

To What Extent Can Need for Cognition and Curiosity Predict Academic Engagement?

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Abstract

Academic Engagement in contemporary literature has been studied with regards to Academic Achievement. The factors that predict Academic Engagement are somewhat known but have not been explored fully. We aimed to use the previously separately studied factors of Curiosity and Need for Cognition together to predict Academic Engagement. To gain new knowledge, Curiosity was split into three aspects: Joyous Exploration, Deprivation Sensitivity, and Stress Tolerance. The last two of which had not been studied before with regards to Academic Engagement. We conducted a survey of first, second, and third-year university students studying psychology using validated multi-item scales. The order of the scales was randomised for each participant. Due to reward schemes, we were able to gather a large though relatively homogenous sample ($N=608$) of psychology students. We found that our study corroborated previous studies that showed Curiosity positively predicting Academic Engagement. This was newly shown across its three aspects. However, when combined with Curiosity we were unable to replicate previous studies that showed Need for Cognition positively predicting Academic Engagement. With the Curiosity aspects accounted for, Need for Cognition appears to not make a valuable contribution to the explained variance of Academic Engagement. Our study results imply that including Curiosity makes Need for Cognition's uniquely explained variance of Academic Engagement negligible.

Keywords: Academic Engagement, Curiosity, Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, Need for Cognition

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Academic performance is an area of continued interest. It is in the greater societal interest to help as many students as possible to prosper in their education and contribute back to society. The benefits are not just external, such as future employability (Pan & Lee, 2011), but also internal to the student. For example, students who exhibit higher Academic Performance also exhibit higher self-esteem (Zheng et al., 2020). Given the benefits of increased Academic Performance, it makes sense that the ability to draw out one's best Academic Performance has been an area of much research.

Many different factors that may influence Academic Performance have been explored, such as Academic Engagement (Alrashidi et al., 2016), Personality (Chamorro-Premuzic & Furnham, 2003; Poropat, 2009), and Intelligence (Poropat, 2009) to name a few. However, our knowledge of these factors themselves is not equal. For example, we have a strong body of research into different personality traits, and their relationships with academic performance (John et al., 1991; Poropat, 2009) or the different factors of intelligence via measuring (Petermann & Wechsler, 2008). With Academic Engagement we know it plays an important role in Academic Performance and that Higher Academic Engagement leads to higher Academic Performance (Salanova et al., 2010). It also may be a protective factor against student burnout (Schaufeli et al., 2002a; Schaufeli et al., 2002b), which is negatively associated with Academic Performance. That said, our understanding of what leads to Academic Engagement is not as extensive.

We do have some knowledge of which factors lead to higher Academic Engagement, such as Curiosity (Robayo-Tamayo et al., 2020) or Need for Cognition (Lavrijsen et al., 2021). However, research into these constructs themselves has evolved leading to new gaps

in our knowledge of their relation to Academic Engagement. By addressing these gaps, we hope to further understand the conditions that lead to higher Academic Engagement.

Academic Engagement research has been modelled on previous research into work engagement (Siu et al., 2014). Work engagement has been defined as ‘...a positive, fulfilling, and work-related state of mind that is characterised by vigour, dedication and absorption’ (Schaufeli & Bakker, 2004, p. 295). Similarly, too then Academic Engagement can be split into the dimensions of vigour, dedication and absorption (Siu et al., 2014). Vigour in terms of Academic Engagement has been defined by high energy levels and mental resilience when undertaking learning, and the desire to put effort into one’s learning (Schaufeli & Bakker, 2004, p. 295). Dedication is defined as a sense of significance, enthusiasm, inspiration, pride, and challenge (Schaufeli & Bakker, 2004, p. 295). Absorption has been defined as being engrossed in one’s learning and fully concentrated to the point where time moves quickly (Schaufeli & Bakker, 2004, p. 295).

