

# Imagining Letting Go: a Preliminary Test of Written Imagery Rescripting to Facilitate Discarding in a High Hoarding Sample

Isaac Sabel<sup>1</sup> · Keong Yap<sup>2</sup> · Jessica R. Grisham<sup>1</sup>

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### Abstract

Mental images appear to be important mental events in hoarding that may maintain the disorder by interfering with discarding. We tested whether a novel written imagery rescripting task, focused on modifying a negative imagined outcome of discarding a hoarded object into a positive alternative, could be used to promote discarding in individuals with hoarding traits, and compared this against other cognitive-behavioural strategies used to encourage discarding. We also examined whether the success of imagery rescripting depended on imagining ability. High hoarding participants (n = 176), recruited through Cloudresearch.com, were asked to imagine a negative outcome of discarding an object they were still attached to. We then randomized them into one of four conditions: imagery rescripting, imaginal exposure, cognitive restructuring, or a positive imagery control, and presented them with a discarding task. Rescripting was associated with increased readiness and motivation to discard, and discarding frequency, compared to other conditions. Rescripting also reduced state negative emotions and increased state positive imagery. The effect of rescripting on readiness and motivation to discard was moderated by imagining ability, such that higher imagining ability was associated with greater readiness and motivation to discard after rescripting. Pending replication and extension, written imagery rescripting may have promise as a clinical strategy to facilitate discarding in individuals with hoarding difficulties.

Keywords Hoarding disorder · Imagery · Conceptual imagery · Imagination · Cognitive behaviour therapy

# Introduction

Hoarding disorder (HD) is a mental health condition primarily characterized by difficulty discarding objects, regardless of their value, resulting in the accumulation of clutter that compromises living spaces (American Psychiatric Association, 2022). It is a chronic mental health condition that affects approximately 2–5% of the population (Postlethwaite et al., 2019) When left untreated, HD costs taxpayers an estimated \$37,000 per afflicted individual (San Francisco Task Force on Compulsive Hoarding, 2009) and results in more functional impairment than other medical and psychiatric

☑ Isaac Sabel i.sabel@unsw.edu.au disorders listed by the World Health Organization in the top 10 leading causes of disability worldwide, such as major depression, chronic pain, and diabetes (Nutley et al., 2022). Risks such as fire, falling injuries, pest infestations, and medical illnesses are associated with severe cases (Lucini et al., 2009; Snowdon et al., 2012).

The gold standard treatment for HD is cognitive behavioural therapy (CBT), based on Frost and Hartl's (1996) model of hoarding. This treatment involves restructuring maladaptive beliefs about possessions, sorting, discarding and non-acquisition exposures, and training problem solving and decision-making skills (Steketee & Frost, 2006). Although CBT for HD leads to moderate improvements in hoarding symptoms from pre- to post-treatment (Rodgers et al., 2021; Tolin et al., 2015), it only results in clinically significant change for 24–43% of cases, leaving as many as two thirds of individuals clinically symptomatic (David et al., 2022; Tolin et al., 2015). Moreover, large numbers of individuals with HD refuse CBT or drop out prematurely (up to 50%), possibly because of its emphasis on decluttering, which is

<sup>&</sup>lt;sup>1</sup> School of Psychology, The University of New South Wales, Sydney, NSW 2052, Australia

<sup>&</sup>lt;sup>2</sup> Faculty of Health Sciences, School of Behavioural and Health Sciences/Psychology, Australian Catholic University, Strathfield, NSW 2135, Australia

experienced as highly aversive (Steketee et al., 2010). Thus, there is ample scope to improve the efficacy and acceptability of existing treatments, such as finding ways to make discarding less difficult and distressing (Grisham et al., 2023).

#### **Mental Imagery in Hoarding**

Burgeoning research suggests targeting mental imagery (i.e., rich, sensory laden mental representations with reallife qualities that differ from forms of verbal thinking; Rachman, 2007) may be a promising avenue for refining HD treatment. Evidence suggests individuals who hoard tend to experience more frequent, intrusive, and distressing mental images during daily life than members of the community, which result in more life-interference and avoidance behaviour (Stewart et al., 2020). As in other mental health conditions, these images tend to correspond to memories of early adverse events or reflect disorder-specific concerns, such as distressing images of clutter (Stewart et al., 2020).

Mental imagery may also serve to maintain hoarding problems more proximally by contributing to discarding difficulties. Merely imagining discarding is highly aversive for individuals with HD, evoking unpleasant emotions such as grief, anger, sadness, and anxiety, and activates fear and decision-making circuits in the brain (An et al., 2009; Shaw et al., 2015; Yap & Grisham, 2020). Moreover, individuals with HD report experiencing intrusive mental images when attempting to discard that make it more difficult for them to part with objects, including resurfacing autobiographical memories linked to their items and images of negative hypothetical outcomes, such as waste and harm coming to the environment (Cherrier & Ponnor, 2010; Stewart et al., 2020). In sum, mental images appear to be important mental events that play a role in the maintenance of hoarding problems, and by targeting these images we may be able improve HD treatment, particularly difficulty discarding.

#### **Imagery Rescripting**

One potential way to do this is through interventions that address problematic mental imagery directly, such as Imagery Rescripting (ImRs; Arntz, 2012). ImRs is an experiential therapeutic technique where the content, meaning, and valence of distressing mental images is reshaped to be more positive or benign, with the aim of weakening the negative cognitive, emotional, and behavioural sequalae of the aversive trace (e.g., avoidance behaviour, negative self-beliefs etc.). During ImRs, a distressing or unpleasant mental image is retrieved in working memory, and then through imagery, the course of the event is modified to be in line with a more desired direction (van der Wijngaart, 2021). Originally conceptualized as a core treatment technique in schema therapy (Young, 1999) a recent meta-analysis of clinical trials has indicated that ImRs holds promise as a stand-alone treatment for a range of disorders (Morina et al., 2017), including those theorised to share important transdiagnostic processes with hoarding, such as anxiety and other obsessive-compulsive spectrum disorders (Strachan et al., 2020). ImRs has also been successfully incorporated into existing cognitivebehavioural treatment packages for other mental health conditions to reduce attrition and enhance therapy outcomes (McEvoy et al., 2015; Stopa, 2021). While its exact working mechanism is still debated, prominent theoretical accounts propose that ImRs works either by updating the intrinsic meaning of the pre-existing problematic image (i.e., Unconditioned Stimulus Re-evaluation theory; see Arntz, 2012) or by creating an alternative image that then competes with the activation of the original trace in working memory (i.e., the Competing Retrieval hypothesis; see Brewin, 2006).

Although ImRs has been traditionally used to address distressing memories (i.e., "flashbacks"), it has also been applied to distressing images of episodic future events (i.e., "flashforwards"), such as images of feared upcoming social situations in social anxiety disorder (Landkroon et al., 2022), prospective obsessional imagery in obsessive compulsive disorder (Cooper et al., 2023) and catastrophizing imagery in generalized anxiety (Ovanessian et al., 2019). In experimental research, rescripting negative future episodic imagery has been found to result in promising emotional and behavioural shifts, such as reductions in anticipatory anxiety, heightened perceived coping, and increased willingness to engage in exposure (Landkroon et al., 2022; Ovanessian et al., 2019). Recently, ImRs has also been suggested as a strategy to address discarding difficulties experienced by individuals with hoarding problems (Stewart et al., 2020). However, to the authors' knowledge, ImRs has never been empirically investigated in this population, and its use is currently limited to anecdotal accounts.

We therefore aimed to fill this gap by piloting a novel experimental task, where participants with hoarding traits were guided to rescript a negative imagined outcome of discarding a hoarded object that they were still attached to into a positive alternative image to see if this facilitated discarding. To achieve this aim, we assessed participants' responses on a range of motivational and emotional discarding-related outcome variables (e.g., discarding anxiety, readiness and motivation to discard), as well as their actual discarding behaviour. In line with recent research suggesting that ImRs is possible to administer online without the presence of a therapist (Cooper et al., 2023), and that ImRs can be successfully delivered in a written-task format (Ovanessian et al., 2019), we decided to pilot an online written rescripting paradigm as a first step in exploring the feasibility of ImRs for hoarding.

