Shevchenko, Jennifer, Ji, Julie L. ORCID logoORCID: https://orcid.org/0000-0003-1688-9708, Cole, Scott ORCID logoORCID: https://orcid.org/0000-0001-8176-283X, Renner, Fritz and Hallford, David J. (2025) Investigating the effect of mental imagery-based future episodic simulation on subsequent behavioral engagement in depressed, dysphoric, and nondepressed individuals. Journal of Applied Research in Memory and Cognition.

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INVESTIGATING THE EFFECT OF MENTAL IMAGERY BASED FUTURE

EPISODIC SIMULATION ON SUBSEQUENT BEHAVIOURAL ENGAGEMENT IN

DEPRESSED, DYSPHORIC, AND NON-DEPRESSED INDIVIDUALS

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Word Count: 4748 (excluding general audience summary)

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Abstract

Previous work has suggested that mental imagery may represent a useful strategy for motivating goal-directed behaviours. Given that individuals experiencing depression symptoms have low motivation to engage in pleasurable activities, this study aimed to explore the effect of mental imagery on activity engagement for pleasurable activities in non-depressed, dysphoric, and depressed individuals (N = 163). Participants selected four activities they wished to engage in and rated expected outcomes and anticipated emotions relating to activity completion before and after mental elaboration of each activity using either mental imagery or verbal reasoning. Over the following week, utilising ecological momentary assessment (EMA), participants recorded the frequency with which they engaged in their chosen activities. Results showed both conditions led to similar levels of behavioural engagement, across all participants, suggesting that both tasks may influence behavioural engagement. Research is now needed to investigate the underlying mechanism/s by which behavioural engagement is occurring.

Keywords: Behavioural Engagement, Depression, Prospective Cognition, Mental Imagery, Ecological Momentary Assessment

General Audience Summary

Depression often leads to negative thinking and loss of interest and motivation to do activities that feel good or make us feel accomplished. Recent research suggests that mental imagery —visualising vivid experiences in the mind without external input — might help improve future outlook and motivation to do feel-good activities. However, previous studies have shown mixed results, indicating the need for further investigation.

In this study, researchers wanted to test whether using mental imagery to mentally rehearse doing the activities and pre-experiencing the positive outcomes would motivate people who differed in their level of depressed mood to do these activities. The study involved 163 participants who chose four pleasurable activities they wanted to do in the following week. Participants were then randomly assigned to mentally elaborate on these activities and focusing on its positive outcomes either using mental imagery or logical thinking. Before and after doing this activity elaboration exercise, participants reported their feelings and expectations about these activities. Over the next week, they recorded how often they engaged in their specific chosen activities, as well as any other pleasurable activities.

The findings indicate that participants in both the mental imagery and logical thinking mental elaboration groups had more positive expectations about their chosen activities after the lab task, and completed similar numbers of these activities in the following week, regardless of participants' level of depressed mood. This suggests that both strategies might motivate action, but more research is needed to understand how they work and what drives this behaviour.

Investigating the Effect of Mental Imagery Future Based Episodic Simulation on Subsequent Behavioural Engagement in Depressed, Dysphoric and Non-Depressed Individuals

The use of positive mental imagery as a possible technique for improving depressed mood (e.g., Blackwell & Holmes, 2010; Lang et al., 2012) and future thinking (e.g., Boland et al., 2018; Hallford et al., 2023) has recently received growing empirical attention. Mental imagery is the simulation or re-creation of perceptual experience that can involve a variety of sensory modalities, e.g., visual (sight) and olfactory (smell) perceptions (Kosslyn et al., 2001). Mental imagery appears to have a stronger effect on emotion than verbal processing (Holmes & Mathews, 2005), possibly because mental images are rated as more real than verbal thoughts (Mathews et al., 2013). Mental imagery-based episodic simulation refers to the ability individuals have to mentally time travel and pre-experience a future event along with its affective consequences (D'Argembeau & Van Der Linden, 2004; Schacter et al., 2008), which could motivate positive future behaviours by enhancing a sense of reward, motivation, and anticipation of pleasure (Hallford et al., 2020), potentially leading people to ultimately choose to engage in positive behaviours.

Recent studies have started to investigate the impact of mental imagery-based episodic simulation on motivation and behavioural engagement. Renner et al. (2019) specifically addressed planned reward activities (activities that can give individuals a sense of reward once completed) in a community sample. Participants self-nominated six activities to complete over the following week and were randomized to either a single-session Motivational Imagery condition, an Activity Reminder control condition, or a No-Reminder control condition. Relative to control groups, the Motivational Imagery group reported higher

101   levels of motivation, anticipated pleasure, and anticipated reward. The Motivational Imagery

102   group also completed significantly more activities than the Activity Reminder group, but not

103   more than the No-Reminder group. Ji et al. (2021) extended this work and found that mental

104   imagery-based motivational elaboration led to higher behavioural activity engagement

105   relative to the scheduling-only control condition, but only for high motivational barrier

106   activities (high "putting off" activities). That study also showed that anticipatory pleasure

107   (present moment) rather than anticipated pleasure (expected in the future) was the primary

108   factor in amplifying motivation via mental imagery. A similar recent study also showed

109   increases in motivation for an imagery group relative to control groups but failed to find a

110   superior effect on increasing specific planned behaviours, even compared to a text reminder

111   only condition (Heise et al., 2022). These studies provide preliminarily, albeit mixed evidence

112   that mental imagery-based episodic simulation can increase motivation and may increase

113   behavioural engagement for specific behaviours in daily life in the general population.

114

115   Researchers have also begun to investigate the role of mental imagery-based episodic

116   simulation in increasing behavioural activity engagement in depression, yielding mixed

117   findings. Drawing secondary data from a Randomized Controlled Trial (Blackwell et al.

