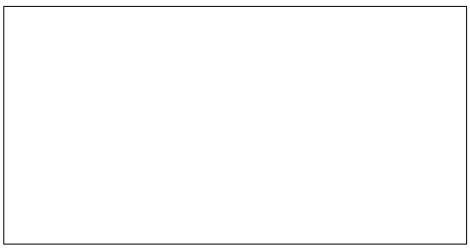

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On the Dangers of Overthinking: A Natural Experiment on Self-Regulatory Thought, Mind-Wandering and Undergraduate Exam Performance

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ABSTRACT

Despite extensive research on motivational factors in academic performance, little is known about the role of ongoing conscious thought. Mind-wandering has been linked with poor educational outcomes, yet can also benefit goal-directed behaviour. We reasoned that mind-wandering should benefit exam performance under certain motivational conditions, including mental contrasting (viewing one's goal in terms of both desired outcome and obstacles to achievement). In an online survey followed by an exam, university students described their assessment goal and reported expectations, exam-related mind-wandering (EMW) and other measures. We predicted that (A) convergence between expectations and performance would be tighter, and (B) EMW would positively predict performance, in students exhibiting mental contrasting. Contrary to predictions, we found no moderation of the expectation-performance relationship, and regarding the EMW-performance relationship, mental contrasters achieved especially *low* grades when mind-wandering frequently about the exam, possibly reflecting a tendency to 'overthink' negative aspects. Theoretical and methodological implications are discussed.

1 | Introduction

Evidence abounds concerning the effects of motivational variables on academic performance. For instance, self-efficacy—the feeling of confidence in one's abilities—is a robust positive predictor of educational outcomes (see review by Schunk and DiBenedetto 2020). Another key area of research concerns *learning goals*, such as mastering a certain topic or outperforming other students (Dweck 1986; Senko 2019). Other things being equal, a student who is confident in their abilities, and motivated not just to pass but to gain a thorough understanding of the course material, will fare relatively well when assessed. However, less is known about the ways in which ongoing conscious thought might interact with such motivational states in determining students' performance (Oettingen and Schwörer 2013; Unsworth and McMillan 2017).

Pham and Taylor (1999) published an influential study comparing the effects of two cognitive strategies—process versus outcome simulation—upon subsequent academic performance. Students who were instructed to imagine their learning goal in terms of the *process* required to succeed obtained better end-of-semester grades than those who imagined an idealised outcome. Moreover, mediation models showed that process simulation affected performance both through promoting planning and decreasing feelings of test anxiety (Pham and Taylor 1999). Thus, the study addressed both underlying approaches to academic goals and the intermediate variables linking these with objective performance.

Subsequent literature supports the principle that a process-based approach to goal pursuit—encompassing obstacles, necessary steps and implementation—is superior to focusing

exclusively on desired outcomes (reviewed by Gollwitzer and Oettingen 2012). Yet rarely has it focused on how such approaches might be expressed in ongoing conscious experience (Oettingen and Schwörer 2013). Students preparing for an assessment are not reducible to static attributes such as 'outcome orientation' or 'high self-efficacy', but rather are subject to fluctuating cognitive, affective and motivational dynamics. Besides identifying mediators (Pham and Taylor 1999), it is also important to consider the *conditions* under which different variables are relevant in predicting performance, as in moderation analysis (Aiken and West 1991).

In this short report, we focus on one category of conscious experience that might predict exam performance under some, but not all, circumstances: mind-wandering (MW; Smallwood and Schooler 2015). To pre-empt the following, we expect that spontaneous MW *about* an upcoming academic exam will be beneficial where one's underlying motivations are coherent (exemplified by mental contrasting; Oettingen 2012), but otherwise unhelpful or even detrimental (Pereira et al. 2020; Seli, Wammes, et al. 2016; Soemer et al. 2024). This possibility has yet to be tested empirically.

