, 2014)—characteristics that are problematic of studies of hoarding in general (Muroff et al., 2011). This homogeneity may have particularly undermined our ability to find consistent impacts of SES on OC tendencies. Future work must replicate our results and further examine the effects of early and current deprivation on washing and hoarding using broad, balanced samples that include both patients and healthy controls, in contexts that are more or less defined by scarcity.

Our garage image task was modeled after a similar, validated HD measure (the clutter image rating scale; Frost et al., 2008), but we intentionally altered the task to present a garage, because our non-patients may not accumulate as much in rooms people visit but may express their tendencies in a room that is hidden from view. We need to validate these findings in a population and room more typical of HD, which involves the excessive accumulation of relatively useless items that prevent people from being able to use rooms for their intended purposes (e.g., Frost & Hartl, 1996; Frost et al., 2011). This is particularly important for our diverging impacts on negative emotion in response to cluttered spaces, which were unstable. We must also contrast the fears and anxieties that people self-reported with those described in the literature, such as concerns that center around possessions per se that we did not test (e.g., Steketee et al., 2003).

Our results are also correlational in nature and, thus, cannot be used to infer causal or longitudinal relationships—only the direction and strength of variables' association, in cross-sectional samples. We must also be cautious about assuming that any similar or different effects in our third sample is specifically due to the presence of the COVID-19 pandemic, because the national sample was also larger, slightly older (same range but higher average), more male, and slightly more educated (the mode completed college whereas students are in college). It is also important to test people in person since online participants are known to endorse more clinical symptoms on MTurk, particularly for depression, anxiety, hoarding, and eating pathology (Arditte, Çek, Shaw, & Timpano, 2016)—all features that we examined.

Final conclusions

This research expands our understanding of how washing and hoarding tendencies are similar and yet present with such seemingly different behaviors. Our results suggest that certain underlying concerns are more universal whereas others are more specific to the condition. These tendencies are also sensitive to context and their interrelationship changes and can even be adaptive during a real-world crisis. Future research must develop diagnostic tools that focus on compassionately addressing each patient's specific and interrelated concerns, rather than just on trying to eliminate the problematic behaviors. With this knowledge, we can better understand the nature of these underlying psychopathologies and help practitioners develop and tailor treatments to the entailments of each condition.

Disclosure of interest

The authors declare that they have no competing interest.

CRediT authorship contribution statement

Tingting Liu: conceptualization; methodology; data collection; formal analysis; visualization; manuscript writing; editing; and preparation; Joshua M. Ackerman: conceptualization; methodology; supervision; manuscript editing and reviewing; Stephanie D. Preston: conceptualization; project administration; resources; supervision; manuscript editing; and final writing and preparation.

Acknowledgments

The authors thank Dr. Christine A. Feak and Lauren Halter for writing assistance. Funding was received from the Department of Psychology at the University of Michigan.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.jbct.2021.05.003.

References

Ackerman, J. M., Hill, S. E., & Murray, D. R. (2018). The behavioral immune system: Current concerns and future directions. *Social and Personality Psychology Compass*, *12*(2), e12371. https://doi.org/10.1111/spc3.12371 (1—14)

American Psychiatric Association. (2000). *DSM-IV-TR: Diagnostic and statistical manual of mental disorders, text revision*. Washington, DC: American Psychiatric Association (75. 78—85. https://doi.org/10.1176/appi.books.9780890423349)

Arditte, K. A., Çek, D., Shaw, A. M., & Timpano, K. R. (2016). The importance of assessing clinical phenomena in

Mechanical Turk research. *Psychological Assessment*, *28*(6), 684—691. https://doi.org/10.1037/pas0000217

Burns, G. L., Formea, G. M., Keortge, S., & Sternberger, L. G. (1995). The utilization of non-patient samples in the study of obsessive-compulsive disorder. *Behaviour Research and Therapy*, *33*(2), 133—144. https://doi.org/10.1016/0005-7967(94)00039-m

