

**Unraveling the Threads of Academic Engagement: The Impact of Curiosity and Need for
Cognition**

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Abstract

In the most advanced societies, we spend a great amount of time and resources in education. Thus, it is important to understand how time in education can be spent in a way that is most conducive of adaptive life outcomes. In modern educational settings, Academic Engagement has emerged as a construct of interest, with findings demonstrating its association with a wealth of positive outcomes. This study aimed to explore the relationship between Curiosity (Joyous Exploration, Deprivation Sensitivity, and Stress Tolerance) and Need for Cognition in predicting Academic Engagement among undergraduate students. A sample of undergraduate students (n=608) from the Psychology program at the University of Groningen completed self-report measures, including the Five-Dimensional Curiosity Scale, the Need for Cognition Scale-6, and the Utrecht Work Engagement Scale. When accounting for the Curiosity traits, the unique contribution of Need for Cognition to Academic Engagement was not significant. Curiosity traits played a crucial role in predicting Academic Engagement. These findings have important implications for educational settings, suggesting that fostering Curiosity traits may enhance students' Academic Engagement and as a result, motivation, and overall success.

Keywords: curiosity, need for cognition, academic engagement, undergraduate students

Unraveling the Threads of Academic Engagement: The Impact of Curiosity and Need for Cognition

The thread of human innovation is woven into an existing web of innovations and discoveries (Heine, 2020). In contrast to our closest ancestors in the animal kingdom, humans are unique in their capacity to build knowledge upon previous findings and generations. Since the establishment of psychology as a science, researchers have pursued knowledge regarding the underlying mechanisms that make up our ability to learn and grow increasingly, generation after generation (Adler & James, 1990). It is no wonder, then, that in the most advanced human societies, we spend an incredible portion of our time in education. Therefore, it is of great value to understand how time in education can be spent in a way that is most conducive to adaptive life outcomes.

In modern educational settings, Academic Engagement has become an important construct of study and has been found to be associated with a wealth of positive outcomes, such as academic motivation, persistence in educational pathways, higher educational aspirations, and lower levels of academic withdrawal (Ketonen et al., 2019). Before its application in the educational context, researchers have studied Engagement in the workplace to create a comprehensive theoretical framework. Bakker and Demerouti (2008) define Work Engagement as a positive, fulfilling state of mind relating to work, which is construed by three lower-order domains: Dedication, Vigor, and Absorption. Dedication pertains to an individual's involvement in work, and an experience of positive valence, significance, and challenge. Vigor refers to a person who is high-energy and possesses mental resilience in the work setting. Finally, Absorption is marked by a pattern of states of high concentration towards one's work and even

difficulties with disengaging with work. Overall, the aforementioned core concepts that characterize Work Engagement include emotions with a positive valence, high energy levels and immersion. Furthermore, people tend to vary in the level to which they express these traits in the workplace (Schaufeli & Bakker, 2004).

In order to conceptualize Engagement as generally adaptive, it is important to delineate between adaptive and pathological approaches to work. Therefore, a distinction between Engagement and addiction or workaholism must be made. According to previous research, the relationship between work addiction and Work Engagement has been found to be marginally positive (Shimazu & Schaufeli, 2009) or non-existent (van Beek et al., 2011). Both engaged workers and workaholics invest significant time and effort into their work. However, engaged workers typically maintain control and lead multidimensional lives without problems. Work Engagement is associated with various positive outcomes, while workaholism often exhibits inverse relationships (Falco et al., 2013; Schaufeli, 2002; Shimazu & Schaufeli, 2009; Shimazu et al., 2012; Shimazu et al., 2010; van Beek et al., 2011). Thus, there is evidence to support making a clear distinction between workaholism or addictive work-related behavior, which are associated with negative outcomes, and Engagement, which predicts positive outcomes.