118   2015), Renner et al. (2017) compared a 4-week positive imagery intervention to a non-

119   imagery control condition and measured behavioural activation five times over 6 months.

120   Behavioural activation scores increased over time in both groups with a greater increase at

121   earlier time points in the imagery condition. Similar effects were found for a two-session

122   future thinking program promoting imagery use at a three-month follow-up on general

123   behavioural activation among people with major depression (Hallford et al., 2023). Notably,

124   behavioural activation in these studies was measured using standardised questionnaires of

125   behavioural activation. Whilst these are designed to measure the extent to which an

126 individual perceives they have been engaging in rewarding and meaningful activities, they do

127 not assess the frequency with which an individual actually engaged in specific planned

128 activities. It is therefore not clear how a focus on imagery for specific planned behaviours

129 translates to engagement in those same behaviours.

130

131   A more recent study has contemporaneously measured behaviour following mental

132 imagery-based episodic simulation exercises in individuals with elevated depressive

133 symptoms. Participants were either randomly allocated to a mental imagery group or an

134 active control group performing relaxation exercises over 10 days (Bar et al., 2024).

135 Compared to relaxation, mental imagery enhanced motivation and reward anticipation, but

136 not behaviour. The authors noted two possible explanations; the focus of the assessment on

137 behaviour in general rather than on execution of the planned activity explicitly, and

138 potentially over-narrow or broad interpretations by participants of being 'active' (something

139 the current study aimed to address). Lastly, using ecological momentary assessment (EMA),

140 Hallford et al. (2020) asked whether the use of imagery-based future thinking for near-future

141 behaviours throughout the day increased the likelihood of engaging in these specific

142 behaviours among people with major depression. Although detail, imagery and anticipatory

143 pleasure for these future behaviours increased, no effect on behavioural engagement was

144 found.

145

146   Thus, recent studies on mental imagery-based episodic simulation have shown mixed

147 results regarding its impact on motivation and behavioural engagement. In the general

148 population, mental imagery has been found to increase motivation and engagement in

149 planned activities (e.g., Renner et al., 2019; Ji et al., 2021). In individuals with depression,

150 mental imagery has shown some promise in boosting behavioural activation, but its influence

151 on engaging in specific planned activities is less consistent (Hallford et al., 2020; Bar et al.,

152 2024). One consideration is whether effects are due to reward-focused activity elaboration in

153 general, rather than imagery-based elaboration per se. Distinguishing these requires the use of

154 an active control condition, such as the verbal elaboration condition used in Ji et al., (2021),

155 matching the imagery elaboration condition on reward focus. Whilst Ji et al. (2021) found

156 differences between these two active groups on the putative mechanisms that should lead to

157 behavioural enactment, they found no difference in behavioural enactment. This may be

158 related to an inadequate sample size to detect group effects, or perhaps low sensitivity to

159 effects in an already normally-functioning community sample. A more effective test to

160 distinguish these two reward-focused activities might use a sample that was larger, and

161 therefore better powered to detect differences, and higher in depressive psychopathology –

162 therefore potentially increasing sensitivity to effects on imagery and behavioural activity.

163

164 **The present study**

165   The present study aimed to extend prior research investigating the use of motivational

166 mental imagery on behavioural engagement in reward activities in depression. Basing the

167 design of the mental imagery and active control task on Ji et al. (2021), the present study

168 compared the effects of a motivational mental imagery and an active control motivational

169 verbal reasoning condition on self-reported expectancy (engagement, control, importance,

170 motivation, effort), emotion (anticipated/anticipatory pleasure, momentary mood), and

171 vividness ratings regarding *specific* chosen activities. The study then utilised EMA to assess

172 behavioural engagement in these *specific* chosen activities in participants' daily life over a

173 one-week period.

174

175   We hypothesised that, compared to the motivational verbal reasoning task, participants

176 in the motivational mental imagery task would show greater improvements in self-reported

177 expectancy, emotion, and vividness ratings from pre-to post experimental manipulation, and

178 would engage in a greater number of chosen activities during their everyday lives. Further,

179 we explored whether the magnitude of these hypothesised effects would be smaller for

180 individuals with higher depression symptoms due to lower capacity to engage in the imagery

181 condition, given prior research indicating impoverished positive mental imagery generation

182 in depression (Holmes et al., 2016).

183

184   In addition, we also explored behavioural engagement for any other "pleasurable"

185 activities that were not used in the experimental task to investigate whether the experimental

186 tasks influenced behavioural engagement beyond the specific activities selected. It was

187 hypothesised that, compared to the motivational verbal reasoning task, participants in the

188 motivational mental imagery task would engage in a greater number of other pleasurable

189 activities during their everyday lives, and we also aimed to explore whether the magnitude of

190 these hypothesised effects differed across the three mood groups.

191
192 **Method**

193 **Participants**

194   163 participants (44 males), with an age range of 18–87 years (M = 31.01, SD =

195 14.86), participated in exchange for course credits or a £20 Love2Shop voucher. All

196 participants provided informed consent, and the procedures were approved by the School of

197 Education, Language and Psychology Research Ethics Committee [RECPSY00065].

198   Participants' current depression status was established based on their profile on the

199   Patient Health Questionnaire-9 (PHQ-9; Kroenke, Spitzer & Williams, 1999). 52 participants

200   met criteria for either moderate, moderately severe, or severe depression symptom levels and

201   formed the depressed group[1]. A further 46 participants met criteria for mild depression

202   symptom levels and formed a dysphoric group. Finally, 65 participants did not meet the

203   threshold criteria for clinically significant depression symptom levels and formed the non-

204   depressed control group.

