# Trait Perceived Control, Depressive Symptoms, and Daily Reward Anticipation: An Experience Sampling Study

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## Abstract

Depression is associated with blunted reward anticipation, a core feature of anticipatory anhedonia. While perceived control has been linked to lower depression severity, its role as a moderator of the depression–reward anticipation relationship remains unexplored in naturalistic settings. This study examined whether trait perceived control moderates this association in university students (n = 142) using experience sampling methodology (ESM), in which reward anticipation was assessed five times daily over fourteen days. Depressive symptoms were measured with the DASS-21 depression subscale and perceived control with the Pearlin Mastery Scale. As hypothesized, depressive symptoms were significantly and negatively correlated with daily reward anticipation. Perceived control significantly moderated this relationship; however, contrary to predictions, higher perceived control was associated with a *steeper* negative association between depressive symptoms and reward anticipation. This unexpected amplifying effect may reflect expectation violation: individuals with high perceived control may experience a greater mismatch when depressive symptoms disrupt their typically strong motivational orientation. These findings complicate the assumption that high perceived control is universally protective and highlight the complex interplay between control beliefs and reward processing in depression. Future research should replicate these findings in more diverse samples and examine emotion-specific control beliefs longitudinally.

# Trait Perceived Control, Depressive Symptoms, and Daily Reward Anticipation: An Experience Sampling Study

Depressive disorder is characterized by persistent low mood, loss of interest or pleasure in activities, and a range of cognitive, somatic, and motivational symptoms that significantly impair daily functioning (American Psychiatric Association, 2013). It is among the most prevalent mental health conditions in the Netherlands. According to the NEMESIS-3 study by the Trimbos Institute, 11.5% of individuals aged 18 to 25 years met DSM-5 criteria for a depressive disorder in the period 2019 to 2022 (Trimbos-instituut, 2023), and the proportion of young adults with psychological complaints doubled between 2017 and 2022 (CBS, 2023). These figures illustrate a public health concern among emerging adults. While early warning signs and risk factors for depression are relatively well established (Iacoviello et al., 2010), psychological factors that may protect against its onset or severity remain considerably less investigated. Identifying such protective factors is important not only for developing effective prevention strategies but also for complementing existing interventions.

A potential target for intervention is *anhedonia*. Defined as diminished interest or pleasure in previously enjoyable activities, represents a broad disruption of the reward processing system (American Psychiatric Association, 2013). It can be parsed into two components: anticipatory anhedonia, referring to a reduced ability to look forward to and seek out rewarding experiences, and consummatory anhedonia, referring to a reduced capacity to experience pleasure in the moment (Gard et al., 2006; Parsons et al., 2025). Research consistently indicates that the anticipatory component, *reward anticipation,* is particularly disrupted in depression. Individuals with depressive symptoms struggle primarily with looking forward to rewarding experiences, rather than with hedonic response once engaged in an activity (Parsons et al., 2025; Ren et al., 2024). This distinction carries direct consequences in daily life. An ecological momentary assessment (EMA) study in young people aged 16 to

25 demonstrated that depression is associated with a broad dampening of anticipation and motivation across leisure and social experiences in daily life, and that anticipatory pleasure predicted future engagement with rewarding activities in healthy controls but not in those with elevated depressive symptoms (Sahni & McCabe, 2025). Similarly, neurophysiological research has shown that individuals with current major depressive disorder (MDD) allocate reduced neural resources to the anticipation of reward, even at subclinical levels of depression severity (Ren et al., 2024). Reduced reward learning is the inability to modulate behavior in response to positive reinforcement. It has likewise been documented as a key feature of depression, with high anhedonia specifically driving this deficit, and reduced reward learning at baseline predicting persistence of an MDD diagnosis after eight weeks of treatment (Vrieze et al., 2013). Together, these findings suggest that reward anticipation is a core, partially independent process within depression that is measurable both neurobiologically and in the context of daily life.

Anhedonia's relationship with depression is unique and complex, positioning reward anticipation as a particularly valuable target for independent investigation. Anhedonia is simultaneously a diagnostic criterion of major depressive disorder (American Psychiatric Association, 2013), a prospective predictor of depressive onset in longitudinal research (Allison et al., 2021; Calafiore et al., 2025; Prizeman & McCabe, 2024), and a construct that is empirically separable from overall depression severity (Gard et al., 2006; Vrieze et al., 2013). Crucially, anhedonia often persists after other depressive symptoms have remitted, and reduced reward learning at baseline predicts the persistence of a depressive diagnosis beyond what depression severity alone can account for (Vrieze et al., 2013). These characteristics suggest that anhedonia, and reward anticipation within it, exists as a semi-independent process that goes beyond a simple symptom-disorder framework. Within the broader construct of anhedonia, reward anticipation is especially suited for measurement in naturalistic contexts,

as it reflects a discrete, recurring experience that can be captured in real time. For the purposes of the present study, reward anticipation is therefore conceptualized as a measurable component of anhedonia that can be assessed independently using validated self-report instruments and experience sampling methodology.

Although substantial research has mapped the neurobiological and psychological underpinnings of blunted reward anticipation in depression, considerably less attention has been given to identifying stable personality traits that may buffer and protect against this deficit. One such trait is perceived control. In Rotter's (1966) social learning theory, perceived control refers to the degree to which individuals believe that outcomes in their lives are contingent upon their own actions and personal characteristics, rather than on chance, luck, or the influence of powerful others. It is conceptualized as a relatively stable, dispositional variable that can be measured on a continuum from high to low perceived control (Pearlin & Schooler, 1978; Rotter, 1966). Perceived control has been consistently associated with lower depression severity and more adaptive responses to stress (Ly et al., 2019; Pearlin & Schooler, 1978).