Engaged workers have been found to receive higher ratings on in-role and extra-role performance (Bakker et al., 2004). Meeting organizational objectives and effective functioning were the defining factors for in-role performance. Extra-role performance encompasses discretionary behaviors exhibited by employees, which are perceived to directly contribute to the effective functioning of an organization, without necessarily having a direct impact on an individual's designated productivity goals. Gierveld and Bakker (2005) confirmed these findings

among 327 secretaries, showing that engaged secretaries outperformed non-engaged ones in the aforementioned performance categories and had more influence in daily business operations.

Gorgievski et al. (2014) found a positive relationship between Work Engagement and entrepreneurs' performance, which included innovative behavior, business growth, and subjective business performance, whereas workaholism showed an inverse relationship. As Engagement has been shown to be related to adaptive outcomes in the workplace, researchers began conducting replication studies, with a goal of expanding the concept of Engagement to an academic context.

Siu et al. (2013) corroborates Bakker and Demerouti's (2008) concept of Engagement, by validating the concept of Study Engagement comprising Dedication, Absorption and Vigor in a replication study using a student sample. Validating the concept of Engagement in the academic setting opened the door to further investigate Engagement as a potentially beneficial variable for students and, ultimately, the society. Thus, Engagement in the academic environment was coined Study- or Academic Engagement. Bakker et al. (2015) suggests that no matter the definition, there is evidence to support that Academic Engagement is related to heightened performance. According to Salanova et al. (2010), engaged students are intrinsically motivated and actively invest in their learning. They eagerly attend classes, participate in study activities, and embrace learning challenges. Altogether, engaged students exhibit energy and dedication towards their studies, which contributes to their overall success.

The majority of previous studies have focused on Engagement in terms of inter-subject variations, which suggests that the variable is to be considered a lasting trait (Bakker et al., 2015). However, there is evidence to support seeing Academic Engagement as a dynamic and

fluctuating state, which can be influenced by a range of internal and external factors (Bakker et al., 2015; Bakker & Bal, 2010; Bakker et al., 2014; Sonnentag et al., 2010). In the current study, we will examine internal factors that may coincide with Academic Engagement. Internal factors pertain, for example, to relatively stable personality traits. In the academic context, where students heavily rely on their mental resources, Curiosity may be a trait that has a connection to Academic Engagement.

In the academic environment - especially in researching undergraduate students - Curiosity is a personality trait that has shown positive correlations with many factors that are conducive to a positive existence as a student (Robayo-Tamayo et al., 2020). Such factors include satisfaction in life, meaningful existence, and vitality (Brdar & Kashdan, 2010); personal growth (Kashdan et al., 2004); well-being and meaning in life (Kashdan & Steger, 2007); positive affect, happiness, and self-acceptance (Kashdan et al., 2009); and academic performance (Lounsbury et al., 2009). These factors come together in a student's life and can jointly improve one's overall success in the academic environment. Over time, persistently acting on curious inclinations serves to broaden one's knowledge, enhance skills, foster stronger social connections, and boost intellectual and creative abilities (Kashdan et al., 2018). These connections point towards Curiosity being a valuable construct to study in the academic setting.

Curiosity can be conceptualized as an important driving force that prompts individuals to take action in order to reduce uncertainty, discover new aspects of their surroundings, and exert a certain degree of control over their environment (Arnone et al., 2011). Two distinct facets of Curiosity include a sense of interest and a sense of deprivation (Litman, 2008). In the first facet, Curiosity works as an inclination to acquire knowledge that can benefit oneself. In the second