Need for Cognition

Need for Cognition is defined as a stable personality trait that describes one’s tendency to seek out, partake in, and enjoy effortful cognitive activity (Cacioppo & Petty, 1982). An outcome of one’s level of Need for Cognition is the amount of intellectual effort an individual is likely to output daily, meaning a person with higher scores in Need for Cognition is more likely output higher intellectual effort than someone who scores lower (Cacioppo et al., 1996). If an individual is a high scorer in Need for Cognition they tend to seek out information to make sense of both stimuli and events (Coelho et al., 2020). Those with low Need for Cognition tend to use heuristics instead of engaging in information seeking behaviour (Coelho et al., 2020). Cacioppo and colleagues (1996), in their literature review on varying Need for Cognition, stated they would expect that if an individual had a higher Need

for Cognition, then they would respond more positively towards situations that require more from them intellectually such as reasoning or problem solving scenarios.

A more recent study, by Lavrijsen and colleagues (2021), of 3002 Flemish 7th graders, hypothesised that the level of one's Need for Cognition would moderate their level of schoolwork engagement. They measured Need for Cognition using a Dutch translation of the German 14-item NFC scale by Preckel and Strobel (2011) designed for elementary school children, and measured schoolwork engagement using the schoolwork engagement inventory (EDA; Salmela-Aro & Upadaya, 2012). Their results showed that Need for Cognition moderated schoolwork engagement when the students were provided adequate challenge.

Given the evidence presented above, those who scored high in Need for Cognition would be expected to score higher in Academic Engagement as they actively willingly seek out information to make sense of events which would correspond to the vigour dimension with regards to willingly investing into their learning. Those who score higher in Need for Cognition could be expected to score higher in Academic Engagement as their need for an adequate challenge corresponds to the dedication dimension which refers to a sense of challenge. And individuals with higher levels of Need for Cognition could also be expected to score higher in Academic Engagement based on the absorption dimensions as engrossment in, and getting carried away with learning could be argued to correspond to seeking out information to make sense of a stimulus.

Curiosity

Curiosity can be often defined as the "... recognition, pursuit, and desire to explore novel, uncertain, complex, and ambiguous events." (Kashdan et al., 2018, p.130). Its function has been stated as to seek out new information or experiences by immersing oneself in different situations (Kashdan et al., 2018). A recent paper separated Curiosity into 5 facets which they used to create a measure for it, namely Joyous Exploration, Deprivation

Sensitivity, Stress Tolerance, Social Curiosity, and Thrill Seeking (Kashdan et al., 2018). For the purpose of this study, we will focus on the first three as they are the most relevant with regards to Academic Engagement which will be explained below.

Joyous Exploration is defined as the colloquial understanding of Curiosity which handles the seeking of new information and experiences which in themselves are their own reward (Kashdan et al., 2018). Deprivation Sensitivity deals with the seeking for information to relieve the tension of not knowing something (Kashdan et al., 2018). It is the seeking to fill a gap in knowledge that causes tension rather than seeking information or experiences for their own reward. Finally, Stress Tolerance describes the perceived capacity to deal with the inherent anxiety in approaching the new (Kashdan et al., 2018). Novel experiences are not without danger and adequate Stress Tolerance is essential for coping with stimuli that are new, uncertain, complex, and conflict laden (Kashdan et al., 2018). In that sense, it is a contributing element to experiencing curiosity and being a curious person (Kashdan et al., 2018).

A study by Robayo-Tamayo and colleagues (2020) hypothesised that Academic Support would mediate the relationship between Curiosity and Academic Engagement. They had 94 undergraduates administered a general questionnaire and a daily questionnaire. The general questionnaire measured Curiosity using the Curiosity and Exploration Index II (CEI-II; Kashdan et al., 2009) and Academic Engagement was measure using the Utrecht Work Engagement Scale for Students (Schaufeli et al., 2006). The scales were also present in the daily questionnaire however for the Curiosity scale the number of items was reduced. They found that Curiosity predicted Academic Engagement and was partially mediated by Academic Support.