1.1 | Fantasy Realisation Theory: A Motivational Framework

Fantasy realisation theory (Oettingen 2012) makes strong distinctions between different self-regulatory thought (SRT) modes: *indulging* in positive fantasies (e.g., imagining achieving the highest grade); *dwelling* on present obstacles (e.g., lack of time, limited subject knowledge); and *mental contrasting*, whereby a positive outcome is imagined and then linked with the obstacles that must be overcome to achieve it.[1] Compared to indulging, dwelling and reverse contrasting (i.e., obstacles *then* outcomes), mental contrasting aligns self-reported goal commitment and objective performance with one's prior expectations of success, resulting in more selective goal pursuit (Cross and Sheffield 2019; Gollwitzer and Oettingen 2012).

Importantly, since these SRT modes are identifiable among naturalistic goal descriptions (elicited without experimenter intervention)—with similar consequences for goal pursuit (Sevincer and Oettingen 2013)—fantasy realisation theory allows us to classify individuals' motivational approach even in contexts where direct experimental manipulation is unfeasible or unethical (e.g., during the COVID-19 pandemic; Clayton McClure and Cole 2022). Given their disparities in effectiveness, manipulating students' SRT modes in the present context would raise significant ethical objections. We therefore conducted a natural experiment, classifying students by naturally occurring SRT mode to examine the factors influencing subsequent exam performance.

1.2 | Mind-Wandering as a Determinant of Academic Performance

One class of variables that might interact with students' underlying motivational approach is those reflecting mind-wandering (Smallwood and Schooler 2015)[2] or spontaneous thought (Klinger et al. 2018). Unintentional MW, whereby the flow of thought is interrupted by internally generated, stimulus-independent contents, has been equated with 'executive failure' (McVay and Kane 2010)—contributing to a focus on its negative effects in education, through disrupting encoding and retention of course material (Kane et al. 2021; Seli, Wammes, et al. 2016; Szpunar et al. 2013; Was et al. 2019).[3] Yet simultaneously, others have proposed a *positive* role for spontaneous MW in goal-directed behaviour more generally (Klinger 2013; Smallwood and Andrews-Hanna 2013), supported by empirical studies of recall performance (Steindorf and Rummel 2017), intertemporal choices (Smallwood et al. 2013) and creative thinking (Baird et al. 2012).

It is therefore important to consider the specific thought patterns investigated under the heading of 'mind-wandering' (Kane et al. 2007; Linz et al. 2019). Unsworth and McMillan (2017) found, using a diary method, that overall MW frequency did not predict subsequent academic performance, though some subtypes (e.g., thinking about one's future academic performance) were related to higher levels of academic interest and motivation. Likewise, Pereira et al. (2020) found the relationship between MW frequency and academic performance to differ according to trait levels of *effortful control* (Rothbart 2007)—with high-control individuals showing a positive, rather than a negative, association. This may reflect differences in the mind-wandering content sampled (see Linz et al. 2019). Furthermore, Wammes et al. (2016) found, by probing mental content during lectures, that instances of *intentional* MW were detrimental to subsequent performance on related quiz questions, whereas unintentional MW had no overall effect.

For present purposes, these sources suggest that the downstream consequences of mind-wandering may differ according to the nature of thoughts sampled (see also Soemer et al. 2024, who found that a tendency to engage in 'positive-constructive', but not 'poor-attention', forms of MW predicted higher reading task performance). For instance, unintentional MW about a specific academic goal, rather than unrelated competing topics, might conceivably benefit performance (e.g., by promoting planning or knowledge consolidation; Klinger 2013; Smallwood and Andrews-Hanna 2013). A primary aim of the present study is to address this as yet unanswered question.

1.3 | Does SRT Mode Moderate the Effect of Mind-Wandering on Performance?

Oettingen and Schwörer (2013) suggested that SRT modes like indulging and mental contrasting might be reflected in spontaneous MW content. Explicitly referring to mind-wandering as a 'tool for behaviour change' (Oettingen and Schwörer 2013, 1), they speculated that spontaneous thoughts featuring mental contrasting (i.e., desired outcomes followed by present obstacles) might produce the typical motivational benefits associated with this formulation (Oettingen 2012). The present study therefore aimed to test the hypothesis that the SRT mode naturally adopted by students should moderate the relationship between MW about an upcoming exam and standardised exam performance.