#### **Comparison Conditions**

Although ImRs has never been empirically investigated in a hoarding sample, other strategies that rely upon mental imagery have shown promise in this population. For example, Imaginal Exposure (IE) to feared imagined discarding scenarios has been shown to lower discarding anxiety, reduce hoarding symptoms, and is generally perceived as an acceptable and useful intervention (Fracalanza et al., 2021, 2024). Indeed, IE is currently recommended in CBT protocols for hoarding as one strategy to make discarding less aversive for those reluctant to engage in in-vivo exposures (Steketee & Frost, 2013). However, as research suggests ImRs facilitates the processing of emotions other than anxiety, such as anger and sadness that are highly relevant to discarding decisions (Arntz et al., 2007; Shaw et al., 2015), and ImRs is generally perceived as more acceptable to both patients and therapists than IE (Schmid et al., 2021), it may be that ImRs is a less distressing and more motivating strategy to facilitate discarding in this population. To address this question, we included an IE comparison condition, where participants were instructed to dwell on their negative imagined outcome of discarding with the aim of habituating to this feared scenario.

Imagery has also been termed an 'emotional and motivational' amplifier (Holmes & Mathews, 2010). That is, compared to the verbal processing of the same information, consciously generating mental imagery is known to result in heightened emotional activation and autonomic arousal (Holmes et al., 2008; Pictet & Holmes, 2013). Individuals are also more likely to act on events that they have simulated in their minds than just reasoned about verbally (Ji et al., 2016; Libby et al., 2007). Because of this, therapeutic interventions that harness mental imagery, such as ImRs, may be better suited than verbal linguistic strategies to assist individual engagement in activities with high motivational and emotional barriers – such as discarding (Ji et al., 2021; Renner et al., 2019). In order to compare ImRs to a common verbal/linguistic strategy used in hoarding treatment to encourage discarding, we also included a Cognitive Restructuring comparison condition (CR; Hartl & Frost, 1999). In this CR condition participants were asked to consider the evidence for and against their negative imagined outcome of discarding coming true. They were then asked to generate a more realistic and balanced prediction.

Finally, to ensure the benefits of ImRs exist over and above a mere positive mood induction and/or distraction task, we also included a Positive Imagery (PI) control, where participants were required to bring to mind unrelated positive and relaxing scenes, such as a pleasant memory of a holiday. Although PI was hypothesised to bring about comparable changes to ImRs in positive and negative emotional states, ImRs was expected to motivate discarding more and increase its frequency.

#### **Imagining Ability as a Potential Moderator**

One important consideration when using clinical strategies that rely on mental imagery is that individual differences in the ability to generate and use mental imagery exist (Keogh et al., 2021). It has been suggested that individuals who are aphantasic (i.e., unable to think in, or access mental images) may be unable to engage in imagery based strategies or benefit less from them therapeutically, while individuals who are hyperphantasic (i.e., experience frequent, vivid, and cognitively accessible mental images) may benefit more (Wicken et al., 2021), and there is some evidence to support this contention (e.g., McEvoy et al., 2015). We thus also examined whether individual differences in imagining ability in our sample moderated the impact of ImRs, hypothesising that individuals who were higher in trait imagining ability would benefit more from rescripting.

#### Summary – The Current Study

In sum, we aimed to determine whether rescripting a negative, future-focused mental image of discarding a hoarded object that one was still attached to (i.e., changing the content, meaning and valence of the imagined outcome of discarding into a positive, alternative image) facilitated discarding in individuals with elevated hoarding traits. This was measured by assessing participants' performance on a range of motivational and emotional outcome variables, as well as their decisions to save or discard a hoarded object. Moreover, we aimed to test whether ImRs outperformed IE, CR, and a PI control, hypothesising that ImRs would motivate discarding more and make it less emotionally aversive, thereby increasing its frequency. Finally, we aimed to test whether participants' trait imagining ability moderated the success of ImRs, hypothesizing that participants higher in this ability would benefit more from rescripting. Using a novel written rescripting paradigm, in an online sample of individuals with elevated hoarding traits, this experimental study represented a first step in exploring the feasibility of ImRs in hoarding to serve as the basis for future clinical replications.

# Method

#### Participants

We pre-screened 2006 participants for elevated hoarding symptoms using the self-report version of the Hoarding Rating Scale (HRS-SR; Nutley et al., 2020; Tolin et al., 2010).

Participants were Mechanical Turk (MTurk) workers who were recruited via Cloudresearch.com and renumerated US\$1 for completing the pre-screen. MTurk workers are registered users on Amazon Mechanical Turk who complete online tasks in exchange for financial reimbursement. Cloudresearch.com is an online platform that connects MTurk workers to research projects and provides additional vetting of participants through data quality features, such as attention and engagement measures (Hauser et al., 2022). Evidence suggests that the quality of data collected from MTurk workers is comparable or superior to traditional data collection methods, especially when samples are restricted to predominantly English-speaking countries (Buhrmester et al., 2011; Thomas & Clifford, 2017). Moreover, MTurk is a suitable platform for clinical research given that past research show that MTurk workers have a high prevalence of psychopathology that is comparable or exceeds that of traditional community samples (Arditte et al., 2016; Forkus et al., 2022), including hoarding problems (Yap et al., 2023). Using an online method of recruitment is particularly relevant to HD research, as despite the high prevalence of HD in the community, the population is considered 'hard to reach', possibly because of the stigma associated with hoarding which limits engagement in traditional clinical and research settings (Bates et al., 2020).

Participation in the study was limited to English-speaking adults (age 18 or older) from the United States of America, who had passed Cloudresearch.com's attention and engagement measures and had completed a minimum of 1000 tasks, with a lifetime MTurk approval rating of 98% (i.e., at least 98% of participant's previous tasks were completed to researcher's satisfaction). Participants with suspicious geocode locations and IP addresses that were duplicates or that were not consistent with their country and state locations were automatically blocked. All workers were also required to pass a CAPTCHA (Completely Automated Public Turing test to tell Computers and Humas Apart), a challenge-response test that ensures participants were not computer bots at the start of the survey (Misra, 2009). We also embedded two validity/attention checks recommended by Agley et al. (2022) throughout the survey.

Of the 2006 participants, 474 scored above the suggested cutoff score of  $\geq 10$  on the HRS-SR, indicating clinically significant hoarding or subclinical/probable HD (Nutley et al., 2020). We invited these 474 participants to participate in the current study. A total of 206 participants responded to the invitation and were reimbursed \$3.50 for their participation. Following data collection, participants were excluded if they were not in their home/ usual place of residence when completing the study and therefore did not have easy access to an item to discard (n=2), dropped out of the study before completing the demographics form (n=2), individual difference measures (n = 5), or T1 ratings (n = 20) prior to randomisation, or provided answers during the written components that did not adhere to task instructions (n = 1). The remaining sample therefore included 176 participants for analysis. Please see the flow diagram in Fig. 1.

Participants ranged from 19 to 84 years old, with a mean age of 42.90 years (SD = 12.63). Of the total sample, 106 participants identified as female, 64 as male, five as nonbinary, and one participant preferred not to disclose their gender. The majority of participants identified as White (n=124, 70.5%), followed by Asian (n=19, 10.8%), African American (n=18, 10.2%), Latino/Hispanic (n=10, 5.7%), and American Indian (n=1, 0.6%). Most participants were employed full time (n=117, 66.5%), had completed a bachelor's degree or higher (n=116, 65.9%). Of the total sample, 82 participants lived in a suburban area, 53 in an urban area and 41 in rural settings.

#### Materials

#### The Hoarding Rating Scale

The self-report version of the *Hoarding Rating Scale* (HRS-SR; Nutley et al., 2020; Tolin et al., 2010) is a short 5-item measure capturing the major features of hoarding (i.e., difficulty discarding, excessive acquisition, clutter), as well as the problems associated with them (e.g., distress, impairment). Responses are rated on an 8-point Likert scale from 0 (No problem) to 8 (Extreme problem). The HRS-SR closely aligns with the DSM-5 criteria for HD (American Psychiatric Association, 2022), and has excellent reliability and validity (Frost & Hristova, 2011). In the current study, the measure also had acceptable internal consistency,  $\alpha = 0.75$ , and was used to screen participants into the study with elevated hoarding traits.