Based on the above evidence we can see that there are connections between Curiosity and Academic Engagement. We can also reason a potential link between Need for Cognition

and Curiosity. Joyous Exploration would appear to line up in part to both Academic Engagement's vigour dimension through desire to put effort into one's learning, and its dedication dimension through the sense of enthusiasm. Following that, Stress Tolerance maps onto vigour through the mental resilience of engaging in learning. With Deprivation Sensitivity we may see a connection to Need for Cognition as those who are high in the trait Need for Cognition's desire to make sense of stimuli or events which is not too dissimilar to Deprivation Sensitivity's need to relieve the tension of the unknown. Given the evidence above and these face value mappings we would expect each aspect of Curiosity to positively predict Academic Engagement.

The Present Study

We aim to build upon previous findings, through a conceptual replication by using different scales and a new sample group, namely psychology undergraduates. We will examine both Need for Cognition and Curiosity together in a model to predict Academic Engagement. They have not been combined before to create a model to predict Academic Engagement. We expect there to be a superior model fit with them together predicting Academic Engagement given their previous research history of separately predicting it (Lavrijsen et al., 2021; Robayo-Tamayo et al., 2020).

We plan to more directly link Need for Cognition to Academic Engagement where it was previously used as a moderator (Lavrijsen et al., 2021). Previous studies with Need for Cognition used unvalidated two item measures or only the highest loading items from longer measures which is far from adequate (Coelho et al., 2020). The aforementioned study by Lavrijsen and colleagues (2021) used a translated to Dutch version of a 14-item German scale by Preckel and Strobel (2011) for elementary schools on Flemish 7th graders. We plan to use another much shorter scale, the Need for Cognition-6 (NFC-6; Coelho et al., 2020) on undergraduates. The choice of the NFC-6 scale (Coelho et al., 2020), which is different to the

one used in past studies (Lavrijsen et al., 2021), and the new sample group allows us to verify past findings. And our more direct link of Need for Cognition predicting Academic Engagement will address a gap in our knowledge.

Previous assessment approaches of Curiosity assumed that feeling curious and subsequent acts of exploration are pleasurable which ignores Deprivation sensitivity (Kashdan et al., 2018). This can be seen in the aforementioned study by Robayo-Tamayo and colleagues (2020) who used the CEI-II (Kashdan et al., 2009) which had measurements for Stretching, which most closely resembles Joyous Exploration, and Embracing which does not encapsulate to Stress Tolerance. We plan to gain greater insight with the newer Five-Dimensional Curiosity Scale (Kashdan et al., 2018) which allows use to break Curiosity into constituent parts. While previous studies used Curiosity as a whole (Robayo-Tamayo et al., 2020), we will be able to see to what extent different aspects of Curiosity predict Academic Engagement. Specifically Joyous Exploration, Deprivation Sensitivity, and Stress Tolerance which to our knowledge have not been separately parsed out and studied with regards to Academic Engagement before and is a gap in our knowledge.

Hypothesis: Need for Cognition, Joyous Exploration, Deprivation Sensitivity and Stress Tolerance will all separately positively predict Academic Engagement.

Methods

Participants

Using a convenience sample, a group of five bachelor students recruited participants via social media, faculty notice boards, and the SONA system for their bachelor's thesis research project. The participants were first-, second-, and third-year students taking either the English or Dutch track of the Psychology program at the University of Groningen. The age range of the participants was 17 to 35 ($M = 20.18$, $SD = 2.25$). Twenty-six percent of the sample consisted of males, 74% consisted of females, and < 1% of participants chose the