Our specific predictions were: (A) that there would be a stronger positive relationship between expectations of success and exam

grades under mental contrasting than under indulging (Sevincer and Oettingen 2013); and (B) that SRT mode would likewise moderate the effect of exam-related MW, such that the latter positively predicts grades only in the context of mental contrasting (Oettingen and Schwörer 2013; Smallwood and Andrews-Hanna 2013). We also controlled for academic self-efficacy and test anxiety (Pintrich and De Groot 1990).

2 | Methods

2.1 | Participants

Seventy-three undergraduate psychology students (58 female, age 21.5 ± 1.7 years) at a large Polish university took part in the study. Participation was compensated with course credits and entry into a prize draw for four cash prizes of 50 PLN (approximately 12 USD). Participants completed the prospective survey at a time of their choosing between 18.05.2021 and 14.06.2021. Their exam scores were subsequently accessed via course instructors, and matched using non-identifiable ID codes, after the end of the exam period on 30.06.2021. Participants gave explicit informed consent for their grades to be obtained and matched in this way.

No a priori power analysis was conducted, due to the inherently restricted sampling context (volunteer sampling in a particular student cohort) and lack of control over which SRT category participants would fall into (see Sections 2.2 and 2.3). Although we acknowledge that the sample may be small relative to rules of thumb for multiple regression (Tabachnick and Fidell 2018), post hoc analysis in G*Power (Faul et al. 2007) suggested an acceptable power level (0.79–0.87) was achieved in the main analysis reported below.

2.2 | Design

The study used a prospective, pseudo-experimental design to examine relationships between SRT, expectations of success, exam-related mind-wandering (EMW), and exam performance. SRT mode was established through content coding of free-text responses, as in previous research (Clayton McClure and Cole 2022; Sevincer and Oettingen 2013). This produced two roughly equal groups of students exhibiting *indulging* ($n = 29$) and *mental contrasting* ($n = 32$). A novel questionnaire measure of EMW was taken as a proxy for the tendency to experience spontaneous thoughts of an upcoming exam in daily life. Finally, raw exam grades were obtained in standardised percentage format (0%–100%), enabling participants to be combined across academic modules. The study was approved by a Research Ethics Committee at the host institution (ref. no. KE/23_2021).

2.3 | Materials and Procedure

The survey consisted of a SRT task followed by a series of short questionnaires, combined within Qualtrics. The SRT task required participants to describe their thoughts and feelings around an academic goal: to succeed, to their own standard of performance, in an upcoming in-person exam. Answers were typed in a large text entry field, of minimum length 50 characters to discourage non-serious responses. This process is termed goal elaboration (Sevincer and Oettingen 2013). Exact instructions were as follows:

> A key goal of this module is to perform well in the exam that will be held in June. First, we would like you to think in detail about this goal. You are free to write about whatever aspects come to mind that are related to succeeding in the exam. Let the mental images pass by in your thoughts and do not hesitate to give your thoughts and images free rein. Take as much space as you need to describe your thoughts.

This was followed by ratings of expectation ('indicate how likely you are to succeed at the level you would like'; 1 = *not at all likely*, 7 = *very likely*) and commitment (5-item composite measure from Sevincer and Oettingen 2013, e.g., 'How hard will you try to realise this goal?'; 1 = *not at all*, 7 = *very*).

Questionnaire measures comprised an adapted version of the MW-S scale (Carriere et al. 2013) designed to capture EMW; 12 items from the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich and De Groot 1990) capturing feelings of academic self-efficacy (eight items) and test anxiety (four items); and two standard MW scales, MW-S and MW-D (Carriere et al. 2013), to assess discriminant validity vis-à-vis the adapted measure.

In the EMW scale, the four original MW-S items were adapted to elicit responses based on spontaneous MW about an upcoming academic exam. For instance, 'When my mind wanders, my thoughts tend to be pulled from topic to topic' was modified to 'When my mind wanders, my thoughts revolve around the upcoming exam'. All items are provided in the Supporting Information. Responses were given on a 7-point Likert (1 = *rarely/almost never*; 7 = *a lot/almost always*).

