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The Role of Mental Imagery in Rumination and Depressive Symptoms

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Mental imagery refers to quasi-perceptual internal representations, which are experienced in the absence of corresponding external stimuli. Despite its central function across a range of cognitive processes, recent research has highlighted the role of visual and auditory mental imagery in ruminations, which are typically maladaptive thoughts that have been shown to perpetuate depressive symptoms. Some individuals are unable to experience visual or auditory mental imagery, due to conditions named aphantasia and anauralia, respectively. The current study is the first to assess whether rumination mediates the relationship between mental imagery capabilities and depressive symptoms, in a targeted sample including individuals who do not experience mental imagery. One hundred thirty-two participants, comprising a sample of self-diagnosed aphantasic individuals and students from the University of Sheffield, were recruited in the current study. In an online experiment, participants completed a modified IRQ as well as the RRS and BDI-II, measuring their visual and auditory mental imagery capabilities, ruminative thought, and depressive symptoms, respectively. A mediation regression analysis was used to investigate whether rumination mediated an association between mental imagery capabilities and depressive symptoms. The results revealed a significant indirect effect of combined visual and auditory mental imagery capabilities on depressive symptoms through rumination, with reduced mental imagery capabilities associated with lower levels of rumination which, in turn, were associated with lower depressive symptoms; however, the total and direct effects of mental imagery on depression were non-significant, thereby indicating an inconsistent mediation. These findings progress the understanding of the role of mental imagery in rumination and psychopathology.

INTRODUCTION

Mental imagery (MI) is a high-level cognitive function that has been important in theories of mental function since at least Plato (Galton, 1880). MI is theorised to be a quasi-perceptual experience without a corresponding external stimulus (Kosslyn, 1980, 1994) that can be experienced across different modalities, including visual, auditory, olfactory, gustatory, tactile, and movement (Arcangeli, 2023; Baddeley & Logie, 1992; Floridou et al., 2021). For the purpose of this paper, the authors will focus solely on visual and auditory MI.

The mechanism underlying mental imagery

It is believed that MI is generated in sensory regions of the brain (for a review, see Kosslyn et al., 2001), and therefore "functions like a weak form of perception" (Pearson et al., 2015, p. 590). In the case of visual MI, top-down signals from the prefrontal cortex activate neurons in early visual areas in the ventral stream (Dentico et al., 2014; Ganis & Schendan, 2008; Koenig-Robert & Pearson, 2020), thereby resulting in a perception-like experience. Auditory MI is believed to be generated by overlapping neural mechanisms that generate overt speech that is audible to others (Jack et al., 2019; Whitford et al., 2017), with neuroimaging research highlighting associated activity in the auditory regions (Yao, 2021), and more vivid inner speech resulting in higher auditory cortex activation (Yao & Scheepers, 2011).

The role of mental imagery in cognitive processes, emotions, and psychopathology

MI has received considerable interest in research due to its role in a variety of cognitive functions (Pearson et al., 2008), such as self-regulation (Tullett & Inzlicht, 2010), working memory (Baddeley & Logie, 1992), problem-solving (Baldo et al., 2010), and reading (Alexander & Nygaard, 2008; Yao, 2021). According to Holmes and Mathews (2010) and Lang (1979), MI also influences emotions through sensory-sensitive emotional systems. Importantly, it has also been argued that altered or maladaptive MI, such as involuntary flashbacks, is experienced in those with psychopathological conditions (Cavedon-Taylor, 2022; Weßlau & Steil, 2014), including post-traumatic stress disorder (PTSD) (American Psychiatric Association, 2013), schizophrenia (McGuire et al., 1996), anxiety disorders, and depression (Holmes et al., 2016)