The relevance of perceived control for reward anticipation is grounded in both theoretical and empirical work. Perceived control has been described as intrinsically rewarding: the opportunity to exert control over one's environment activates the reward circuitry and carries motivational value in and of itself (Leotti et al., 2010; Ly et al., 2019). Low perceived control has been consistently linked to reduced goal-directed motivation and diminished engagement in approach behaviors (Ly et al., 2019). When perceived control is low, individuals may overestimate the effort required and underestimate the probability of success, thereby reducing the subjective value of reward-seeking behavior and suppressing anticipatory motivation. This mechanism would manifest as blunted reward anticipation in daily life. The ability to exert control over one's environment can boost reward network

activation and motivational drive (Ly et al., 2019). Consequently, when perceived control is high, depressive symptoms find less expression in blunted reward anticipation.

Despite this theoretical link, the specific role of perceived trait control as a moderator of the relationship between depressive symptoms and reward anticipation has not been directly tested in daily-life contexts. Most existing research on reward anticipation in depression relies on neurobiological evidence, including fMRI, EEG, and probabilistic reward tasks(He et al., 2019; Parsons et al., 2025; Ren et al., 2024; Vrieze et al., 2013). However, these studies offer limited ecological validity, which is important in a construct that can fluctuate from moment to moment. The *experience sampling method* (ESM) addresses this limitation by repeatedly capturing reward-related experiences in real-time across naturalistic daily contexts, thereby reducing recall bias. Research using this method has already established a link between depressive symptoms and reward anticipation (Sahni & McCabe, 2025), but perceived control as a moderator of this relationship in daily life remains unexamined.

The central question of this study is: Does perceived control moderate the relationship between depressive symptoms and reward anticipation in students? Two hypotheses are proposed. First, it is expected that depressive symptoms are negatively correlated with reward anticipation, such that individuals with more depressive symptoms report lower anticipatory pleasure (h1). Second, it is expected that this negative relationship between depressive symptoms and reward anticipation is moderated by perceived control, such that the negative association is weaker in individuals with higher perceived control compared in those with lower perceived control (h2).

## Method

### Design

This study employed a correlational design in which participants were not divided into groups. Data were collected at two levels: a single baseline laboratory questionnaire and a subsequent Experience Sampling Methodology (ESM) component, in which participants completed brief questionnaires repeatedly across fourteen days. For the present analyses, reward anticipation was operationalized as the mean of each participant's repeated ESM measurements, yielding a single aggregated score per participant. Because the repeated measurements were averaged in this way, the analysis is cross-sectional rather than longitudinal. The criterion variable was reward anticipation, and the predictor variables were depressive symptoms and perceived control, with perceived control serving as a moderator. Given the correlational design, the terms predictor and criterion are used rather than independent and dependent variables, because the variables' levels were not experimentally manipulated.

**Procedure**

Prior to the main study, a pilot study was conducted to evaluate the technical functionality and clarity of the laboratory questionnaire, the ESM questions, and the ESM setup. Feedback from the pilot informed minor adjustments to the procedural order and its allocated times, and to the wording of the ESM questions.

Participation consisted of two parts. For the first part, participants arrived at the lab, where they were briefed on the research. To reduce bias in their responses, the study was framed as research on students' well-being in their daily lives. The researchers and participants communicated in either English or Dutch, based on the preference of one or more participants present in the lab at that time. After the briefing, participants were asked to provide informed consent and were informed about the voluntary nature of the study and their right to withdraw at any time. They then completed a baseline questionnaire created in Qualtrics. The questionnaire consisted of 128 items assessing resilience, social support, self-efficacy, reward

anticipation, humor styles, perceived control, loneliness, well-being, depression, anxiety, stress, and affect. The Qualtrics questionnaire was available in both English and Dutch, and participants could choose their preferred language. The researcher told participants that this part would take roughly 30 minutes, asked them to answer truthfully, and asked them to note the participant number that was generated.

Following the questionnaire, participants were instructed on the second part of the research, which was conducted using the Experience Sampling Method (ESM) via a mobile app called m-Path (Mestdagh et al., 2023). This application is designed for intensive longitudinal data collection in daily life. The app allows researchers to schedule repeated assessments, send notifications, and collect momentary self-report data in participants' daily lives and environments. On this app, participants received two-minute questionnaires five times a day for fourteen days. Each ESM questionnaire consisted of 31 to 34 items assessing momentary reward anticipation, affect, and contextual factors in daily life. The number of items varied depending on the participant's answer to the item "I am looking forward to the next three hours"; if participants answered above 50, they received follow-up questions about the upcoming three hours. The notifications were sent at fixed times, always three hours apart, with the first notification set at 8:45 AM. Participants could indicate whether they wanted to change the schedule to a different start time, while maintaining a constant three-hour interval between questionnaires (e.g., 8:45, 11:45, 14:45, 17:45, 20:45). From the moment participants received a notification, they had 30 minutes to complete the questionnaire. To clarify the ESM questions, participants were walked through the questionnaire together with the researcher, who answered questions as needed.