Bhikram, T., Abi-Jaoude, E., & Sandor, P. (2017). OCD: Obsessive—compulsive... disgust? The role of disgust in obsessive—compulsive disorder. *Journal of Psychiatry & Neuroscience: JPN*, *42*(5), 300. https://doi.org/10.1503/jpn.160079

Bloch, M. H., Bartley, C. A., Zipperer, L., Jakubovski, E., Landeros-Weisenberger, A., Pittenger, C., et al. (2014). Meta-analysis: Hoarding symptoms associated with poor treatment outcome in obsessive—compulsive disorder. *Molecular Psychiatry*, *19*(9), 1025—1030. https://doi.org/10.1038/mp.2014.50

Caudek, C., Sica, C., Marchetti, I., Colpizzi, I., & Stendardi, D. (2020). Cognitive inflexibility specificity for individuals with high levels of obsessive—compulsive symptoms. *Journal of Behavioral and Cognitive Therapy*, *30*(2), 103—113. https://doi.org/10.1016/j.jbct.2020.03.010

Chiu, S. N., Chong, H. C., & Lau, S. P. F. (2003). Exploratory study of hoarding behaviour in Hong Kong. *Hong Kong Journal of Psychiatry*, *13*(3), 23—31.

Coles, M. E., Frost, R. O., Heimberg, R. G., & Steketee, G. (2003). Hoarding behaviors in a large college sample. *Behaviour Research and Therapy*, *41*(2), 179—194. https://doi.org/10.1016/s0005-7967(01)00136-x

Coughtrey, A. E., Shafran, R., Lee, M., & Rachman, S. (2013). The treatment of mental contamination: A case series. *Cognitive and Behavioral Practice*, *20*(2), 221—231. https://doi.org/10.1016/j.cbpra.2012.07.002

Damecour, C. L., & Charron, M. (1998). Hoarding: A symptom, not a syndrome. *Journal of Clinical Psychiatry*, *59*(5), 267—272.

Danet, M., & Secouet, D. (2018). Insecure attachment as a factor in hoarding behaviors in a non-clinical sample of women. *Psychiatry Research*, *270*, 286—292. https://doi.org/10.1016/j.psychres.2018.09.053

David, B., Olatunji, B. O., Armstrong, T., Ciesielski, B. G., Bondy, C. L., & Broman-Fulks, J. (2009). Incremental specificity of disgust sensitivity in the prediction of obsessive-compulsive disorder symptoms: Cross-sectional and prospective approaches. *Journal of Behavior Therapy and Experimental Psychiatry*, *40*(4), 533—543. https://doi.org/10.1016/j.jbtep.2009.07.004

de Jong, P. J., & Merckelbach, H. (1998). Blood-injection-injury phobia and fear of spiders: Domain specific individual differences in disgust sensitivity. *Personality and Individual Differences*, *24*(2), 153—158. https://doi.org/10.1016/s0191-8869(97)00178-5

Duncan, L. A., Schaller, M., & Park, J. H. (2009). Perceived vulnerability to disease: Development and validation of a 15-item self-report instrument. *Personality and Individual Differences*, *47*(6), 541—546. https://doi.org/10.1016/j.paid.2009.05.001

Evans, G. W., & Kantrowitz, E. (2002). Socioeconomic status and health: the potential role of environmental risk exposure. *Annual Review of Public Health*, *23*(1), 303—331, doi:10.1146.

Foa, E. B., Amir, N., Bogert, K. V., Molnar, C., & Przeworski, A. (2001). Inflated perception of responsibility for harm in obsessive-compulsive disorder. *Journal of Anxiety Disorders*, *15*(4), 259—275. https://doi.org/10.1016/S0887-6185(01)00062-7

Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., et al. (2002). The Obsessive-Compulsive Inventory: Development and validation of a short version. *Psychological Assessment*, *14*(4), 485. https://doi.org/10.1037/1040-3590.14.4.485

Frost, R. O., & Gross, R. C. (1993). The hoarding of possessions. *Behaviour Research and Therapy*, *31*(4), 367—381. https://doi.org/10.1016/0005-7967(93)90094-b