The spectrum of visual and auditory mental imagery

The experience of MI is highly variable (Milton et al., 2021), as visual MI

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vividness is experienced on a spectrum, ranging from severely reduced, or completely absent (Hinwar & Lambert, 2021; Zeman et al., 2015), to photo-like strength (Pearson, 2019; Zeman et al., 2020). Coined by Zeman et al. (2015), the term "aphantasia" (p. 2) refers to the spectrum condition of reduced, or absent, voluntary visual MI. While recent research has identified that those with aphantasia experience reduced MI in other sensory modalities (Hinwar & Lambert, 2021; Dawes et al., 2020), the current paper defines aphantasia as weakened or absent visual MI, in line with the majority of related research (e.g., Keogh & Pearson, 2018; Zeman et al., 2015). This condition is a very poorly understood phenomenon (Takahashi & Gyoba, 2021), which has an estimated prevalence rate of 2–5% in the general population (Faw, 2009), and is believed to be driven by the inability to produce visual MI, rather than by impoverished metacognitive awareness or introspective capabilities (Keogh & Pearson, 2018). More recently, a lack of auditory MI, termed anauralia, has been identified in individuals, with a reportedly very high co-occurrence rate between aphantasia and anauralia (Hinwar & Lambert, 2021). Consistent with aphantasia, auditory imagery in anauralia, including the capacity to consciously experience an "inner voice", ranges from weakened to completely absent (Hinwar & Lambert, 2021). Research so far has primarily focused on aphantasia over anauralia (e.g., Keogh & Pearson, 2018), whereby the comparison of aphantasic individuals to those with typical MI has revealed functional differences in memory (Bainbridge et al., 2021; Jacobs et al., 2018), and face recognition (Milton et al., 2021).

The role of mental imagery in rumination

MI can evoke strong emotional responses (Holmes & Mathews, 2010), and is a hallmark in many psychopathological conditions (Cavedon-Taylor, 2022; Weßlau & Steil, 2014), such as post-traumatic stress disorder (PTSD) (American Psychiatric Association, 2013), anxiety disorders, and depression (Holmes et al., 2016). One maladaptive response style often experienced after distress, seen in many psychopathological conditions, is rumination (Nolen-Hoeksema, 1998, 2000). It reportedly holds primarily verbal features (Fresco et al., 2002; Moffatt et al., 2020; Nolen-Hoeksema, 1998), but can hold visual features as well (Moritz et al., 2013; Patel et al., 2007). Rumination is defined as the frequent and repeated activation of negatively valenced cognitive representations, whereby negative information processing biases and executive control deficits contribute to an increased tendency to ruminate (Watkins & Roberts, 2020). Cognitive representations associated with rumination are characterised by increased negativity and self-criticism, reduced optimism and self-confidence (Lyubomirsky et al., 1999), and increased negative future thinking (Lavender & Watkins, 2004), amongst others (Lyubomirsky et al., 1998). Importantly, these cognitive representations can occur as visual images (Lawrence et al., 2018; McLaughlin et al., 2007; Newby & Moulds, 2011b) and verbal thoughts (Calvete et al., 2005; Fresco et al., 2002; Moffatt et al., 2020; Nolen-Hoeksema, 1998). While the majority of research in this area has been on auditory-verbal-based cognitions, visual ruminations are reportedly common, with over half of a sample of 127 participants reporting to experience either visual, or visual and verbal cognitive representations when ruminating (Lawrence et al., 2018).

The role of rumination and mental imagery in depression

Major depressive disorder is one of the most common mental disorders worldwide with a 15–18% lifetime risk (Kessler et al., 2003; Malhi & Mann, 2018; Steffen et al., 2020). The role of rumination in depression has been widely studied, and it has been shown to predict the onset of, exacerbate, and prolong depressive symptoms (Ehring, 2021; Nolen-Hoeksema, 1991, 2004; Watkins & Roberts, 2020); recent research has therefore focused on reducing depressive symptoms through interventions aimed at reducing rumination (Li et al., 2022).