**Data Collection**

The dataset was prepared by the main researchers, Vera Heininga and Jessie van Grieken. Data from the ESM measures were provided by the main researchers in the form of summary

statistics (means and standard deviations) of the relevant variables. For the baseline questionnaire, the raw dataset was supplied. Prior to sharing, the data were anonymized to remove any personally identifying information. In addition, trial entries in the ESM data generated during the initial setup were excluded because they did not provide valid measures. Data were stored on secure servers of the University of Groningen, accessible only to the research team. This study was approved by the University of Groningen Institutional Review Board (IRB) (approval no. PSY-2526-S-0158).

A prior power analysis was conducted for the overall study using G*Power (Faul et al., 2009), based on a multiple regression model with two predictors, a small-to-medium effect size that is typical in psychological research (.09), a Bonferroni-corrected alpha level of .008, and a desired power of .80. This resulted in a required sample size of N = 121. The final sample exceeded this requirement.

**Participants**

Participants were recruited through the SONA system at the University of Groningen and through the researchers' social networks. As a result, participants were primarily first-year psychology students at the University of Groningen who participated as part of their course requirements. The inclusion criteria were as follows: at least 16 years of age, currently enrolled as a university student, and proficient in Dutch or English. A total of 157 students were initially recruited. Participants were between 18 and 28 years old (M = 19.81, SD = 1.16). From the sample, 133 identified as women (84.71%), and 24 as men (15.29%). Participants who entered through the SONA system received credits based on their compliance rate and were therefore incentivized to complete as many questionnaires as possible. Participants were compensated with up to 4.6 SONA credits for their participation. They received 1.1 credits for completing the baseline questionnaire. Additional credits were awarded based on response rate to the ESM questionnaire: participants with a response rate

below 50% received 0.9 credits, those with a response rate of 50–74% received 1.8 credits, and those with a response rate of 75% or higher received the full remaining 3.5 credits.

## Instruments

### *Perceived Control*

Perceived control was assessed using the Pearlin Mastery Scale (Pearlin & Schooler, 1978), which consists of seven items rated on a 5-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*). An example of a question is "What happens to me in the future mostly depends on me." Higher scores indicate greater perceived control. The scores for items 1 through 5 of the PMS had to be mirrored because they were phrased negatively. In the current sample, the scale showed a Cronbach's α of .701.

### *Depressive symptoms*

Depression was assessed using the subscale depression of the Depression, Anxiety, and Stress Scale (DASS-21; Lovibond & Lovibond, 1995). The subscale consists of 8 items, rated on a 4-point scale from 0 (*not at all*) to 3 (*very much/most of the time*). The sum of items 1, 3, 5, 10, 13, 16, 17, and 21 of the DASS-21 was calculated. Higher scores on each question reflect greater symptom severity. A sample question is "I couldn't seem to experience any positive feeling at all." In the current sample, the scale showed a Cronbach's α of .827.

### *Mean Daily reward anticipation*

Reward anticipation was assessed in the questionnaire by the question "I am looking forward to the next three hours". This was measured on a Visual Analogue Scale (VAS) from 1 (*little reward anticipation*) to 100 (*a lot of reward anticipation*).

## Statistical analysis

First, distributions of variables were examined for normality, outliers, and missing data. Next, to test hypothesis 1, Pearson's correlations were computed for all combinations of variables. Before interpreting the results, assumptions were checked.

To test hypothesis 2, two models were made. First, a regression analysis was performed with reward anticipation as the criterion variable and depressive symptoms and perceived control as predictor variables. Secondly, a moderator variable was added for model two. To simplify interpretation, the predictor variables were centered. Next, an interaction term was created by multiplying the two centered predictor variables, and the analysis was then conducted.To interpret the significant interaction effect, simple slopes were examined at low *(−1 SD*) and high *(+1 SD*) levels of perceived control. After computing the regression analysis, but before interpreting the results, assumptions were checked by residual plots.

## Results

### Descriptive Statistics

The study included 161 participants, of whom 156 completed the baseline survey and 142 completed the ESM questionnaires. Of those participants, 24 were male, and 133 were female. The participants' ages ranged from 18 to 28, with a mean of 19.81. The mean response rate for the ESM questionnaires was 88.43%.

Histograms of the criterion and predictor variables show normal distributions for reward anticipation and perceived control, but a right-skewed distribution for depressive symptoms (see Appendix A). Because of this right-skewed distribution, looking at the median is more informative than the mean. These descriptives are presented in Table 1.

**Table 1**

*Descriptive statistics*

| Variable | *M* | *Mdn* | *SD* |
|---|---|---|---|
| Reward anticipation | 49.81 | 49.75 | 14.07 |
| Perceived control | 26.56 | 27.00 | 3.72 |

| | | | |
|---|---|---|---|
| Depressive symptoms | 12.10 | 11.00 | 3.70 |

*Note: M = Mean; Mdn = Median; SD = Standard Deviation.*

*Reward anticipation represents person-level means aggregated across each participant's ESM report. The person-mean is based on an average of 62 valid self-reports, with a minimum of 38.*

Table 2 shows that the correlation between reward anticipation and perceived control was not significant. The correlation between reward anticipation and depressive symptoms was significant. The correlation between perceived control and depressive symptoms is significant.

**Hypothesis 1: Reward Anticipation is Negatively Correlated with Depressive Symptoms**

To answer the first hypothesis, the Pearson's correlation between Reward anticipation and depressive symptoms is examined. Evidence supporting this hypothesis is found in Table 2, which shows a significant negative correlation between reward anticipation and depressive symptoms. So, more depressive symptoms are correlated with less reward anticipation. There was no evidence that the scatterplot-based assumptions were violated. Linearity, homoscedasticity, and outliers were checked with a scatterplot of the two variables (see Appendix B). Although depressive symptoms were right-skewed, indicating a departure from normality, the sample is large enough that Pearson's *r* remains robust.