Example MSLQ items were 'I'm confident I can do an excellent job on the upcoming exam' (self-efficacy) and 'I worry a great deal about tests' (test anxiety). All MSLQ items were answered on a 7-point Likert (1 = *not at all true of me*; 7 = *very true of me*) and presented in an intermixed order. All scale items were translated into Polish by the last author. The entire survey took approximately 10 min to complete, after which students' exam grades were obtained as specified above without additional participant burden. The time lag between survey and exam completion was approximately 3 weeks ($M = 21.6$ days, SD = 7.1 days).

2.4 | Coding SRT Mode From Free-Text Goal Elaborations

Goal elaboration responses were first broken down into distinct syntactic statements (e.g., 'My goal is to get a first' or 'I am anxious about the exam'). Each statement was then classified as either *desired future*, *present reality*, or *other*, and the order of statements was used to determine SRT mode (Sevincer and Oettingen 2013). Elaborations containing only present reality statements were classified as *dwelling*; those containing only desired future statements

as *indulging*; those referencing a desired future followed by present reality as *mental contrasting*; and those referencing both aspects in the opposite order as *reverse contrasting* (Oettingen 2012). Unclassifiable elaborations were tagged as 'other'. This process was undertaken twice, in Polish and in English (translations by the last author), with acceptable reliability (agreement = 77%, $k = 0.64$). English classifications were used for analysis.

3 | Results

3.1 | Descriptive Statistics and Bivariate Correlations

Analyses were based on the subgroup of 61 participants exhibiting indulging or mental contrasting (full breakdown of SRT modes provided in Supporting Information). Table 1 presents summary statistics for the main variables, specifying measurement ranges and transformations where applicable. Cronbach's alpha ranged from 0.65–0.93, the highest being EMW. Following the recommendations of Tabachnick and Fidell (2018), any variable with absolute skewness and/or kurtosis of at least twice the corresponding standard error (i.e., $|z| \geq 2$) was submitted to either a square-root (SQRT) or natural log transformation (LN) depending on the severity of the deviation. Transformed variables were approximately normally distributed (for details, see Supporting Information).

Next, bivariate correlations were computed between the resulting variables (Table 2). Although many of the questionnaire measures were intercorrelated at this level (e.g., expectations and self-efficacy, $r_{59} = 0.819$, $p < 0.001$; Table 2), only self-efficacy showed a significant correlation with transformed exam score ($r_{59} = 0.297$, $p < 0.001$). EMW showed a trend-level negative correlation with exam score ($r_{59} = -0.246$, $p = 0.056$). Commitment was not significantly correlated with any other measure ($|r| < 0.21$, $p > 0.10$); nor were the standard spontaneous (MW-S; $|r| < 0.16$, $p > 0.20$) and deliberate mind-wandering scales (MW-D; $|r| < 0.23$, $p > 0.08$), aside from their positive intercorrelation replicating previous findings ($r_{59} = 0.822$, $p < 0.001$; Carriere et al. 2013). These three measures were hence excluded from further analysis.

Prior to regression analysis, we also compared the two SRT groups (indulging, mental contrasting) on all remaining measures (i.e., expectations, EMW, self-efficacy, test anxiety and transformed exam score). Independent samples *t*-tests showed no significant differences ($|t| < 1.80$, $p > 0.07$). Although such tests cannot definitively establish equivalence (i.e., by 'proving' the null), and some results were close to the significance threshold, they suggest there were no pronounced asymmetries on key measures that might substantially influence the interpretation of subsequent multivariate results.