205   **Design**

206   The study consisted of two parts: an online experimental session and an activity week

207   during participants' everyday lives. The online experimental session employed a 2 (Time; pre

208   vs post experimental task) x 3 (Mood group; non-depressed vs dysphoric vs depressed) x 2

209   (Experimental Task; Motivational Mental Imagery vs Motivational Verbal Reasoning) mixed

210   design, with between subjects employed on the final two factors. Qualtrics randomly assigned

211   participants to one of the two experimental tasks. Dependent variables were the ratings made

212   by participants before and after the Activity Rating Task, and endorsement of whether

213   activities were engaged in or not over the activity week. A power analysis was conducted to

214   determine the sample size required. The power analysis was conducted based on the 3 (Mood

215   group) x 2 (Experimental Task) interaction. Using G Power 3.1 software, a sample size of

216   158 was required to provide adequate power (0.8) to detect a medium effect.

217   **Materials**

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[1] We did not establish whether any of the participants within this group had a clinical diagnosis of depression. We use "depressed group" as a distinction from participants in the other two groups who scored significantly less on the PhQ-9.

218   *The Patient Health Questionnaire (PHQ-9;* Kroenke et al., 1999). The PHQ-9 is a 9-

219   item inventory used to assess the presence of depressive symptoms as defined by the

220   Diagnostic and Statistical Manual of Mental Disorders (DSM; American Psychiatric

221   Association, 2013). Each item on the inventory is scored using a four-point scale with respect

222   to the extent the individual has experienced that symptom over the previous 2-week period: 0

223   = Not at all; 1 = several days; 2 = more than half the days, 3 = Nearly every day. Summation

224   of responses provides a total score between 0 and 27. A score between 0-4 indicates no

225   depressive symptoms, 5-9 indicates mild depression, 10-14 indicates moderate depression,

226   15-19 indicates moderately serve depression, and 20-17 indicates severe depression. The

227   PHQ-9 has shown good psychometric properties for identifying probable depression and

228   assessing the severity of depressive symptoms (Kroenke et al., 2001).

229   *Activity Selection.* In the Activity Selection phase, participants were prompted to

230   select four activities from a list of thirty (see Appendix A) that they would like to engage

231   more with. It was stipulated that they must not already be a part of participants' daily/weekly

232   routine, they must not require extensive preparation, and the activities must be able to be

233   done for ten minutes or more.

234   *Activity Rating Task.* For each activity, participants made ratings on how likely they

235   were to engage with the activity in the future (likelihood), how much control they had over

236   engaging with the activity (perceived control), how important engaging in the activity was to

237   them (importance), how motivated they were to engage with the activity (self-reported-

238   motivation), how much effort they thought engaging in the activity would require (perceived

239   effort), how much pleasure they felt right now thinking about engaging with the activity

240   (anticipatory pleasure), and how much pleasure they thought they would feel if they engaged

241   with the activity (anticipated pleasure). Participants were also required to rate how vividly

242   they could imagine engaging with the activity (vividness). Each rating was made on a 7-point

243   scale, with 0 being the least and 6 being the highest.

244   *Momentary Mood.* Positive and negative momentary mood were assessed using two

245   visual analogue scales as used by Nelis at el., (2015). To measure positive mood, scores

246   ranged from totally not in a positive mood (0) to in a very positive mood (100). To measure

247   negative mood, scores ranged from totally not dejected, down, sad, depressed (0) to very

248   dejected, down, sad, depressed (100). Participants had to indicate how they felt in the

249   moment.

250   *Motivational Mental Imagery Task.* Adapted from Ji et al., (2021), the imagery audio

251   script required participants to vividly imagine themselves performing each of their chosen

252   activities. Participants were instructed to close their eyes during the imagery task and to focus

253   on the most positive aspects of their image while imagining themselves doing the activity.

254   The audio guide directed participants through imagining the context of the activity (e.g.

255   location), the multi-sensory aspects of engaging with their activity (e.g. visual, auditory,

256   sensory), and the most powerful aspect that make them want to do the activity. To encourage

257   participants to follow the instructions, they were required to answer the following questions

258   at the end of the task: "What did you see in your imagination?", "What sounds did you

259   hear?", "What bodily sensations did you feel?" and "What feelings did you experience?".

260   *Motivational Verbal Reasoning Task.* Adapted from Ji et al., (2021), the verbal

261   reasoning audio script required participants to engage with in verbal analytical thinking about

262   the benefits of their chosen activities and why they should engage in the activity. To

263   encourage participants to follow the instructions, they were required to answer the following

264   questions at the end of the task: "Think about the most logical reasons why you should follow

265   through with the plan for this activity. What are they?"; "As accurately as you can, predict the

266   benefits of completing this activity"; "What positive emotional consequences might there be,

267   if any, of completing this activity", "Analyse why the benefits of this activity might outweigh

268   the effort (e.g. mental, physical, time) required to complete the activity".

269   *Daily Activity Engagement Diary.* Participants received an email (via Qualtrics), or a

270   notification (via SEMA3; O'Brien et al., 2024) at 8pm each night of the activity week. They

271   were required to answer yes or no to two questions: "did you engage with any of your chosen

272   activities in the previous 24 hours?" and "did you engage with any other pleasurable activities

273   in the previous 24 hours?", to indicate whether they engaged with any activities or not

274   (irrespective of how many).

275   **Procedure**

276   The experimental tasks were presented on Qualtrics. Participants either took part in a

277   psychology lab (*n*=56), or via a video call on MS Teams (*n*=107), with a researcher present in

278   both. Following the consent procedure, participants completed the PHQ-9 and the momentary

279   mood scale. Participants then completed the activity section and activity rating tasks.

280   Participants then either completed the motivational mental imagery task or the motivational

281   verbal reasoning task, followed by the activity rating task and the momentary mood scale for

282   a second time. Over the next 7 days, participants completed the daily activity engagement

283   diary.