#### The Saving Inventory – Revised

The Saving Inventory- Revised (SI-R; Frost et al., 2004) is a 23-item self-report questionnaire that measures the major features of hoarding based on factor analysis: compulsive acquisition, difficulty discarding, and excessive clutter. The SI-R total score can also be used as a measure of hoarding symptom severity. Responses are made on a Likert scale from 0 (None/Not at all/Never) to 4 (Almost all/Extreme/ Very Often). The SI-R demonstrates good internal consistency, construct validity, and test-retest reliability (Frost et al., 2004). In the current study, the measure also had very high internal consistency,  $\alpha = 0.94$ , and was used as a more comprehensive measure of hoarding symptom severity.



Fig. 1 Flow of the protocol from the initial screening through to randomisation and analysis

#### The Vividness of Visual Imagery Questionnaire

The Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973; McKelvie, 1995); is a 16-item measure of imagining ability. Participants are asked to visualize four scenes and rate the clarity of the mental image on a 5-point Likert scale from 1 (No image at all) to 5 (Perfectly clear and as vivid as real seeing). The VVIQ has excellent psychometric properties (McKelvie, 1995). In the current study, the VVIQ had very high internal consistency,  $\alpha = 0.91$  and was used to assess trait imagining ability.

#### The Object Attachment Questionnaire

# The Object Attachment Questionnaire (OAQ; Grisham et al., 2009) is a 13-item self-report measure designed to measure a participant's level of attachment to a specific object. Respondents indicated their level of agreement on a 7-point Likert scale from 1 (Not at all/Strongly disagree) to 7 (Very much/Strongly agree). The OAQ has been shown to have excellent reliability and validity (Grisham et al., 2009). In the current study, the measure also had very high internal consistency, $\alpha = 0.92$ , and was used as a pre-to-post dependent measure. The wording of one item (Item 6: "How easy would it be for you to return this item to the experimenters?") was altered slightly ("How easy would it be for you to give this item to someone else?") as participants in the present study rated their attachment to items already in their possession, rather than a given object.

#### **Readiness and Motivation to Discard**

Two single item indices of participant's readiness and motivation to discard a hoarded object (i.e., "How ready/motivated do you feel right now to throw away your item?") rated on a 7-point Likert scale from 1(Not at all ready/motivated) to 7 (Extremely ready/motivated) were constructed by two hoarding experts (i.e., IS and JG) as pre-to-post dependent measures. We elected to use these brief bespoke measures over pre-established motivational assessments (e.g., the 32-item University of Rhode Island Change Assessment; McConnaughy et al., 1983) to shorten the length of the study and reduce participant burden.

#### **State Positive and Negative Emotions**

Five single item indices of participants' state negative (i.e., anxiety, sadness, anger) and positive (i.e., happiness, relaxation) emotions, considered relevant to the experience of discarding, were devised by two hoarding experts (i.e., IS and JG) as pre-to-post dependent measures. Participants were asked to rate their state emotions (i.e., 'Please use the slider to indicate how anxious/sad/relaxed (etc) you feel right now') on a visual analogue scale from 0 (Not at all anxious/sad/happy etc.). As above, we elected to use these single item measures over pre-established measures of emotional experiencing (e.g., the 32-item Discrete Emotions Questionnaire; Harmon-Jones et al., 2016) to shorten the length of the study and reduce participant burden.

#### **Discarding Decision-Making**

A single item, 4-option behavioural index of participants' decision to save or discard a hoarded object was constructed by two hoarding experts (i.e., IS and JK) to administer to participants at the end of the study as a final dependent measure. On this index, participants could indicate whether they (1) discarded their object (e.g., put it in the trash, placed it in a donation bin, gave it to someone else etc.), (2) made some steps towards discarding (e.g., discarded part of their object, placed it in a bag ready to be donated etc.), (3) decided to discard it later (e.g., made a plan to throw it away in the future, set the intention to discard etc.) or (4) decided against discarding their object. The options on this index were devised by attempting to apply the transtheoretical stages of change model (Prochaska & Velicer, 1997) to a hoarding specific discarding scenario (i.e., no discarding = pre-contemplative, decided to discard later = contemplative, made steps towards discarding = preparation, discarded = action).

#### Interventions

#### **Item Preparation**

Prior to randomisation, participants were asked to choose an object in their possession that they were attached to and having difficulty parting with to focus on throughout the study. To ensure participants selected an item that was representative of a typically hoarded object that might be used in a discarding exposure, participants were instructed to choose an item that was relatively low in monetary value, no longer used or useful, one that other people would generally have no difficulty parting with, and an item that they felt they should be able to part with but were having lots of trouble doing so. These parameters to guide item selection have been used in previous research (e.g., Yap & Grisham, 2020). Several example items were provided to participants to assist with their selection, such as old clothes, books, mementos, paper items (e.g., letters, bills, newspapers), CDs, electrical appliances and homewares. Once participants selected an item, they were asked to provide a short description of it.

#### **Generating Target Imagery**

Participants were then asked to briefly imagine what they feared would happen if they discarded their chosen object, and then describe the mental image(s)/scenes that came to mind. Once an image of a feared discarding scenario was selected, participants, were asked to provide a one-sentence description of it. Working with these negative imagined discarding scenarios formed the basis of the following exercises.

An example description of a negative imagined discarding scenario from a participant is provided below: "My Note 2 cell phone will end up in a huge and disgusting garbage pile that contains human waste and is surrounded by rats".

#### **Imagery Rescripting Condition**

In the ImRs condition, participants were asked to imagine what it would be like if discarding their object played out differently to their negative imagined scenario and had a positive, alternative outcome. They were then instructed to write a detailed sensory image script describing this alternative outcome coming true. In this script, participants were asked to write in narrative form, beginning with a description of the circumstances leading up to discarding, followed by a description of discarding, and ending with a description of the positive consequences of discarding. To enhance the vividness of the sensory image script, participants were instructed to write in the firstperson present tense, as though the situation was happening in the here-and-now, to make the image as specific and detailed as possible – locating it in a specific place and time, to write about their sensory-perceptual experiences (e.g., what they see, hear etc.), and to describe in detail their emotional and physical reactions (Ji et al., 2016). In line with existing ImRs protocols (Arntz, 2012), participants were encouraged to include in the image whatever they needed to make the outcome of discarding most desirable for them - for example by including an attachment figure or fantasy and spiritual elements, and to write about any positive meanings the new image represented about themselves, others, or the world.

An example of a ImRs sensory image script from a participant is provided below: "I came across this old disposable camera as I was cleaning the house and I thought, "Is today the day?". I decide that it is! It's time to throw away that old thing that I'll never use, the pictures I snapped will never get developed. In fact, I don't even know what's on the camera. I have to do it though, and not make a big deal of it or it might NEVER get thrown away! Just do it and move on to something else... So I throw it in the waste can and a feeling of absolute freedom washes over me. It's almost like heavy restraints

have been removed from my limbs. I feel free and unrestricted! And all of a sudden, I imagine myself swimming in the ocean under a bright warm sun... or driving fast down a country road in a convertible, with no speed limit! And then I wonder: Could I have been feeling this free if I would have discarded that old camera long ago? Or is it just something about today – that it had to be thrown away today or this magical feeling wouldn't be the same? It makes me want to think about other "phobias" I have, and whether I can conquer them and feel as much victory as I am feeling right now. It's certainly worth some consideration, no? Maybe I'll look around the house and see what else I can find that I have a certain attachment to...".

### **Imaginal Exposure Condition**

In the IE condition, participants were asked to continue to fixate on their feared imagined outcome of discarding their item instead of changing the image in any way. They were then asked to write a detailed sensory image script describing this mental image coming true, as per the instructions given in the ImRs condition. However, unlike the ImRs condition, participants were encouraged to make their script as *negative* as possible to capture their 'worst-case' discarding scenario (see Fracalanza et al., 2024; Fracalanza et al., 2021), for example, by including any *negative* meanings their image might represent about themselves, others, or the world.