Frost, R. O., & Hartl, T. L. (1996). A cognitive behavioral model of compulsive hoarding. *Behaviour Research and Therapy*, *34*(4), 341—350. https://doi.org/10.1016/0005-7967(95)00071-2

Frost, R. O., Hartl, T. L., Christian, R., & Williams, N. (1995). The value of possessions in compulsive hoarding: Patterns of use and attachment. *Behaviour Research and Therapy*, *33*(8), 897—902. https://doi.org/10.1016/0005-7967(95)00043-w

Frost, R. O., Krause, M. S., & Steketee, G. (1996). Hoarding and obsessive-compulsive symptoms. *Behavior Modification*, *20*(1), 116—132. https://doi.org/10.1177/01454455960201006

Frost, R. O., Steketee, G., & Grisham, J. (2004). Measurement of compulsive hoarding: Saving Inventory-Revised. *Behaviour Research and Therapy*, *42*(10), 1163—1182. https://doi.org/10.1016/j.brat.2003.07.006

Frost, R. O., Steketee, G., & Tolin, D. F. (2011). Comorbidity in hoarding disorder. *Depression and Anxiety*, *28*(10), 876—884. https://doi.org/10.1002/da.20861

Frost, R. O., Steketee, G., & Tolin, D. F. (2012). Diagnosis and assessment of hoarding disorder. *Annual Review of Clinical Psychology*, *8*, 219—242. https://doi.org/10.1146/annurev-clinpsy-032511-143116

Frost, R. O., Steketee, G., Tolin, D., & Brown, T. (2006). *Diagnostic issues in compulsive hoarding*. Paris: European Association of Behavioural and Cognitive Therapies.

Frost, R. O., Steketee, G., Tolin, D., & Glossner, K. (2010). Diagnostic comorbidity in hoarding and OCD. In *World Congress of Behavioral and Cognitive Therapies Boston*.

Frost, R. O., Steketee, G., Tolin, D. F., & Renaud, S. (2008). Development and validation of the clutter image rating. *Journal of Psychopathology and Behavioral Assessment*, *30*(3), 193—203. https://doi.org/10.1007/s10862-007-9068-7

Frost, R. O., Steketee, G., Williams, L. F., & Warren, R. (2000). Mood, personality disorder symptoms and disability in obsessive-compulsive hoarders: A comparison with clinical and nonclinical controls. *Behaviour Research and Therapy*, *38*(11), 1071—1081. https://doi.org/10.1016/s0005-7967(99)00137-0

George, D., & Mallery, M. (2010). *SPSS for windows step by step: A simple guide and reference, 17.0 update* (10th ed.). Boston, MA: Pearson.

Gravetter, F. J., Wallnau, L. B., Forzano, L. A. B., & Witnauer, J. E. (2020). *Essentials of statistics for the behavioral sciences* (10th). New York: Cengage Learning.

Grisham, J. R., & Baldwin, P. A. (2015). Neuropsychological and neurophysiological insights into hoarding disorder. *Neuropsychiatric Disease and Treatment*, *11*, 951—962. https://doi.org/10.2147/NDT.S62084

Grisham, J. R., Frost, R. O., Steketee, G., Kim, H. J., Tarkoff, A., & Hood, S. (2009). Formation of attachment to possessions in compulsive hoarding. *Journal of Anxiety Disorders*, *23*(3), 357—361. https://doi.org/10.1016/j.janxdis.2008.12.006

Grisham, J. R., Fullana, M. A., Mataix-Cols, D., Moffitt, T. E., Caspi, A., & Poulton, R. (2011). Risk factors prospectively associated with adult obsessive-compulsive symptom dimensions and obsessive-compulsive disorder. *Psychological Medicine*, *41*(12), 2495—2506. https://doi.org/10.1017/s0033291711000894

Haidt, J., McCauley, C., & Rozin, P. (1994). Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. *Personality and Individual Differences*, *16*(5), 701—713. https://doi.org/10.1016/0191-8869(94)90212-7

Hanna, G. L. (1995). Demographic and clinical features of obsessive-compulsive disorder in children and adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry*, *34*(1), 19—27. https://doi.org/10.1097/00004583-199501000-00009