284   **Results**

285   *Participant demographics.* A one-way ANOVA established the three groups differed

286   significantly with respect to PHQ-9 scores, $F_{(2,162)} = 336.08$, $p < 0.001$. The depressed

287   group scored significantly higher (*M*=13.38, *SD*=3.57) compared with both the dysphoric

288   (*M*=6.91, *SD*=.31) and non-depressed groups (*M*=2.45, *SD*=1.24); additionally, the dysphoric

289   group scored significantly higher than the non-depressed group (all *ps* < 0.001).

290   To assess the change in each rating for participants chosen activities, a 2 (Time: pre-

291   vs. post-experimental task) x 2 (Experimental Task: Motivational Mental imagery vs.

292   Motivational Verbal reasoning) x 3 (Mood group: Non-depressed vs. Dysphoric vs.

293   Depressed) mixed ANOVA was conducted, with repeated measures on the first factor.

294   Bonferroni adjusted pairwise comparisons were conducted, where required, to clarify the

295   nature of significant effects. Descriptive statistics are displayed in Table 1.

296   [Insert table 1 here]

297   *Likelihood of Engagement.* A significant main effect emerged for Time

298    $F(1,157)=132.42$, $p <.001$, $\eta p2 = .46$, with likelihood of engagement being predicted as more

299   likely post experimental task. There were no other significant main effects or interactions (*Fs*

300   ≤ 2.32, $ps \geq .10$, $\eta p2s \leq .03$).

301   *Perceived Control.* A significant main effect emerged for Time $F(1,157)=7.34$, p

302    $=.007$, $\eta p2 = .05$, with activities being predicted as more controllable post experimental task.

303   There were no other significant main effects or interactions (*Fs* ≤ 2.49, $ps \geq .086$, $\eta p2s \leq .03$).

304   *Importance.* A significant main effect emerged for Time $F(1,157)=37.66$, $p =.001$,

305    $\eta p2 = .19$, with activities being predicted as more important post experimental task. There

306   were no other significant main effects or interactions (*Fs* ≤ 2.26, $ps \geq .30$, $\eta p2s \leq .03$).

307   *Self-Reported Motivation.* A significant main effect emerged for Time

308    $F(1,157)=46.02$, $p =.001$, $\eta p2 = .23$, with motivation increasing post experimental task. A

309   Time x Mood group interaction also emerged $F(2,157)=4.49$, $p=.011$, $\eta p2=.23$. Bonferroni

310 pairwise comparisons revealed pre-experimental task the non-depressed participants had

311 significantly more motivation compared to the dysphoric participants ($p=.027$), with no

312 difference post-experimental task ($p=1.00$). There were no other significant main effects or

313 interactions ($Fs \leq 1.54$, $ps \geq .059$, $\eta p2s \leq .02$).

314 *Perceived Effort.* A significant main effect emerged for Time $F(1,157)=5.32$, $p =.022$,

315 $\eta p2 = .03$, with perceived effort of doing the activity decreasing post experimental task.

316 There were no other significant main effects or interactions ($Fs \leq 1.80$, $ps \geq .17$, $\eta p2s \leq .02$).

317 *Anticipatory pleasure.* A significant main effect emerged for Time $F(1,157)=35.32$, p

318 $<.001$, $\eta p2 = .18$, with anticipatory pleasure increasing post experimental task. A main effect

319 of Mood group also emerged $F(2,157)=10.14$, $p =.047$, $\eta p2 = .04$, demonstrating that non-

320 depressed participants had higher anticipatory pleasure compared to the dysphoric

321 participants across time-points and experimental task ($p =.041$), with no difference between

322 the non-depressed and the depressed mood groups ($p =.85$), or the dysphoric and depressed

323 mood groups ($p =.50$). There were no other significant main effects or interactions ($Fs \leq 2.47$,

324 $ps \geq .20$, $\eta p2s \leq .01$).

325 *Anticipated pleasure.* A significant main effect emerged for Time $F(1,157)=29.61$, p

326 $<.001$, $\eta p2 = .16$, with anticipated pleasure increasing post experimental task. A Time x

327 Mood group interaction also emerged $F(2,157)=3.87$, $p =.023$, $\eta p2 = .05$. Bonferroni pairwise

328 comparisons revealed a significant increase over time in anticipated pleasure for both the

329 dysphoric and depressed groups only ($p<.001$ & $p=.010$ respectively), as depicted in Figure 1.

330 There were no other significant main effects or interactions ($Fs \leq 2.63$, $ps \geq .076$, $\eta p2s \leq .03$).

331 [Insert Figure 1 here]

332   *Positive Momentary mood.* A significant main effect emerged for Time

333    $F(1,157)=35.83$, $p <.001$, $\eta p2 = .19$, with positive momentary mood increasing post

334   experimental task. There was also a main effect for Mood group, $F(2,157)=53.26$, $p <.001$,

335    $\eta p2 = .40$, with both non-depressed and dysphoric participants reporting higher levels of

336   positive momentary mood compared to depressed participants (both *ps* <.001), and the non-

337   depressed having higher levels of positive momentary mood compared to dysphoric

338   participants (*p*=.007). There were no other significant main effects or interactions (*Fs* ≤ 2.07,

339   *ps* ≥ .058, *ηp2s* ≤ .01).

340   *Negative Momentary mood.* A significant main effect emerged for Time

341    $F(1,157)=32.80$, $p <.001$, $\eta p2 = .17$ with negative momentary mood decreasing post

342   experimental task. There was also an effect for Mood group $F(2,157)=32.79$, $p <.001$, $\eta p2 =$

343   .30, with both non-depressed and dysphoric participants reporting lower levels of negative

344   momentary mood compared to depressed participants (both *ps* <.001), and the non-depressed

345   having lower levels of negative momentary mood compared to dysphoric participants

346   (*p*=.037). A significant 3-way interaction also emerged $F(2,157)=3.06$, $p =.05$, $\eta p2 = .04$ (see

347   Figure 2). Bonferroni pairwise comparisons revealed that in the Imagery task negative mood

348   decreased in the dysphoric and depressed mood groups only (*p*=.033 & *p*<.001 respectively),

349   whereas in the verbal reasoning task negative mood decreased for the non-depressed and

350   dysphoric mood groups only (*p*=.009 & *p*=.045 respectively). There were no other significant

351   main effects or interactions (*Fs* ≤ 1.83, *ps* ≥ .18, *ηp2s* ≤ .02).