MI appears to play an important role in depression, as 27–42% of depressed individuals report the presence of visual MI in depressive cognitions (Lawrence et al., 2018; Moritz et al., 2013; Patel et al., 2007) and 87–96% report visual MI in flashbacks to negative life events (Brewin et al., 1996; Newby & Moulds, 2011a). It is thought that imagery significantly impacts emotion because (1) it directly influences emotional systems that are responsive to sensory inputs (Holmes & Mathews, 2010; Lang, 1979), (2) the processes underlying MI and perception overlap, resulting in a response consistent with that induced by real emotionally-arousing events (Baddeley & Andrade, 2000; Holmes & Mathews, 2010; Segal & Fusella, 1969), and (3) imagery has the capacity to activate memories of past emotional episodes (Conway, 2001; Holmes & Mathews, 2010). Supporting the notion that MI has significant clinical implications, Moritz et al. (2013) found participants with sensory-rich depressive thoughts had more severe depressive symptomatology, increased numbers of depressive episodes and were more frequently hospitalised than those without sensory-rich depressive thoughts. Thus, the existing body of research suggests MI plays a notable role in psychopathological conditions.

The evidence base contrasting the role of visual- and verbal-imagery-based ruminations in depressive cognitions is currently mixed, with research highlighting a stronger association between rumination and depressive symptoms for visual-image-based ruminations, as opposed to verbal-thought-based ruminations (Lawrence et al., 2018; Lawrence et al., 2022); however, other research has highlighted more abstract-level ruminations in depressed individuals (Cribb et al., 2006; Watkins & Moulds, 2007), and verbal-based rumination, which occurs at this abstract level, can be more difficult to resolve through problem solving and self-regulation, as opposed to more concrete visual-based rumination (Stöber, 1998; Watkins, 2008).

Gaps in the literature and the current study

As verbal thought and visual imagery are argued to play important roles in rumination (Fresco et al., 2002; Moritz et al., 2013), the current paper aimed to investigate whether rumination mediates a relationship between MI and depressive symptoms, in a sample made up of aphantasic and non-aphantasic individuals. To the best of the author's knowledge, this forms the first research assessing the role of rumination in depressive symptoms in an aphantasic sample. As aphantasia and anauralia have only recently emerged in the literature (e.g., Arcangeli, 2023; Dance et al., 2022), it is currently unknown whether this lack of inner imagery can impact depressive symptoms. If MI plays a significant role in rumination (Fresco et al., 2002; Patel et al., 2007) and psychopathology (Lawrence et al., 2018; Moritz et al., 2013), then it might be expected that those who lack this MI would be less susceptible to rumination, thereby acting as a protective factor to depressive symptoms; however, it must be noted that self-report data from Newby and Moulds (2011a) revealed some individuals experience rumination simply as a "feeling" (p. 237), rather than through MI. As there is evidence that individuals with aphantasia employ cognitive strategies to compensate, at least partially, for a lack of MI (Jacobs et al., 2018), it may be possible that this "feeling" form of rumination counteracts any impairments in visual- and auditory-based rumination.

It was hypothesised that rumination would mediate the relationship between MI and depressive symptoms, with reduced MI predicting lower depressive symptoms.

METHODS

Participants

132 adult participants (44 male, 84 female, 3 prefer not to say and 1 other, mean age = 29 years, SD = 16.52, age range = 18–78) were recruited through opportunity sampling and took part in the study. In order to collect a participant sample with a range of visual and auditory MI capabilities, participants were recruited through two different sources: (1) Self-identified aphantasic participants were voluntarily recruited via the online forum Reddit (https://www.reddit.com/r/aphantasia; see **Appendix A**). Those with aphantasia were targeted during the recruitment stage because of the very high co-occurrence rate between aphantasia and anauralia (Hinwar & Lambert, 2021), and because aphantasia is more widely discussed in the media (and thus more widely recognised) than anauralia. (2) Undergraduate students from the University of Sheffield were voluntarily recruited via SONA, an online system used at the University of Sheffield in the Department of Psychology. It was deemed appropriate to use non-aphantasic and aphantasic participants given that MI capabilities and experiences vary across non-clinical