Huppert, J. D., Simpson, H. B., Nissenson, K. J., Liebowitz, M. R., & Foa, E. B. (2009). Quality of life and functional impairment in obsessive-compulsive disorder: A comparison of patients with and without comorbidity, patients in remission,

and healthy controls. *Depression and Anxiety*, *26*(1), 39—45. https://doi.org/10.1002/da.20506

Kroenke, K., & Spitzer, R. L. (2002). The PHQ-9: A new depression diagnostic and severity measure. *Psychiatric Annals*, *32*(9), 509—515. https://doi.org/10.3928/0048-5713-20020901-06

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9. *Journal of General Internal Medicine*, *16*(9), 606—613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x

Levy, H. C., Worden, B. L., Gilliam, C. M., D'Urso, C., Steketee, G., Frost, R. O., et al. (2017). Changes in saving cognitions mediate hoarding symptom change in cognitive behavioral therapy for hoarding disorder. *Journal of Obsessive-Compulsive and Related Disorders*, *14*, 112—118. https://doi.org/10.1016/j.jocrd.2017.06.008

Litman, L., Robinson, J., & Abberbock, T. (2017). TurkPrime.com: A versatile crowdsourcing data acquisition platform for the behavioral sciences. *Behavior Research Methods*, *49*(2), 433—442. https://doi.org/10.3758/s13428-016-0727-z

Löwe, B., Decker, O., Müller, S., Brähler, E., Schellberg, D., Herzog, W., et al. (2008). Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. *Medical care*, 266—274. https://doi.org/10.1097/mlr.0b013e318160d093

Mataix-Cols, D., Rauch, S. L., Manzo, P. A., Jenike, M. A., & Baer, L. (1999). Use of factor-analyzed symptom dimensions to predict outcome with serotonin reuptake inhibitors and placebo in the treatment of obsessive-compulsive disorder. *American Journal of Psychiatry*, *156*(9), 1409—1416. https://doi.org/10.1176/ajp.156.9.1409

Mathes, B. M., Timpano, K. R., Raines, A. M., & Schmidt, N. B. (2020). Attachment theory and hoarding disorder: A review and theoretical integration. *Behaviour Research and Therapy*, *125*, 103549. https://doi.org/10.1016/j.brat.2019.103549 (1—18)

Mortensen, C. R., Becker, D. V., Ackerman, J. M., Neuberg, S. L., & Kenrick, D. T. (2010). Infection breeds reticence: The effects of disease salience on self-perceptions of personality and behavioral avoidance tendencies. *Psychological Science*, *21*(3), 440—447. https://doi.org/10.1177/0956797610361706

Muroff, J., Bratiotis, C., & Steketee, G. (2011). Treatment for hoarding behaviors: A review of the evidence. *Clinical Social Work Journal*, *39*(4), 406—423.

Murphy, D. L., Moya, P. R., Fox, M. A., Rubenstein, L. M., Wendland, J. R., & Timpano, K. R. (2013). Anxiety and affective disorder comorbidity related to serotonin and other neurotransmitter systems: Obsessive-compulsive disorder as an example of overlapping clinical and genetic heterogeneity. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *368*(1615), 20120435. https://doi.org/10.1098/rstb.2012.0435

Olatunji, B. O., Adams, T., Ciesielski, B., David, B., Sarawgi, S., & Broman-Fulks, J. (2012). The three domains of disgust scale: Factor structure, psychometric properties, and conceptual limitations. *Assessment*, *19*(2), 205—225. https://doi.org/10.1177/1073191111432881

Olatunji, B. O., Sawchuk, C. N., Lohr, J. M., & de Jong, P. J. (2004). Disgust domains in the prediction of contamination fear. *Behaviour Research and Therapy*, *42*(1), 93—104. https://doi.org/10.1016/s0005-7967(03)00102-5