**Table 2**

*Pearson's bivariate correlations between key variables.*

| Variable | *Pearson's r* | *P value* |
|---|---|---|
| Reward anticipation – Perceived Control | .107 | .211 |
| Reward Anticipation – Depressive Symptoms | -.207 | .014 |

| | | |
|---|---|---|
| Perceived Control – Depressive Symptoms | -.506 | < .001 |

**Hypothesis 2: Perceived Control as Moderator of the Association Between Depressive Symptoms and Reward Anticipation**

The first model (M1) consisted only of the two IVs; the second (M2) included the moderator variable as well (see Table 3). The first model is significant, $F(2, 136) = 3.057$, $p = .050$, $R^2 = .043$, indicating that depressive symptoms and perceived control together explained 4.3% of the variance in reward anticipation. The second model (M2) added the interaction term (depressive symptoms × perceived control) to the predictors. This model was also significant and explained 3.1% more variance than M1 (see Table 3). The full model (M2) accounted for 7.4% of the variance in reward anticipation (see Table 3).

**Table 3**

*Hierarchical Regression Analysis to Predict Reward Anticipation from Depression, Perceived Control and a Moderator of Both predictor Variables*

| | *Model 1* | | | | *Model 2* | | | |
|---|---|---|---|---|---|---|---|---|
| | *B* | *ß* | *SE* | *p* | *B* | *ß* | *SE* | *p* |
| (Intercept) | 60.08 | - | 13.15 | < .001 | 65.85 | - | 13.27 | < .001 |
| Depressive Symptoms | -.794 | -.211 | 0.375 | .036 | -1.311 | -.348 | .444 | .004 |
| Perceived Control | -0.026 | -.007 | 0.378 | .945 | -.051 | -.014 | .373 | .891 |

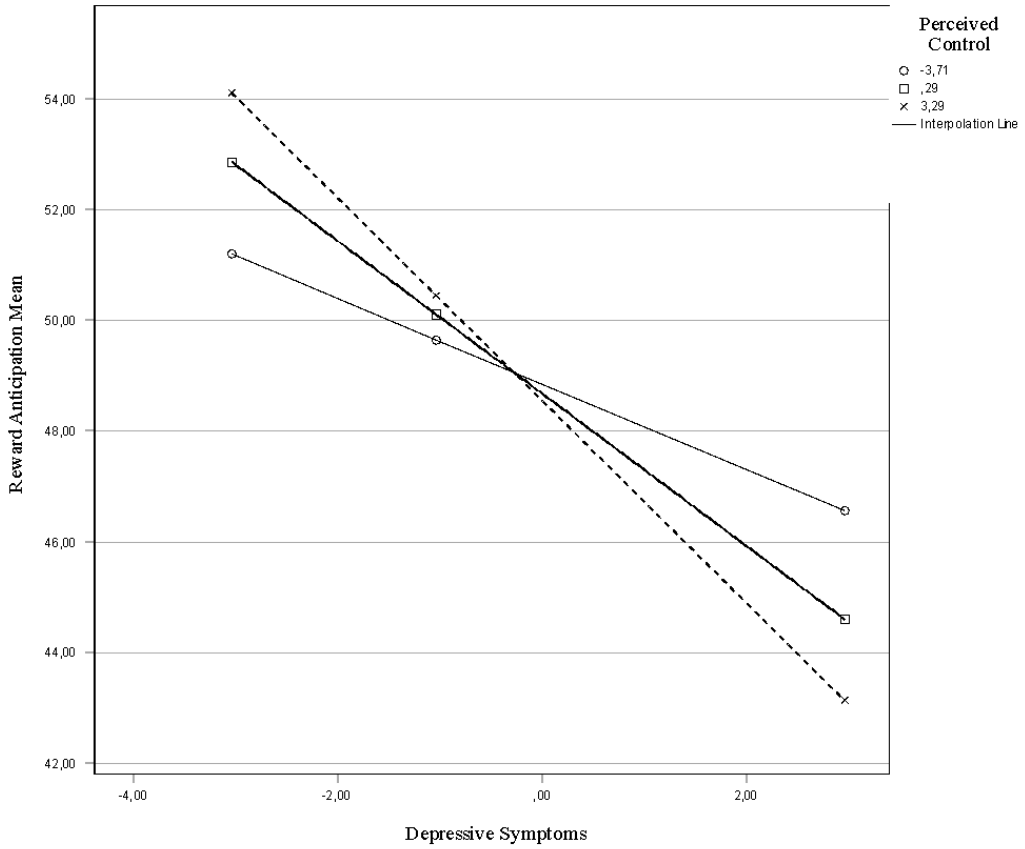
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depressive Symptoms * Perceived Control | - | - | - | -.151 | -.220 | .071 | .036 |
| $R^2$ | .207 | | | | .271 | | |
| $\Delta R^2$ | - | | | | .031 | | |

*Note: Model 1 is a multiple regression analysis with Depressive symptoms as the predictor variable (s). Model two includes the former, and an interaction term between the two predictor variables. B = regression coefficient; ß = standardized regression coefficient; SE = Standard error.*

To further examine the nature of this significant interaction, simple slopes were inspected and plotted in Figure 1. The negative relationship between depressive symptoms and reward anticipation was present at all levels of perceived control. However, the slope appears steeper at high perceived control (PMS_c = 3.29) than at low perceived control (PMS_c = −3.71), suggesting that the negative association between depressive symptoms and reward anticipation is stronger when perceived control is high.