facet, Curiosity is fueled by the desire to alleviate the ambiguity and unease that arises from a lack of knowledge. Kashdan et al. (2018) calls these two subfactors of Curiosity Joyous Exploration and Deprivation Sensitivity. The two facets of Curiosity - one relating to the joy of discovering something new and the other on filling knowledge gaps - tend to emerge as distinct factors in correlational research. The distinction between Curiosity facets Joyous Exploration and Deprivation Sensitivity has been supported by multiple exploratory and confirmatory factor analyses (Litman, 2008). Overall, there is a consensus that the primary role of Curiosity is to actively search for and interact with situations that offer the possibility of novel information and experiences. Indeed, Curiosity has also been associated with Engagement: a variable of interest in the present study (Garrosa et al., 2017). However, although Curiosity has generally been investigated with the understanding that it is comprised of a sense of interest and a sense of deprivation, studies utilizing measures that evaluate the two facets and how they relate to Academic Engagement are scarce (Litman, 2008; Robayo-Tamayo et al., 2020). Thus, our study incorporates measures that specifically investigate Joyous Exploration and Deprivation Sensitivity, to investigate their relationships with Academic Engagement. Finally, in order for the Curiosity traits to manifest in the real world, a pivotal component of Curiosity must be taken into account, namely, Stress Tolerance.

Kashdan et al. (2018) found that among different types of curious people, the most archetypally curious were those who were also highest in Stress Tolerance, compared to other, less curious types. This suggests that a high tolerance to the stress that novelty can induce, is an essential element in people who exhibit a pattern of frequent curious behaviors. Individuals high on Stress Tolerance are found to be more resilient to doubt, confusion, and other forms of

distress when exploring new environments. Furthermore, they seem to be more likely to embrace the inherent anxiety that comes with encountering novelty, which at face value seems like an important quality in the academic environment, where novelty is ever-present. According to the study conducted by Kashdan et al. (2018), there is a significant positive relationship between Stress Tolerance and Grit. Grit is defined as the ability to persistently pursue meaningful and long-term goals, as described by Duckworth and Quinn (2009). Thus, there may be value in investigating the relationship between Stress Tolerance and whether it predicts students' Engagement. In addition, Kashdan et al. (2018) found evidence that among the construct of Curiosity, Stress Tolerance, along with Joyous Exploration, were specifically found to be most closely associated with well-being. As Academic Engagement has to do with a positive, fulfilling state of mind relating to one's studies (Bakker et al., 2015), the connection higher Stress Tolerance has with higher well-being may be a clue to its importance in students' Engagement. Although previous findings corroborate a positive relationship between Joyous Exploration, Deprivation Sensitivity and Work Engagement, there is a lack of research that investigates the relationship between all three Curiosity traits and Engagement in the academic setting (Garrosa et al., 2017). Adding Stress Tolerance into a model of Curiosity, together with Joyous Exploration and Deprivation Sensitivity, could shed more light into understanding Academic Engagement.

In Kashdan et al.'s (2018) five-dimensional model of curiosity, there are two Curiosity traits in addition to Joyous Exploration, Deprivation Sensitivity and Stress Tolerance. The final two are called social curiosity and thrill seeking. However, it seems that these two traits are less important to Academic Engagement. Firstly, Kashdan et al. (2018) argued that the thrill seeking

dimension does not revolve around the pursuit of knowledge or personal development. Instead, it embodies the belief that a fulfilling life is characterized by actively seeking pleasure and excitement, particularly when it entails substantial physical, social, legal, and/or financial risks. Secondly, Kashdan et al. (2018) found that social curiosity - a fascination and even preoccupation with understanding the thoughts and behaviors of other individuals - had the smallest link to epistemic curiosity, which was more closely aligned with Joyous Exploration, Deprivation Sensitivity and Stress Tolerance. Thus, in this study, we will focus on three of Kashdan et al.'s (2018) five Curiosity dimensions: Joyous Exploration, Deprivation Sensitivity and Stress Tolerance.