Olatunji, B. O., Williams, N. L., Tolin, D. F., Abramowitz, J. S., Sawchuk, C. N., Lohr, J. M., et al. (2007). The Disgust Scale: Item analysis, factor structure, and suggestions for refinement. *Psychological Assessment*, *19*(3), 281. https://doi.org/10.1037/1040-3590.19.3.281

O'Connor, J. (2014). To hold on or to let go? Loss and substitution in the process of hoarding. *European Journal of Psychotherapy & Counselling*, *16*(2), 101—113. https://doi.org/10.1080/13642537.2014.896023

Paolacci, G., & Chandler, J. (2014). Inside the Turk: Understanding Mechanical Turk as a participant pool. *Current Directions in Psychological Science*, *23*(3), 184—188. https://doi.org/10.1177/0963721414531598

Pertusa, A., Fullana, M. A., Singh, S., Alonso, P., Menchón, J. M., & Mataix-Cols, D. (2008). Compulsive hoarding: OCD symptom, distinct clinical syndrome, or both? *American Journal of Psychiatry*, *165*(10), 1289—1298. https://doi.org/10.1176/appi.ajp.2008.07111730

Pew Research Center. (2020). *People financially affected by COVID-19 outbreak are experiencing more psychological distress than others*. https://www.pewresearch.org/fact-tank/2020/03/30/people-financially-affected-by-covid-19-outbreak-are-experiencing-more-psychological-distress-than-others/

Phillips, K. A., Stein, D. J., Rauch, S. L., Hollander, E., Fallon, B. A., Barsky, A., et al. (2010). Should an obsessive-compulsive spectrum grouping of disorders be included in DSM-V? *Depression and Anxiety*, *27*(6), 528—555. https://doi.org/10.1002/da.20705

Preston, S. D. (2001). *Effects of stress on decision-making in the Merriam's Kangaroo Rat (Dipodomys Merriami)* (Doctoral dissertation). Berkeley: University of California (https://doi.org/10.1037/0735-7036.119.2.187)

Preston, S. (2020). Your brain evolved to hoard supplies and shame others for doing the same. *The Conversation*, *27* (https://theconversation.com/your-brain-evolved-to-hoard-supplies-and-shame-others-for-doing-the-same-134634)

Preston, S. D. (2014). Hoarding in animals: The argument for a homology. In R. O. Frost, & G. Steketee (Eds.), *The Oxford handbook of hoarding and acquiring* (p. 187). Oxford: Oxford University Press (https://doi.org/10.1093/oxfordhb/9780199937783.013.009).

Preston, S. D., & MacMillan-Ladd, A. D. (2021). Object attachment and decision-making. *Current Opinion in Psychology*, *39*, 31—37. https://doi.org/10.1016/j.copsyc.2020.07.019

Preston, S. D., Muroff, J. R., & Wengrovitz, S. M. (2009). Investigating the mechanisms of hoarding from an experimental perspective. *Depression and Anxiety*, *26*(5), 425—437. https://doi.org/10.1002/da.20417

Preston, S. D., Vickers, B. D., Abelson, J., Deldin, P. J., & Liu, T. (2014). *The affect object link: Transdiagnostic chronic affect influence material preferences*. (Unpublished manuscript).

Pushkarskaya, H., Lenkic, P., Stewart, B., Tolin, D., & Woody, S. R. (2020). Hoarding symptoms correlate with the endowment effect. *Journal of Behavioral and Cognitive Therapy*, *30*(3), 201—210. https://doi.org/10.1016/j.jbct.2020.06.002

Rachman, S. (1994). The overprediction of fear: A review. *Behaviour Research and Therapy*, *32*(7), 683—690. https://doi.org/10.1016/0005-7967(94)90025-6

Radomsky, A. S., Rachman, S., Shafran, R., Coughtrey, A. E., & Barber, K. C. (2014). The nature and assessment of mental contamination: A psychometric analysis. *Journal of Obsessive—Compulsive and Related Disorders*, *3*(2), 181—187. https://doi.org/10.1016/j.jocrd.2013.08.003

Rasmussen, S. A., & Eisen, J. L. (1992). The epidemiology and clinical features of Obsessive-Compulsive Disorder. *Psychiatric Clinics of North America*, *15*(4), 743—758. https://doi.org/10.1016/S0193-953X(18)30205-3

Rozin, P., Haidt, J., & McCauley, C. R. (2008). Disgust. In M. Lewis, J. M. Haviland, & L. F. Barrett (Eds.), *Handbook of emotions* (pp. 757—776). New York: Guilford Press.