option “other”. The demographic distribution of the participants included three categories: Dutch (n = 313), German (n = 133), and other (n = 162). The exclusion criteria included checks for language proficiency and answer sincerity. The participants’ language proficiency was tested via the question “Do you think your level of English was good enough to answer the questions in the survey reliably?“, with answer options “Yes” or “No”. The participants’ answer sincerity was checked via the question “Did you try to answer all questions in this survey seriously and honestly so that we can use your data in our research?“, with answer options “Yes” or “No”. A “No” answer to either the language proficiency or answer sincerity questions, resulted in exclusion. Additionally, attentive responding was verified by an instructed response item, namely, a question that asked a participant to choose a specific number on a Likert scale; only participants who answered as instructed were included in the data. The final number of excluded participants was 104. The sample consisted of 507 first-year students and 101 second- and third-year students, which resulted in a total sample of 608 students. Consent of the Ethics Committee of psychology of the University of Groningen was granted before initiation of the sampling procedure.

Materials

Curiosity was measured using the Five-Dimensional Curiosity Scale (Kashdan et al., 2018). This scale consists of 25 items measuring five Curiosity modalities, five questions for each. Three Curiosity modalities were used in our study, namely Joyous Exploration, Deprivation Sensitivity and Stress Tolerance. For Joyous Exploration an example of a corresponding item is "I view challenging situations as an opportunity to grow and learn". For Deprivation Sensitivity an example item is "I can spend hours on a single problem because I just can't rest without knowing the answer". Finally, for Stress Tolerance an example item is "I cannot handle the stress that comes from entering uncertain situations". Participants were asked to indicate the degree to which each statement accurately describes them on a seven-

point Likert scale where 1 = does not describe me at all, and 7 = completely describes me. To compute a participant's overall score in each modality, we calculated the average scores across the items of the corresponding subdomains. The sample provided sufficient reliability for all Curiosity subdomains, namely Joyous Exploration (Cronbach's $\alpha = 0.78$), Deprivation Sensitivity (Cronbach's $\alpha = 0.82$) and Stress Tolerance (Cronbach's $\alpha = 0.82$). Previous studies have demonstrated that the Curiosity scale has sufficient construct validity, which confirms that we can trust the test accurately measures the concept it was designed to evaluate (e.g., Kashdan et al., 2018).

The second scale used was the Need for Cognition Scale-6 (NCS-6; Coelho et al., 2020) which is an abbreviated version of a larger scale called The Efficient Assessment of Need for Cognition (NCS-18; Cacioppo et al., 1984). In the shortened six-item scale, participants had to indicate whether the statements are characteristic of themselves. This indication was made on a five-point Likert scale with 1 = extremely uncharacteristic of me and 5 = extremely characteristic of me. Examples of items from the NCS-6 include statements such as "I would prefer complex to simple problems" or "I really enjoy a task that involves coming up with new solutions to problems". To compute the scores for the variable Need for Cognition, we calculated the average of each participant's scores on the six questions. This measure offers good psychometric properties (Cronbach's $\alpha = 0.75$). Finally, construct validity has previously been found to be sufficient (Coelho et al., 2020). The last scale participants had to fill out with relevance to our study was the Utrecht Work Engagement for Students (UWES-9S; Carmona-Halty et al., 2019) which was an abbreviated version of the 17-item Utrecht Work Engagement Scale (UWES; Schaufeli et al., 2006). This questionnaire consisted of nine statements regarding one's feelings about studying at university. The UWES-9S assesses students' Engagement towards their studies across three modalities, namely Vigor, Dedication, and Absorption. For Vigor an example of a

corresponding item is "When I'm doing my work as a student, I feel bursting with energy". For Dedication an example item is "I am enthusiastic about my studies". Finally, for Absorption an example item is "I am immersed in my studies". This seven-point Likert scale starts at 0 = never, and goes up to 6 = always / every day. This measure offers an excellent reliability of $\alpha = 0.91$, and good construct validity (Seppälä et al., 2009).