352   [Insert Figure 2 here]

353   *Vividness ratings.* A significant main effect emerged for Time $F(1,157)=36.54$, *p*

354   <.001, $\eta p2 = .19$, with vividness ratings increasing post experimental task. There were no

355   other significant main effects or interactions (*Fs* ≤ 3.34, *ps* ≥ .069, *ηp2s* ≤ .02).

15

356   To assess behavioural engagement levels over the one-week activity period, two 2

357   (Experimental Task: Motivational Mental Imagery vs. Motivational Verbal Reasoning) x 3

358   (Mood group: Non-depressed vs. Dysphoric vs. Depressed) between subjects ANOVA was

359   conducted on participants chosen activities and any other pleasurable activities. Due to some

360   technical issues in the early stages of data collection, not all participants received surveys to

361   complete each day. Given the differing numbers of surveys received across participants, we

362   converted the activity count into percentages. Notably, only participants who received five or

363   more (out of seven) consecutive notifications to record their data were included in the final

364   data set. Descriptive statistics are displayed in Table 2.

365   [Insert table 2 here]

366   *Behavioural Engagement: Chosen Activities.* No significant main effects for

367   Experimental Task $F(1,157)=.30$, $p =.58$, $\eta p2 = .002$ nor Mood group $F(2,157)=1.37$, $p =.26$,

368    $\eta p2 = .02$ emerged, nor a significant interaction $F(2,157)=.04$, $p =.96$, $\eta p2 = .001$, depicted in

369   Figure 3.

370   [Insert Figure 3 here]

371   *Behavioural Engagement: Other Pleasurable Activities.* There was no significant

372   main effect for Experimental Task $F(1,157)=.02$, $p =.88$, $\eta p2 = .000$. A significant main

373   effect for Mood group emerged $F(2,157)=3.51$, $p =.032$, $\eta p2 = .04$, with the non-depressed

374   participants engaging with significantly more activities, beyond their chosen activities,

375   compared to the depressed participants ($p=.038$). No significant interaction emerged

376    $F(2,157)=.1.66$, $p =.19$, $\eta p2 = .02$.

377   **Discussion**

378   This study tested the effects of motivational mental imagery against an active

379   motivational verbal reasoning control condition on expectancy/emotion ratings and behaviour

380   in individuals varying in depressive symptomatology. Self-reported ratings of engagement,

381   control, importance, effort, motivation/anticipated pleasure, anticipatory pleasure, and

382   vividness increased to similar degrees across conditions. However, negative mood was

383   reduced in the mental imagery condition only for depressed and dysphoric participants and

384   for non-depressed and dysphoric participants only following the verbal reasoning task. This

385   suggests that in depression, mental imagery may have a superior capacity to impact emotion,

386   consistent with previous findings (e.g., Holmes & Mathews, 2005).

387   The lack of disparity between the two experimental tasks has also been noted in

388   previous research measuring anticipated motivation (Ji et al., 2021). One possible explanation

389   may be that during the verbal reasoning task, participants not only thought about the benefits

390   of and reasons for engagement in their chosen activities as requested, but also employed

391   mental imagery, which can occur spontaneously and voluntarily (e.g., Cole & Kvavilashvili,

392   2019). When individuals are asked to think about pleasurable activities, they tend to engage

393   in mental imagery to a similar extent irrespective of explicit instruction to do so (Ji et al.,

394   2024). Alternatively, the verbal reasoning condition may have active components that have

395   similar effects to mental imagery. Previous studies assessing belief in occurrence suggest that

396   reasoning (explaining why a particular outcome will come about) increases the perceived

397   likelihood of that outcome (see Koehler, 1991 for a review). Our verbal reasoning task

398   required participants to explore the reasons why they should engage with their chosen

399   activities, which could have enhanced both their expectancy and emotion. Future research

400   should aim to establish to what extent mental imagery is being used within the different tasks;

401   however, even if participants across both tasks report that they experienced mental imagery,

402   there may be qualitative differences in this imagery in terms of content and function.

403 Therefore, future research should go beyond attempts to measure quantity of imagery use

404 during the tasks and ask about the content and characteristics of such imagery.

405   A surprising finding was that the non-depressed and dysphoric mood groups showed

406 significant differences in their anticipatory pleasure ratings, while no such differences were

407 observed between the non-depressed and depressed mood groups. Furthermore, we did not

408 find support for our hypothesis that the non-depressed mood group would show an increase in

409 anticipated pleasure. Further research could address the possibility that participants had

410 already considered engaging with these activities prior to the experiment, such that their

411 anticipated pleasure was already established.

412   We found no significant difference between conditions in terms of participants'

413 behavioural engagement in their everyday lives over the week following the experiment,

414 consistent with previous findings failing to show simple and consistent effects for imagery on

415 specific behaviours (e.g., Bar et al., 2024; Heise et al., 2022; Hallford et al., 2020; Ji et al.,

416 2021; Renner et al., 2017). However, there was also no significant difference across the three

417 mood groups (across both experimental tasks), indicating that all mood groups engaged with

418 their chosen activities to a similar extent. This is an encouraging finding, as one of the

419 symptoms of depression is diminished engagement in pleasurable activities (Peeters et al.,

420 2003; Carvalho & Hopko, 2011).