Table 1

Summary of Descriptive Statistics for Visual and Auditory Subcomponents of the IRQ, the Combined IRQ, and the RRS and BDI-II Scores (N = 132)

	M	SD
IRQ – Visual	28.70	14.31
IRQ – Auditory	38.69	9.51
IRQ – Combined	67.40	19.74
RRS	45.93	14.24
BDI-II	17.05	11.46

samples (Floridou et al., 2021; Gulyás et al., 2022; Isaac & Marks, 1994; Talamini et al., 2023). While recruitment methods were designed to attract individuals with aphantasia, using a forum of self-identified aphantasics, it was not assumed that any specific groups lacked MI. This approach enabled MI to be measured independently of participants' understanding of aphantasia, using the Internal Representations Questionnaire (IRQ; see **Design and materials**). Any participants with a diagnosed reading difficulty were excluded, which was relevant to a separate part of a larger experiment. An informed consent form was given to participants, who were then asked to review it before agreeing to participate.

Design and materials

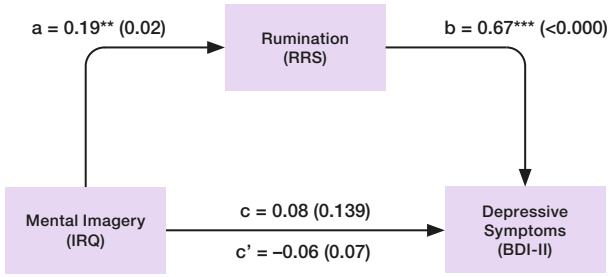
The current study used a repeated-measures design to examine the relationship between mental imagery, rumination and depressive symptoms. To assess participants' verbal and visual MI, a modified version of the Internal Representations Questionnaire (IRQ) (Roebuck & Lupyan, 2020) was used (see **Appendix D**). The modified IRQ Factors used questions only from the "Visual" and "Verbal" representations subscales, resulting in a 22-item self-report questionnaire. Roebuck and Lupyan (2020) confirmed the measure's good test-retest reliability and high internal validity, hence why this measure was chosen for the current study. Participants responded using a 5-point Likert scale, with the following response options: 1 = "Strongly Disagree", 2 = "Slightly Disagree", 3 = "Neither Agree nor Disagree", 4 = "Slightly Agree", 5 = "Strongly Agree". Item 20 "I rarely vocalise thoughts in my mind" was reverse scored. The minimum score is 22, maximum is 110, where higher scores indicate a higher frequency of visual and verbal MI.

The Ruminative Responses Scale (RRS; Nolen-Hoeksema & Morrow, 1991) was used to assess the degree to which individuals ruminate (see **Appendix B**). The RRS is a 22-item self-report questionnaire, containing three factors: (1) depression, (2) brooding, and (3) reflection. Participants respond to statements such as "How often do you think about a recent situation, wishing it had gone better" using a 4-point Likert scale with the following response options: 1 = Almost Never, 2 = Sometimes, 3 = Often, 4 = Almost Always. The minimum score is 22, maximum is 88, where higher scores indicate higher degrees of rumination. It has been shown to have adequate internal consistency and good test-retest stability (Roelofs et al., 2006), and to be a reliable and valid measure of ruminative cognition (Erdur-Baker & Bugay, 2010; Treynor, 2003).

To measure the severity of depressive symptoms the Beck Depression Inventory-II (BDI-II; Beck et al., 1996a) was used (see **Appendix C**), due to its high reliability and validity (Beck et al., 1996b; Kühner et al., 2007; Wang & Gorenstein, 2013). There are 21 groups of statements that participants respond to by selecting which statement (rated 0–3) in the group best describes how they have been feeling for the past two weeks: for example, "Sadness: (0) I do not feel sad. (1) I feel sad much of the time. (2) I am sad all the time. (3) I am so sad or unhappy that I can't stand it." For item 16 (Changes in Sleeping Pattern) and item 18 (Changes in Appetite), seven options are available: 0, 1a, 1b, 2a, 2b, 3a, 3b, to indicate an increase or decrease in behaviour/motivation. The maximum score is 63 which indicates severe depression, with 0–13 indicating minimal depression.