An example of IE sensory-image script from a participant is provided below: "I know my frying pan is scratched and that I should by a new one, but the one I have feels like a trusted friend who's been with me through a lot of life... It makes me feel like I'm throwing away a friendship, even though I know it's only an object. I grab the frying pan, throw it in the garbage, pull the strings tight on the garbage bag and then walk the bag out to the bin. I'm stressed out now. I feel uncomfortable and sad knowing that I threw away something that I cherished. I want to rip open the bag and save the frying pan.... I know I need a new pan, but I also know that I'm strangely attached to the pan and feel incredibly uncomfortable now knowing it's in the garbage with slimy things like banana peels and rotten vegetables. I force myself to go back into the house and start looking for new pans online. I feel like I can't find one that's as good and sturdy as my old pan. I've got anxiety scrolling through the choices, even though I know the new pans will probably work better. I literally want to walk back out to the garbage

again and "rescue" my pan from its sad fate. I feel like my pan, even in bad shape, is better than any other pan, and that I'll regret giving it up. My pan is my friend, and I just threw my friend in the garbage. I feel like I have a boulder on my chest now. I feel like I betrayed my friend and that I'm disloyal. I feel heartbroken."

#### **Positive Imagery Condition**

In the PI control condition, participants were asked to imagine something pleasant and relaxing, totally unrelated to the prospect of discarding their item, such as a pleasant memory of a holiday. They were then asked to write a detailed sensory image script of this pleasant scene coming true, using the prompts given in the ImRs and IE conditions (e.g., writing in the first-person present tense, writing about what they see, hear etc.).

An example of PI sensory-image script from a participant is provided below: "I'm at the beach in the Bahamas with my husband. It is our first day of vacation and we have just arrived. We are wearing new swimsuits that flatter our bodies. We walk on the warm sand with our towels, lotion and books. No one else is on the beach at the moment and we find a good place to lay out our towels. We sit down and begin to lather ourselves up with sunscreen. It smells of coconut and we exclaim how much we love that smell. The breeze is warm and soothing. After warming up for a few minutes we get up and start walking towards the water. It is a heavenly blue and you can see all the way through to the sand. We step into the water and it is cool but not too cold. We walk further out jumping over each wave and holding hands together....We taste the salt water on our lips and feel the sting of it in our eyes. After playing in the water for a good while we walk back to our towels and feel a gentle tiredness from being out in the ocean. We lay down and let the sun dry us off and feel the evaporation of the water on our skins. We settle in to read our books while listening to the waves and feeling the warm breeze. It is a gentle breeze and doesn't blow anything away. While reading we occasionally doze off and every time we wake up we hear a bird call out. It is peaceful and relaxing and we look over at each other every time we get a chance and smile and giggle at the enormous gratitude we feel by being at this beautiful beach."

#### **Cognitive Restructuring Condition**

In the CR condition, participants were asked to consider the evidence for and against their negative imagined outcome of discarding coming true, and then instructed to re-write this as a more realistic and balanced prediction. Participants were instructed to keep the evidence they generated to factual statements, avoiding emotional reasoning. A series of question prompts were provided to participants to assist them with the exercise (e.g., "What is the likelihood that this will actually come true? Is there a different way of looking at things? What happened when I discarded something similar in the past?").

An example of a re-appraised discarding outcome from a participant is provided below:

Evidence for	Evidence against	Realistic & balanced prediction
Even though I have a good memory, I am getting older and the possibility of me losing some of my memory is probably real, like it is for many older people. My oldest son died four years ago, and while I think of him every day, I find some things fading, like the sound of his voice, his manner- isms. [There's] other pos- sessions that I no longer have, such as a cast when one of my kids broke their arm as a small child. Now I can't even seem to remember when and where they broke their arm. When I have dis- carded old cards or letters, ones where the message to me was meaningful and heartfelt, I find I can't remember what they said, and I lose that good feeling. And really, my life doesn't have many good feelings in it anymore.	<ul> <li>I still remember so many things, prob- ably most things if I think about it [so] I don't need a visual or physical prompt to remem- ber a person, place, or event.</li> <li>I know that I get no good feelings from remembering my mother, as it relates to her treatment of me. So not having physical reminders might be okay.</li> </ul>	- While I won't forget my mom, unless I get dementia, I don't need these few items of her clothes to remind me of anything essential. To be honest, I rarely look at them other than to refold them and shift them about to another place in the closet. What I will probably forget is what exactly these items look like, but the essence of my mom wearing them, her particular style, her bearing, her attitude, her pos- sessiveness of her clothes, will remain with me. And even that probably isn't very important in the end.

#### **Procedure and Design**

All procedures were approved by the university's human research ethics committee (HREC File no. HC220235), which applies research ethics principles in accordance with the Declaration of Helsinki. Following ethics approval, MTurk workers were recruited using cloudresearch.com. The research was advertised as a study investigating whether the power of imagination could be used to help people make decisions about their possessions and was hosted online using Qualtrics survey software (Qualtrics, Provo UT). It took approximately 40 min to complete. After consenting to the study, participants answered demographics questions and completed the individual difference measures (i.e., the SI-R and VVIQ). They were then asked to imagine a negative outcome of discarding an object they were still attached to.

The study used a mixed between and within-subjects design. After selecting an item and generating a negative imagined outcome of discarding their chosen object, we randomly assigned participants to either the ImRs, IE, CR or PI control condition. Participant responses for each condition on the following target outcomes were assessed both before (T1) and after (T2) the exercises: motivation and readiness to discard, object attachment, state anxiety, sadness, anger, happiness, and relaxation.

At the end of the exercises, participants were given 5 min to locate the item in their home and discard it. At the end of the 5-minute period, participants rated whether they were able follow through with discarding on the discarding decision-making index. Participants were then debriefed, thanked, and provided with a code to receive financial remuneration on MTurk.

#### **Data Analyses**

Analyses were conducted using SPSS version 26 (IBM Corp, 2019). Outcomes were assessed with mixed between-within subjects multivariate analysis of variance (MANOVAs) and analysis of variance (ANOVAs) at T1 and T2 with Bonferroni corrections, chi-square tests and regression models. Moderation analyses were conducted using the PROCESS Macro extension (Hayes, 2018).

Preliminary assumption testing was done to check for violations prior to all analyses. As Box's M test was significant for the multivariate analyses (p < .001), violating homogeneity of variance-covariance assumptions, Pillai's trace was used as the omnibus test statistic (Olson, 1974). Examination of boxplots for each combination of between group factors and Mahalanobis Distance calculations revealed 11 extreme univariate and 9 multivariate outliers in the dataset (p < .001). However, a decision was made to retain all outliers in the final sample as MANOVA and ANOVA outcomes were identical when re-run with the outliers excluded.

# Results

#### **Confirming Randomisation**

Chi-square analyses indicated there were no there were no significant differences in distributions of gender, ethnicity,

education, employment status or rurality between the four study conditions (gender:  $\chi^2(12, n = 176) = 6.47$ , p = .89, ethnicity:  $\chi^2(15, n = 176) = 14.33$ , p = .50, education:  $\chi^2(18, n = 176) = 10.85$ , p = .90, employment:  $\chi^2(21, n = 176) = 31.78$ , p = .62, rurality:  $\chi^2$  (6, n = 176) = 4.25, p = .64). A between subjects ANOVA confirmed there was no difference in ages between groups, F(3,172) = 0.37, p = .77.

Between-subjects ANOVAs were also conducted comparing the different measures at baseline between the four study conditions. No significant differences between conditions were found for hoarding symptoms F(3,172) = 0.77, p = .51, imaging ability, F(3,172) = 1.37, p = .25, object attachment: F(3,172) = 1.46, p = .23, motivation: F(3,172) = 1.56, p = .20, readiness F(3, 172) = 1.21, p = .31, state sadness, F(3,172) = 1.36, p = .26, state anger, F(3,172) = 1.36, p = .26, state happiness F(3, 172) = 0.65, p = .58, and state relaxation F(3,172) = 0.41, p = .74, indicating that randomization was largely successfully. However, there were differences between conditions at baseline on state anxiety: F(3,172) = 5.35, p = .002, such that that those in the CR condition had lower baseline anxiety scores than participants in the ImRs ( $M_{Diff}$ =5.57, p=.001) and IE conditions ( $M_{Diff}$ = 5.60, p = .003). However, as the primary analytic methods (i.e., mixed-model MANOVAs and ANOVAs) control for pre-existing differences amongst participants, this was not seen as a cause for concern.