When it comes to a student's willingness to approach an intellectual challenge, a wider array of traits called investment traits are purported to be key influences (von Stumm et al., 2011). According to cognitive or intellectual investment theories, personality traits - specifically referred to as investment traits - play a role in shaping the development of intelligence (von Stumm & Ackerman, 2013). These traits influence individuals' decisions regarding when, where, and how they invest their time and effort in intellectual pursuits. It is believed that such investment contributes to variations in cognitive growth and the accumulation of knowledge throughout one's life. Similarly, investment traits seem to play an important role in guiding students' decisions in their studies. Among these traits, Need For Cognition has been suggested to be a fundamental aspect of the desire to be involved with mentally demanding tasks (von Stumm & Ackerman, 2013).

Need for Cognition can be defined as the inclination to actively pursue, participate in, and derive pleasure from cognitive tasks that require significant mental exertion (Cacioppo et al.,

1996). Conceptually, Need for Cognition has been suggested to align with an individual's typical level of intellectual involvement, i.e., the degree of cognitive exertion one is inclined to exert in everyday scenarios (Cacioppo et al., 1996). When trying to understand individual differences between students, it is clear that there are differences not only in cognitive capacity, but also in how much students enjoy cognitive exertion. Need for Cognition has become a valuable trait of interest because measures assessing cognitive capacity (e.g., IQ), do not seem to explain the differences between people in willingness to engage intellectually. Previous research has demonstrated only a modest correlation between Need for Cognition and IQ, with correlation coefficients between Need for Cognition and various measures of intelligence usually falling in the range of 0.15 to 0.30 (Lavrijsen et al., 2021). Additionally, Lavrijsen et al., (2021) found that when students were high in Need for Cognition, being adequately challenged in schoolwork was especially important for their Study Engagement. Steinhart & Wyer (2009) found that students with high Need for Cognition tend to display increased motivation towards an intellectual task when they anticipate that the task will be challenging, whereas those low in Need for Cognition are relatively unaffected by such expectations.

Although Need for Cognition and Curiosity share some commonalities, the conceptual difference between the traits seems to be that Curiosity deals with the inherent joy of engaging with novel information and experiences, whereas Need for Cognition has to do with the enjoyment of cognitive exertion. Both Need for Cognition and Curiosity have been found – by themselves - to be associated with Academic Engagement (Garrosa et al., 2017; Lavrijsen et al., 2021). In addition, the three Curiosity traits Joyous Exploration, Deprivation Sensitivity and Stress Tolerance have been found to have moderate to strong associations with Need for

Cognition (Kashdan et al., 2018). Considering the theoretical definitions, there is a possibility that the traits are different enough for them to separately contribute meaningful parts to Academic Engagement. To our knowledge, Academic Engagement has never been studied using a model that includes both Curiosity and Need for Cognition. In order to understand Academic Engagement and how it is predicted by different traits, it is important to use a model that includes both Curiosity and Need for Cognition, to investigate whether both meaningfully contribute to Academic Engagement.

In this study, we explored a new model which includes three Curiosity facets (Joyous Exploration, Deprivation Sensitivity and Stress Tolerance) and Need for Cognition, which we contrasted to Academic Engagement. While a wealth of research has focused on how Curiosity and Need for Cognition relate to Academic Engagement separately, not much research has been conducted with a model that includes Curiosity - including the three dimensions Joyous Exploration, Deprivation Sensitivity and Stress Tolerance - and Need for Cognition. In line with previous evidence, we expected all traits to have a positive relationship with Academic Engagement. Within our analysis, we also investigated whether the Curiosity traits and Need for Cognition all have meaningful contributions to Academic Engagement when included in the same model. This will shed light into individual relationships and possible overlapping between these variables, as they pertain to 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

To determine the applicability of regression analysis, we assessed several key assumptions, including linearity of relationships, normal distribution of errors and homoscedasticity. Additionally, we looked for the presence of any influential outliers. Linearity of relationships was assessed using scatterplots, contrasting each independent variable to the dependent variable. Additionally, it was confirmed that each independent variable has a significant correlation with the dependent variable (Table 1). Using histograms and quantile-

quantile plots, the normality assumption was investigated. Homoscedasticity was assessed by using scatterplots with the residuals against the dependent variable to check for any patterns. Boxplots and the maximum Cook's distance were used to analyze the possibility of influential outliers in the data. None of the data points exhibited a Cook's distance > 1 . Finally, the amount of multicollinearity between the independent variables was assessed checking the variance inflation factor. No values > 4 were observed, with the largest variance inflation factor value being 1.87. Based on these assumption checks, we concluded that no major violations were found.