**Figure 1**

*Simple Slopes of the Relationship Between Depressive Symptoms and Reward Anticipation with Perceived Control as the Moderating Variable.*




There is no evidence that the assumptions were violated (see Appendix C). A Q-Q plot and a histogram of the residuals indicate that the normality assumption has not been violated. Based on an observed-versus-predicted residuals plot, the homoscedasticity assumption does not appear to be violated. Based on the study design, there is no evidence that the assumption of independent measurements is violated. Additivity is intentionally relaxed because an interaction is modeled. VIF values were acceptable, indicating no problematic multicollinearity (see Appendix D).

## Discussion

The present study examined whether trait perceived control moderates the relationship between depressive symptoms and reward anticipation in a sample of university students, using experience sampling methodology (ESM). Two hypotheses were tested: first, that depressive symptoms would be negatively associated with reward anticipation; and second,

that this negative association would be weaker among individuals with higher perceived control. Both hypotheses were statistically supported; however, the direction of the moderation effect was contrary to expectations. Rather than buffering against the negative association, higher perceived control was associated with a *stronger* negative relationship between depressive symptoms and reward anticipation. The implications of these findings, alongside the study's methodological strengths and limitations, are discussed below.

### Hypothesis 1: Depressive Symptoms and Reward Anticipation

The first hypothesis was confirmed. The correlation between depressive symptoms and mean daily reward anticipation was significant and negative, indicating that students with more depressive symptoms anticipated the next three hours less positively in their daily lives. This finding is consistent with a substantial body of research characterizing anticipatory anhedonia as a particularly disrupted feature of depression (Parsons et al., 2025; Ren et al., 2024; Sahni & McCabe, 2025; Vrieze et al., 2013). In contrast to neurobiological studies relying on laboratory paradigms such as probabilistic reward tasks, fMRI, or EEG, the present study captured this association in real-time, naturalistic settings across a two-week period. The ecological validity added by this approach complements existing neuroimaging findings (He et al., 2019; Ren et al., 2024) and is consistent with Sahni and McCabe's (2025) ecological momentary assessment study, which similarly demonstrated that depressive symptoms are linked to a broad dampening of anticipation and motivation in everyday life among young people.

The moderate effect size is consistent with prior ESM-based work (Sahni & McCabe 2025). Notably, the correlation between perceived control and depressive symptoms was considerably stronger, and the correlation between perceived control and reward anticipation was non-significant. This pattern is important to consider in interpreting the moderation

results, as it suggests that perceived control is more closely associated with depressive symptoms than with reward anticipation at the zero-order level.

An important note is that there might be a tautological correlation, as reward anticipation is captured in both the ESM question and the DASS-21, in items 10 and 16. The DASS-21 items capture reduced reward anticipation and are negatively correlated with the person-mean reward anticipation. The correlations for questions 10 and 16 with person-mean reward anticipation have moderate effect sizes: $r$ = -.223, $p$ = .008, and $r$ = -.238, $p$ = .005, respectively. Therefore, partial overlap exists between the DASS-21 and reward anticipation, but cannot fully account for the association. This overlap concerns only the correlation between depressive symptoms and reward anticipation; moderation by perceived control is unaffected, as the Pearlin Mastery Scale has no item content in common with reward anticipation.

**Hypothesis 2: The Unexpected Moderating Role of Perceived Control**

The second hypothesis was supported: perceived control significantly moderated the relationship between depressive symptoms and reward anticipation. However, the direction of the interaction was contrary to predictions. Simple slopes analysis revealed that the negative association between depressive symptoms and reward anticipation was steeper at high perceived control than at low perceived control. Rather than weakening the negative effect of depressive symptoms on reward anticipation, higher perceived control amplified it.

This unexpected finding needs careful interpretation. One plausible explanation is that individuals with high perceived control hold stronger expectations about their ability to regulate their own mood and motivational states. When depressive symptoms disrupt these regulatory capacities, the mismatch between expectation and experience may be especially salient, thereby further suppressing anticipatory pleasure. This aligns with Njus and Brockway's (1999) observation that an internal locus of control is protective specifically for

positive, but not negative, outcomes: individuals who strongly believe that outcomes are contingent on their own actions may attribute their inability to feel anticipatory pleasure to personal failure, which may deepen the dampening of reward anticipation. Similarly, Mirowsky and Ross (1990, as cited in Njus & Brockway, 1999) described how a strong internal orientation can turn into self-blame when positive outcomes fail to materialize, particularly among those vulnerable to depression.

This interpretation is also theoretically supported by Ly et al.'s (2019) reward-based framework of perceived control, in which perceived control is intrinsically rewarding because it activates reward circuitry and increases motivational drive. When this motivational activation fails to translate into anticipatory pleasure, as would be expected under elevated depressive symptoms, the subjective experience of that discrepancy may be more pronounced for those who habitually expect their sense of control to enhance their motivational states. Supporting this at the neural level, He et al. (2019) demonstrated blunted reward network responses in individuals with major depressive disorder, suggesting that the facilitating link between perceived control and reward processing may be fundamentally disrupted in the presence of depressive symptoms.

An alternative interpretation concerns the operationalization of perceived control. The Pearlin Mastery Scale (Pearlin & Schooler, 1978) measures a generalized, dispositional sense of mastery over life outcomes, rather than control over mood or emotional states specifically. Individuals scoring high on this scale may therefore be characterized by particularly strong goal-directed orientations and high self-efficacy expectations. In the presence of depressive symptoms, which directly interfere with goal-directed motivation and reward learning (Vrieze et al., 2013), such individuals may be more acutely aware of the discrepancy between their typical motivational state and their current dampened anticipatory capacity. Future research

would benefit from using more targeted measures of perceived emotional control, which may better capture the mechanisms underlying the present moderation pattern.