#### **Descriptive Statistics**

Descriptive statistics of participants' hoarding symptoms, imagining ability, as well as their motivation and readiness to discard, object attachment, and state positive and negative emotions at baseline and T2 between conditions are presented in Table 1. Notably, across conditions, participants had mean scores on the SI-R above the cut-off for clinically significant hoarding (i.e., 39; Kellman-McFarlane et al., 2019), and were comparable to means reported in other studies employing gold-standard assessment methods (i.e., diagnostic interviews combined with self-report measures; Chou et al., 2018), indicating that the screening process was successful in recruiting MTurk workers with elevated hoarding traits.

# **Motivation and Readiness to Discard**

To understand the effect of condition on participants' motivation and readiness to discard their chosen object, we conducted a 4 (Condition: ImRs, IE, CR, PI) by 2 (Time: preintervention, post-intervention) mixed model MANOVA, with condition as the between subjects factor, time as the within subjects factor, and motivation and readiness to discard as the dependent variables. There was a significant 
 Table 1
 Mean scores on the SI-R, VVIQ, OAQ, the indices of motivation and readiness to discard and state positive and negative emotions between conditions

Measure	ImRs ( <i>n</i> =44)	IE ( <i>n</i> =43)	CR (n=43)	PI ( <i>n</i> =46)
SI-R	63.68 (14.60)	60.19 (12.98)	58.95 (11.91)	60.76 (19.39)
VVIQ	59.93 (10.50)	55.77 (10.77)	58.70 (8.83)	56.41 (13.33)
OAQ				
T1	55.57 (18.36)	57.19 (12.44)	50.16 (14.26)	53.96 (19.03)
T2	45.98 (17.60)	60.35 (14.84)	44.74 (15.87)	48.93 (19.28)
Motivatio	n to discard			
T1	1.75 (0.94)	1.74 (0.85)	2.19 (1.20)	1.89 (1.29)
T2	3.36 (1.37)	1.63 (1.00)	2.53 (1.32)	2.37 (1.31)
Readiness	to discard			
T1	1.80 (1.11)	1.51 (0.80)	1.84 (1.04)	1.91 (1.21)
T2	3.41 (1.35)	1.51 (0.91)	2.49 (1.28)	2.28 (1.42)
Anxiety				
T1	62.27 (22.45)	60.58 (23.50)	43.53 (25.30)	48.80 (31.31)
T2	27.14 (23.83)	65.26 (27.47)	34.84 (27.24)	15.02 (22.28)
Sadness				
T1	58.32 (27.55)	61.37 (27.05)	49.19 (30.36)	52.22 (33.83)
T2	21.98 (25.00)	66.72 (29.76)	27.88 (26.15)	15.20 (23.47)
Anger				
T1	34.34 (32.91)	28.74 (26.34)	22.81 (23.80)	26.00 (27.95)
T2	8.61 (15.981)	28.79 (31.41)	13.53 (20.74)	7.93 (17.08)
Happines	s			
T1	14.64 (26.67)	8.77 (15.27)	11.77 (17.20)	13.76 (23.52)
T2	51.70 (29.53)	6.70 (14.11)	22.60 (22.57)	68.89 (27.35)
Relaxatio	n			
T1	15.98 (23.89)	14.07 (19.45)	19.14 (19.91)	16.98 (22.47)
T2	53.50 (31.64)	10.79 (18.36)	31.65 (26.71)	67.78 (31.33)

SI-R Savings Inventory-Revised, VVIQ Vividness of Visual Imagery Questionnaire, OAQ Object Attachment Questionnaire, ImRs Imagery Rescripting, IE Imaginal Exposure, CR Cognitive Restructuring, PI Positive Imagery

main effect of time, F(1,172) = 66.22, p < .001, partial  $\eta^2 = 0.28$  and a significant time by condition interaction, F(3,172) = 21.43, p < .001, partial  $\eta^2 = 0.27$ , suggesting that changes from pre- to post-intervention in participants' levels of motivation and readiness to discard their chosen object differed among the conditions. When considering participants' motivation and readiness levels separately using mixed model ANOVAS with the same design and a Bonferroni adjusted alpha level of 0.01 ( $\alpha = 0.05/4$ ), interactions remained significant for both motivation to discard, F(3, 172) = 17.01, p < .001, partial  $\eta^2 = 0.23$ , and readiness to discard, F(3, 172) = 17.19, p < .001, partial  $\eta^2 = 0.23$ .

To decompose the interaction terms, we conducted follow up analyses using Bonferroni adjusted ( $\alpha = 0.05/4$ ) paired sample t-tests within each condition. We found that participants' motivation to discard significantly increased over time in the ImRs and PI conditions, but not in CR, or IE (see Table 2). Pairwise comparisons at post-intervention indicated participants in the ImRs condition demonstrated significantly greater motivation to discard compared to those in IE ( $M_{Diff} = 1.74$ , SD = 0.27, p < .001), CR ( $M_{Diff} =$ 0.83, SD = 0.27, p < .001) and PI ( $M_{Diff} = 0.99$ , SD = 0.26, p < .001) conditions (see Fig. 2).

We also found that participants' readiness to discard significantly increased over time in ImRs and CR, but not in IE or in PI (see Table 3). Pairwise comparisons at post-exercise again demonstrated that those in the ImRs condition were significantly more ready to discard than participants in the IE ( $M_{Diff} = 1.92$ , SD = 0.27, p < .001), CR ( $M_{Diff} = 0.92$ , SD = 0.27 p < .01) and PI ( $M_{Diff} = 1.07$ , SD = 0.27, p < .001) conditions (see Fig. 2).

#### **Object Attachment**

To understand the effect of condition on participants' attachment to their chosen object, we performed a mixed model ANOVA with the same design, except with object attachment as the dependent variable. There was a significant main effect for time, F(3,172) = 24.41, p < .001, partial  $\eta^2 = 0.13$ ,

 Table 2
 Test statistics for pre-to-post motivational and emotional outcome variables

	ImRs $(n=44)$		IE ( <i>n</i> =43)		CR(n=43)		PI ( <i>n</i> =46)					
	t (43)	р	Cohen's d	t (42)	р	Cohen's d	t (42)	р	Cohen's d	t (45)	р	Cohen's d
Motivation to discard	-8.03	< 0.001	1.21	0.73	0.47	0.11	-2.02	0.05	0.30	-2.79	0.01	0.42
Readiness to discard	-7.55	< 0.001	1.14	0.00	1.0	0	-3.92	< 0.001	0.60	-0.237	0.02	0.36
Object Attachment	4.36	< 0.001	0.66	-2.09	0.04	0.31	3.30	< 0.01	0.50	4.49	< 0.001	0.68
Anxiety	7.99	< 0.001	1.20	-1.60	0.12	0.24	1.69	0.10	0.26	7.21	< 0.001	1.09
Sadness	7.22	< 0.001	1.09	-2.11	0.04	0.31	4.25	< 0.001	0.65	6.46	< 0.001	0.97
Anger	6.14	< 0.001	0.93	-2.80	0.01	0.42	2.13	0.04	0.33	4.62	< 0.001	0.70
Happiness	-7.42	< 0.011	1.12	1.31	0.20	0.20	-2.77	0.01	0.42	-10.75	< 0.001	1.62
Relaxation	-7.96	< 0.001	1.20	1.83	0.07	0.27	-3.01	< 0.01	0.46	-9.55	< 0.001	1.44



Fig. 2 Mean scores for motivation and readiness to discard, object attachment, and state negative and positive emotions before and after each condition. error bars represent 95% confidence intervals

	Discarding decision							
Group	Did not discard	Decided to discard later	Made steps towards dis- carding	Discarded				
ImRs	11	11	12	10				
	(25%)	(25%)	(27.3%)	(22.7%)				
IE	29	5	8	1				
	(67.4%)	(11.6%)	(18.6%)	(2.3%)				
CR	16	11	10	6				
	(37.2%)	(25.6%)	(23.3%)	(14%)				
PI	24	9	7	6				
	(52.2%)	(19.6%)	(15.2%)	(13%)				

ImRs Imagery Rescripting, IE Imaginal Exposure, CR Cognitive Restructuring, PI Positive Imagery

and a significant interaction term, F(3,172) = 9.64, p < .001, partial  $\eta^2 = 0.14$ , suggesting that participants' changes from pre- to post-intervention in their levels of attachment to their chosen object differed among conditions. To decompose the interaction term, we conducted follow up analyses using Bonferroni adjusted ( $\alpha = 0.05/4$ ) paired sample t-tests within each condition. We found that participants' attachment to their chosen object significantly decreased in the ImRs, CR, and PI conditions, but not in IE (see Table 2). Pairwise comparisons at post-intervention indicated that participants in the ImRS condition did not significantly differ in their level of object attachment from those in the CR ( $M_{Diff} = 1.22$ , SD = 3.65, p = .74) or PI conditions ( $M_{Diff} = -2.96, SD = 3.36$ , p = .41), but were significantly less attached to their object than those in IE  $(M_{Diff} = -14.37, SD = 3.65, p < .001)$  (see Fig. 2).