As the first-year student sample and the second- and third-year student samples were collected with different incentives, we wanted to ensure that there were no mean differences between the groups, regarding the variables of interest. Welch's independent two-sample t-tests were administered, contrasting first-year students with second- and third-year students in terms of Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, Need for Cognition and Academic Engagement. No significant differences were found regarding Joyous Exploration (JE), $t(140.95) = -0.907, p = .366$, Deprivation Sensitivity, $t(149.87) = 0.111, p = .912$, Stress Tolerance, $t(138.25) = 0.91, p = .367$, Need for Cognition, $t(142) = -1.625, p = .106$ and Academic Engagement, $t(149.27) = 1.401, p = .163$. Thus, we confirmed that the samples are comparable and without significant baseline differences.

Descriptive statistics with means and standard deviations of all five study variables can be found in Table 1. All variables show means slightly higher than average, which may be explained by the sample that comprises of university students. For example, undergraduate students may represent a population who are more curious and enjoy more cognitive exertion

than the general population. Correlations between the variables of interest were examined using Pearson's correlation coefficients (see Table 1). Statistical significance was reached when the two-tailed $p < .05$. All correlations were significant at the $p < .01$ level. Joyous Exploration had a medium positive correlation with Deprivation Sensitivity, a strong positive correlation with Need for Cognition, and a medium correlation with Academic Engagement. Joyous Exploration had a medium positive correlation with Stress Tolerance. Deprivation Sensitivity had a medium positive correlation with Need for Cognition, a small positive correlation with Academic Engagement, and a medium positive correlation with Stress Tolerance. Stress Tolerance had a medium positive correlation with Need for Cognition and a small positive correlation with Academic Engagement. Finally, Need for Cognition had a medium positive correlation with Academic Engagement.

Table 1

Descriptive Statistics and Pearson Correlations

Variable	Mean	SD	Correlations					
			1	2	3	4	5	
1. Joyous Exploration	5.11	0.92	.					
2. Deprivation Sensitivity	4.36	1.21	0.38**	.				
3. Stress Tolerance	4.38	1.27	0.32**	0.11**	.			
4. Need for Cognition	3.60	0.64	0.64**	0.41**	0.31**	.		
5. Academic Engagement	4.67	0.94	0.40**	0.29**	0.24**	0.35**	.	

Note. * Correlation is significant at 0.05 level; ** Correlation is significant at 0.01 level.

Main Hypothesis: Joyous Exploration, Deprivation Sensitivity, Stress Tolerance and Need for Cognition Positively Predict Academic Engagement

A standard multiple linear regression was used to test whether Joyous Exploration, Deprivation Sensitivity, Stress Tolerance and Need for Cognition significantly predicted Academic Engagement. The analysis showed a model that was statistically significant ($F(4, 603) = 40.43, R^2 = .21, R^2_{adj} = .21, p < .001$). This suggests that the model comprising of three Curiosity traits and Need for Cognition collectively explain a statistically significant portion (21%) of the variance in Academic Engagement. In accordance with our hypothesis, Joyous Exploration ($B = 0.22, t(606) = 4.47, p < .001, sr^2 = .026$), Deprivation Sensitivity ($B = 0.15, t(606) = 4.58, p < .001, sr^2 = .027$) and Stress Tolerance ($B = 0.13, t(606) = 4.18, p < .001, sr^2 = .023$) were positively associated with outcome variable Academic Engagement. However, contrary to our expectation, the relationship between Need for Cognition and the outcome variable was not significant ($B = 0.12, t(606) = 1.61, p = .11, sr^2 = .003$). While the Curiosity traits all have meaningful individual contributions to Academic Engagement, Need for Cognition was found non-significant. The regression coefficient represents the estimated change in Academic Engagement for a one-unit increase in Need for Cognition, when the other variables are held constant. The positive value is in line with the significant positive correlation (Table 1). However, with the Curiosity traits taken into account, the non-significance of Need for Cognition in the model implies that its contribution may be explained by mere chance, rather than a reliable effect. Furthermore, the low value for the semi-partial correlation suggests that Need for Cognition explains only a negligible portion of the variability in Academic Engagement after controlling for other variables in the model. In terms of direction and significance, the