Procedures

To participate in the study, participants filled out a questionnaire via the online portal Qualtrics. First-year students were recruited through the SONA platform. For second- and third-year students, the questionnaire links were distributed via online messengers such as WhatsApp, alongside flyers on bulletin boards around the building of the Faculty of Behavioral and Social Sciences of the University of Groningen. The first-year students received SONA credits after completing the questionnaire. Second- and third-year students were presented with an incentive of €1.50 upon completing the questionnaire. As the questionnaire was filled out online in each participant's environment of choice, the researchers were not involved in the data collection, except for the recruitment of the sample.

Participants were encouraged to fill out the entire questionnaire in one go. At the start of the questionnaire, participants were asked to indicate which year and study program they were currently in. Only participants who indicated they were first-, second- or third-year psychology students were authorized to proceed with the questionnaire - other participants were asked to leave the study. Students who were selected to proceed were then given information about the study, their data, and the consequences of participating. The information included an explanation that the study has to do with "hunger for knowledge" and "experiences of concentration in everyday life". Additionally, the participants were informed that participation is voluntary. After reading this information they were asked to give their informed consent, acknowledging that their personal data will be erased after a

given date. Finally, the participants were given the choice of granting the researchers access to their grades, which may be used in other studies. Once the participant decided whether to consent, they were able to begin the survey.

The survey starts by asking the participants to fill out questions about their demographic information, including information about their biological sex, age, nationality, professional status, and education level. After they filled out their information, participants were presented with the scales in a randomized order. In addition to the scales used in our study, the questionnaire included four scales and measures of medical history that the participants were requested to fill out. This information was not relevant for our current study. After answering all the questions, participants were presented with checks for language proficiency and answer sincerity. Additionally, they were free to leave any comments they had concerning the study. Upon completion of the survey, they were then asked to fill out a follow-up survey to claim their monetary reward if they were a second- or third-year student, or to enter their SONA number to receive SONA credits if they were a first-year student.

Data Preparation and Statistical Analysis

After the exclusion criteria were applied, the data was checked for statistical outliers. Using the Cook's distance, a univariate outlier measure, no influential outlier was found. Based on the Mahalanobis distance, a measure to detect multivariate outliers, no influential outliers were found. Thus, using univariate and multivariate outlier detection, no data was removed from our sample. A standard multiple linear regression analysis using the enter method was applied using the following five variables: independent variables (IV) Need for Cognition, Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, and the dependent variable (DV) Academic Engagement. Additionally, zero-order Pearson correlations were computed to investigate the relationships between the variables. Finally, semi-partial

correlations of the IV's were explored to differentiate between their independent contributions to the DV. All values and calculations were computed using SPSS 27 software.

Results

Upon collection of our data and after data cleaning and preparation, assumptions checks were made. It was found that the assumptions for the Multiple Linear Regression of the relationships between our dependent variable Academic Engagement and the independent variables Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, and Need for Cognition were met. Using both histograms and QQ plots the assumption of normality was met. Inspection of scatterplots supported that homoscedasticity of the residuals and also linearity held. While inspecting box plots, four outliers each were found in both Academic Engagement and Joyous Exploration and three outliers were found in Need for Cognition. There was one overlapping outlier between Academic Engagement and Joyous Exploration. These outliers were not removed as the scales used were 7 point Likert scales and thus it was within the realms of belief that an individual could score this way. The multicollinearity statistic VIF scores were all less than 2 which indicated no multicollinearity was present.

An exploratory analysis was performed to see if there was a statistically significant difference between our first year responders and, our second and third year responders' scores in Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, Need for Cognition and Academic Engagement. Both groups were recruited independently from one another at different timeframes. To do this comparison we used a Welch 's T-Test, as the sample sizes were unequal, with academic year as our dependent variable. When performed, our Welch's T-Test showed that there was not a statistically significant difference between the two cohorts with the result showing lowest value $p=.106$ for Need for Cognition and the highest $p=.912$ for Deprivation Sensitivity.