#### **Positive and Negative Emotions**

To understand the effect of condition on state positive emotions, we conducted a 4 (Condition: ImRs, IE, CR and PI) by 2 (Time: pre-intervention, post-intervention) mixed model MANOVA, with condition as the between subjects factor, time as the within subjects factor, and state positive emotion indices (i.e., happiness and relaxation) as the dependent variables. For the overall mixed model MANOVA, there was a significant main effect of time, F(1,172) = 148.03, p < .001, partial  $\eta^2 = 0.46$ , and a significant interaction,  $F(3, \beta)$  $(172) = 37.90, p < .001, partial \eta^2 = 0.40, suggesting changes$ from pre- to post-intervention in participants' ratings of their positive emotions differed among the conditions. When we considered these positive emotion indices separately using mixed model ANOVAS with the same design and a Bonferroni adjusted alpha level of 0.01 ( $\alpha = 0.05/4$ ), interaction effects remained significant for state happiness,

F(3,172) = 36.01, p < .001, partial  $\eta^2 = 0.37$ , and state relaxation F(3,172) = 30.64, p < .001, partial  $\eta^2 = 0.35$ .

Using Bonferroni adjusted ( $\alpha = 0.05/4$ ), paired sample t-tests to decompose the interaction term within each condition, we found that participants' state happiness and relaxation increased from pre-to-post intervention in the ImRs CR and PI conditions, but not in IE (see Table 2). Pairwise comparisons at post-intervention revealed that participants in the ImRs condition had significant higher state happiness levels than those in the IE ( $M_{Diff} = 45.01$ , SD = 5.19, p < .001) and CR ( $M_{Diff} = 29.10, SD = 5.19, p < .001$ ) conditions (see Fig. 2), but significantly lower state happiness levels than those in the PI condition ( $M_{Diff} = -17.19, SD = 5.11,$ p = .01). Regarding state relaxation levels at post-exercise, participants in the ImRs condition had statistically equivalent relaxation levels to those in the PI condition  $(M_{Diff} =$ -14.28, SD = 5.83, p = .91) but higher levels than those in the IE ( $M_{Diff}$ = 42.71, SD = 5.93, p < .001) and CR ( $M_{Diff}$  = 21.95, SD = 5.93, p < .001) conditions (see Fig. 2).

To understand the effect of condition on state negative emotions, we conducted the same mixed model MANOVA but with state anxiety, sadness and anger as the dependent variables. For the overall mixed model MANOVA, there was a significant main effect of time, F(1,172) = 87.54, p < .001, partial  $\eta^2 = 0.34$ , and a significant time by condition interaction, F(3, 172) = 24.11, p < .001, partial  $\eta^2 = 0.30$ , suggesting that changes from pre to-post intervention in participants' state negative emotions differed among the conditions. When we considered these positive emotion indices separately using mixed model ANOVAS with the same design and a Bonferroni adjusted alpha level of 0.01  $(\alpha = 0.05/4)$ , interaction effects remained significant for state anxiety, F(3,172) = 19.72, p < .001, partial  $\eta^2 = 0.26$ , sadness, F(3,172) = 16.69, p < .001, partial  $\eta^2 = 0.23$  and anger  $F(3,172) = 13.85, p < .001, partial \eta^2 = .20.$ 

Using Bonferroni corrected ( $\alpha = 0.05/4$ ) paired sample t-tests to decompose the interaction terms within each condition, we found participants' state anxiety significantly decreased from pre- to post-intervention in the ImRs and PI conditions, but not in CR or IE (see Table 2). Participants' state sadness decreased from pre-to-post intervention in ImRs, CR, and PI conditions, but not in IE. Finally, participants' state anger decreased from pre- to post- intervention in the ImRs and PI conditions, but not in CR, and significantly increased in IE. Pairwise comparisons at follow up indicated that those in ImRs showed significantly less anxiety than those in IE ( $M_{Diff} = -38.12, SD = 5.41, p < .001$ ), but equivalent levels to those in the PI ( $M_{Diff}$ = 12.12, SD = 5.32, p = .15), and CR ( $M_{Diff} = -7.70$ , SD = 5.41, p = .49) conditions (see Fig. 2). The same was true for anger, where participants in the ImRs condition showed lower levels of state anger and post-exercise than those in IE ( $M_{Diff} = -30.18$ ,

SD = 4.73, p < .001), but equivalent levels to those in the PI  $(M_{Diff} = 0.77, SD = 4.65, p = .88)$  and CR conditions  $(M_{Diff} = -4.92, SD = 4.73, p = .30)$ , and for sadness, where participants in the ImRS condition showed lower levels of state sadness at post-exercise than those in IE  $(M_{Diff} = -44.74, SD = 5.61, p < .001)$ , but equivalent levels to those in the PI  $(M_{Diff} = 6.78, SD = 5.51, p = .22)$  and CR conditions  $(M_{Diff} = -5.91, SD = 5.61, p = .29)$ .

# **Discarding Decision-Making**

As the decision to discard was coded as a categorical variable (i.e., discarded, took some steps towards discarding, decided to discard later, did not discard), a Chi-square test was performed to determine whether the frequency of discarding decisions differed between conditions. The frequencies differed significantly by condition,  $\chi^2(9, 176) = 0.33$ , p < .01 (See Table 3). Specifically, 22.7% of participants in the ImRs condition chose to discard their item, compared to 2.3% of participants in the IE condition. Moreover, 25% of participants in the ImRs condition chose not to do anything with their item, compared to 67.4% of those in IE.

# **Imagining Ability**

Two regression models were tested to determine whether imagining ability moderated the effects of ImRs and the other cognitive behavioural interventions (i.e., IE and CR) on participants' readiness and motivation to discard. These variables were selected for analysis as they were the only outcomes where ImRs demonstrated consistent superiority to the other experimental conditions. In both models, participants' pre-motivation and readiness levels were entered as covariates and the PI control was the reference group.

The overall regression models were significant for both readiness to discard  $R^2 = 0.51$ , F(8, 167) = 21.82, p < .001, and motivation to discard,  $R^2 = 0.44$ , F(8, 167) = 16.42, p < .001. In both models, imagining ability significantly moderated the effect of ImRs only (although trended towards significance for IE; see Table 4). These interactions are depicted in Fig. 3. For the motivation to discard model, the standardized slope for the effect of ImRs was non-significant (p=.12) when imagining ability was one SD below the mean  $(\beta = 0.51)$ , but significant (p < .001) at the mean  $(\beta = 0.99)$ and at one SD above the mean ( $\beta = 1.48$ ). Similarly, for the readiness to discard model, the standardized slope for the effect of ImRs was non-significant (p = .08) when imagining ability was one SD below the mean ( $\beta = 0.56$ ), but significant (p < .001) at the mean  $(\beta = 1.11)$  and at one SD above the mean ( $\beta = 1.66$ ). As shown in Fig. 3, as imagining ability increased, the strength of the relationship between ImRs and participants' motivation and readiness to discard increased.