Ruscio, A. M., Stein, D. J., Chiu, W. T., & Kessler, R. C. (2010). The epidemiology of obsessive-compulsive disorder in the National Comorbidity Survey Replication. *Molecular Psychiatry*, *15*(1), 53—63. https://doi.org/10.1038/mp.2008.94

Russell, J. J., Moskowitz, D. S., Zuroff, D. C., Bleau, P., Pinard, G., & Young, S. N. (2011). Anxiety, emotional security and the interpersonal behavior of individuals with social anxiety disorder. *Psychological medicine*, *41*(3), 545. https://doi.org/10.1017/S0033291710000863

Sampson, J. M., Yeats, J. R., & Harris, S. M. (2012). An evaluation of an ambiguous loss based psychoeducational support group for family members of persons who hoard: A pilot study. *Contemporary Family Therapy*, *34*(4), 566—581. https://doi.org/10.1007/s10591-012-9214-6

Samuels, J., Bienvenu, O. J., III, Riddle, M. A., Cullen, B. A. M., Grados, M. A., Liang, K. Y., et al. (2002). Hoarding in obsessive-compulsive disorder: Results from a case-control study. *Behaviour Research and Therapy*, *40*(5), 517—528. https://doi.org/10.1016/S0005-7967(01)00026-2

Samuels, J. F., Bienvenu, O. J., Grados, M. A., Cullen, B., Riddle, M. A., Liang, K. Y., et al. (2008). Prevalence and correlates of hoarding behavior in a community-based sample. *Behaviour Research and Therapy*, *46*(7), 836—844. https://doi.org/10.1016/j.brat.2008.04.004

Samuels, J., Shugart, Y. Y., Grados, M. A., Willour, V. L., Bienvenu, O. J., Greenberg, B. D., et al. (2007). Significant linkage to compulsive hoarding on chromosome 14 in families with obsessive—compulsive disorder: Results from the OCD Collaborative Genetics Study. *American Journal of Psychiatry*, *164*(3), 493—499. https://doi.org/10.1176/ajp.2007.164.3.493

Saxena, S., Brody, A. L., Maidment, K. M., Smith, E. C., Zohrabi, N., Katz, E., et al. (2004). Cerebral glucose metabolism in obsessive—compulsive hoarding. *American Journal of Psychiatry*, *161*(6), 1038—1048. https://doi.org/10.1176/appi.ajp.161.6.1038

Sorrell, J. M. (2012). Understanding hoarding in older adults. *Journal of Psychosocial Nursing and Mental Health Services*, *50*(3), 17—21. https://doi.org/10.3928/02793695-20120208-02

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine*, *166*(10), 1092—1097. https://doi.org/10.1001/archinte.166.10.1092

Steketee, G., Frost, R. O., & Kyrios, M. (2003). Cognitive aspects of compulsive hoarding. *Cognitive Therapy and Research*, *27*(4), 463—479.

Timpano, K. R., Buckner, J. D., Richey, J. A., Murphy, D. L., & Schmidt, N. B. (2009). Exploration of anxiety sensitivity and distress tolerance as vulnerability factors for hoarding behaviors. *Depression and Anxiety*, *26*(4), 343—353. https://doi.org/10.1002/da.20469

Timpano, K. R., & Schmidt, N. B. (2013). The relationship between self-control deficits and hoarding: A multimethod investigation across three samples. *Journal of Abnormal Psychology*, *122*(1), 13. https://doi.org/10.1037/a0029760

Timpano, K. R., Shaw, A. M., Cougle, J. R., & Fitch, K. E. (2014). A multifaceted assessment of emotional tolerance and intensity in hoarding. *Behavior Therapy*, *45*(5), 690—699.