Our alpha level was 0.05 for all analyses and no adjustments were made for multiple comparisons. On analysis of our filtered data (See Table 1.), Joyous Exploration had a mean score of 5.1135, a SD = .91695, and was found to be moderately positively correlated at $r = .396$, which was statistically significant at a $< .001$ level, with Academic Engagement which had a mean of 4.6743, SD = .94088. Following that, Deprivation Sensitivity had a mean score of 4.3602, a SD = 1.21183, and was found to be weakly positively correlated at $r = .289$, which was statistically significant at a $< .001$, with Academic Engagement. Stress Tolerance had a mean score of 3.6194, a SD = 1.27361, and was found to be weakly positively correlated at $r = -.242$, which was statistically significant at a $< .001$, with Academic Engagement. Need for Cognition had a mean score of 3.6025, a SD = .64425, and was found to be weakly positively correlated at $r = .350$, which was statistically significant at a $< .001$, with Academic Engagement (See Table 2).

Table 1

Descriptive Statistics and Correlations

	Correlations					Descriptives	
	1	2	3	4	5	Mean	SD
1.JE	-	<.001	<.001	<.001	<.001	5.114	.917
2.DS	.377	-	.006	<.001	<.001	4.360	1.212
3.ST	.321	-.111	-	<.001	<.001	4.381	1.274
4.NFC	.636	.409	-.306	-	<.001	3.603	.644
5.AE	.396	.289	-.242	.350	-	4.674	.941

Note. Corresponding two-tailed significance values are reported on the right side of this diagonal. JE, DS, ST, NFC, AE are Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, Need for Cognition, and Academic Engagement respectively.

Table 2*Regression Coefficients^a*

Model		Standardized		Sig.	Correlations	
		Coefficients			Partial	Part
		Beta	T			
1	(Constant)		10.389	<.001		
	JE	.218	4.469	<.001	.179	.162
	DS	.193	4.577	<.001	.183	.165
	ST	.170	4.184	<.001	.168	.151
	NFC	.080	1.611	.108	.065	.058

a. Dependent Variable: Engagement

Our hypothesis was that our independent variables Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, and Need for Cognition would all positively predict our dependent variable Academic Engagement. A multiple linear regression was performed to test this. Our model was able to explain 20.6% of the variance in Academic Engagement and had an adjusted $R^2 = .206$. Positive coefficient values were found for the predictors (See Table 2.) Joyous Exploration ($\beta = .218$) with $t(606) = 4.469$ $p < .001$, Deprivation Sensitivity ($\beta = .193$) with $t(606) = 4.577$ $p < .001$, Stress Tolerance ($\beta = .170$) with $t(606) = 4.184$, $p < .001$, and Need for Cognition ($\beta = .080$) with $t(606) = 1.611$ $p = .108$. These results were partially in line with our hypothesis and show evidence that our independent variables positively predict our dependent variable Academic Engagement. The exception being, Need for Cognition was not shown to be a statistically significant predictor of Academic

Engagement in our model ($p = .108$) with a small squared semi-partial correlation of $sr^2 = 0.003$. That said, though not statistically significant, the coefficient value of Need for Cognition ($\beta = .080$) was slightly positive and that is in line with our hypothesis. Though no claims can be made due to the uncertainty given the lack of statistical significance. The other predictors were all found to be statistically significant at $p = <.001$. The model had an F Change statistic of 40.428 with $p = <.001$.