3.2 | Confirmatory Regression Analysis

A hierarchical linear regression model was computed to examine the two moderation hypotheses outlined above, controlling for one another and for background motivational variables (e.g., self-efficacy, test anxiety). Continuous predictors were mean-centered prior to analysis (Aiken and West 1991). In step 1 of the model, expectations and SRT mode were entered alongside self-efficacy, test anxiety and EMW (see Table 3). This gives a baseline against which to compare the addition of two interaction terms in Step 2 (expectations*SRT mode and EMW*SRT mode), computed by multiplying continuous scores by dummy-coded SRT mode (mental contrasting = 0, indulging = 1). Model details are summarised in Table 3.[4]

In both model steps, collinearity statistics were acceptable, despite several intercorrelated predictors (tolerance > 0.24, VIF < 4.20). In Step 1, no predictor explained significant variance ($p > 0.14$), and the model was not significant overall ($R^2 = 0.111$, $p = 0.248$). Step 2, however, explained an additional 17.4% of variance in exam scores, and was significant overall ($R^2 = 0.285$, $p = 0.009$). Significant predictors, highlighted in bold in Table 3, were EMW ($b = -0.056$, $p = 0.005$) and the interaction between EMW and SRT mode ($b = 0.091$, $p = 0.002$).

These results shed light on our above predictions. Firstly, the absence of a significant expectations*SRT mode interaction suggests that the relationship between expectations and grades was no different under mental contrasting (and indeed, non-significant overall). Secondly, the significant EMW*SRT mode

TABLE 1 | Descriptive statistics for untransformed main measures, $n = 61$.

Measure	Mean (SD)	Skewness[a]	Kurtosis[b]	Transformation
Expectations [1–7]	4.72 (1.21)	−0.598	0.372	None
Commitment [5–35]	27.31 (4.95)	−0.932	1.240	Reflect-SQRT-reflect
EMW [4–28]	12.93 (6.52)	0.289	−0.962	None
Self-efficacy [8–56]	37.02 (9.25)	−0.101	−0.817	None
Test anxiety [4–28]	16.97 (6.51)	−0.138	−0.935	None
MW-S [4–28]	19.15 (4.62)	−0.255	−0.030	None
MW-D [4–28]	19.33 (4.36)	−0.829	1.677	Reflect-SQRT-reflect
Exam grade [0–100]	79.76 (14.64)	−2.847	13.667	Reflect-LN-reflect

[a]Standard error = $\sqrt{(6/61)} = 0.314$.
[b]Standard error = $\sqrt{(24/61)} = 0.627$.

TABLE 2 | Correlations (Pearson's *r*) for $n = 61$.

Variable	1.	2.	3.	4.	5.	6.	7.	8.
1. Expectations	—							
2. Commitment	0.114 (0.384)	—						
3. EMW	−0.515** (<0.001)	0.205 (0.113)	—					
4. Self-efficacy	0.819** (<0.001)	0.201 (0.120)	−0.495** (<0.001)	—				
5. Test anxiety	−0.558** (<0.001)	0.196 (0.131)	0.467** (<0.001)	−0.521** (<0.001)	—			
6. MW-S	0.004 (0.973)	−0.045 (0.729)	−0.068 (0.601)	0.027 (0.837)	0.152 (0.242)	—		
7. MW-D	−0.050 (0.704)	0.013 (0.923)	0.086 (0.510)	−0.030 (0.818)	0.225 (0.082)	0.822** (<0.001)	—	
8. Exam score	0.213 (0.100)	−0.109 (0.401)	−0.246 (0.056)	0.297* (0.020)	−0.208 (0.108)	0.047 (0.719)	−0.030 (0.819)	—

Note: *p* values in parentheses.
*$p < 0.05$.
**$p < 0.001$.

TABLE 3 | Hierarchical linear regression model predicting exam scores ($n = 61$).