421   We found no significant difference across tasks in engagement in 'pleasurable'

422 activities not featuring in the activity selection task: that is, in broader behavioural

423 engagement (i.e., a carryover effect to other pleasurable activities). However, across

424 conditions, non-depressed participants engaged in significantly more additional pleasurable

425 activities than depressed participants. Thus, for individuals with depression, behavioural

426 engagement may be limited to the specific activities with which they have mentally engaged.

427 Another plausible explanation is that the groups may have had different behavioural activity

428 levels prior to the experimental tasks, and the experimental task caused differential *change*

429 during the activity week. Since pre-experimental tasks behavioural activity levels were not

430 measured, this cannot be ascertained, but findings from other studies indicate it is possible

431 (e.g., Renner et al., 2017; Hallford et al., 2023).

Limitations and Future Directions

433 There are several limitations in the present study that warrant caution when

434 interpreting the results. First, although the aim of the study was to test the specificity of

435 mental imagery-based activity elaboration on behavioural engagement by contrasting it

436 against an active control condition (verbal reasoning), for feasibility reasons we did not

437 additionally employ a passive control group. As such, the impact of mental imagery and

438 verbal reasoning-based elaboration relative to no activity elaboration remains to be

439 established in non-depressed, dysphoric, and depressed individuals, and the results should be

440 interpreted with caution.

441 Second, as discussed earlier, we did not measure mental imagery engagement during

442 the experimental tasks, making it difficult to determine whether participants in the verbal

443 reasoning task also engaged with mental imagery, and if they did, whether there were any

444 qualitative differences. Similarly, as part of the activity rating task, participants were asked to

445 rate how vividly they could imagine their chosen activities, both before and after the

446 experimental tasks. This may have unintentionally primed them to use mental imagery.

447 Future research should take care to avoid inadvertently prompting participants to use imagery

448 in conditions unrelated to mental imagery to resolve this ambiguity, and should include

449 manipulation checks to assess whether participants are engaging with the conditions as

450 expected.

451   Third, although our findings indicate that the depressed and dysphoric groups did not

452   engage in fewer activities than the non-depressed group, it remains unclear whether inherent

453   differences in activity engagement exist between the groups or whether the experimental

454   tasks promoted comparable levels of engagement across all participants. Future studies

455   should determine baseline activity levels.

456   Fourth, the daily question participants received about their activity engagement

457   assumed participants remembered the activities they selected at the beginning of the study,

458   which may not have been the case for all participants. Future studies should ensure the

459   activities selected are incorporated into this question as a reminder.

460   Finally, while participants chose their activities, they were limited to a predefined list.

461   This may have restricted the tasks' impact if participants struggled to find activities they

462   wanted to engage in. Future studies could allow participants to come up with their own

463   activities.

464   **Conclusion**

465   In summary, present results demonstrate that motivational mental imagery and verbal

466   reasoning-based elaboration of activities had similar positive impacts on expectancy and

467   emotion ratings and resulted in similar behavioural activity engagement levels across

468   participants, irrespective of depression symptom level. Research is now needed to try to

469   understand the potential underlying mechanism/s by which behavioural engagement is

470   occurring.

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473   **CRediT authorship contribution statement**

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475   **Jennifer Shevchenko** – Conceptualization; Investigation; Methodology; Supervision; Project

476   Administration; Data curation; Formal Analysis; Writing – original draft; **Julie L. Ji** -

477   Conceptualization; Methodology; Writing – review & editing; **Scott N. Cole** –

478   Conceptualization; Writing – review & editing; **Fritz Renner** – Conceptualization;

479   Methodology; Writing – review & editing; **David J. Hallford** – Conceptualization;

480   Methodology Supervision; Writing – review & editing.

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Appendix A

1. Cooking
2. Going for a walk
3. Meditation
4. Reading
5. Listening to a podcast
6. Playing a game
7. Going for a coffee
8. Playing a musical instrument
9. Going for a meal
10. Baking
11. Going for a run
12. Phoning a family member or friend
13. Going to the cinema
14. Waking up earlier, and getting ready at a leisurely pace
15. Star gazing
16. Painting/drawing/cooking
17. Swimming
18. Going to the gym
19. Yoga
20. Listening to music
21. Watching a boxset
22. Meeting friends
23. Going to an exercise class
24. Attending a quiz
25. Having a picnic
26. Doing a jigsaw puzzle
27. Doing some self-care
28. Learning a new language
29. watching the sunset or sunrise
30. Dancing

633 **Table 1:** Mean expectancy, emotion, and vividness ratings (and standard deviations) as a function of time, experimental task, and depression status.