Discussion

One of the goals of this study was to conceptually replicate evidence found in previously mentioned studies (Robayo-Tamayo et al., 2020; Lavrijsen et al., 2018) that both Curiosity and Need for Cognition positively predict Academic Engagement. We did this by testing a different sample group, namely university students. We also aimed to expand upon previous Curiosity research predicting Academic Engagement (Robayo-Tamayo et al., 2020) by separating Curiosity into subcategories when performing our regression, specifically Joyous Exploration, Deprivation Sensitivity, and Stress Tolerance. This was distilled into the hypothesis that Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, and Need for Cognition would all positively predict Academic Engagement. The analysis of the data partially supports this hypothesis. We were able to replicate previous findings that curiosity positively predicts Academic engagement and our data shows this across the three aspects. However, Need for Cognition did not show evidence of an effect on Academic Engagement when combined with our Curiosity aspects. This was contrary to what we expected as we thought Need for Cognition would positively predict Academic Engagement and add to the explained variance.

In line with the hypothesis, each of the predictors Joyous Exploration, Deprivation Sensitivity, and Stress Tolerance positively predicted Academic Engagement. This was an expected result. Our study results provide deeper insight and support to previous findings that

Curiosity predicts Academic Engagement (Robayo-Tamayo et al., 2020). As mentioned before, Robayo-Tamayo and colleagues used the Curiosity and Exploration Inventory II (Kashdan et al., 2009). This scale does not measure Deprivation Sensitivity at all and does not completely capture Stress Tolerance. By using the Five Dimension Curiosity Scale (Kashdan et al., 2018) we were able to capture Joyous Exploration, and both Deprivation Sensitivity and Stress Tolerance in predicting Academic Engagement. This expands the knowledge to now include Deprivation Sensitivity and Stress Tolerance, and also shows three of the aspects of Curiosity separately which had not been done previously.

Our predictor variables were all shown to be partially related to one another. This makes sense between the different aspects of Curiosity. More of note were the relationships between two of the Curiosity aspects, Joyous Exploration and Deprivation Sensitivity, with Need for Cognition. Of those, Joyous Exploration was on the high end and Deprivation Sensitivity was on the low end of a moderately positive correlation. A possible explanation for their comparatively higher correlation may lie in the definitions of each construct given above. Need for Cognition is defined as one's tendency to seek out and enjoy effortful cognitive activity. This is not dissimilar to the definitions given for Joyous Exploration and Deprivation Sensitivity which also describe seeking behaviour toward information or experiences.

All this is not without basis given previous research regarding investment traits. Investment traits regulate whether and how people invest their time and effort in cognitive endeavours (Lavrijsen et al., 2021). Curiosity is one such trait and it is stated that Need for Cognition constitutes the core of the investment traits meaning it is a higher order trait (Lavrijsen et al., 2021). The findings in our study would suggest that a hierarchical factorial analysis could be warranted to see if Need for Cognition is indeed a higher order trait to those Curiosity aspects.

Perhaps related to the above, Need for Cognition did not show evidence of being a predictor of Academic Engagement in our model. This was an unexpected finding. In previous studies both Curiosity and Need for Cognition, separately predicted Academic Engagement. Though in the case of Need for Cognition it was used as a moderator. We expected both would combine to create a model with a superior fit that explained more of the variance of Academic Engagement. This was not the case. A possible explanation for this could be seen in the relationships mentioned above between Need for Cognition and both Joyous Exploration, and Deprivation Sensitivity. The theories given for those relationships above based on investment traits and also the similarity in seeking behaviour could also explain why we failed to find evidence of Need for Cognition predicting Academic Engagement. Though the constructs are not one in the same, it is not beyond reason that any effect Need for Cognition would have in explained variance of Academic Engagement would already better explained by Joyous Exploration and Deprivation Sensitivity. Further studies that replicate our findings are needed and a test for discriminant validity between the measures for those three may be warranted.

We conducted an exploratory analysis to test if there was a statistically significant difference between our first-year psychology respondents and our combined second and third-year psychology respondents. The findings of this study indicate that there was no difference between the two groups on our variables. We did not have a particular reason to expect there to be a difference between the two groups as they did not differ in course and share the fact that they are all students at the same university. That said, it was still important to control for potential differences between academic years. Current research on differences in our variables depending on the academic year or duration of study, at the time of writing, is lacking so there was nothing to indicate there would or would not be a difference between the groups. Our findings show evidence that our variables may generalise between different

year cohorts in a same three-year bachelor's degree, but further research would be needed to substantiate this.