relationships between the other independent variables and the dependent variable were as expected. Overall, the explained variance of the model shows support for the main hypothesis.

Discussion

The present study analyzed how Need for Cognition and different Curiosity traits, namely Joyous Exploration, Deprivation Sensitivity and Stress Tolerance, relate with Academic Engagement, a set of traits which - according to our knowledge - has yet to receive thorough investigation, as they together relate to Academic Engagement. An auxiliary goal was to increase our understanding of how Need for Cognition and the Curiosity traits uniquely contribute to a person's Academic Engagement. As expected, all the included traits positively predicted Academic Engagement. Individually, Joyous Exploration and Need for Cognition had the strongest association with Academic Engagement, highlighting that a person who experiences much joy when discovering something new, and who is inclined to pursue, participate in, and derive pleasure from cognitive exertion, is more likely to be Academically Engaged. However, with the Curiosity traits taken into account, having a higher Need for Cognition did not seem to contribute to a person's Academic Engagement, suggesting the possibility of a large overlap between Need for Cognition and the three Curiosity traits included in the study.

The positive relationships observed between the Curiosity and Academic Engagement align with previous research, highlighting the importance of Curiosity in educational settings (Garrosa et al., 2017). The Curiosity traits appear to contribute to students' Engagement in their academic activities, which is consistent with the idea that Curiosity motivates individuals to seek out and explore new knowledge, enhancing their overall academic experience (Arnone et al., 2011; Kashdan et al., 2018; Litman, 2008). Students who exhibit higher levels of Joyous

Exploration, characterized by a positive and eager approach to learning, may be more likely to actively participate in class, ask questions, and pursue additional resources to deepen their understanding. In this way, the behaviors related to Joyous Exploration seem to relate to the part of Academic Engagement that relates to the positive valence experienced while engaging with study-related activities (Bakker & Demerouti, 2008). Individuals with higher levels of Deprivation Sensitivity, who are more aware of missing information or knowledge gaps, may display a greater drive to fill those gaps resulting in greater Engagement in academic tasks. This Curiosity trait might motivate students to engage academically by actively seeking out additional resources and study materials or partake in discussions to overcome their perceived knowledge deficits (Arnone et al., 2011). The positive association between Stress Tolerance and Academic Engagement, an association that has not been previously explored, suggests that individuals who are more tolerant of the challenges and uncertainties associated with learning have the ability to persevere in their academic pursuits, thus engaging more actively in the learning process. In line with this interpretation, Kashdan et al. (2018) found that Stress Tolerance is indeed related to Grit, which is defined by perseverance toward meaningful, long-term goals (Duckworth & Quinn, 2009). Finally, our results indicated that in a model with Need for Cognition, all three Curiosity traits contributed meaningful amounts to Academic Engagement. Although higher levels of all three Curiosity traits predicted increased levels of Academic Engagement, Joyous Exploration predicted a higher elevation in Academic Engagement, in comparison to Deprivation Sensitivity and Stress Tolerance.