	R^2	Model *p*	ΔR^2	$p(\Delta R^2)$	Predictor	*b* (95% CI)	*β*	*t*	*p*
Step 1	0.111	0.248	—	—	Expectations	−0.090 (−0.335, 0.155)	−0.173	−0.733	0.466
					EMW	−0.015 (−0.046, 0.017)	−0.152	−0.926	0.359
					Self-efficacy	0.023 (−0.008, 0.053)	0.335	1.478	0.145
					Test anxiety	−0.005 (−0.037, 0.026)	−0.055	−0.338	0.737
					SRT mode	0.045 (−0.298, 0.389)	0.036	0.264	0.792
Step 2	**0.285**	**0.009**	**0.174**	**0.003**	Expectations	−0.106 (−0.352, 0.139)	−0.205	−0.866	0.390
					EMW	**−0.056 (−0.094, −0.017)**	**−0.580**	**−2.897**	**0.005**
					Self-efficacy	0.017 (−0.011, 0.046)	0.257	1.231	0.224
					Test anxiety	−0.020 (−0.051, 0.010)	−0.212	−1.358	0.180
					SRT mode	0.000 (−0.315, 0.315)	0.000	−0.001	0.999
					Expectations*SRT mode	0.052 (−0.245, 0.349)	0.068	0.352	0.726
					EMW*SRT mode	**0.091 (0.035, 0.148)**	**0.668**	**3.224**	**0.002**

Note: SRT mode dummy-coded (MC = 0, indulging = 1). Significant results in bold.

interaction indicates that the relationship between EWM and grades differed between mental contrasting and indulging subgroups, warranting follow-up simple slopes analyses.

Simple slopes analyses were then conducted separately for participants exhibiting mental contrasting ($n = 32$) and indulging ($n = 29$). For each group, transformed exam scores were regressed against self-efficacy, test anxiety, expectations and EMW (all mean-centred) in a single regression step. For the mental contrasting group, this analysis produced a significant model ($R^2 = 0.45$, $p = 0.002$) with significant coefficients for self-efficacy ($\beta = 0.64$, $p = 0.022$) and EMW ($\beta = -0.43$, $p = 0.020$). For the indulging group, the model was not significant ($R^2 = 0.19$, $p = 0.27$) and there was a borderline significant *positive* coefficient for EMW ($\beta = 0.53$, $p = 0.049$) but no other significant effects ($ps \geq 0.077$). These contrasting findings, visualised in Figure 1 (see separate fit lines), suggest that participants exhibiting mental contrasting achieved lower grades the more frequently they reported mind-wandering about the exam, whereas those exhibiting indulging tended to achieve higher grades with higher EMW. Findings also indicate that high self-efficacy predicted success for mental contrasters.

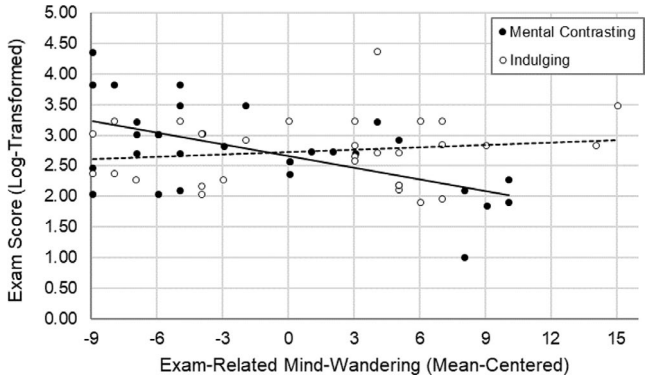

FIGURE 1 | Linear relationships between EMW and exam score for mental contrasting and indulging participants (solid fit line = mental contrasting; dashed fit line = indulging).

4 | Discussion

The present study examined the effects of SRT mode and EWM upon exam performance in an undergraduate sample. Results were expected to mirror those of Sevincer and Oettingen (2013), who found that students adopting mental contrasting showed a stronger positive relationship between prior expectations of success and subsequent performance than those adopting other thought modes (e.g., indulging). Furthermore, we predicted that the relationship between exam-related MW and performance would be moderated in the same way by SRT mode, with more frequent EMW predicting higher grades for those engaging in mental contrasting (see Oettingen and Schwörer 2013).

Our first prediction was not supported by the present data, with no evidence of moderation between expectations and SRT mode. This unexpected result conflicts with the bulk of published work showing 'expectancy-dependent' benefits of mental contrasting (Hauser 2018; Oettingen 2012; Sevincer and Oettingen 2013). We found partial support for the second prediction, detecting significant moderation of EMW by SRT mode when predicting exam performance. Yet the direction of this relationship was opposite to what we predicted: Students adopting mental contrasting fared worse, not better, the more frequently they mind-wandered about their upcoming exam (as confirmed by simple slopes regression). We first discuss possible explanations for these results, before addressing wider implications and study limitations.