Figure 1

Inconsistent Mediation of Rumination (RRS) in the Relationship Between Mental Imagery (IRQ) and Depressive Symptoms (BDI-II)



Note. Coefficients presented are standardised mediation regression coefficients. ** $p < 0.01$. *** $p < 0.001$

Procedure

The University of Sheffield's Ethics Committee reviewed and approved the materials, procedure and protocol for this research. Participants were provided a link to Gorilla (www.gorilla.sc), where the experiment was conducted. in the study. Participants responded to the IRQ first to assess their visual and verbal MI. The order in which participants completed the BDI-II and RRS was then randomised. One question per screen was presented to participants, with the different response options presented as buttons below the question text, including a "Skip question" button. Participants indicated their chosen response option by clicking with their mouse, or by tapping their chosen option on the touchscreen of their device. Data was collected by Gorilla and analysed using IBM SPSS Statistics PROCESS macros (Hayes, 2018). Upon fulfilment, all participants were provided with a debrief which provided the main objectives, contact details of the main researchers should they require further information, complaints regarding safeguarding and signposts to support services. While no monetary compensation was offered to participants, credits towards passing an undergraduate module were awarded to University of Sheffield students who participated in the project.

RESULTS

Data analysis

A mediation regression analysis was performed to assess whether rumination mediated a relationship between MI and depressive symptoms. To prepare the data, participants' raw scores were downloaded from Gorilla to Excel. BDI-II scores from items 16 and 18 were re-coded in accordance with BDI-II's scoring guide. Item 20 from IRQ was reversed for each participant. Modality specific responses (visual and verbal responses) from the IRQ were calculated separately, and then added together to get the combined MI score for each participant. Additionally, total scores for the RRS and BDI-II were calculated for each participant. The means and standard deviations of these scores are presented in **Table 1**. Data were then analysed using IBM SPSS Statistics PROCESS macros (Hayes, 2018). Inspection of the box and whisker plots revealed there were no outliers in the data. Visual inspection of histograms revealed an approximately normal distribution of data, and scatter plots revealed data met homoscedastic assumptions.

A mediation regression analysis was conducted to test the direct and indirect effects of combined verbal and visual MI (independent variable) on depressive symptoms (dependent variable), via rumination (see **Figure 1**). The direct effect of combined MI on depressive symptoms (path **c'**) was found to be non-significant, $B = -0.06$, SE = 0.03, $p = 0.070$, 95% CI [–0.12, 0.01]; however, the indirect paths between combined MI and rumination (path **a**), $B = 0.19$, SE = 0.06, p = 0.002, 95% CI [0.07, 0.32], and between rumination and depressive symptoms (path **b**), $B = 0.67$, SE = 0.04, $p < 0.001$, 95% CI [0.59, 0.75] were both significant (see **Table 1**). Bootstrapping procedures were used to obtain the 95% confidence interval of the indirect effect using 5,000 bootstrap samples (Preacher & Hayes, 2008). The total indirect effect was significant, *B*

= 0.13, SE = 0.04, 95% CI [0.05, 0.21]; however, the total effect (**c**) was non-significant, B = 0.08, SE = 0.05, p = 0.14, 95% CI [−0.12, 0.04], indicating an inconsistent mediation model.