Our study was not without both strengths and limitations. One of the strengths of our study was our sample size. Our sample size for our study was particularly large which should mean it is overall a fair representation of the population group, less likely to be a biased, and it increases the overall power of our study. That gives us more confidence that the results we found were accurate. Another strength was the rewards offered upon completion of our study. The incentive may have increased the response rate in our student population which are often targeted for surveys and may otherwise not have completed our survey due to overexposure. Second and third-year students received financial compensation of €1.5 upon completion. The first-year students however completed the study as part of their curriculum and received progress towards completing a course which explains the large disparity between response rates between first years and their second and third-year counterparts. These incentives insured we had a large sample size for our data.

A weakness of our study is that the sample itself was quite homogenous. They were all students that shared the same degree type and university of study. This narrows our ability generalise to a wider student population unrestricted by degree type or location of study. To combat this, we could have opened our study to different degree types or to students at different universities. Another factor is the group may have included a sizable portion of international students. It may be that they bias the sample as they are not a typical or common type of student. An argument can be made that the act of moving abroad to study may indicate that those students would have above average levels of Academic Engagement as moving to a new country in itself is a massive commitment.

Another weakness is the one-time self-report nature of our study. Due to this we both lack the ability to make causal claims and also are open to potential social desirability bias.

We attempted to mitigate against social desirability bias by asking participants if they responded to the best of their ability and excluded their data if they replied “no”. That said, we are asking students to potentially report they lied or have socially undesirable qualities such as a lack of engagement in their studies. They may have oversold the degree to which they truly exhibit more socially desirable traits and not reported having done so. Adding grades data to the model may have combatted this by giving us the ability to potentially compare reported Academic Engagement with real world results and look for outliers in the relationship between the two.

Our study focused on psychology students, but future research could expand that to a more heterogeneous sample that varied across degrees of study or locations of study. If our findings were replicated across those domains, then it would build upon them and increase their generalisability. Also Curiosity was measured but without specific information about where it is directed (e.g., hobbies or areas of interest outside of academia). Future studies could attempt to create more specific measures by including where the Curiosity is directed. Perhaps make a measure of Academic Curiosity defined as Curiosity behaviour directed toward academic endeavours.

We were able to replicate and expand on findings in previous research on Curiosity and Need for Cognition predicting Academic Engagement. We gained new deeper insight into Curiosity predicting Academic Engagement by breaking it into its different aspects. This had not been done before. The use of the Five Dimension Curiosity scale (Kashdan et al., 2018) also allowed us to account for Deprivation Sensitivity and Stress Tolerance which had not been accounted for in previous Curiosity research predicting Academic Engagement. Our results showed that Curiosity aspects of Joyous Exploration, Deprivation Sensitivity and Stress Tolerance all positively predict Academic Engagement. This was not shown before in previous research.

We also showed evidence that when Curiosity is accounted for, Need for Cognition shows no evidence of added predictive power with regards to Academic Engagement. This means our explained variance, which was substantial, is only provided by Curiosity. As postulated above, information seeking behaviour in Academia Engagement may be best explained by Curiosity. In future research, variables that do not include information seeking behaviour, such as Conscientiousness or Intrinsic Motivation, should be combined with Curiosity. It may be a way to increase the already substantial explained variance given by Curiosity.

Future attempts at strategies to foster Academic Engagement by schools and universities could focus on promoting students Joyous Exploration behaviour of academic material by making its delivery more appealing. Education facilities could make sure to provide adequate support tools to students to allow them to fill in gaps in their knowledge as related to Deprivation Sensitivity. Finally, training in techniques to increase their ability to handle the stress of the unknown and could allow students be less inhibited in their learning due by low Stress Tolerance.

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