The first result is puzzling, given extensive evidence that mental contrasting exerts a moderating influence on the predictive power of one's expectations regarding goal success (reviewed by Oettingen 2012). For academic goals, as in other domains (e.g., health behaviour; Cross and Sheffield 2019), thinking about an ideal outcome followed by present obstacles has been shown to promote pursuit of achievable goals and disengagement from those less likely to succeed (Oettingen 2012). Thus, one would anticipate an interaction effect between expectations and SRT when predicting student exam grades. However, given the non-significant main effect of expectations ($p = 0.39$; Table 3), it is possible that issues of measurement specificity are at play here. In previous research (e.g., Sevincer and Oettingen 2013), participants have first stated their specific goal (e.g., achieve an 'A' grade) before rating expectations. Although we used the same rating scale, we omitted the initial 'goal statement' question because the goal was assumed to be constant across participants (i.e., to perform well in the exam). Participants might therefore have rated their expectations on a different basis than when stating a specific goal beforehand (cf. Kappes et al. 2013; Unsworth and McMillan 2017). It is also possible, given the high average levels of exam performance, that ceiling effects played a part (discussed further below).

The moderation of EMW's effect on grades according to SRT mode is broadly consistent with the view that MW is not always dysfunctional, but rather its effects vary between individuals and contexts (Klinger et al. 2018; Linz et al. 2019; Smallwood and Andrews-Hanna 2013). More specifically, it reinforces the proposition that MW is not always negatively associated with academic performance (Pereira et al. 2020; Unsworth and McMillan 2017). Nonetheless, the direction of the moderation effect was unexpected: Simple slopes analyses indicated that more frequent MW about the exam was harmful, rather than beneficial, to performance under mental contrasting (cf. Oettingen and Schwörer 2013); while students who exhibited the indulging thought mode tended to achieve higher grades with more frequent MW. Although the limited sample size and non-randomised nature of the group comparison necessitate caution, these results could reflect a protective effect of holding an underlying positive outlook on one's academic goal—buffering against excessive exam-related worry (Littman-Ovadia and Nir 2014; Rand et al. 2020).

Consistent with this possible interpretation, EMW correlated negatively with self-efficacy ($r = -0.50$) and positively with test anxiety ($r = 0.47$). It therefore seems likely that, in evaluating items like 'When my mind wanders, my thoughts revolve around the upcoming exam', participants often reflected on *negative* spontaneous thoughts such as worries about their knowledge level or the prospect of performing under pressure (Wine 1971). The use of a simple questionnaire measure makes it impossible to verify this directly; but it remains possible that, were such thoughts captured individually across time (i.e., through experience sampling; Kane et al. 2007; Linz et al. 2019), any detrimental effects on performance might be carried by thoughts identified as negative (see Poerio et al. 2013).

Despite substantial literature supporting the benefits of mental contrasting for goal pursuit (Cross and Sheffield 2019; Gollwitzer and Oettingen 2012), there is emerging evidence that it may not be beneficial in all cases (Clayton McClure and Cole 2022; Schmidt et al. 2023). Hence, the assumption that mental contrasting should trigger further beneficial effects (e.g., from more frequently thinking about an exam) may be challenged. Reviewing the raw data, many participants classified as mental contrasting in this study focussed predominantly on negative aspects (i.e., present obstacles), despite mentioning the desired future first (Oettingen 2012). This highlights a potential avenue for further investigation—probing the limits of effective mental contrasting according to the relative weight given to future and present aspects (see

Kappes et al. 2011). In this study, the general pattern of results might reflect a tendency to 'overthink' negative aspects of one's academic goal, amounting to a present-focussed 'dwelling' approach which forfeits the usual advantages of mental contrasting (Oettingen 2012).