To assess the influence of visual and verbal subcomponents of MI, separate mediation analyses were conducted for each element on depressive symptoms. For visual MI, the direct effect was found to be non-significant, B = −0.07, SE = 0.04, p = 0.08, 95% CI [−0.15, 0.01]. The indirect paths between visual MI and rumination (path **a**; B = 0.23, SE = 0.09, p < 0.01, 95% CI [0.07, 0.40]) and rumination and depressive symptoms (path **b**; B = 0.66, SE = 0.04, p < 0.001, 95% CI [0.58, 0.75]) were both significant, consistent with the combined measure; however, bootstrapping procedures showed the total indirect effect observed for the combined measure was non-significant for visual imagery only, (B = 0.15, SE = 0.06, 95% CI [0.05, 0.26]) and the total effect (c) was also non-significant (B = 0.08, SE = 0.07, 95% CI [0.05, 0.02]). A similar pattern of findings was observed for the mediation performed for verbal MI (path **a**: B = 0.31, SE = 0.13, p < 0.01, 95% CI [0.05, 0.56]; path **b**: B = 0.66, SE = 0.04, p < 0.001, 95% CI [0.58, 0.75]; direct effect **c'**: B = −0.09, SE = 0.06, p = 0.13, 95% CI [−0.21, 0.03], total effect (c) B = 0.11, SE = 0.07, CI [−0.09, 0.32], total indirect effect, B = 0.21, SE = 0.08, 95% CI [0.04, 0.36]). In summary, the indirect paths between MI, rumination and depressive symptoms are robust for individual subscales of MI, however, the total indirect effect is only present for a combined score of internal visual and verbal imagery.

DISCUSSION

The current study aimed to investigate the mediational effect of rumination on the relationship between MI and depressive symptoms. While the results showed no significant direct effect of combined MI on depressive symptoms, the total indirect effect was significant. When the visual MI and auditory MI scores were entered into the mediation model separately, the indirect paths between MI (visual or auditory) and rumination, and between rumination and depressive symptoms, were significant, though the total indirect effect, and the total effect were non-significant. It can therefore be concluded from the current study that greater combined MI capabilities predict higher levels of rumination, and that higher levels of rumination predict higher depressive symptoms. As the total indirect effect of the combined MI mediation was significant, but the total effect was non-significant, the hypothesis that rumination will mediate the relationship between MI and depressive symptoms is only partially supported.

The association between mental imagery, rumination and depressive symptoms

The current findings revealed that auditory, visual and combined MI capabilities were negatively associated with rumination scores, consistent with evidence of the highly sensory nature of ruminative thought (Newby & Moulds, 2011a). Furthermore, the current study also highlighted a significant positive relationship between rumination and depressive symptoms, consistent with past findings (Donaldson & Lam, 2004; Just & Alloy, 1997; Kuehner & Weber, 1999; Nolen-Hoeksema, 1991, 2000). Concerns have been raised regarding the potential item overlap between depression symptoms and RRS items (Erdur-Baker & Bugay, 2010), though others have argued that item overlap did not contribute to the association between RRS and BDI-II scores in their data (Erdur-Baker & Bugay, 2010; Roberts et al., 1998; Segerstrom et al., 2000; Treynor, 2003).

Our findings revealed a significant indirect effect in the mediation model, only when the visual and verbal MI scores were combined into a single measure. As over 37% of a recent sample reported experiencing a combination of auditory and visual-based rumination (Lawrence et al., 2018), it is likely that this combined measure captures a more comprehensive account of the participants' MI-based cognitive representations (or lack thereof), and therefore explains a greater amount of variance in their ruminations and depressive symptoms. Previous literature has highlighted the critical role that visual, and especially verbal MI, plays in rumination (Fresco et al., 2002; Moffatt et al., 2020; Nolen-Hoeksema, 1998). While recent research has independently analysed the role of visual and auditory MI in rumination and depressive symptoms (Lawrence et al., 2018), the current paper is the first to investigate the role of MI in rumination and depressive symptoms, using a targeted sample of participants with impoverished MI.

Proposed antithetical effects of mental imagery on depressive symptoms

Despite the significant indirect effect, where reduced combined MI capabilities predicted lower levels of rumination which, in turn, predicted lower depressive symptoms, the total effect of combined MI on depressive symptoms was non-significant, indicating an inconsistent mediation model. Since inconsistent mediation models are a result of a direct effect (**c'**) and indirect effect (**ab**) being of opposite directions (MacKinnon et al., 2000; Shrout & Bolger, 2002), it is possible that a variable not assessed in the current design may have increased depressive symptoms in those with lower combined MI.