**Table 4** Predicting motivation and readiness to discard from the different experimental conditions and imagining ability, controlling for pre-motivation levels

Predictor	β	SE	t	р
Outcome variable: Motiv	vation to Dis	scard		
Constant	1.26	0.21	5.95	< 0.001
ImRs	1.00	0.23	4.37	< 0.001
IE	-0.59	0.23	-2.57	0.01
CR	-0.02	0.23	-0.08	0.94
VVIQ	-0.01	0.01	-0.38	0.71
ImRs x VVIQ	0.04	0.02	2.24	0.03
IE x VVIQ	0.04	0.02	1.90	0.06
CR x VVIQ	0.02	0.02	0.99	0.32
Pre-motivation levels	0.59	0.08	7.79	< 0.001
Outcome variable: Readi	ness to Disc	card		
Constant	1.01	0.21	4.90	< 0.001
ImRs	1.11	0.22	5.09	< 0.001
IE	-0.45	0.22	-2.03	0.04
CR	0.24	0.22	1.10	0.27
VVIQ	0.00	0.01	-0.36	0.72
ImRs x VVIQ	0.05	0.02	2.65	0.01
IE x VVIQ	0.03	0.02	1.69	0.09
CR x VVIQ	0.03	0.02	1.29	0.20
Pre-readiness levels	0.66	0.07	8.95	< 0.001

ImRs Imagery Rescripting, IE Imaginal Exposure, CR Cognitive Restructuring, VVIQ Vividness of Visual Imagery Questionnaire

#### Discussion

Using a novel online written paradigm, this study aimed to determine whether rescripting a negative imagined outcome of discarding a hoarded object (i.e., changing the content, meaning and valence of the imagined outcome of discarding into a positive alternative) facilitated discarding in individuals with hoarding traits. We contextualised these findings by comparing ImRs to other cognitive-behavioural strategies (i.e., IE, CR) and a PI control on a range of motivational and emotional outcome variables, as well as actual discarding behaviour. As a secondary aim, we endeavoured to determine whether participants' trait-level ability think in mental images impacted their ability to benefit from rescripting and the other exercises. Our primary findings demonstrated that rescripting had promising effects in motivating discarding, making it less aversive and increasing its frequency, relative to the other strategies. Additionally, participants who had a higher imagining ability were more motivated and ready to discard after rescripting. To our knowledge, our study is the first to investigate the use of ImRs in a hoarding sample and adds to the nascent literature of rescripting applied to future-oriented negative mental imagery (Cooper et al., 2023; Landkroon et al., 2022; Ovanessian et al., 2019).



Fig. 3 Imagining ability as a moderator between ImRs and readiness and motivation to discard

Moreover, our study is one of the few to show that imagining ability influences the efficacy of rescripting (McEvoy et al., 2015). These findings have important implications for future research.

# **Changes in State Emotions**

As predicted, rescripting made the prospect of discarding less aversive to participants, evident in the pre- to post-intervention changes rescripting brought about in state negative and positive emotions. Rescripting lowered participants' state anxiety, sadness, and anger about discarding to a similar extent as the PI and CR exercises, and more so than IE. Rescripting was also more effective than both restructuring and exposure in evoking positive emotions about discarding, evident in the pre- to post-exercise increases in state happiness and relaxation. These results align with a body of work showing that rescripting can be a powerful tool to facilitate adaptive emotional changes about fear-provoking future events (Ovanessian et al., 2019) and can make the prospect of engaging in difficult therapeutic tasks, like exposure, less distressing (Landkroon et al., 2022).

Pending replication and extension in a clinical sample, these results preliminarily suggest ImRs may be a useful addition to hoarding treatment, where large numbers of participants are thought to refuse or drop out of prematurely because decluttering is so distressing (Steketee et al., 2010). Rescripting may be a particularly helpful technique to employ prior to in-vivo exposures for individuals who are highly anxious about discarding to make them less emotionally aversive. Items that individuals recognize they logically need to discard but are having a lot of trouble doing so due to anxiety or other emotional blocks may be particularly well suited to a rescripting intervention.

Curiously, despite being recommended as a strategy in hoarding treatment to facilitate discarding (Steketee & Frost, 2013), IE did not lead to any pre-to-post reductions in negative affect about discarding, including anxiety, and intensified participants' experiences of anger. One explanation of this finding is that a single, brief session of IE was used in the current study instead of several consecutive prolonged trials, which may be required for individuals to benefit from this technique (Hoyer & Beesdo-Baum, 2012). Supporting this notion, studies using consecutive administrations of IE have found benefit in hoarding samples (Fracalanza et al., 2021, 2024). It is also possible that the high levels of experiential avoidance found in HD populations negatively impacted upon the efficacy of IE in our study (Avers et al., 2014). While our instructions were designed to maximise engagement with the feared material and most participants in the IE condition wrote responses that were several paragraphs in length, perhaps some participants employed subtle avoidance behaviours throughout the exercise that diluted its intended effects (e.g., refraining from writing about their 'worst-case' imagined outcome). Future studies should examine the use of prolonged and repeated exposure sessions, ensuring maximal engagement with the feared material, and include follow up analyses to determine if there are delayed positive effects (e.g., reductions in discarding anxiety) overtime before concluding that IE is not useful or contraindicated in hoarding treatment as a strategy to promote discarding.

#### **Changes in Object Attachment**

While exposure made participants more attached to their object, we observed comparable decreases in object attachment in the rescripting, restructuring, and the PI conditions.

While the reductions in object attachment found in rescripting and restructuring were unsurprising, given that both techniques involve mentally changing the meaning of a stimulus (e.g., changing the appraisal of an object from valuable to less valuable; Frost et al., 2016), the decrease in object-attachment we observed in the PI control was unexpected, given that participants were explicitly instructed in this condition to refrain from thinking about their object. Other than viewing these results as temporary reductions that are consistent with distraction, another plausible explanation of this finding is that the control condition primed interpersonal attachment. Indeed, a review of the qualitative data from our control group indicated that many participants wrote about personally relevant autobiographical memories involving meaningful attachment figures (see example in PI condition). As one theory of hoarding considers the disorder to emerge as a compensatory process, where unmet relatedness needs lead to excessive object attachment (Yap & Grisham, 2020), perhaps we inadvertently primed memories of healthy interpersonal attachment through the positive imagery control, thereby facilitating reductions in object attachment. Future research could investigate this idea more explicitly by observing the effects of attachment-imagery on object attachment in hoarding problems.

# Changes in Motivation, Readiness and Discarding Frequency

Importantly, rescripting increased participant's motivation and readiness to discard their chosen item more so than any other technique included in this study, and this motivation translated into more decisions to discard – supporting the role of imagery as a 'motivational amplifier' (Holmes & Mathews, 2010). This may be because as part of the rescripting process, participants were instructed to focus on envisioning positive consequences of discarding their object. Previous research on episodic future thinking has found that imagining behaviours that lead to highly pleasurable and/or rewarding outcomes significantly increases the chances of enacting those behaviours in the future (Libby et al., 2007; Renner et al., 2019). This may be due to mental imagery's unique capacity to create 'pre-experiences' of reward in the present moment. For example, research has shown that imagining consuming sugar, nicotine, and alcohol can lead to desired sensory-experiential states, such as relief, pleasant tastes, satiation and relaxation, while simultaneously highlighting the absence of these rewards in the present moment, motivating approach-seeking behaviour (May et al., 2015). By getting participants to envision a positive future outcome of discarding their object, rescripting may have allowed participants to 'pre-experience' the benefits discarding would bring into their lives (e.g., less clutter, positive relationships etc.), thereby increasing their motivation to engage in this usually avoided activity.

Alternatively, perhaps rescripting had a positive impact on the decision-making difficulties experienced by many individuals who hoard. Individuals with HD are known to be highly indecisive (Frost et al., 2011), and have been observed to have a decision-making style that is slower than controls (Tolin et al., 2012), more risk-averse (Siev et al., 2019) and highly elaborate (i.e., needing to think through all the possible uses of an item before discarding it; Wheaton & Topilow, 2020). According to normative models of decisionmaking (e.g., Weber et al., 2002) the choice to engage in a particular behaviour occurs when its expected benefits are considered to probabilistically outweigh its risks. Perhaps by instructing participants to imagine positive consequences of discarding in the imagery, we prompted them to consider more reasons in favour of discarding relative to its perceived risks, and made these positive outcomes feel more likely, thereby 'tipping the scales' towards change. Indeed, mental imagery can seem so vivid that it can be sometimes mistaken for reality (Mathews et al., 2013). This explanation would make ImRs conceptually similar to motivational interviewing strategies that are increasingly used in hoarding treatment (e.g., Wong et al., 2023).