While the Curiosity traits demonstrated a consistent and significant relationship with Academic Engagement, the lack of added contribution of Need for Cognition to Academic

Engagement may point toward Need for Cognition being closely related to the broader Curiosity traits. A potential overlap occurs when there is a high association between the constructs, with which we want to predict another (Agresti, 2018). More precisely, we found Need for Cognition to have moderate associations with Deprivation Sensitivity and Stress Tolerance, while the association with Joyous Exploration was strong. This may make it difficult to disentangle their unique contributions to the construct of interest, namely Academic Engagement. However, this study did not methodologically analyze the overlap between Curiosity and Need for Cognition, but only their relationships with Academic Engagement.

Our study produced many results that show convergence with previous findings. Although the main finding of our research showed that beyond the contribution of Curiosity traits, Need for Cognition did not significantly contribute to Academic Engagement, its individual relationship with Academic Engagement was positive (Steinhart & Wyer, 2009; Lavrijsen et al., 2021). Furthermore, our findings are in line with previous research that has found associations between Need for Cognition and the Curiosity traits: Joyous Exploration, Deprivation Sensitivity and Stress Tolerance were all found to have moderate to strong associations with Need for Cognition (Kashdan et al., 2018). Although our hypothesis was based on the idea that the theoretical and definitional differences between Need for Cognition and Curiosity may be distinct enough, our results did not support this idea - at least in terms of how they jointly predict Academic Engagement.

von Stumm & Ackerman (2011) argued that Need for Cognition is a higher-order dimension of intellectual investment, which encompasses variations among individuals in their inclination to find, participate in, derive satisfaction from, and persistently engage in effortful

cognitive activities. Additionally, Intellectual Curiosity was one of the eight intellectual investment trait categories in von Stumm & Ackerman's (2013) meta-analysis. While the Need for Cognition construct used in this study is theoretically in line with von Stumm & Ackerman's (2013) research, our study used a more novel - and arguably a more comprehensive - approach to measure Curiosity, namely, Kashdan et al.'s (2018) five-dimensional model of curiosity. Thus, the data gathered in this study shows evidence that the three Curiosity traits in the five-dimensional model of curiosity, namely Joyous Exploration, Deprivation Sensitivity and Stress Tolerance, may be a more sophisticated approach in explaining these motivational tendencies manifested in Academic Engagement, in comparison to Need for Cognition. Although our model did not fully account for variation in Academic Engagement - as is typical in social and behavioral sciences - we were able to confirm that Curiosity traits meaningfully predict Academic Engagement. Thus, the findings have important implications for educational settings.

Understanding the role of Curiosity traits in promoting Academic Engagement can inform instructional practices aimed at fostering a positive learning environment. Kashdan and Yuen (2007) support this view with their finding, that the advantages of Curiosity, such as academic grades or higher national achievement scores, are triggered when students believe that the school environment aligns with their values regarding growth and learning. Conversely, these benefits can be hindered when students perceive a mismatch between themselves and their environment, possibly leading to lowered Engagement in the study environment (Sansone & Smith, 2000). Thus, educators may consider incorporating activities that encourage Joyous Exploration, provide opportunities for addressing knowledge gaps to cater to Deprivation Sensitivity, and teach stress management techniques to enhance Stress Tolerance (Kashdan et al.,

2004). By promoting and nurturing these Curiosity traits, educators can potentially boost students' Academic Engagement, which in turn has a positive association with motivation, well-being, and overall academic success (Garrosa et al., 2017; Kashdan, & Steger, 2007).