Tolin, D. F., Brady, R. E., & Hannan, S. (2008). Obsessional beliefs and symptoms of obsessive-compulsive disorder in a clinical sample. *Journal of Psychopathology and Behavioral Assessment*, *30*(1), 31—42. https://doi.org/10.1007/s10862-007-9076-7

Tolin, D. F., Frost, R. O., & Steketee, G. (2010). A brief interview for assessing compulsive hoarding: The Hoarding Rating Scale-Interview. *Psychiatry research*, *178*(1), 147—152. https://doi.org/10.1016/j.psychres.2009.05.001

Tolin, D. F., Frost, R. O., Steketee, G., Gray, K. D., & Fitch, K. E. (2008). The economic and social burden of compulsive hoarding. *Psychiatry Research*, *160*(2), 200—211. https://doi.org/10.1016/j.psychres.2007.08.008

Tolin, D. F., Frost, R. O., Steketee, G., & Muroff, J. (2015). Cognitive behavioral therapy for hoarding disorder: A meta-analysis. *Depression and Anxiety*, *32*, 158—166. https://doi.org/10.1002/da.22327

Tolin, D. F., Meunier, S. A., Frost, R. O., & Steketee, G. (2010). Course of compulsive hoarding and its relationship to life events. *Depression and Anxiety*, *27*(9), 829—838. https://doi.org/10.1002/da.20684

Tolin, D. F., Meunier, S. A., Frost, R. O., & Steketee, G. (2011). Hoarding among patients seeking treatment for anxiety disorders. *Journal of Anxiety Disorders*, *25*(1), 43—48. https://doi.org/10.1016/j.janxdis.2010.08.001

Tolin, D. F., Woods, C. M., & Abramowitz, J. S. (2003). Relationship between obsessive beliefs and obsessive-compulsive symptoms. *Cognitive Therapy and Research*, *27*(6), 657—669. https://doi.org/10.1023/A:1026351711837

Tybur, J. M., Lieberman, D., & Griskevicius, V. (2009). Microbes, mating, and morality: Individual differences in three functional domains of disgust. *Journal of Personality and Social Psychology*, *97*(1), 103. https://doi.org/10.1037/a0015474

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., et al. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *International Journal of Environmental Research and Public Health*, *17*(5), 1729. https://doi.org/10.3390/ijerph17051729

Wei, M. A., Van Kirk, N., Reid, A. M., Garner, L. E., Krompinger, J. W., Crosby, J. M., et al. (2020). Emotion regulation strategy use and symptom change during intensive treatment of transitional age youth patients with obsessive-compulsive disorder. *Journal of Behavioral and Cognitive Therapy*, *30*(2), 95—102. https://doi.org/10.1016/j.jbct.2020.03.009

West, S. G., Finch, J. F., & Curran, P. J. (1995). Structural equation models with nonnormal variables: Problems and remedies. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 56—75). Thousand Oaks, CA: Sage Publications, Inc.

Woody, E.Z., Szechtman, H. (2005). Motivation, time course, and heterogeneity in obsessive-compulsive disorder: Response to Taylor, McKay, and Abramowitz (2005). https://doi.org/10.1037/0033-295X.112.3.658.

Woody, E. Z., & Szechtman, H. (2011). Adaptation to potential threat: The evolution, neurobiology, and psychopathology of the security motivation system. *Neuroscience & Biobehavioral Reviews*, *35*(4), 1019—1033. https://doi.org/10.1016/j.neubiorev.2010.08.003

Wu, K. D., & Watson, D. (2005). Hoarding and its relation to obsessive—compulsive disorder. *Behaviour Research and Therapy*, *43*(7), 897—921. https://doi.org/10.1016/j.brat.2004.06.013

Zachary, Z., Brianna, F., Brianna, L., Garrett, P., Jade, W., Alyssa, D., et al. (2020). Self-quarantine and weight gain related risk factors during the COVID-19 pandemic. *Obesity Research & Clinical Practice*, *14*(3), 210—216. https://doi.org/10.1016/j.orcp.2020.05.004