It should also be noted that although the moderation was statistically significant and explained incremental variance, the full model accounted for only a modest proportion of the variance in reward anticipation overall. This is not unexpected given the complexity of reward anticipation. Momentary anticipatory affect is likely influenced by a wide range of individual, situational, and contextual factors not assessed in the present study, including sleep quality, social context, and acute life events.

**Strengths**

The present study has several notable strengths. The use of ESM represents a meaningful methodological advance over laboratory-based reward paradigms. By capturing reward anticipation five times daily over fourteen days, the study provides ecological validity and reduces recall bias, thereby addressing a limitation identified in previous neurobiological research (He et al., 2019; Parsons et al., 2025; Ren et al., 2024). The high mean ESM compliance rate of 88.43% further supports the quality and representativeness of the momentary data.

**Limitations**

Several limitations should be considered when interpreting the present findings. First, the sample consisted predominantly of first-year female psychology students at a single Dutch university. This restricts the generalizability of the findings to broader populations, and particularly to clinical samples with more severe depressive symptomatology. The right-skewed distribution of depressive symptoms in the present sample is consistent with a non-clinical, predominantly healthy cohort, and it remains unclear whether the observed moderation pattern would replicate among individuals with a formal diagnosis of major depressive disorder.

Second, reward anticipation was assessed using a single visual analog scale item ("I am looking forward to the next three hours"). Although single-item ESM measures are pragmatically necessary in intensive longitudinal designs, they capture a limited operationalization of the construct, and their internal reliability cannot be assessed. Though single-item momentary anticipation measures of this kind have precedent in validated ESM work, no validity estimate exists for this specific item. Parsons et al. (2025) demonstrated that different measurement approaches to reward anticipation are only moderately intercorrelated, suggesting that results may vary depending on the operationalization used. Furthermore, the item's three-hour framing ties anticipation to whatever the upcoming window contains. Because beeps occurred at set times of the day, some momentary assessments fell within intervals with little opportunity for reward (e.g., shortly before sleep), where a low rating may reflect the circumstantial absence of predictable events rather than diminished reward anticipation itself. This introduces situational variance unrelated to the construct, adding error and noise to each person-mean.

Third, the ESM data were aggregated to the person-mean, essentially not utilizing the full richness of the data. The core strength of ESM is the ability to investigate within-person variance with multilevel modeling. Given the methodological scope of a bachelor-level thesis, multilevel analysis was beyond the analytical framework of the present project, and only between-person variance could be examined.

Finally, the internal consistency of the Pearlin Mastery Scale was modest. This may partly reflect its structure: the scale combines positively phrased mastery items with reverse-scored helplessness items, and reverse-scoring assumes that these items tap opposite ends of a single dimension. Yet the absence of perceived control may not be psychologically equivalent to the presence of helplessness. Beyond its internal structure, the scale assesses generalized control over life outcomes rather than control beliefs specific to emotional states,

which may limit its sensitivity as a moderator of mood-related processes such as reward anticipation. Together, these concerns suggest that the scale was a suboptimal moderator, and that because measurement error in a moderator tends to attenuate interaction effects, the observed moderation may be conservative or imprecise. Future work should employ a more targeted and better-validated measure of emotion-specific control beliefs, which may yield more theoretically coherent results.

### Future Directions

The present findings point to several directions for future research. Replication in more diverse samples, with the presence of clinically depressed participants, is needed to establish the generalizability of the moderation pattern, and specifically to determine whether the amplifying effect of high perceived control holds at clinical levels of symptom severity. Research combining self-reported reward anticipation with neurobiological measures, such as stimulus-preceding negativity (Ren et al., 2024) or striatal activation during reward anticipation (He et al., 2019), could further clarify whether the self-report moderation reflects differential neural reward processing as a function of perceived control.

It would also be valuable to distinguish between trait and state perceived control in future ESM designs, as momentary fluctuations in the sense of control may have different effects on reward anticipation than the stable dispositional orientation assessed here. Multilevel modeling approaches could provide greater clarity regarding between-person and within-person associations.

## Conclusion

The present study investigated whether trait perceived control moderates the relationship between depressive symptoms and daily reward anticipation among university students, using experience sampling across two weeks. Depressive symptoms were negatively associated with reward anticipation, replicating the link between depression and anticipatory anhedonia in an

ecologically valid context. Perceived control significantly moderated this relationship, but contrary to the hypothesis, higher control was associated with a *steeper* negative association rather than a buffering effect. This suggests the interplay between perceived control and reward processing in depression is more complex than a straightforward protective model implies, complicating the assumption that high internal control is universally adaptive. Future research should prioritize replication in clinical samples, employ measures of emotion-specific control beliefs, and use longitudinal designs addressing causal questions. Understanding when perceived control amplifies versus attenuates reward processing deficits has direct implications for interventions targeting anticipatory anhedonia in depression.

## Generative AI disclosure

In the making of this thesis, Generative AI has been used in the following ways:

Grammarly AI has been used for spelling, grammar and formulation checks of my writing.

Claude AI (sonnet 4.6) has been used for generating keywords for PsychINFO and PubMed, to provide feedback on argumentation, and to brainstorm when I was stuck in my writing.