For example, auditory- and visual-based cognitive representations have also been shown to have positive impacts on mood and mental health, as positive visual imagery has been shown to induce positive affect (Holmes et al., 2009), whereas training to produce positive visual MI can reduce depressive symptoms (Blackwell et al., 2015). Likewise, MI has been shown to be effective in adapting distressing memories or addressing previous distressing experiences, with clinically significant effects in depressed patients (Brewin et al., 2009; Wheatley et al., 2007). In the current findings, it is possible that those with reduced volitional MI are less likely to ruminate in a negative capacity, but also less likely to engage in positively framed, beneficial MI. Consequently, the non-significant total effect in the mediation model may be due to the exacerbatory role of MI in depressive symptoms negating the hypothesised protective effect. Despite the non-significant total effect, the current findings are useful in expanding our understanding of the role of MI in rumination and depressive symptoms, and in highlighting the need for further research on the clinical implications of impoverished MI (Blackwell, 2019).

Limitation of the current study and future directions

The understanding of the subjective experience of MI, as well as its underlying cognitive processes, have often been disputed (Brogaard & Gatzia, 2017; Kosslyn, 1980, 1994; Thomas, 1999). For example, there is notable evidence for the existence of unconscious visual imagery (Brogaard & Gatzia, 2017), and it remains unclear whether this can be experienced by those who report not consciously experiencing MI. Furthermore, there is evidence that involuntary intrusive negative images are still experienced by aphantasic individuals (Birrer et al., 2007; Zeman et al., 2015), and it has consequently been argued that aphantasia is primarily an absence of volition to generate MI (Cavedon-Taylor, 2022; Pounder et al., 2022; Zeman et al., 2015). Maintenance factors in psychopathological conditions, such as imagery-based flashbacks/memories, occur without volition and intrusively. These involuntary mechanisms may remain intact in aphantasia and anauralia, and thereby contribute to psychopathological condition susceptibility (Cavedon-Taylor, 2022; Zeman et al., 2015). Future research should build on the current findings by differentiating between voluntary and involuntary MI, in order to independently assess their role in depressive symptoms, and to investigate whether a lack of MI disproportionately impacts different psychopathological symptoms.

Operationalising MI as a measurable process is extremely methodologically challenging (Alderson-Day et al., 2018), and some doubt remains as to whether this is even possible (Schwitzgebel, 2008). Despite measures showing high test-retest reliability, like the IRQ measure, it is unknown how accurately participants respond to items that track in-the-moment subjective experience (Roebuck & Lupyan, 2020). There are, however, methodological workarounds to this uncertainty, such as Descriptive Experience Sampling (DES; Hurlburt & Akhter, 2006). Alderson-Day and Fernyhough (2015) reported that participants overestimated internal representations in comparison to DES, due to self-report questionnaires being susceptible to reporting biases, affecting recall, and judgements on the frequency of occurrence. Future research could therefore build on the current study, by introducing multiple experimental techniques such as DES, or by implementing neuroimaging techniques (e.g. ,Alderson-Day

et al., 2016; Kosmyna et al., 2018) or behavioural measures of MI capabilities (e.g., Keogh & Pearson, 2018), as alternative, and perhaps more direct measures of MI.

CONCLUSION

The current study revealed a significant indirect effect between combined MI and depressive symptoms, that was mediated by rumination; however, the total effect of the mediation model was non-significant. While further research is required to tease apart the complex impact which absent MI appears to have on depressive symptoms, the current study was the first to investigate this using a targeted sample of individuals unable to experience MI. Furthermore, it provides tentative support for an increased focus on MI's contribution to the aetiology of depressive symptoms, whereby future research may consider exploring the mechanisms of potential adaptive, as well as maladaptive impacts of absent MI on depressive symptoms.

SUPPLEMENTARY MATERIALS

Appendix

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