	Experimental Task	Non-Depressed		Dysphoric		Depressed	
		Pre	Post	Pre	Post	Pre	Post
Likelihood	Imagery	4.14 (1.50)	5.00 (1.46)	4.33 (1.36)	4.89 (1.49)	4.58 (1.23)	5.21 (1.14)
	Verbal Reasoning	4.52 (1.36)	5.37 (1.07)	3.55 (1.22)	4.39 (1.08)	4.24 (1.45)	4.94 (1.47)
Control	Imagery	4.94 (1.48)	5.04 (1.62)	5.64 (1.00)	5.71 (1.21)	5.25 (1.11)	5.38 (1.01)
	Verbal Reasoning	5.27 (1.10)	5.63(0.99)	5.08 (1.17)	5.22 (1.13)	5.03 (1.33)	5.24 (1.24)
Effort	Imagery	4.37 (1.23)	4.18 (1.38)	4.67 (1.30)	4.51 (1.25)	4.68 (1.14)	4.67 (1.36)
	Verbal Reasoning	4.38 (1.09)	4.46 (1.11)	4.56 (0.79)	4.16 (0.90)	4.59 (0.96)	4.24 (1.03)
Motivation	Imagery	4.92 (1.14)	5.15 (1.12)	4.85 (0.94)	5.43 (1.04)	4.88 (1.19)	5.15 (1.13)
	Verbal Reasoning	5.12 (1.05)	5.45 (1.06)	4.09 (1.18)	4.97 (0.84)	4.94 (0.90)	5.29 (0.91)
Importance	Imagery	4.58 (1.23)	4.99 (1.25)	4.73 (0.88)	4.97 (1.02)	4.93 (1.14)	5.28 (1.16)
	Verbal Reasoning	5.08 (0.98)	5.49 (1.03)	4.44 (1.05)	4.80 (1.06)	4.90 (0.87)	5.01 (0.92)
Anticipatory Pleasure	Imagery	5.05 (1.05)	5.43 (0.95)	4.84 (0.99)	5.38 (1.03)	4.78 (1.07)	5.17 (1.06)
	Verbal Reasoning	5.38 (0.92)	5.58 (0.92)	4.53 (0.82)	4.95 (1.17)	5.28 (0.90)	5.49 (0.85)
Anticipated Pleasure	Imagery	5.49 (1.02)	5.63 (1.01)	5.10 (0.76)	5.67 (0.80)	5.27 (1.05)	5.56 (0.98)
	Verbal Reasoning	5.67 (0.73)	5.78 (0.82)	5.05 (0.74)	5.44 (0.85)	5.72 (0.75)	5.91(0.58)
Positive Mood	Imagery	81.24 (11.36)	83.68 (13.06)	68.92 (19.29)	74.96 (19.06)	50.32 (18.69)	60.28 (18.26)
	Verbal Reasoning	76.26 (12.74)	80.58 (13.99)	69.59 (8.79)	73.32 (13.07)	46.11 (20.64)	53.48 (17.90)
Negative Mood	Imagery	9.56 (11.99)	8.12 (11.98)	18.58 (19.00)	14.04 (13.59)	37.68 (23.81)	28.32 (19.27)
	Verbal Reasoning	14.19 (17.28)	9.26 (10.79)	22.50 (16.66)	18.05 (13.40)	38.41 (23.36)	35.04 (21.79)
Vividness	Imagery	5.43 (1.15)	5.82 (1.19)	5.67 (1.16)	5.86 (1.17)	5.18 (0.95)	5.86 (0.99)
	Verbal Reasoning	5.71 (0.85)	5.92 (0.86)	5.22 (0.85)	5.45 (1.00)	5.69 (0.87)	5.92 (0.86)

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635 **Table 2:** Percentage of activities completed (and standard deviations) as a function of experimental task and depression status.

Activities	Experimental Task	Non-Depressed	Dysphoric	Depressed
Chosen	Imagery	58.68 (32.28)	63.29 (29.24)	66.78 (33.04)
	Verbal Reasoning	59.49 (32.20)	67.45 (27.23)	69.89 (29.76)
Other	Imagery	79.76 (30.06)	69.35 (27.94)	62.19 (30.48)
	Verbal Reasoning	69.26 (21.81)	78.92 (27.25)	61.00 (33.30)