Another potential explanation for these promising findings is that instructing participants to imagine explicitly handling then throwing away their object in the rescripting procedure allowed for action rehearsal (Moran et al., 2012). Mentally simulating action sequences has been found to improve the likelihood of future skilful performance in a variety of domains, from assertive communication to surgical skills (Arora et al., 2011; Kazdin & Mascitelli, 1982). Moreover, for events that are anticipated to be stressful or difficult (such as discarding), mentally pre-rehearsing specific constructive behaviours increases the plausibility of positive outcomes and motivates engagement in active coping strategies (Jing et al., 2016; Rivkin & Taylor, 1999). Such an approach would therefore make rescripting similar to strategies that start with roleplays as rehearsal for real-life situations.

Regardless of the mechanism of these results, preliminarily our findings suggest ImRs might be a useful addition to hoarding treatment for clients struggling with the motivation to initiate decluttering. Individuals with HD frequently report ambivalence about treatment and low motivation to change (Frost et al., 2010), and this has been hypothesised as one reason behind the high-dropout rate reported in CBT trials for HD (Tolin et al., 2019). Items that the client is struggling to 'get started on', or items that individuals are struggling to see the benefits of throwing away may be particularly well-suited targets for rescripting to 'kick-start' the discarding process.

#### **Imagining Ability**

An important finding in the present research is that participants who were better able to think in mental images were more motivated and ready to discard after rescripting. These results add to a nascent body of literature showing that individuals with higher trait imagining ability may benefit more from therapeutic interventions involving mental imagery, such as rescripting (McEvoy et al., 2015). Moreover, to the author's knowledge, this study is the first to demonstrate that imagining ability influences the efficacy of rescripting prospective imagery, which has been identified as a limitation in previous research (Cooper et al., 2023; Landkroon et al., 2022). Pending replication and extension in a clinical sample, our results suggest it may be fruitful for clinicians and researchers to assess an individual's imagining ability prior to engaging in interventions like imagery rescripting to assess how much therapeutic benefit they are likely to derive. Future research should also continue to assess other moderators of treatment outcomes, such as emotion regulation ability and avoidant coping, as these traits have been hypothesised to be important variables affecting clients' ability to initiate or benefit from rescripting (Hayes & van der Wijngaart, 2020; Strachan et al., 2020) and are known difficulties in HD populations (Ayers et al., 2014; Barton et al., 2021).

# Limitations

Several limitations of this study are noteworthy. Firstly, we utilized a non-clinical sample of participants with high-hoarding tendencies. Although the mean score for participants on the SI-R across conditions was well above the recommended cut-off for clinically significant hoarding (i.e., 39; Kellman-McFarlane et al., 2019), and comparable to studies where gold-standard assessment methods have been used (i.e., self-report measures and diagnostic interviews; e.g., Chou et al., 2018), formally diagnosing hoarding disorder requires the use of a structured clinical interview, so it is uncertain how many participants met diagnostic criteria in our sample.

Secondly, we piloted this study using an online sample of workers recruited from Cloudresearch.com. Although we rigorously screened the data and utilized several response validity indicators, online sampling methods have been critiqued for the quality of the data that they produce (Chmielewski & Kucker, 2019). Moreover, they limit access to those who are familiar with using technology which may not reflect the wider HD community, who tend to present as older compared to other clinical groups (Thew & Salkovskis, 2016). However, this method of recruitment gave us access to a large sample of individuals with hoarding problems in comparison to previous studies, which have been limited by small sample sizes and power concerns (Fracalanza et al., 2021; Przeworski et al., 2014). Moreover, individuals with HD also report experiences of stigmatization, which can impact engagement in traditional clinical and research settings (Bates et al., 2020). Online sampling methods offer greater anonymity and accessibility to 'hard to reach' populations such as hoarding (Forkus et al., 2022).

Another limitation of our research is that we targeted just one type of problematic mental imagery experienced by individuals with hoarding problems - imagery of future, negative discarding scenarios (Cherrier & Ponnor, 2010; Fracalanza et al., 2021; Stewart et al., 2020). Individuals with HD also report other types of problematic mental imagery, such as re-experiencing imagery from negative life events (Stewart et al., 2020) and positive autobiographical memories linked to their objects (Frost & Steketee, 2022). Future research should address these other types of images, using more traditional and novel variants of imagery rescripting (e.g., Arntz & Weertman, 1999). For example, Stewart et al. (2020) hypothesise that helping individuals with HD to collaboratively generate a negative image to link with their object (e.g., an image highlighting the negative consequences of continuing to save the item) to 'compete' with the activation of the positive memory may be a useful therapeutic strategy.

It is also important to note that we applied the rescripting process to just one object, and hoarding involves a pathological attachment to an excessive number of objects (American Psychiatric Association, 2022). Moreover, while rescripting was superior to the other strategies in motivating discarding, the frequency of actual discarding behaviour in the rescripting condition was still somewhat low (i.e., 22.7%). The clinical relevance of this technique to reduce excessive clutter may therefore still be limited. Future research should examine whether applying ImRs to one object generalizes to other objects, or whether rescripting can be applied to entire classes or categories of objects simultaneously. Moreover, rescripting should be compared to other strategies used in hoarding treatment to encourage discarding, such as thought listing, which has been shown to outperform restructuring in promoting discarding behaviour (Frost et al., 2016) and is said to rely on different mechanisms of action (i.e., 'Distancing'; Cacioppo et al., 1997). A follow up should also be included in future studies to determine whether the positive effects of rescripting last over time.

Finally, some outcome measures were assessed via subjective single-item self-report measures without pre-established psychometric properties, including our index of discarding behaviour. While the construction of this discarding decision making index was theoretically informed (i.e., with the transtheoretical model of behaviour change in mind; Prochaska & Velicer, 1997), and there are currently no empirically validated or agreed upon 'best' methods to assess discarding behaviour in online hoarding research, it is possible our measure suffered from some construct validity problems. For example, it is plausible some options on the scale (i.e., the 'discard it later' or 'made some steps towards discarding' options) were actually capturing the indecisiveness and subtle avoidance behaviour common in hoarding (Ayers et al., 2014; Frost et al., 2011), rather than reflecting positive shifts in motivational states. To overcome this issue, in the future we would likely amend this index to have a 2-option forced choice format (i.e., 'discarded', 'did not discard'), and include other ways to verify discarding has genuinely taken place, such as photo-verification methods (de la Cruz et al., 2013).

# **Concluding Remarks**

This study provided preliminary evidence that rescripting can be used to motivate discarding, make it less aversive, and increase its frequency in individuals with hoarding difficulties relative to other cognitive behavioural strategies. While we acknowledge the limitations of our novel experimental paradigm, we believe these findings are remarkable, given that this experiment was hosted online using a survey platform, was designed as a self-guided written exercise without the presence of a therapist, and involved a task as complex as rescripting aversive imagery, in less time than would be afforded in a clinical setting. These results fit with a growing literature suggesting that ImRs can be applied to future-related distressing images, in addition to aversive memories (Arntz, 2012; Strachan et al., 2020), and that imagery-based interventions may have great potential to enhance CBT (McEvoy et al., 2015; Stopa, 2021). Pending replication in further experimental research and extension to a clinical sample, our results suggest using imagery rescripting to target discarding difficulties may be a promising addition to cognitive behavioural treatments for hoarding.

Author Contributions Isaac Sabel: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Project administration, Writing – Original Draft. Jessica R Grisham: Conceptualisation, Formal analysis, Resources, Writing- Review and Editing, Supervision. Keong Yap: Resources, Data Curation, Writing – Review and Editing.

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**Data Availability** The data that support the findings of this study are available from the corresponding author upon reasonable request.

#### Declarations

**Consent to Participate** Consent was obtained for all participants prior to their participation in the study.

**Ethics Approval** The study was conducted in accord with the Declaration of Helsinki and was approved by the University of New South Wales Research Ethics advisory panel.

**Conflict of Interests** Isaac Sabel, Keong Yap and Jessica Grisham declare that they have no conflicts of interest.

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