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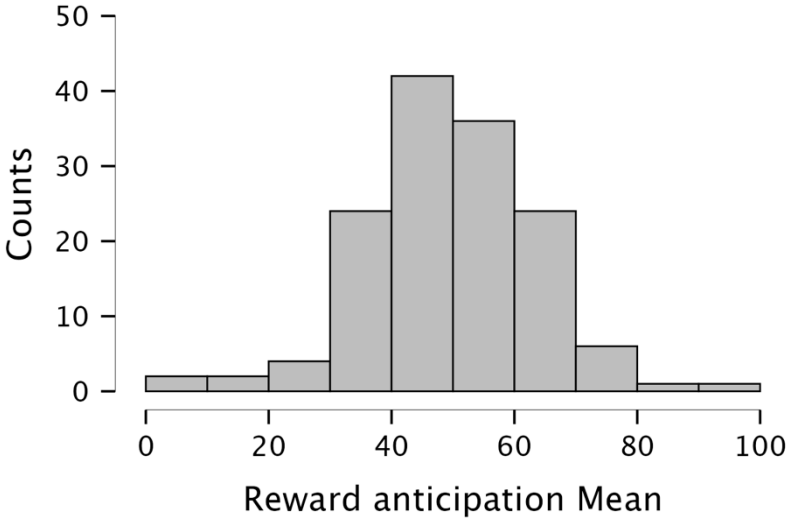
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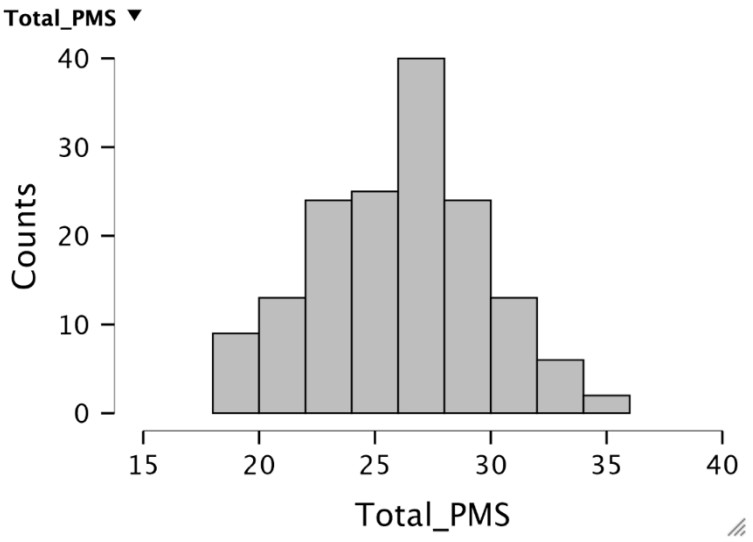
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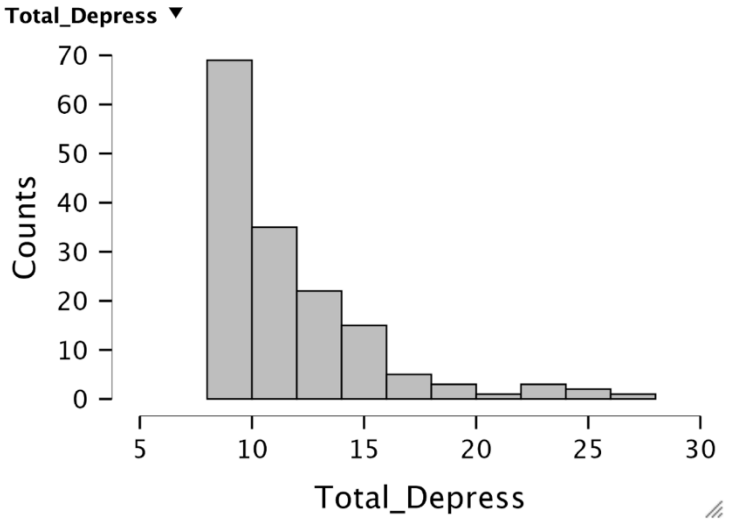
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# Appendix A