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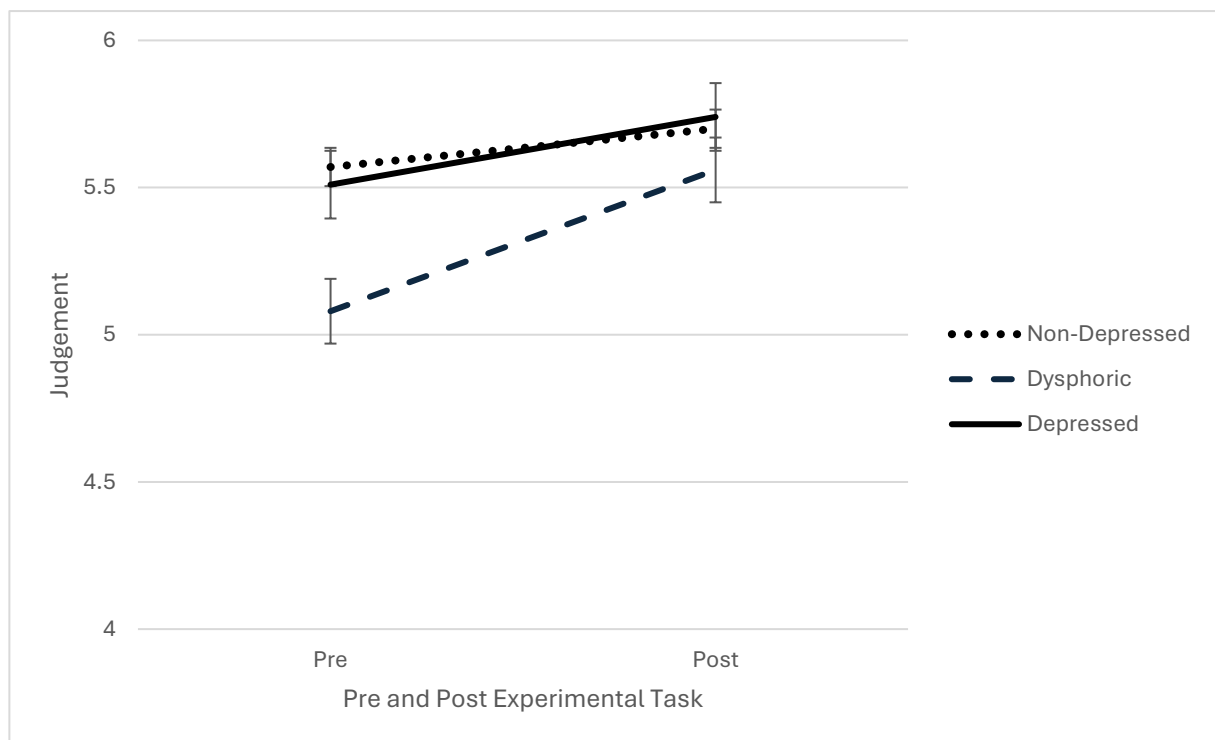
654 **Figure 1:** Mean anticipated pleasure as a function of time and depression status (across both
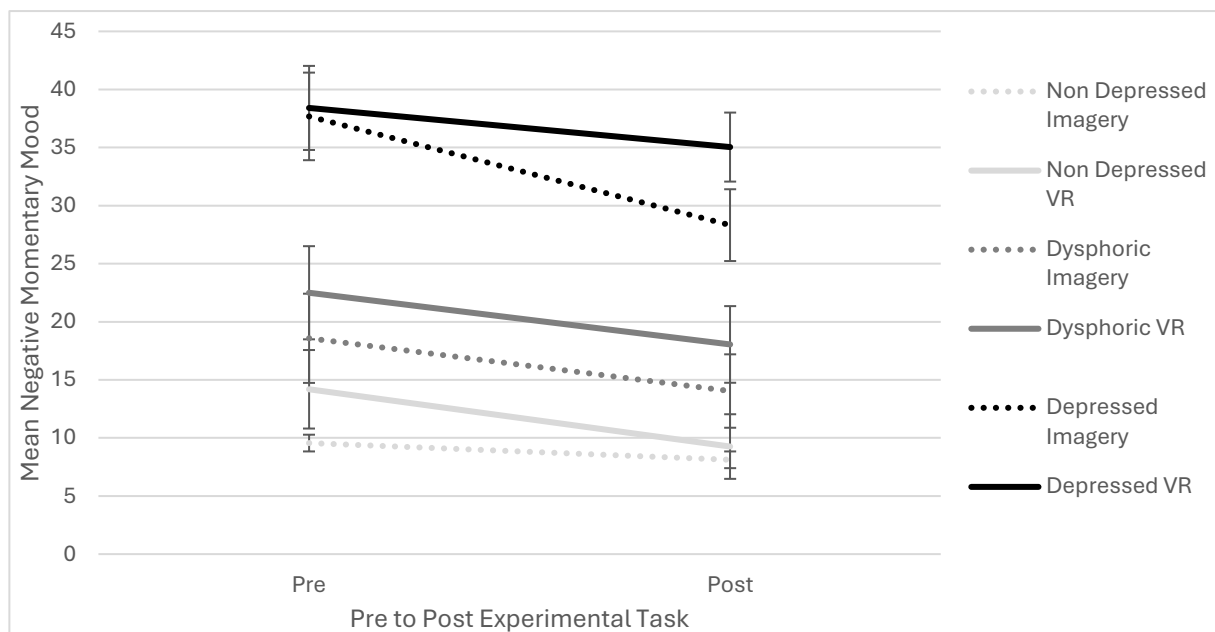655 experimental tasks). Error bars indicate standard error.

Figure 2: Mean negative momentary mood as a function of time, experimental task
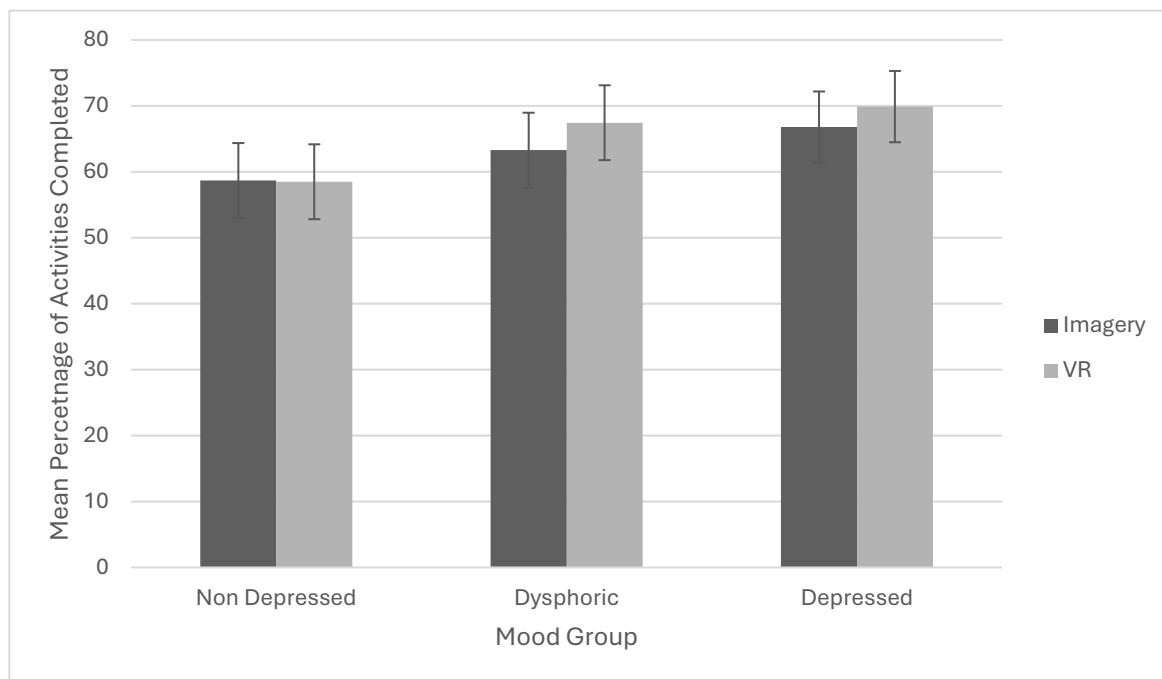(VR=Verbal Reasoning) and depression status. Error bars indicate standard error.

Figure 3: Mean Percentage of chosen activities completed as a function of experimental task (VR=Verbal Reasoning) and depression status. Error bars indicate standard error.