However, it is important to acknowledge the limitations of this study. First, as is usual with cross-sectional studies, the correlational nature - by itself - prevents establishing causality between the variables. Therefore, notions regarding longitudinal developments remain speculative. Future research employing longitudinal designs could help shed light on the directionality of the relationships observed. For example, since there is evidence to support seeing Academic Engagement as a dynamic and fluctuating state (Bakker et al., 2015; Bakker & Bal, 2010; Bakker et al., 2014; Sonnentag et al., 2010), more research is required to explore how Curiosity and Need for Cognition relate to Academic Engagement over an extended period of time. For example, to build on top of our findings, research could employ a longitudinal design, where a person's Curiosity traits are measured, after which their level of Academic Engagement is measured at multiple points in time. This would enlighten us on the temporal precedence of the Curiosity traits as antecedents of Academic Engagement. Moreover, when utilizing self-report measures, response biases may occur. This can especially take place, as our sample consisted of psychology students who may have insight into what the study is trying to measure, thus resulting in social desirability effects. Although the measures of the traits of interest showed adequate reliability, the reliability measure merely demonstrates the internal consistency of response values across a set of questions that relate to a specific construct (Cronbach, 1951). This means that if the psychology students answer consistently in a socially desirable way, it would not affect the reliability measure. Thus, validating our findings in another student cohort -

preferably comprising of other study majors where students do not work with psychological testing - will provide a more comprehensive understanding of the constructs under investigation. In line with this idea, the relationships between Curiosity, Need for Cognition and Academic Engagement are not automatically generalizable to other student cohorts; more supporting evidence using the same model should be gathered from different disciplines, study programs and age groups - also extending to younger populations in mandatory education, as a student who is not studying from their own free will may be less engaged in their studies. In line with the findings of our study, university students may be above average in Curiosity, Need for Cognition and Academic Engagement at baseline; in cohorts where the trait averages are lower, the traits may not operate in accordance with our findings. Finally, almost three quarters of our sample comprised of Dutch and German students, who come from cultures that are quite similar to each other. Further studies could peer into Curiosity and Need for Cognition as antecedents to Academic Engagement in students in different countries and continents.

Strengths of this study include a large undergraduate sample of students spread across all study years, and - to our knowledge - a previously unexplored model where all traits were measured by validated measurements (Carmona-Halty et al., 2019; Coelho et al., 2020; Kashdan et al., 2018). The study addressed research gaps and expanded our knowledge by exploring the association between specific Curiosity traits, namely Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, and Academic Engagement. Moreover, the Curiosity traits and Need for Cognition were - to our knowledge - studied for the first time in tandem, as they jointly relate to Academic Engagement. We expanded on previous knowledge by using the Five-Dimensional Curiosity Scale (Kashdan et al., 2018) to predict Academic Engagement with three

of the most relevant Curiosity traits. Additionally, a relatively new measure for Need for Cognition, namely, the Need for Cognition Scale-6 (Coelho et al., 2020) was utilized. As a result, our study showed for the first time, to the best of our knowledge, that the Curiosity traits significantly predict Academic Engagement. Our study added to pre-existing knowledge by showing that Need for Cognition does not meaningfully predict Academic Engagement, when the three Curiosity traits are taken into account. Whereas other studies have found Curiosity and Need for Cognition to predict Academic Engagement separately (Garrosa et al., 2017; Lavrijsen et al., 2021), our results suggest that the interpretation of these findings may have been simplistic and suffered from leaving out other relevant variables. Lastly, the use of self-report measures allowed us to capture participants' subjective experiences and perceptions, providing valuable insights into their cognitive and Curiosity characteristics in an academic context.

In conclusion, this study highlights the importance of Curiosity traits, including Joyous Exploration, Deprivation Sensitivity, and Stress Tolerance, in predicting Academic Engagement. While Need for Cognition - in line with previous research - had a significant relationship with Academic Engagement (Lavrijsen et al., 2021; Steinhart & Wyer, 2009), it was not a significant predictor of Academic Engagement in the model, due to a lack of uniquely explained variance. Moreover, the findings of this research point towards the three traits of the five-dimensional model of curiosity (Kashdan et al., 2018) emerging as the more comprehensive precursor to Academic Engagement, in comparison to Need for Cognition. By recognizing and nurturing these Curiosity traits in educational settings, educators can create an environment that fosters Engagement, enhances motivation, and promotes academic success among students.

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