## Distribution of Predictor Variables

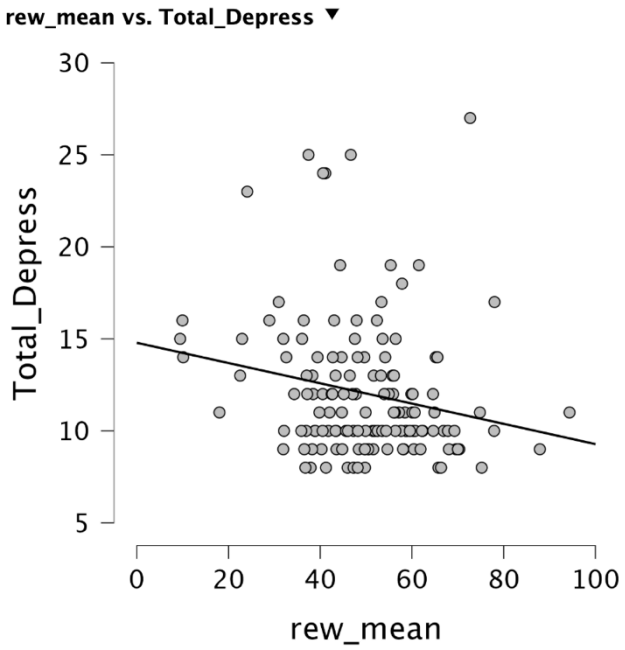




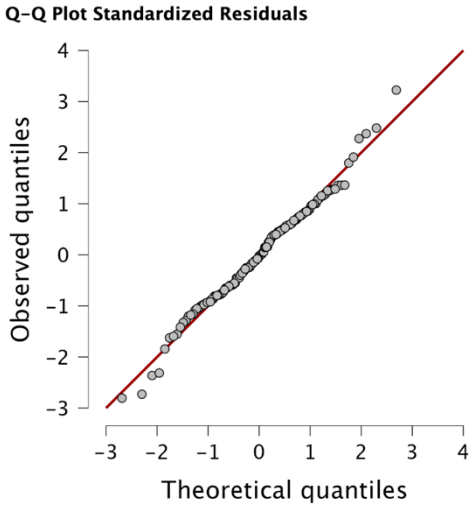

## Appendix B

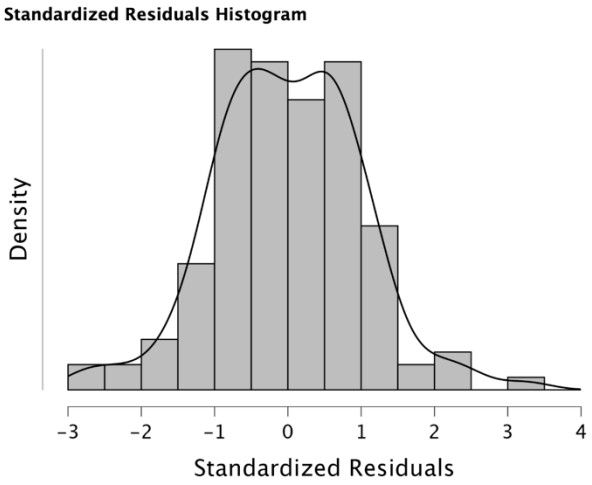
### Scatter Plot for Checking Assumptions of Hypothesis 1

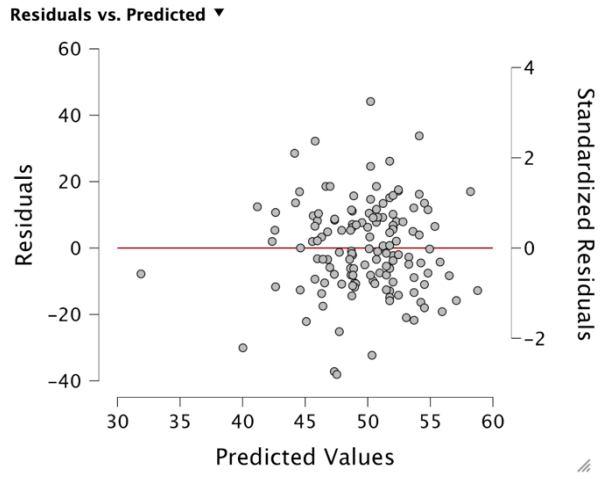

rew_mean vs. Total_Depress
Total_Depress
30
25
20
15
10
5
0
20
40
60
80
100
rew_mean

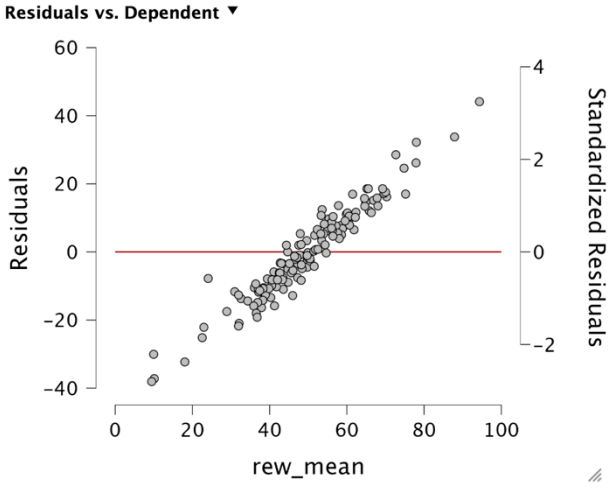
# Appendix C

## Residual Plots for Checking Assumptions of Hypothesis 2




Residuals vs. Predicted
Residuals
Standardized Residuals
Predicted Values
60
40
20
0
−20
−40
4
2
0
−2
30
35
40
45
50
55
60


Residuals vs. Dependent
Residuals
Standardized Residuals
rew_mean
60
40
20
0
−20
−40
4
2
0
−2
0
20
40
60
80
100

# Appendix D

## Coefficients Table with Variance Inflation Factor

*Coefficients* ▼

| Model | | Unstandardized | Standard Error | Standardized | t | p | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Tolerance | VIF |
| $M_0$ | (Intercept) | 49.81 | 1.198 | | 41.59 | < .001 | | |
| $M_1$ | (Intercept) | 60.08 | 13.15 | | 4.570 | < .001 | | |
| | Total_PMS | −0.026 | 0.378 | −0.007 | −0.069 | .945 | 0.709 | 1.410 |
| | Total_Depress | −0.794 | 0.375 | −0.211 | −2.119 | .036 | 0.709 | 1.410 |
| $M_2$ | (Intercept) | 65.85 | 13.27 | | 4.964 | < .001 | | |
| | Total_PMS | −0.051 | 0.373 | −0.014 | −0.138 | .891 | 0.709 | 1.411 |
| | Total_Depress | −1.311 | 0.444 | −0.348 | −2.956 | .004 | 0.494 | 2.024 |
| | PMS_c_X_Depress_c | −0.151 | 0.071 | −0.220 | −2.115 | .036 | 0.631 | 1.584 |