Besides testing two theoretically derived predictions, the present study makes an important methodological contribution by introducing a novel measure and demonstrating its reliability and discriminant validity. Not only was the 4-item EMW measure shown to be highly reliable ($\alpha = 0.93$); it was also uncorrelated with the existing trait measure of spontaneous MW, the MW-S (Carriere et al. 2013). This suggests that the two scales represent substantially different constructs; hence, thinking frequently and unintentionally about an upcoming exam is not simply a function of being a habitual 'mind-wanderer' (Ottaviani and Couyoumdjian 2013). Next, it would be advantageous to assess the convergent/predictive validity of the EMW scale by administering it together with experience sampling during exam preparation (cf. Seli, Risko, and Smilek 2016).

Key study limitations include the use of naturally occurring (as opposed to experimentally induced) SRT modes; using only questionnaire-based MW measures; and restricted sample size (as a consequence of data collection during a time-limited collaboration). On the first point, basing comparisons upon post hoc content coding (although precedented in the literature, e.g., Sevincer and Oettingen 2013) limits the scope to draw causal inferences as it is possible that any differences are due to confounding factors. Regarding MW measures, future work would benefit from the addition of online thought capture (Seli, Risko, and Smilek 2016), to avoid overreliance on retrospective/meta-cognitive judgements of MW frequency and to be able to examine the possible effects of different MW contents (e.g., presence/absence of mental contrasting) at a more fine-grained level. Finally, we acknowledge that the present sample size is limited and that our conclusions must remain tentative (despite reasonable post hoc power estimates, group differences approaching significance and moderate but non-significant correlations in Table 2 argue for larger sample sizes in future work). Furthermore, given that mean exam performance was almost 80% (see Table 3), it is likely that students self-selected based on (high) academic ability; hence the results may not be generalisable to students as a whole.

5 | Conclusions

The present study tested two predictions regarding motivational and cognitive determinants of exam performance in undergraduates. The first stemmed directly from the SRT literature (i.e., mental contrasting should align performance with expectations; Oettingen 2012; Sevincer and Oettingen 2013); the second was derived from theoretical perspectives on the functional value of MW (Oettingen and Schwörer 2013; Smallwood and Andrews-Hanna 2013). In an online survey, students elaborated on their assessment goal and reported expectations, EWM and control measures several weeks before sitting a formal exam. Contrary to the first prediction, there was no evidence of a moderating effect of mental contrasting on the predictive value of expectations. Furthermore, mental contrasters achieved especially *low* (rather than high) grades when mind-wandering frequently about the exam, possibly reflecting a tendency to 'overthink' negative aspects, while indulgers tended to benefit from more frequent EMW. Although tentative due to restricted sample size and naturalistic (non-randomised) group assignment, results support the notion that MW may impact goal pursuit differently depending on context and content (Klinger et al. 2018; Linz et al. 2019; Soemer et al. 2024), warranting further investigation in an academic achievement setting using complementary methods (i.e., experience sampling).

Author Contributions

J. Helgi Clayton McClure: conceptualization, writing – original draft, methodology, formal analysis, project administration. **Scott N. Cole:** conceptualization, writing – review and editing, supervision. **Krystian Barzykowski:** investigation, writing – review and editing, supervision, project administration, conceptualization.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

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

Endnotes

[1] This could be seen as a combination of outcome-based and process-based thought (see Pham and Taylor 1999).

[2] We acknowledge that while the present focus is on spontaneous (i.e., unintentional) ongoing thoughts, some definitions of mind-wandering encompass deliberate forms of stimulus-independent thought (Seli et al. 2018).

[3] Was et al. (2019) showed MW in the form of task-unrelated thoughts (TUTs) during online video viewing to predict lower judgements of learning (JOL), and objective performance on linked quiz questions, than instances where participants were on-task. Notably, MW categorised as 'task-related thoughts', while still predicting lower performance, was *perceived* as less disruptive than TUTs on the JOL measure.

[4] Note that results did not materially differ when separate hierarchical regressions were computed to assess each moderation hypothesis. Therefore, for reasons of succinctness, these have been omitted.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Table S1:** SRT mode breakdown for $n = 73$ (total sample). **Table S2:** Items from exam-related mind-wandering (EMW) scale. **Table S3:** Distributional data for transformed variables.